ACTION SUMMARY SHEET
STATE BOARD OF EDUCATION

DATE: October 7, 2013

ISSUE: Approval of Agenda

BACKGROUND:

SUGGESTED MOTION(s)/RECOMMENDATION(s):

To approve the Agenda for the October 7-8, 2013 State Board of Education meeting.

SUPPORTING INFORMATION ATTACHED:

- Agenda

PREPARED BY: *Bailey Anthony*
Bailey Anthony, Executive Assistant

ACTION TAKEN BY STATE BOARD: _____DATE:_____

COMMENTS:

Wyoming State Board of Education Agenda

The Wyoming State Board of Education will empower an educational system that will enable Wyoming students to have the knowledge, skills, and habits of mind to succeed.

October 7, 2013 Hathaway Building, Room 126 2300 Capitol Ave. Cheyenne, WY		
7:45-8:30 a.m.	Breakfast on Your Own	
8:30 – 8:45 a.m.	State Board of Education • Call to order • Pledge of Allegiance • Roll Call • Approval of Agenda • Approval of Minutes	 Tab A Tab B
8:45 – 9:00 a.m.	Discuss new relationship with the Board and the Director – Ron Micheli	
9:00 – 11 a.m.	Director's Report - Website update - Strategic Plan	
11 – noon	Lunch	
Noon – 12:30 p.m.	Discuss new position for the Board – Ron Micheli	
12:30 – 1:00 p.m.	Summary on Governor's Education Outreach Meeting – Pete Gosar	
1:00 – 1:30 p.m.	Supervisory Committee Report	
1:30 – 2:00 p.m.	Legislative Committee Report	
2:00 – 2:15 p.m.	Break	
2:15 – 3:00 p.m.	Multiple Measures Update – Chad Buckendahl	Tab C
October 8, 2013 Hathaway Building, Room 126 2300 Capitol Ave. Cheyenne, WY		
9:00 – 9:15 a.m.	State Board of Education • Call to order • Pledge of Allegiance • Roll Call	
9:15 – 9:30 a.m.	Treasurer's Report – Pete Gosar	Tab D
9:30 – 10:00 a.m.	Discuss Board Retreat & Set Next Board Meetings – Ron Micheli	
10:00 – 10:15 a.m.	Break	
10:15 – 10:45 a.m.	Presentation on CCSS – Amy Edmonds	
10:45 – 11:15 a.m.	Testimony on CCSS – parent, teacher, business person	Tab E
11:15 – 12:15 p.m.	Revised Standards for Career & Vocational	Tab F, G, H, I

	Education, Social Studies, Physical Education and Science– Laurie Hernandez, Stephanie Brady & Jim Verley	
12:15 – 1:15 p.m.	Lunch	
1:15 – 1:35 p.m.	Chapter 10 Rules – Wyoming Content & Performance – Laurie Hernandez	Tab J
1:35 – 3:00 p.m.	Phase I October 15th Accountability Report - Accountability Model – Mike Flicek - PJP – Mike Beck - System of Support – Rich Crandall - Assessment Options – Deb Lindsey - Multiple Measures and District Assessment System – Paige Fenton Hughes & Julie Magee - Outreach – Paige Fenton Hughes	 Tab K Tab L Tab M Tab N Tab O
3:00 – 3:45 p.m.	Select Committee Assessment Motion – Paige Fenton Hughes	Tab P
3:45 – 4:00 p.m.	Public Comment	

ACTION SUMMARY SHEET
STATE BOARD OF EDUCATION

DATE: October 7, 2013

ISSUE: Approval of Minutes

BACKGROUND:

SUGGESTED MOTION/RECOMMENDATION:

To approve the minutes from the State Board of Education meeting on August 23, 2013

SUPPORTING INFORMATION ATTACHED:

- Minutes of August 23, 2013

PREPARED BY: *Bailey Anthony*
Bailey Anthony, Executive Assistant

ACTION TAKEN BY STATE BOARD: _____DATE:_____

COMMENTS:

WYOMING STATE BOARD OF EDUCATION
August 23, 2013
WEN Meeting

Wyoming State Board of Education members present: Ron Micheli, Kathy Coon, Sue Belish, Richard Crandall, Hugh Hageman, Joe Reichardt, Kathryn Sessions, Belenda Willson, and Walt Wilcox

Also present: Julie MaGee, WDE, Tom Lacock, WDE, Shelly Andrews, WDE, Chad Buckendahl, Alpine Testing Solutions, Mike Flicek, Bailey Anthony, WDE and Mackenzie Williams, Attorney General's Office (AG)

CALL TO ORDER

Chairman Ron Micheli called the meeting to order at 1:04 p.m.

Bailey Anthony conducted roll call and established that a quorum was present.

APPROVAL OF AGENDA

Walt Wilcox moved to approve the agenda, seconded by Joe Reichardt; the motion carried.

APPROVAL OF MINUTES

Minutes from the May 30, 2013, State Board of Education meeting were presented for approval.

Joe Reichardt moved that the minutes be approved, seconded by Ken Rathbun; the motion carried.

WDE UPDATES

Rich Crandall updated the board regarding his entrance to the Director role. He spoke about filling 16 vacant positions and working with the Department of Enterprise Technology Services on some of those logistics. He discussed his CCSS Communication Implementation Strategy and that it will be vital to go on the offensive to let teachers and parents talk about why it is so important to prepare our students for college. We need to talk about the benefits of the standards over everything else. He has some upcoming meetings with the Governor and Superintendents to talk about education and to talk about early childhood learning. His high priority for the next 4 weeks is to work on where do we go from her and focusing on the strategic plan.

SBE UPDATE

Paige updated the board regarding the trip to Gillette to WASA and WSEA. The purpose of the visit was to get feedback on the legislative agenda and there is almost 100% agreement on

priority items. Things are falling into place for the Professional Judgment Panel. Data is getting ready and Mike Beck is receiving information to create the agenda. She talked about appreciating the partnership of the department regarding all of the current initiatives. Next week is the tour to 5 sites across state, and two blackboard sessions, to share information about the pieces of the accountability bill and to gather information for inclusion in the October report to the legislature. There is a presentation scheduled at the School Improvement Conference and follow up outreach meetings will be held the following week.

MULTIPLE MEASURES UPDATE

Chad Buckendahl updated the Board on Multiple Measures and the discussion of the Thought Leaders Group. The outcome is three assessment levels:

1. Leveraging existing assessments for ELA, writing and Math and common assessments that were given at the state level for science and social studies. Information would be collected across multiple courses.
2. Leveraging the WDE leadership to develop a framework by which there are some different options for science and social studies. This might be some consortia effort throughout the state while providing flexibility to the districts.
3. The 3rd level is leveraging even more information within the state of what districts and the state are doing for content areas including world language, health, fine and performing arts. These are the areas where the districts have the least capacity to develop and support such a system.

The TLP was keen on ensuring that all 9 subject areas are a part of the revised system, even though they realized that this would still require quite a bit of work on their end as well as state support. The definition of a Wyoming graduate was discussed within the TLP and it was decided that when you are talking eligibility it needs to be something that you can measure and hold somebody accountable for, cognitive traits.

Sue wondered if this definition was limiting and if there was a way to measure some other indicators of those “soft” skills that we know good workers need to have.

Paige mentioned that if we went with this proposal the way it is you only have one chance to take the English or math and science. Because for the science the way this is written would be for whatever the state test is at 11th grade. Now the language says “a measure or multiple measures” and we don’t know what kinds of interim or benchmark assessments may be associated with those ELA and Math tests later on.

UPDATE ON ACCOUNTABILITY MODEL – DR. MICHAEL FLICEK

Mike updated the board on the PJP Data, and said the 3-8 model has been completely built. As far as the high school model they are having difficulty on the two new data elements, including grade 9 credits and Hathaway eligibility.

The last time the Select Committee met they charged the SBE with creating some prototypes for school report cards. They wanted people to look at what would be on the report card so they could get a sense of whether or not the right things were being measured and that the information provided on that report card would be helpful to various stakeholder groups. Then Mike walked through each of the report cards.

DRAFT

Next steps and communication was then discussed by the board. An idea was proposed to hold regional meetings to review the report cards, answer questions and receive feedback.

PROFESSIONAL JUDGEMENT PANEL – DR. MICHAEL BECK

Mike updated the Board on the PJP and informed them that he has been a part of the review of the materials and is now ready to create the agenda and slides. The PJP meetings will be similar to last year, coaching the sessions in a methodology that's professionally acceptable and pretty well credentialed and validated. Also, Mike Flicek's data will be able to provide some on the spot analysis and data to the panelists to inform their revised judgments before they finalize those judgments of what the impact of those recommendations will be statewide.

NEXT BOARD MEETING

It was decided that some dates would be sent out for the next board meeting via email and selected at a later time.

UPDATE FROM RULES REVISION SUBCOMMITTEE

MacKenzie stated that the Governor has asked all state agencies to create a plan to reduce agency rules by 1/3 both in terms of the amount of rules and the number of chapters. They have been working on a plan to add some local superintendents, and WDE employees who are interested in doing this work and providing their feedback. The plan is to have two very focused work groups on what should be in the rules vs. policy and also how to reduce those rules. At the end of this process we are hoping to have a recommendation from the subcommittee to present to the board for discussion. Sue mentioned that if anybody else on the SBE would like to be a part of this, it would be appreciated. Kathryn Session volunteered to participate.

BOCES AGREEMENT

MacKenzie reminded the Board that under Wyoming law, individual districts and community college districts are able to form an agreement called a Board of Cooperative Education Services (BOCES) to provide educational services that aren't necessarily provided by the existing districts. Wyoming law requires that an agreement be formed between the participating districts and there are certain requirements for that agreement, and the State Board needs to approve that agreement. I'm pleased to offer my opinion to the board that the agreement you've been presented with meets all of the requirements under Wyoming law.

Joe Reichardt moved to approve the agreement, seconded by Walt Wilcox; the motion carried.

CHAPTER 31 AND CHAPTER 10 RULES

Julie spoke about these rules that have discussed at previous meetings and reported that only 3 comments were received during the 45 day public comment period. The Chapter 31 rules address the high school graduation requirements, and the District Assessment System. It also addresses the state standards and in this proposal would like to move the state standards out of

the chapter 31 rules and into its own chapter. This would be The Chapter 10 rules called the Wyoming Content and Performance Standards and would be for greater transparency for people who maybe looking for the rules that specifically address the standards. What we're left with in the chapter 31 rules are all things related to the high school graduation requirements including the District Assessment System. Julie addressed the 3 comments that were submitted, along with proposed responses. What she is looking for is approval from the board to move forward with the 75 day review from the Governor.

Ken Rathbun moved to approve the rules to move forward for the Governor's review, seconded by Kathy Coon; the motion carried.

DISTRICT ASSESSMENT SYTEMS

Julie reminded the board that she was asked to do was work on the District Assessment System based on the way it is now outlined in EA116. As you know, there were a lot of changes including the removal of BOE and that this DAS will now be reviewed K-12 instead of just 9-12 in all content areas, instead of perhaps the core areas. In the past it was one core area and one non-core area. Julie went through the guidebook that was provided in the packet that the steering committee has been working on, which includes the definitions of the 4 criteria, the timeline for the pilot and full implementation, and the process for districts to submit their DAS as well as WDE to review them. Some issues were discussed including the way standard setting would be done, allowing time for public comment sooner rather than later, the need for professional development throughout the state, and the use of the term adequately and being descriptive in the rubrics. It was decided that public comment would begin simultaneously with the pilot.

Sue Belish moved that we go forward with the proposed DAS as proposed and revisit this next summer with a final version to presented to the board for approval, seconded by Kathryn Sessions; the motion carried.

The State Board of Education adjourned at 3:30 p.m.

DRAFT

Summary of Wyoming Thought Leaders Committee Meeting

Chad W. Buckendahl, Ph.D.

Alpine Testing Solutions

July 8-9, 2013

Special thanks to Jeanie Iberlin and Paige Fenton Hughes for sending their notes from the in-person meeting; and Lisa Paul for deciphering my handwriting from notes documented on a whiteboard and then photographed.

On July 8-9, the Wyoming Thought Leaders Committee (TLC) met in Casper at the University of Wyoming's Outreach Center to discuss options for secondary assessment and accountability that would focus on Multiple Measures and replace the Body of Evidence (BOE) system that districts are currently using. Chad Buckendahl from Alpine Testing Solutions facilitated the discussion with assistance from Paige Fenton Hughes, consultant to the Wyoming State Board of Education.

At the outset of the meeting, goals and desired outcomes were discussed along with some guiding principles. The first stipulation for the discussion was that the secondary assessment system would change, but that the nature of that change had yet to be determined. The input from these meetings would contribute to these decisions. A second stipulation was that the resultant system could not be a rebranded BOE given some of the challenges that districts have experienced in developing, maintaining, and revising the existing system. A third request to the group was to think in terms of assessment system efficiency (e.g., try to reduce redundancy in the system).

With these principles as a starting point, there was also an acknowledgement at the outset that there would likely be some combination of external, common measures, along with something at the local level. Further, that a perfect solution to respond to the range of stakeholders' interests did not exist, but that assurances without evidence are not substitutes for measurement information.

Definition of a Wyoming Graduate:

As a reference for the discussion and to focus on the secondary population, the TLC revisited the discussion the group had in June 2013 that outlined desirable academic characteristics of a Wyoming graduate. Some of the discussion revolved around the distinction between graduation eligible and college or career ready. It is likely that the definition of graduation eligibility will more closely align with expectations for students entering the workforce immediately after high school (i.e., career ready). Although there was also some discussion of the potential for including non-cognitive or personality characteristics in the definition, the group consensus was to focus the operational definition of graduation expectations on the following:

- Student's ability to enter post-secondary work, training, or education without needing to take remedial coursework to be at a level of career or college ready.
    - Career readiness and college readiness have different definitions; therefore, the definition of remedial coursework would be mitigated by these definitions.
    - A lack of remedial coursework with respect to career readiness does not suggest that students would be prepared to enter into a given occupation without relevant domain-specific or on the job training.

- Academic expectations that span across all subject areas and are not limited to those promulgated by the State (i.e., Chapter 31, Sections 8 and 9).

Although State rules expect at minimum core subject areas, Wyoming has been requiring a broader range of subject areas included in graduation eligibility policy. To this end, the group discussed the current "5 of 9" requirements in terms of meeting graduation eligibility expectations across subject areas and the differential application across districts. Although there were some suggestions from TLC members that certain subject areas (i.e., English Language Arts and Mathematics) could be considered required with additional flexibility for districts, the consensus among the group members was that the current flexibility in practice was desirable with an acknowledgement that the level of effort would be greater to develop and maintain such a system as opposed to just focusing on core subject areas.

Existing State Requirements for Secondary Assessments:

The state currently requires selected assessments at the secondary level. Currently, these assessments are the ACT suite at grades 9-11 (Explore, PLAN, ACT), optional for grade 12 (Compass) and District Level Assessments that encompass the requirements for measuring students' performance across all subject areas. In addition, many districts currently opt to administer NWEA's Measures of Academic Progress (MAP) in grades 9-10. The group noted some redundancy in the existing system that could be eliminated through restructuring.

Proposed Models for Secondary Assessment:

The majority of the meeting was spent discussing the advantages and disadvantages of different models of assessment as it pertains to responsibilities for development, validation activities, and maintenance. These models were organized into two broad categories: extant assessments and state developed. As noted at the outset of the meeting, we anticipated that some combination of these models would likely represent a potential solution.

Extant Assessments

The first category of assessment models that the group discussed was the use of extant assessments (e.g., ACT, MAP, SBAC, PARCC) as part of a revised secondary assessment system. Table 1 illustrates the summary advantages and disadvantages of using assessments that already exist or presumably will exist at the point of desired implementation (e.g., SBAC, PARCC).

Table 1. Advantages and disadvantages of using extant assessments in a secondary assessment system.

Advantages	Disadvantages
Convenience *	One more step to a National Curriculum/CCSS
Money (less expensive than everyone developing their own) *	Backlash
Investment by Students (Ownership)	Perceived as High Stakes for kids
Commonality/Comparability *	Lack of Wyoming flavor
Alignment with Common Core (certain subject areas)	Loss of Local Control
Time Savings (Teachers, WDE) *	Point in Time
Consistent Administration	Single Driving Force/High Stakes
High Quality of Questions	Only testing some subject areas, not all 9
Quicker Turnaround Time	Score reports are not instructionally supportive
Statistical Credibility/Responsibilities	(ACT) accommodations eligibility process
State-to-State Sharing of Resources	Multiple choice focus (ACT)
Prep Materials	Timed Test (ACT)
Multiple Uses/Efficiency (SBAC, ACT, beyond, can reduce need for other assessments (e.g., MAP, full ACT suite) *	Sustainability (SBAC, PARCC)
Reduced time for testing *	Protecting Against Misuse of Data
Fairness for Students	Lack of Flexibility
Adaptive Efficiency	Loss of Teacher ownership
-Targeted to Student Ability	Increase Teacher stress due to accountability
Growth Indicator	Harder to provide Remediation
Professional Development is built as part of system (e.g., SBAC, PARCC)	Technology tied up for testing rather than instruction
Time Management (Shorter)	Ability to adapt technologies
Public Legitimacy	Course offerings and sequencing
Consistent Target	Connection to local grading/classroom practices
College Readiness/Placement	
Tie-in to Accountability	
Opportunity to change Legislation	
Technology Capabilities	
WY Educators Involvement in Scoring	
Formative Assessment Resources	
Research based instructional tools	

* indicates that the advantage aligns with a stated goal of the redevelopment activities

State Developed Assessments

The second category of assessment models that the group discussed was state developed assessments, whether in-house at WDE, through state directed consortia (e.g., regional, modified structure of current MOU between WDE and UW), or through third party vendors or resources. Because of the range of development and validation strategies that could be employed, the advantages and disadvantages noted in Table 2 may be more relevant to a particular implementation strategy than another.

Table 2. Advantages and disadvantages of using state developed assessments in a secondary assessment system.

Advantages	Disadvantages
Reduced burden on local system *	Have done it before
-Time, Money	Another assessment window (time commitment)
Statewide Commonality (students, schools, districts) *	Course offerings and sequence
Closer Alignment to State Standards *	Return of results
Any Content Area	Obtrusive assessments
Used in lieu of BOE part of System *	Loss of local control
Statistical Credibility	Impact on state curriculum and instruction
Cognitive Depth (Comparability)	State level personnel
Could be Designed to meet stakeholders' needs	Data and Student Management system
Prioritization of Items	Transition period for implementation
More control and flexibility at state	Public relations of more content for newspapers
Equity across Districts (Large vs. Small Districts)	Narrowing of curriculum
Comparison for Districts *	Overlap with other assessments (e.g., SBAC, ACT)
Wyoming Context	District staff will be doing more
Quality of Questions	Increase in teacher stress due to accountability
Ownership of Educators (Potential for Assessment Literacy)	Pilot process that doesn't count
Sustainability	Less meaningful for teachers and students
Potential for PD Connection	Less teacher ownership
Collaboration across State	Growth model potential
More systematic	Administration challenges (e.g., Security)
Potential for Pre/Post for growth	Timing of administration
DAS Consortium	
-Existing Local Assessments	
-Criteria for Use?	

* indicates that the advantage aligns with a stated goal of the redevelopment activities

Support Systems

Following the discussion of different assessment models that could be used in combination to inform a revised secondary assessment structure, the TLC shifted its focus from design to implementation and infrastructure characteristics that would be necessary to support successful transition from the current system to one that is based on the series of Multiple Measures noted below in the proposed model. During this part of the meeting the group discussed four themes of activities that should serve as a starting point for a framework for sustainability of a revised system beyond initial development efforts.

Table 3. Summary of support system characteristics by theme.

Assessment Development, Validation, and Maintenance	Professional Development (Pre-Service and In-Service)	Technology (Hardware and Software)	Financial (Development and Maintenance)
Sustainability standards -WDE design (or external) -Continuous responsibility -Process and timeline for activities Regional (Quadrant) Cultivation -State, Higher Ed, District Blend with operational development (i.e., not prototypes or proof of concept, but assessments that would be used for the intended purposes of the program) Data collection, scoring, and analysis Score reporting -Timing of results -Meaningful feedback -Strengths/weaknesses Communications Plan -Blueprint -Assessment Design	Opportunities for Assessment Literacy -Developers -Users Meshing existing support systems, common training for coaches to help support districts Interpretation and use of data *Standards for Educational and Psychological Testing* (AERA, APA, & NCME, 1999) Better consumers of testing information, validity, reliability, fairness	Hardware, Software Data management and Reporting Delivery systems (e.g., Computer based, adaptive, staged) Platform -Devices (BYOD) -Accessibility (Universal Design) -Bandwidth (State level assistance) -Content Management, leveraging SBAC technology resources	State and local budgets District contributions (financial, in-kind) Grants or other external sources

Proposed Secondary Assessment Model

Following the discussion of advantages and disadvantages of different assessment models and the types of support systems that would be needed to implement and sustain a revised secondary assessment model, the TLC proposed the following division of responsibilities. Specifically, for English Language Arts, Writing, and Mathematics, these could be easily addressed through commercially available assessments (e.g., SBAC, ACT). Note that because Wyoming became a governing state for the Smarter Balanced Assessment Consortium (i.e., SBAC), there was a working assumption that if this revised model was adopted that SBAC would serve as the extant resources. This would then also permit the state to evaluate the continued use of other assessments such as Explore and PLAN from state level required assessments; and districts to evaluate the use of other commercial assessment such as MAP. The ACT would potentially still be needed for college admissions depending on whether secondary institutions accept the results of SBAC assessments. In addition, Compass could remain an option for districts that wanted to use it.

Because extant assessments may not align sufficiently with Wyoming's expectations for representation across all subject areas, there was a desire to have Wyoming Department of Education (WDE) develop and maintain common, statewide assessments for science and social studies, each of which would be a survey (rather than End of Course) of the most common courses for each (e.g., biology, physical science, government, U.S. history). Many of the advantages of extant assessments were also noted for assessments suggested for this level of responsibility.

The third category of responsibility extends the TLC's consensus that all 9 subject areas be retained in a revised secondary assessment system. The strategy underlying this level is to have leadership from Wyoming's Department of Education, but that significant district level involvement would be needed for the development and validation of assessments for World Language, Health, Career and Technical Education, Fine and Performing Arts, and Physical Education. Levering experiences from existing systems developed across the state, the approach for these fields would be to provide structure with some additional options for districts in their assessment strategies in these subject areas. This structure could be accomplished through regional consortia where multiple districts collaborated on common assessments, statewide development of a limited menu of options that could be used across the state, or some other organizational strategy. Although there could be some flexibility in terms of what is administered, a statewide structure would be needed to facilitate equity and comparability.

Figure 1. Proposed division of secondary assessment responsibilities

Extant	ELA/ Writing Mathematics
WDE	Science (Common Courses such as biology, physical science) Social Studies (Common Courses such as civics, government, U.S. history)
WDE - DAS	World Language Health Career and Technical Education Fine & Performing Arts Physical Education

Next steps

Based on the proposed structure of a secondary assessment system and anticipating a formal development and validation schedule, the TLC also discussed some anticipated next steps if this plan or a variation of it is adopted by the state. Some of the initial steps in planning for the development processes would include creation of a development calendar around the proposed program. Each subject area would have its own project schedule for development, validation, and maintenance. Using that design as a starting point, we would anticipate that the full development process would take multiple years to cycle through the subject areas.

A critical component of the design and implementation of a multiple measures system like the one proposed above is a data management component that would be common across the state. The development, support, and maintenance of the system would need to permit users at the district level to enter and manage assessment information for subject areas where they have greater responsibility that can then be easily integrated with data for which the state has greater responsibility. Presumably, this would reduce some of the systems development and data management workload at the district level and provide greater commonality for training and support of the system. The development of such a system would occur concurrently with the assessment system development to be able to align expectations.

(Federal budgets) - % flow-through	
% Admin	
Total must equal 100%	**0%**

BUDGET TITLE & COMPLETE BUDGET CODING: 13-001-005-6101-610

OBJECT CODES		CURRENT BUDGET	DECREASE	INCREASE	NEW TOTAL
103	Salaries - Permanent	38,000.00	38,000.00		**0.00**
104	Salaries - Temporary			35,000.00	**35,000.00**
105	Benefits			3,000.00	**3,000.00**
	SUB-TOTAL	**38,000.00**	**38,000.00**	**38,000.00**	**38,000.00**
202	Equipment Repair & Maintenance				
203	Teleconference	-424.52		2,000.00	**1,575.48**
204	Communications				
207	Professional Development & Training	13,065.28	1,500.00		**11,565.28**
208	Advertising	-1,126.98		1,500.00	**373.02**
221	Travel In-State				
222	Travel Out-of-State	9,623.81	2,000.00		**7,623.81**
227	Travel Out-of-State				
230	Supplies-Safety-Security				
231	Supplies-Office, Printing				
234	Supplies-Food & Food Service				
236	Educational Supplies				
240	Intangible Assets				
241	Office Equipment, Furniture				
242	Data Processing & Other Computer Equipment				
246	Educational Recreational & Technical Equipment				
251	Room & Building Rental				
257	Awards Monetary Taxable/Nonmonetary Nontaxable				**0.00**
271	Awards				
292	Maintenance Agreements	0.00	0.00		**0.00**
	SUB-TOTAL	**21,137.59**	**3,500.00**	**3,500.00**	**21,137.59**
301	Cost Allocation (Federal)				
	SUB-TOTAL	**0.00**	**0.00**	**0.00**	**0.00**
410	Data Processing				
420	A&I Telecommunication Charges				
	SUB-TOTAL	**0.00**	**0.00**	**0.00**	**0.00**
607	Scholarships, Educational Assistance				
626	School Districts				
	SUB-TOTAL	**0.00**	**0.00**	**0.00**	**0.00**
901	Contract Services				
	SUB-TOTAL	**0.00**	**0.00**	**0.00**	**0.00**
	GRAND TOTAL	**59,137.59**	**41,500.00**	**41,500.00**	**59,137.59**

Funding Source:

Additional Funds? **YES** **NO**

Approval Signatures:

Unit Director **Date**

Internal Budget **Date**

Program Manager **Date**

Important dates and information about the adoption of the Common Core State Standards in Wyoming

2009 – Wyoming State Superintendent of Public Instruction, Dr. Jim McBride, and Governor Dave Freudenthal sign memorandum of agreement (MOA) with the Council of Chief State School Officers (CCSSO) and National Governors Association for Best Practices (NGA) regarding the CCSS. The MOA allows the state to participate a state-led process to draw on evidence to lead to a set of common core state standards (CCSS) in language arts and mathematics for students in grades K-12. This effort is voluntary, and states may leave the CCSS at any time.

Key points from MOA document:

- Individual states decide how to best align curriculum materials and instructional methods to CCSS. This has and will continue to be a local decision; curriculum and instruction in each of the nine content areas must align to those specific content area standards.
- Individual states decide how to align the statewide assessment (PAWS in Wyoming) to the CCSS. The statewide assessment has always aligned to the standards. When the standards change, the assessment changes to measure the new standards.
- Participating states, like Wyoming, were invited to "provide input into the drafting of the common core." The timeline below includes opportunities the states had to submit feedback related to the CCSS initiative.
- Individual states chose *how* to adopt the CCSS. There were three options:
    - Adopt the CCSS in its entirety, as it was written and published on corestandards.org;
    - Align at least 85% of a state's "home-grown" standards to the CCSS; or,
    - Adopt the CCSS in its entirety with the option to "include additional state standards beyond the common core standards."

  In Wyoming, content review committees for math and language arts chose to adopt the CCSS in its entirety without adding additional standards. The content review committees included educators from K-12 and higher education, as well as parents.
- The MOA describes ways the USDE can support states that choose to adopt the CCSS. However, no state was required to adopt the CCSS, and every state had the option to pull out of the CCSS consortium – before or even after adoption of the CCSS. Additionally, no state is required to accept support from the USDE (i.e. Race to the Top funds) as a result of adopting the CCSS. States can choose to adopt and support the implementation of the CCSS on their own. Wyoming currently receives <u>no</u> federal dollars as a result of its adoption of the CCSS. The decision to adopt the CCSS in Wyoming was made following its state-initiated standards review process.

September 25, 2009 – Wyoming Department of Education informs districts through a Superintendent's Memo that the NGA and CCSSO have released the first official public draft of the college and career readiness standards in language arts and math. People were

encouraged to comment on this iteration of the CCSS by October 21, 2009. An FAQ document related to the CCSS initiative accompanied this memo and can be found here: http://edu.wyoming.gov/PublicRelationsArchive/supt_memos/2009/2009_150.pdf

March 12, 2010 – NGA and CCSSO request additional public comment on the draft CCSS for language arts and math. Wyoming Department of Education sends a Superintendent's Memo to the districts asking for public comments and feedback on a survey. The memo and accompanying request from NGA and CCSSO can be found here: http://edu.wyoming.gov/PublicRelationsArchive/supt_memos/2010/2010_052.pdf Another FAQ document related to the CCSS initiative was also provided by NGA and CCSSO and can be found here: http://www.corestandards.org/assets/CoreFAQ.pdf

March 26, 2010 – The Wyoming Department of Education sends districts an online survey for educators to submit feedback regarding the first draft of the standards and their potential impact on Wyoming education. Wyoming Department of Education sends districts notification in a Superintendent's Memo which can be found here: http://edu.wyoming.gov/PublicRelationsArchive/supt_memos/2010/2010_065.pdf

June 16, 2010 – The Wyoming State Board of Education gives approval for *consideration* of the Common Core State Standards in its next standards review process. This vote did not solidify an adoption of the CCSS in Wyoming; instead, it gave the Wyoming content review committees an avenue to consider the CCSS as an option during the standards revision process.

Summer 2010 through Summer 2011 – Wyoming standards review committee revises its state content standards in the fields of math, language arts, and health (please note that health is not part of CCSS). Pursuant to W.S. 21-2-304, the State Board of Education reviews the standards every five years to ensure they are still meeting the needs of Wyoming students. The review process involves Wyoming educators; additionally, Wyoming business leaders, parents, legislators, and educational board members are invited to be part of the review process. In general, approximately 35 people participate per content area.

September 23, 2011 – The Wyoming standards review committee presents the revised standards for math and language arts (CCSS), as well as health, to the State Board of Education. The Board approves the revised Wyoming content standards in language arts, math, and health. This date marks the completion of each review committee's work. The affirmative vote gives authority to begin the rules promulgation process, which includes another opportunity for public comment. Board members require additional language stating no part of this action (affirmative vote) should be interpreted as any attempt to dictate curriculum at the national or state level. This statement is added to the rationale document that accompanies the standards.

December 2011 through February 2012 – Rules promulgation takes place for standards revisions in math, language arts, and health.

December 7, 2011 – Wyoming Department of Education posts proposed content standards in language arts, math, and health on WDE website. All of the content-area standards can be found on the WDE website:
http://edu.wyoming.gov/Programs/standards.aspx
Included with each of the standards is a rationale written by each content-area committee explaining the reason for the current revisions. This rationale is included for the math and language arts standards, which are now the Common Core State Standards and can be found here: http://edu.wyoming.gov/sf-docs/standards/final-2012-math-standards.pdf (math), http://edu.wyoming.gov/sf-docs/standards/final-2012-ela-standards.pdf (language arts).

December 12, 2011 – The Wyoming Department of Education begins accepting public comment on the content standards in math and language arts (which are now the Common Core State Standards). As part of the rules promulgation process, the general public is invited to comment on the revised standards. Announcements were posted on our website and distributed via memo to every school district, as well as through a press release. Additionally, all State Board meetings are open to the public, and people had the opportunity to comment on the CCSS in that forum as well. Finally, the WDE sponsored multiple public hearings across the state (see dates listed below).

January 25, 2012 – Public Comment period for content standards in math and language arts closes.

February 6, 2012 – Wyoming Department of Education holds public hearing on new content standards in Gillette.

February 7, 2012 – Wyoming Department of Education holds public hearing on new content standards in Casper.

February 8, 2012 – Wyoming Department of Education holds public hearing on new content standards in Thermopolis.

February 9, 2012 – Wyoming Department of Education holds public hearing on content standards in Rock Springs.

February 10, 2012 – Wyoming Department of Education holds public hearing on content standards in Cheyenne.

February 13, 2012 – Wyoming Department of Education holds public hearing on content standards over the Wyoming Equality Network (WEN) in Casper, Cheyenne, Laramie, Riverton, Rock Springs, Powell and Torrington.

February 14, 2012 – Wyoming Department of Education reports to State Board on public comment received during statewide hearings.

March 20, 2012 – State Board receives suggestions on rule promulgation for state standards as well as written feedback from public hearings and public comment period.

April 27, 2012 – State Board of Education takes a roll call vote to decide whether or not to allow the revised standards in math, language arts, and health to move forward to the governor for his 75-day review. Eight out of 12 Board members voted in favor of the new standards (see below).

A roll call vote to adopt revised standards in health, language arts, and math (proposed standards for language arts and math are CCSS):
Scotty Ratliff-Yes
Pete Gosar-Yes
Matt Garland-No
Belenda Willson- Yes
Ron Micheli- No
Cindy Hill- No
Joe Reichardt-Yes
Sue Belish- Yes
Hugh Hageman- No
Kathy Coon- Yes
Walt Wilcox- Yes
Dana Mann-Tavegia- Yes
The motion is carried.

July 11, 2012 – After a 75-day review following the State Board of Education's vote to adopt the revised standards, Governor Matt Mead signs new content standards in math, language arts, and health into law.

Q & A:

- What does the *common* in Common Core State Standards mean?
    - The standards are *common* in that a child in Wyoming will have the same expectations as a child in Massachusetts. A child in Massachusetts will have the same expectations as a child in Arizona. Standards define what a child should know and be able to do in a given content area within a given timeframe. For instance, "A student recognizes and names all letters of the alphabet by the end of kindergarten." This is an example of a *common* expectation of students from state to state.
- Does *common* mean we treat all students as if they are the same?
    - No. Students enter the classroom with differences in background and ability. While the expectations of all students may be the same (i.e. students exiting kindergarten should be able to recognize and name all letters of the alphabet), the curriculum materials and instructional methods may vary to meet individual student needs. This is called differentiated instruction: the end goal is the same (*common*), but the path to reach that goal differs based on student need.
- Does *common* mean every district in every state has to use the same curriculum materials?
    - No. States have their own policies about curriculum (i.e. textbooks) adoption. In Wyoming, there is local control. That means individual school boards, districts, schools, and/or teachers choose the materials used to help students meet the standards (expectations). For example, if a standard says a student should be able to describe the way dialogue or actions in a story contribute to the plot, a teacher may choose a work of fiction s/he deems most appropriate to meet that expectation. These curriculum and instructional decisions are <u>not</u> made by federal or state government.
- If the curriculum materials are not *common* from state to state, and if curriculum decisions remain with individual school districts, why is there a list of texts and narratives on the CCSS website?
  (see http://www.corestandards.org/assets/Appendix_B.pdf)
    - This list contains <u>suggestions</u> of exemplar texts and narratives that teachers may choose to use to deliver instruction toward the standards. Teachers may opt not to use any of the suggested materials in favor of choosing their own texts and narratives that align to the standards.
- Do the CCSS replace *all* of Wyoming's standards?
    - No. The CCSS apply to math and language arts. Wyoming has nine content areas, each of which has its own standards: math, language arts, health, foreign language, fine & performing arts, science, social studies, career/vocational education, and P.E. Each content area goes through a review and revision process every five years per state statute. The State Board of Education has oversight of standards revisions.
- The CCSS for language arts include literacy in history/social studies, science, and technical subjects in grades 6-12. Isn't that replacing standards in those content areas?

    - No. This section of the CCSS for language arts sets expectations for students to become literate in each of those content areas. For example, in a Wyoming History course, a student would be expected to understand visual information (i.e. maps, charts, photographs) and connect it to the information presented in the text. To read the complete set of 6-12 literacy standards described here, please visit http://www.corestandards.org/ELA-Literacy and scroll down to **Grades 6-12 Literacy in History/Social Studies, Science, & Technical Subjects** on the left-hand side.
- Does the existence of the literacy standards in 6-12 mean language arts teachers have to teach those subjects now?
    - No. The literacy standards in 6-12 are intended to be integrated into those specific content areas (i.e. social studies literacy will be integrated in the social studies classroom; science literacy will be integrated in the science classroom; etc.).

Additional FAQ's related to Wyoming's adoption of the CCSS can be found here:
http://edu.wyoming.gov/Programs/standards/common-core-state-standards-faq.aspx (link)
http://edu.wyoming.gov/sf-docs/standards/ccssfaq.pdf?sfvrsn=2 (PDF)

Resources related to the CCSS for educators and parents can be found here:
http://edu.wyoming.gov/Programs/standards/common-core-state-standards.aspx

Information and resources related to the CCSS in Wyoming are continually being added to our website, so please check back for updates. You may also contact the following WDE staff for specific questions:

- Julie Magee, Standards Division Administrator
  julie.magee@wyo.gov 307.777.8740
- Deb Lindsey, Assessment Division Administrator
  deb.lindsey@wyo.gov 307.777.8753
- Laurie Hernandez, Standards Supervisor and Math Consultant
  laurie.hernandez@wyo.gov 307.777.3469
- Catherine Reeves, English/Language Arts Consultant
  catherine.reeves@wyo.gov 307.777.8595

WYOMING SCHOOL BOARDS ASSOCIATION

"Serving Wyoming Education Through School Board Leadership"

2323 Pioneer Avenue
Cheyenne, WY 82001
Phone (307) 634-1112
FAX (307) 634-1114
www.wsba-wy.org

Gerald 'Joe' Reichardt, Chairman
Wyoming State Board of Education
2 Holloway Road
Wheatland, WY 82201

January 17, 2012

Dear Chairman Reichardt,

Thank you for the opportunity to provide public input on the proposal to adopt the Common Core State Standards. The Board of Directors of the Wyoming School Boards Association is composed of nineteen school board trustees from across the state. Based upon input from these board member's teachers and administrators, the Wyoming School Boards Association Board of Directors voted to support the adoption of the Common Core State Standards at their January 13th Board of Directors meeting.

The WSBA Board supports accountability efforts in our state and believes the adoption of the Common Core Standards will increase rigor in our standards and help to prepare students to be more successful when they leave the public school system. Adopting the Common Core Standards will also allow for much more collaboration with the 30 plus other states which have adopted the standards and allow for better national comparisons with other states.

The WSBA Board applauds the State Board of Education for their efforts in moving this important initiative forward. The State Board has the full support of the WSBA Board of Directors in this matter.

Sincerely,

Loren L Heth

Loren Heth, President
Wyoming School Boards Association

Wyoming School Boards Association
2012
Officers and Directors

Office/ Area	Name	Counties	Term Expires
President	**Loren Heth**		
President-Elect	**David Fall**		
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Area 1	**Brian Farmer**	Laramie #1	2013
Area 2	**Audrey Cotherman**	Natrona	2012
Area 3	**Carl Manning**	Fremont #24, #25, #38	2013
Area 4	**David Fall**	Campbell	2012
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Area 11	**Loren Heth**	Niobrara, Goshen, Laramie #2	2013
Area 12	**Joe Hicks**	Park	2012
Area 13	**Terry Harding**	Sweetwater #2	2013
Area 14	**Janice Marshall**	Albany	2012
Area 15	**Juli Miller**	Carbon	2013
Area 16	**John Riesland**	Crook, Weston	2012
Area 17	**Heidi McStay**	Fremont #1, #2, #6, #14, #21	2013
Area 18	**Koleen Sponsel**	Big Horn	2012
Area 19	**Janine Bay-Teske**	Teton, Lincoln #2	2013

WYOMING ASSOCIATION OF SCHOOL ADMINISTRATORS
2323 Pioneer Avenue
Cheyenne WY 82001
307-631-9010
Fax: 307-634-1114
Email: danstephan@bresnan.net
Website Address: www.wasa-wy.org
Dan D. Stephan, Executive Director

January 16, 2012

Gerald 'Joe' Reichardt, Chairman
Wyoming State Board of Education
2 Holloway Road
Wheatland WY 82201

Dear Mr. Reichardt:

I am writing this letter as the President of the Wyoming Association of School Administrators in an effort to express support for the Common Core State Standards. At the Wyoming Association of School Administrators General Membership Meeting held November 16, 2011, the WASA membership voted unanimously to support this effort.

The standards are clear, rigorous learning expectations that certainly articulate knowledge and skills readiness for post secondary experiences. The superintendents in Wyoming believe that if students demonstrate proficiency on these standards, they will be highly successful as they complete college coursework. Wyoming students will be disadvantaged if we do not adopt the new standards as national comparisons place us in competitive environments with other states. These national comparisons will only be relevant if we are employing common tools to make the comparisons. The adoption of the new standards will 'raise the bar' for Wyoming school districts, students, staff and communities without federal entanglements.

Thank you for this opportunity to provide the thoughts of Wyoming district superintendents through this public comment process.

Respectfully,

Paul Grube

Paul Grube, President
Wyoming Association of School Administrators

WYOMING EDUCATION ASSOCIATION

115 East 22 Street, #1 Cheyenne WY 82001-3795 800.442.2395 wyoea.org

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SWR Representative

Ed Decastro
SWR Representative

Ron Sniffin
Acting Executive Director

Wyoming Department of Education
Attn: Standards Team
Hathaway Building, 2nd Floor
2300 Capitol Avenue
Cheyenne, WY 82002

Dear Board Chairman Reichardt and the WDE Standards Team:

The Wyoming Education Association (WEA) supports adoption of the Common Core State Standards (CCSS) as Wyoming's content and performance standards in the content areas of Language Arts and Mathematics.

WEA believes in the purpose of the CCSS, namely, to ensure that all students, regardless of where they live, leave school prepared for success in post-secondary education and careers. Use of the Common Core State Standards will allow a smooth education transition for students moving between states and/or school districts; those of us who have taught in Wyoming's classrooms recognize this to be very important to student success.

Because the actual curricula and teaching methods in Wyoming for each content area are **LOCAL** decisions, we don't believe the adoption of these standards should be a political issue. It's a matter of equal opportunity for all students in our state and in America.

Wyoming's Language Arts & Math Content Standards Review Committees support the adoption of the CCSS as Wyoming's revised standards in both Language Arts and Math. These review committees were comprised totally of Wyoming educators and community members, and we believe they had the best interests of Wyoming students in mind when they made their recommendations.

Although we know that "national" assessments are being created as a result of the Common Core standards, such assessments are not in place at this time. Wyoming would have to make a conscious and considered decision on whether to join in on a multi-state assessment, and our state won't necessarily agree to participate. We are certain that the State Board and the Department of Education would seek public input before such a decision would be made.

For these reasons, the Wyoming Education Association urges your adoption of the proposed revisions to the content and performance standards in Language Arts and Mathematics.

Sincerely,

Kathryn Valido

Kathryn Valido, President

Pam Shea, Ed.D.
Teton County School District #1
P.O. Box 568
Jackson, WY 83001

January 24, 2012

Mr. Joe Reichardt, Chairman
Wyoming State Board of Education
2300 Capitol Avenue
Hathaway Building, 2nd Floor
Cheyenne, WY 82001-0050

RE: Common Core State Standards

Dear Chairman Reichardt:

As the Superintendent of Teton County School District #1, I am writing to urge The State Board of Education to adopt the Common Core State Standards in Language Arts and Mathematics in their **nationally vetted form** and not as presented in Wyoming's Proposed Chapter 31 Rules and Regulations. What follows is our District's reasoning for this request.

By adopting a hybrid version of the Common Core State Standards, Wyoming will essentially lose the opportunity to partner with other states as they collectively develop resources to advance the work of helping young people become college and career ready. At a time when revenues to states and local districts are being reduced, this ability to partner and share resources with other states will become increasingly more important. Additionally, by adopting a hybrid version of the standards, Wyoming will lose the ability to compare the academic growth of its student to the growth of students in other states. In essence, the adoption of a hybrid version of the Common Core State Standards acts only to over-complicate and over-obligate our educational systems.

It is our District's belief that the Common Core State Standards as adopted at the national level provide a consistent and clear understanding of what students are expected to learn. These standards have been informed by the highest, most effective models from states across the country. As such, they provide teachers and parents with a common understanding of what students are expected to learn. What's more, they provide appropriate benchmarks for all students, regardless of where they live.

It is for these reasons that our District respectfully urges you to consider its request that the State Board of Education adopt the Common Core State Standards, but only in their nationally vetted form.

If you have any questions or require any additional information, please don't hesitate to contact me.

Respectfully,

Pam Shea
Superintendent

Wyoming Curriculum Directors Association

President–	Jeanie Barent	307-684-9571
President Elect–	Scott James	307-322-1518
Secretary-	Scott James	307-322-1518
Treasurer–	Teri Turner	307-876-2576

Regional Representatives:
Northeast Region: Mike Bond & Teresa Brown
Southwest Region: Sheryl Wilson & Kim Dolezal
Northwest Region: RJ Kost & Teri Turner
Southeast Region: Roger Humphrey & Scott James

November 28, 2011

State Board of Education
2300 Capitol Avenue
Hathaway Building, 2nd Floor
Cheyenne, WY 82002-0050

Dear State Board of Education:

On behalf of the Wyoming Curriculum Directors Association (WCDA), I am writing to ask your support of the adoption of the Common Core State Standards. At a recent WCDA meeting in Casper, 34 school districts were represented and *all* of them are already vested in the process of some level of implementation of the Common Core or are in full support of it. This work was started by all of our school districts when in June 2010 the State Board of Education had recommended the adoption of the Common Core State Standards.

The WCDA has several reasons for asking for your support in their adoption. Primarily, the Common Core Standards are a *rigorous* set of clear educational standards that prepare students for college and the workforce. These standards are aligned with international standards to give Wyoming students a competitive edge globally. Current Wyoming standards have been rated as significantly lower than other states and nations by many groups including the Fordham Foundation and the EPIC Survey Center, and if Wyoming is to become the best in the nation as articulated by many legislators, more challenging and definitive standards will be needed for comparisons to other states and nations.

These rigorous standards were developed by teams of experts including experienced teachers, leaders, and content experts, and are <u>not</u> a national curriculum. Rather, they provide a *very clear picture* of what students need to know and be able to do at a state, national and global level. This consistency will assure that students across our fine state are receiving the highest quality education. From this clear picture, Wyoming teachers can then create their individualized curriculum and build lesson plans around them. If Wyoming were to try to write or revise our own state standards, we would spend a lot of time and effort replicating great work that has already been accomplished by experts in the field.

Thank you for your careful consideration of supporting the adoption of the Common Core State Standards. I'd be happy to answer any questions you may have.

Respectfully,

Dr. Jeanie M Barent

Dr. Jeanie M. Barent, WCDA President

In total, there were nearly 150 comments received between December 12, 2011 and February 13, 2012. Of those, 98 were in support of CCSS, 44 were opposed, and 6 comments were unrelated to the CCSS.
JM

2013 WYOMING
CAREER & VOCATIONAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

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Adopted on XXX, XX, 2013

ACKNOWLEDGMENT

The Wyoming State Board of Education would like to thank the Wyoming Department of Education, as well as educators, parents, students, business and industry representatives, community college representatives, and the University of Wyoming for all their help with the development of these standards.

Richard Crandall, Director
Wyoming Department of Education

Julie Magee, Division Administrator
Standards and Accountability Division

Laurie Hernandez, Standards Team Supervisor

Catherine Leigh Reeves, WDE Consultant / Committee Facilitator

Wyoming Department of Education
Hathaway Building, 2nd Floor
2300 Capitol Avenue
Cheyenne, Wyoming 82002-0050

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The Wyoming Department of Education does not discriminate on the basis of race, color, national origin, sex, age, or disability in admission or access to, or treatment or employment in its educational programs or activities. Inquiries concerning Title VI, Title IX, Section 504, and the Americans with Disabilities Act may be referred to the Wyoming Department of Education, Office for Civil Rights Coordinator, 2nd floor, Hathaway Building, Cheyenne, Wyoming 82002-0050 or (307) 777-6252, or the Office for Civil Rights, Region VIII, U. S. Department of Education, Federal Building, Suite 310, 1244 Speer Boulevard, Denver, CO 80204-3582, or (303) 844-5695 or TDD (303) 844-3417. This publication will be provided in an alternative format upon request.

2013 WYOMING CAREER & VOCATIONAL EDUCATION CONTENT AND PERFORMANCE STANDARDS

RATIONALE

As part of the 21st century workforce, college and career ready students will need to be equipped with knowledge, skills, and characteristics that allow them to be productive, contributing members of an innovative, dynamic global society. Schools today must assist students in developing the necessary skills, intellectual abilities, and personal traits that help them to secure and maintain meaningful employment in the world of work. Nearly eight in ten future job openings in the next decade in the U.S. will require postsecondary education or training. Forty-five percent will be in "middle skill" occupations, which require at least some postsecondary education and training, while 33% will be in high skilled occupations for which a Bachelors degree or more is required. By contrast, only 22% of future job openings will be "low skill" and accessible to those with a high school diploma or less. (The American Diploma Project)

The foundation for rewarding careers and productive employment is built through exploration and understanding of career choices. Today's employers seek creative, critical thinkers who are able to access and use information from a variety of sources to assist them in solving problems and making informed workplace decisions. In order to secure career advancements, an employee must demonstrate a willingness to learn on the job by embracing lifelong learning, and exhibit initiative, productivity, and responsibility. Additionally, an employee must advocate and continually demonstrate safe work practices.

Students must demonstrate the collaborative skills that play a major role in personal and career success. An individual should have the ability to participate as a member of a diverse team, teach others new skills, exercise leadership, compromise, and serve clients and customers. A student must be able to acquire, evaluate, interpret, organize and maintain data, and process and communicate information. In order to be a productive member of society, students must be able to manage personal and workplace resources including time, materials and finances. In addition, they must be flexible and adaptive with technology in a dynamic and ever-changing digital world.

ORGANIZATION OF STANDARDS

Standards specify the essential learning that students must master. They provide a K-12 framework to assist school districts, schools, and communities in developing and strengthening curriculum rather than prescribing courses, materials, or instructional methodology. Teachers ensure that students achieve standards by using a range of instructional strategies that they select based on their students' needs. Content and performance standards are identified for grade spans K-5, 6-8, 9-12 with benchmarks at grades five, eight, and eleven. The standards have not been assigned an order of importance. Terms used in this document are defined in the glossary.

Kindergarten through fifth grade students, parents, and teachers work toward the achievement of the fifth grade benchmarks. Sixth grade through eighth grade students, parents, and teachers work toward the achievement of the eighth grade benchmarks. Ninth grade through eleventh grade students, parents, and teachers work toward the achievement of the eleventh grade benchmarks. Success at each benchmark level requires the effort and commitment of all who

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prepare for that level. It also requires a commitment of support and cooperation between the three levels (elementary, middle and high school) and the district administration.

Content Standards: These statements define what students are expected to know and be able to do by the time they graduate. They do not dictate what methodology or instructional materials should be used, nor how the material is delivered.

Benchmarks: These statements specify what students are expected to know and be able to do at the end of each of the benchmark grade levels, in this document, grades 5, 8, and 11. These benchmarks specify the skills and content students must master along the way in order to demonstrate proficiency of the content standard by the time they graduate.

Performance Level Descriptors: These statements describe how well students must perform the benchmarks. The "proficient" level is required in order to demonstrate mastery of the standards. Descriptors help teachers assess where students are performing in relation to the benchmarks, and ultimately, the content standards.

THE PROCESS OF STANDARDS DEVELOPMENT

Consistent with its responsibility to evaluate and review the uniformity and quality of the standards at least every five years, the Wyoming State Board of Education Board directed the Wyoming Department of Education (WDE), working in consultation and coordination with local school districts, to formulate and implement a process to evaluate and review the uniformity and quality of the standards by December 2013.

The Wyoming Career/Vocational Education Content and Performance Standards represent a cooperative effort. The C/VE Committee was formed in May 2012 with representatives from school districts, community colleges, and businesses state-wide. This committee met for the first time in June 2012 to begin the revision process. Members began with a systematic evaluation of the uniformity and quality of the 2008 standards. The standards were reviewed for cognitive complexity, and it was decided to integrate a degree of national standards to establish the rigor of the Wyoming Career/Vocational Education Content and Performance Standards.

The Committee incorporated and adapted the Common Core State Standards (CCSS) for Literacy in Science and Technical subjects, and referenced the Common Career Technical Core (CCTC), 21st Century Skills, and International Society for Technology in Education (ISTE) in the Standards. The C/VE Committee chose not to adopt the CCTC Standards in order to develop a cohesive K-12 system. Alignment between national standards and the new C/VE Standards are drawn below:

ISTE Standard		C/VE Code
1	Creativity & Innovation	CV11.3.4
2	Communication & Collaboration	Standard 2
3	Research & Information Fluency	Standard 4
4	Critical Thinking, Problem Solving, and Decision Making	Standard 3
5	Digital Citizenship	Standard 5, Benchmark 3
6	Technology Operations and Concepts	Standard 5

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CCTC Career Ready Practices		C/VE Code
1	Act as a responsible and contributing citizen and employee.	CV11.1.4
2	Apply appropriate academic and technical skills.	n/a
3	Attend to personal health and financial well-being.	n/a
4	Communicate clearly, effectively and with reason.	CV11.2.1
5	Consider the environmental, social and economic impacts of decisions.	CV11.3.4
6	Demonstrate creativity and innovation.	CV11.3.4
7	Employ valid and reliable research strategies.	CV11.3.3
8	Utilize critical thinking to make sense of problems and persevere in solving them.	Standard 3
9	Model integrity, ethical leadership and effective management.	CV11.2.2
10	Plan education and career path aligned to personal goals.	CV8.1.1 & 8.1.2
11	Use technology to enhance productivity.	Standard 5
12	Work productively in team while using cultural/global competence	CV11.2.3

All other documents reviewed by the Committee are referenced on page #23 of this document.

To completely revamp the standards to reflect greater rigor and closer alignment to national standards, grade-band groups of K-5, 6-8, 9-12 were formed to evaluate, update, and create standards, benchmarks, and performance level descriptors relevant to the skills needed by the 21st Century learner. Groups met via the Wyoming Education Network, on-line, as well as face-to-face to continue development and alignment. A public comment period via the Wyoming Department of Education website was allowed for one month before the team met again face-to-face to address potential edits and finalize the document. Throughout the drafting process, the C/VE Committee developed interdisciplinary, project-based standards which focus on high-level questioning, critical thinking, and problem solving across the grade spans. These standards will guide teachers toward effective instruction to aid in students' preparation for college and careers.

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INTRODUCTION TO THE STANDARDS

CTE programs across the state of Wyoming are dynamic and diverse, encompassing the National 16 Career Clusters (http://www.careertech.org/) and their corresponding Career Pathways, linked below:

Agriculture, Food & Natural Resources	Education & Training
Architecture & Construction	Finance
Arts, A/V Technology & Communications	Government & Public Administration
Business, Management & Administration	Health Science
Hospitality & Tourism	Manufacturing
Human Services	Marketing
Information Technology	Science, Technology, Engineering & Mathematics
Law, Public Safety, Corrections & Security	Transportation, Distribution & Logistics

Wyoming CTE programs are further enhanced by professional organizations that provide annual professional development opportunities for CTE teachers: WVATA (Wyoming Vocational Agricultural Teachers Association); WBEA (Wyoming Business Education Association; WNRS (New and Related Services- guidance and career centers); WHSTE (Wyoming Health Services Teacher Education); WATFACS (Wyoming Association of Family and Consumer Sciences); WMEA (Wyoming Marketing Association); WTEA (Wyoming Technical Education Association.); and WACTE (Wyoming Association for Career and Technical Education).

Curricula need to stay current with rapid changes in the workplace and to recognize the differing sizes of programs within our state. For these reasons, the standards are written with broad scope and purpose. Intended also to promote college and career readiness, as defined by the American Diploma Project Network. "To be college- and career-ready, high school graduates must have studied a rigorous and broad curriculum, grounded in the core academic disciplines, but also consisting of other subjects that are part of a well-rounded education. Academic preparation alone is not enough to ensure postsecondary readiness but it is clear that it is an essential part of readiness for college, careers, and life in the 21st century." (http://www.achieve.org/college-and-career-readiness)

The standards have been organized into five major categories:

1. **Career Development and Readiness**
2. **Communication and Collaboration**
3. **Critical Thinking and Problem Solving**
4. **Technical Literacy**
5. **Technical Proficiency and Productivity**

The standards are not prioritized; rather, they are listed alphabetically. A brief description is provided for each of these standards.

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Career Development and Readiness: Students demonstrate career planning and employability skills.

Communication and Collaboration: Students develop the skills necessary to effectively lead, collaborate, and communicate.

Critical Thinking and Problem Solving: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate technology, tools, and resources.

Technical Literacy: Students effectively read, evaluate, write, and communicate technical information.

Technical Proficiency and Productivity: Students safely, ethically, and productively use existing and new technologies and systems.

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Connections to the Common Core State Standards (CCSS) for Literacy in History, Science, and Technical Subjects: Standards Coding for English/Language Arts & Math

Content Standard	CCSS Coding	Stands for	Where You'll Find It
ELA	R.CCR.9 W.CCR.1	Reading / Writing College- and Career-Ready Anchor Standard **Example:** R.CCR.9 = Reading, Individual College and Career Readiness (CCR) Anchor Standard, Standard 9	Language Arts Standards - CCSS ELA pages, after the introduction (Reading - CCR, K-5 pg. 10; Gr. 6-12 pg. 35) (Writing - CCR, K-5 pg. 18; Gr. 6-12 pg. 41)
Reading	RL.3.2 RI.4.3	Reading of Literature, Gr. 3 Reading for Information, Gr. 4 **Example:** RI.4.3 = Reading, Informational Text, Grade 4, Standard 3	Language Arts Standards - CCSS ELA pages, after the introduction (K-5 pp. 11-12; Gr. 6-12 pp. 36-38) (K-5 pp.13-14; Gr. 6-12 pp. 39-40)
Writing	W.5.1a	Writing, Gr. 5 **Example:** W.5.1a Writing, Grade 5, Standard 1a	Language Arts Standards - CCSS ELA pages, after the introduction (K-5 pp. 19-21; Gr. 6-12 pp. 42-47)
Literacy Standards for History, Science, & Technical Subjects	RHST.CCR.2 RH.9-10.3 RST.11-12.3 WHST.CCR.2 WHST.9-10.3	Reading for History/S.S., Science, & Technical Subjects), CCR Anchor Standard #2 Reading Lit. in History, Gr. 9-10 Reading Lit. in Science & Technical Subjects, Gr. 11-12 **Example:** RST.6-8.3 = Reading, Science and Technical Text, Grade 6-8, Standard 3	Language Arts Standards - CCSS ELA pages, after the introduction (Gr. 6-12) (Reading - CCR pg. 60) (Reading - History pg. 61) (Reading - Science & Technical Subjects (RST) pg. 62) (Writing - CCR pg. 63) (Writing for Literacy in History, Science, & Technical Subjects (WHST) pp. 64-66)
Math	MP.2 7.G.A.2	Math Practice #2 7th Grade Geometry **Example:** 4.MD.A.2 = 4th Grade Math, Measurement & Data Domain, 1st Cluster Heading, Standard 2	Mathematics Standards – CCSS Math pages, after the introduction (K-12 pp. 10-83)

All Standards Documents can be found on the Wyoming Department of Education Standards Page at http://edu.wyoming.gov/Programs/standards.aspx.

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2013 WYOMING CAREER & VOCATIONAL EDUCATION CONTENT AND PERFORMANCE STANDARDS					
CAREER & VOCATIONAL EDUACTION CONTENT STANDARD **1. Career Development and Readiness** Students demonstrate career planning and employability skills.					
GRADE SPAN K-5		GRADE SPAN 6-8		GRADE SPAN 9-12	
CODE	GRADE 5 BENCHMARKS	CODE	GRADE 8 BENCHMARKS	CODE	GRADE 11 BENCHMARKS
CV5.1.1	Students identify and describe various occupations.	CV8.1.1	Career-aware students explore several career pathways including but not limited to outlook, salary, needed training, duties and lifestyle.	CV11.1.1	College and career-ready students evaluate current knowledge and interests in order to set career goals.
CV5.1.2	Students describe how work relates to meeting needs for goods, clothing, shelter, and other necessities for living.	CV8.1.2	Career-aware students conduct an inventory of personal skills, aptitude and interests and identify career pathways that align with their results.	CV11.1.2	Career-ready students explore careers including outlook, salary, needed training, duties and lifestyle utilizing all available resources including mentors and industry experts.
CV5.1.3	Students identify and demonstrate behaviors contributing to the successful completion of workplace tasks.	CV8.1.3	Career-aware students prepare a self improvement plan including secondary and postsecondary programs to gain desired knowledge and experience toward possible career opportunities.	CV11.1.3	Career-ready students prepare an educational and career plan to enable them to gain desired knowledge and experience.
CV5.1.4	Students complete tasks within an allotted time by acquiring, storing, organizing, and using materials and space efficiently.	CV8.1.4	Career-aware students demonstrate an awareness of characteristics and skills necessary to enhance employability.	CV11.1.4	College and career-ready students demonstrate employability skills that enable them to be responsible and contributing citizens and employees.

CAREER & VOCATIONAL EDUCATION CONTENT STANDARD **2. Communication and Collaboration** Students develop the skills necessary to effectively lead, collaborate, and communicate.					
GRADE SPAN K-5		GRADE SPAN 6-8		GRADE SPAN 9-12	
CODE	GRADE 5 BENCHMARKS	CODE	GRADE 8 BENCHMARKS	CODE	GRADE 11 BENCHMARKS
CV5.2.1	Students identify and practice compromise and conflict resolution skills.	CV8.2.1	Career-aware students effectively communicate using a variety of appropriate methods.	CV11.2.1	College and career-ready students communicate clearly, effectively, and with reason.
CV5.2.2	Students share new concepts learned through peer teaching and presenting to a group.	CV8.2.2	Career-aware students successfully lead a group activity.	CV11.2.2	College and career-ready students identify and model integrity, ethical leadership and effective management skills.
CV5.2.3	Students identify and actively participate in group roles and responsibilities while demonstrating respect and awareness of diversity.	CV8.2.3	Career-aware students actively participate as a team member to accomplish group goals while effectively working with diverse individuals/groups.	CV11.2.3	College and career-ready students work productively in teams while using cultural global competence.
CV5.2.4	Students apply safe, legal, and responsible use of information and technology as appropriate to the task.	CV8.2.4	Career-aware students apply safe, legal, and responsible use of information and technology as appropriate to the task.	CV11.2.4	College and career-ready students apply safe, legal, and responsible use of information and technology as appropriate to the task.

CAREER & VOCATIONAL EDUCATION CONTENT STANDARD **3. Critical Thinking and Problem Solving** Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate technology, tools, and resources.					
GRADE SPAN K-5		GRADE SPAN 6-8		GRADE SPAN 9-12	
CODE	GRADE 5 BENCHMARKS	CODE	GRADE 8 BENCHMARKS	CODE	GRADE 11 BENCHMARKS
CV5.3.1	Students identify and define real-world problems and meaningful questions for investigation.	CV8.3.1	Career-aware students identify real-world problems and efficiently locate & effectively use various sources of information for informed decision making.	CV11.3.1	College and career-ready students identify and define authentic problems and significant questions for investigation.
CV5.3.2	Students plan and manage activities to develop a solution or complete a project.	CV8.3.2	Career-aware students demonstrate an awareness of the working process of business and political systems and how they affect specific careers.	CV11.3.2	College and career-ready students identify trends, forecast possibilities, and explore complex systems and issues.
CV5.3.3	Students collect and analyze data to identify solutions and make informed decisions.	CV8.3.3	Career-aware students demonstrate an ability to explain and interpret solutions to problems using data and information compiled from a variety of reputable sources.	CV11.3.3	College and career-ready students employ valid and reliable research strategies and apply prior knowledge to solve a problem or complete a project.
CV5.3.4	Students seek help from appropriate people (staff, students, parents, etc) and appropriate resources.	CV8.3.4	Career-aware students plan, manage and complete projects in a timely and effective manner.	CV11.3.4	College and career-ready students demonstrate creativity and innovation while considering the environmental, social, and economic impacts of decisions.

CAREER & VOCATIONAL EDUCATION CONTENT STANDARD **4. Technical Literacy** Students effectively read, evaluate, write, and communicate technical information.					
GRADE SPAN K-5		GRADE SPAN 6-8		GRADE SPAN 9-12	
CODE	GRADE 5 BENCHMARKS	CODE	GRADE 8 BENCHMARKS	CODE	GRADE 11 BENCHMARKS
CV5.4.1	Students use a variety of methods including oral, written, graphic, pictorial, and/or multimedia in order to create and share a product.	CV8.4.1	Career-aware students produce clear and coherent writing in which the development, organization and style are appropriate to task, purpose and audience. (*CCSS W.9.4)	CV11.4.1	College and career-ready students produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (*CCSS W.11.4)
CV5.4.2	Students read and comprehend a variety of sources that provide workplace information, including functional texts.	CV8.4.2	Career-aware students demonstrate an ability to identify sources from which they locate, interpret, extract and summarize data in an ethical and appropriate manner.	CV11.4.2	College and career-ready students determine the meaning of symbols, key terms, and other content-specific words and phrases as they are used in technical context. (*Adapted from CCSS RL.9.11)
CV5.4.3	Students explain events, procedures, ideas, or concepts in technical texts, including what happened and why, based on specific information in the text. (*Adapted from CCSS RI.4.3)	CV8.4.3	Career-aware students demonstrate the ability to create compositions and presentations of technical data in both written and verbal formats.	CV11.4.3	College and career-ready students acquire, manipulate, analyze, diagnose, and/or report information, using the appropriate technology.
CV5.4.4	Students interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (*Adapted from CCSS RI.4.7)	CV8.4.4	Career-aware students integrate and translate content presented in diverse formats and media, including visually and quantitatively, as well as in words. (*Adapted from CCSS R.CCR.7)	CV11.4.4	College and career-ready students precisely follow a complex multistep procedure when performing technical tasks. (*Adapted from CCSS RL.9.3) ***Coding can be found on page 8 of this document**

CAREER & VOCATIONAL EDUCATION CONTENT STANDARD **5. Technical Proficiency and Productivity** Students safely, ethically, and productively use existing and new technologies and systems.					
GRADE SPAN K-5		GRADE SPAN 6-8		GRADE SPAN 9-12	
CODE	GRADE 5 BENCHMARKS	CODE	GRADE 8 BENCHMARKS	CODE	GRADE 11 BENCHMARKS
CV5.5.1	Students explain the need for rules within organizational systems.	CV8.5.1	Career-aware students identify technical and digital systems, how they are properly and ethically used and their relationship to other systems globally.	CV11.5.1	College and career-ready students manage resources to develop, analyze, and implement systems and applications.
CV5.5.2	Students examine family, community, monetary, and school systems.	CV8.5.2	Career-aware students plan tasks recognizing human resources, financial and timeline constraints that take into account priorities and goals.	CV11.5.2	College and career-ready students productively complete tasks taking constraints, priorities and resources into account.
CV5.5.3	Students understand and apply the responsibilities of digital citizenship.	CV8.5.3	Career-aware students demonstrate technical knowledge and skills by safely, ethically and appropriately acquiring, storing, organizing and using materials, tools, and workspace.	CV11.5.3	College and career-ready students safely and ethically use current industry-standard tools and emerging technologies.
CV5.5.4	Students understand and appropriately use available technology systems.	CV8.5.4	Career-aware students demonstrate proficiency in selecting and utilizing technologies in the completion of tasks and projects.	CV11.5.4	College and career-ready students utilize technology to develop innovative solutions or products.

ELEMENTARY (K-5)	MIDDLE SCHOOL (6-8)	HIGH SCHOOL (9-12)
C/VE STANDARD 1 **Career Development and Readiness**	**C/VE STANDARD 1** **Career Development and Readiness**	**C/VE STANDARD 1** **Career Development and Readiness**
Students demonstrate career planning and employability skills.	Career-aware students demonstrate career planning and employability skills.	College and career-ready students demonstrate career planning and employability skills.
ADVANCED PERFORMANCE	**ADVANCED PERFORMANCE**	**ADVANCED PERFORMANCE**
Students complete tasks on time and manage materials and space. Students compare and contrast various occupations and can evaluate the importance of an occupation.	Students explore several career pathways. They identify career pathways and independently align strengths and interests. Students independently establish a self improvement career plan that includes secondary and postsecondary program completion and related extracurricular (CTSO & community) involvement. Students describe, assess, improve, and demonstrate personal employability skills and characteristics.	Students understand and verbalize the career pathways model. They have worked with a career counselor to develop an inclusive Plan of Study that is aligned with their career interests and strengths. Students work independently with a career counselor to monitor and adjust their Plan of Study as their needs change. This includes secondary and postsecondary coursework opportunities as well as related CTSO & community service involvement. Students can accurately demonstrate personal employability skills and characteristics using both written and verbal communication methods.
PROFICIENT PERFORMANCE	**PROFICIENT PERFORMANCE**	**PROFICIENT PERFORMANCE**
Students regularly complete tasks on time and manage materials and space. Students compare various occupations and can explain the importance of an occupation.	Students explore and identify several career pathways that align with individual strengths and interests. Students have established a self improvement career development plan that includes secondary & postsecondary program completion. Students can accurately identify employability skills and characteristics.	Students understand the career pathways model. They have worked with a career counselor to begin development of a Plan of Study that is aligned with their career interests and strengths. Students identify secondary and postsecondary coursework opportunities as well as related CTSO & community service involvement that may benefit them. They can identify and discuss valuable personal employability skills and characteristics.
BASIC PERFORMANCE	**BASIC PERFORMANCE**	**BASIC PERFORMANCE**
Students occasionally complete tasks on time and manage materials and space. Students compare two occupations and provide limited information on the importance of an occupation.	Students explore and identify, with assistance, a limited number of career pathways that align with individual strengths and interests. Students have established a partial self improvement career development plan. With assistance, students can identify employability skills and characteristics.	Students have a limited understanding of the career pathways model. They have identified coursework around their career interests and strengths that would be used to develop a Plan of Study. Students have identified secondary and postsecondary coursework opportunities that are of interest to them. Students can discuss several personal employability skills and characteristics.
BELOW BASIC PERFORMANCE	**BELOW BASIC PERFORMANCE**	**BELOW BASIC PERFORMANCE**
Students require significant support to complete tasks on time and manage materials and space. Students can identify occupations.	Students require extensive support or provide little or no evidence in meeting the standard.	Students require extensive support or provide little or no evidence in meeting the standard.

ELEMENTARY (K-5)	MIDDLE SCHOOL (6-8)	HIGH SCHOOL (9-12)
C/VE STANDARD 2 **Communication and Collaboration**	**C/VE STANDARD 2** **Communication and Collaboration**	**C/VE STANDARD 2** **Communication and Collaboration**
Students develop the skills necessary to effectively lead, collaborate, and communicate.	Career-aware students develop the skills necessary to effectively lead, collaborate, and communicate.	College and career-ready students develop the skills necessary to effectively lead, collaborate, and communicate.
ADVANCED PERFORMANCE	**ADVANCED PERFORMANCE**	**ADVANCED PERFORMANCE**
Students compromise and use conflict resolution skills independently. They share new concepts learned with others without prompting. Students are able to actively participate in group roles and responsibilities without teacher direction. When working with others, they demonstrate respect and incorporate diverse views, opinions, and thoughts. Students use information safely, ethically, and responsibly and are able to articulate the importance of doing so in and out of school.	Students positively recognize and utilize group diversity & productively interact with all team members to accomplish group goals. Students communicate effectively in all settings using a variety of methods. Students independently & successfully lead a group activity. They demonstrate global competencies, utilizing perspectives and strengths for the benefit of the team. Students consistently demonstrate safe, legal, and responsible use of information and technology as appropriate to the task.	Students are capable of fulfilling many roles on a team. They recognize that everyone brings different skills to a team and are able to effectively lead, collaborate, and communicate in order to successfully complete a project. They consistently share project progress and results. They demonstrate global competencies, utilizing perspectives and strengths for the benefit of the team.
PROFICIENT PERFORMANCE	**PROFICIENT PERFORMANCE**	**PROFICIENT PERFORMANCE**
Students are able to compromise and use conflict resolution skills with coaching. They share new concepts learned with others through an assigned task. Students are able to identify and participate in group roles and responsibilities. When working with others, they consistently demonstrate respect for diverse views, opinions, and thoughts. Students safely, responsibly, and ethically use information in a structured environment.	Students positively and productively interact with all team members to accomplish group goals. Students communicate effectively in most settings using a variety of methods. Students successfully lead a group activity with limited guidance. They demonstrate global competencies, learning from and working collaboratively with others. Students safely, legally, and responsibly use information and technology as appropriate to the task.	Students are active participants on a team. They communicate via standard methods with each other, and they utilize typical protocols to share project progress and results. They demonstrate global competencies, learning from and working collaboratively with others.
BASIC PERFORMANCE	**BASIC PERFORMANCE**	**BASIC PERFORMANCE**
Students are able to sometimes compromise and use conflict resolution skills during a structured setting with coaching and support. They occasionally share new concepts with others, and have difficulty participating and understanding some group roles and responsibilities. At times, students need support in showing respect for diverse views, opinions, and thoughts. Students need coaching to safely, responsibly, and ethically use information.	Students show little interest in group goals and seldom and/or inappropriately interact with team members. Students communicate effectively in some settings when given a specific method. Students lead a group activity with a lot of guidance. They have difficulty demonstrating global competencies, learning from and working collaboratively with others. With guidance students safely, legally, and responsibly use information and technology as appropriate to the task.	Students occasionally participate and communicate with other team members. They work toward project goals as individuals, rather than as a group. These students have a limited understanding that there are multiple means of communication and only utilize very basic methods to share project results. They have difficulty demonstrating global competencies, learning from and working collaboratively with others.

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ELEMENTARY (K-5)	MIDDLE SCHOOL (6-8)	HIGH SCHOOL (9-12)
C/VE STANDARD 2 **Communication and Collaboration**	**C/VE STANDARD 2** **Communication and Collaboration**	**C/VE STANDARD 2** **Communication and Collaboration**
Students develop the skills necessary to effectively lead, collaborate, and communicate.	Career-aware students develop the skills necessary to effectively lead, collaborate, and communicate.	College and career-ready students develop the skills necessary to effectively lead, collaborate, and communicate.
BELOW BASIC PERFORMANCE	**BELOW BASIC PERFORMANCE**	**BELOW BASIC PERFORMANCE**
Students require significant support in making compromises or in using conflict resolution skills during a structured setting. With significant support, they are able to share concepts with others, or participate and understand group roles and responsibilities. Even with support, students struggle to show respect for diverse views, opinions, and thoughts. Students need significant support to safely, responsibly, and ethically use information.	Students require extensive support or provide little or no evidence in meeting the standard.	Students require extensive support or provide little or no evidence in meeting the standard

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ELEMENTARY (K-5)	MIDDLE SCHOOL (6-8)	HIGH SCHOOL (9-12)
C/VE STANDARD 3 **Critical Thinking and Problem Solving**	**C/VE STANDARD 3** **Critical Thinking and Problem Solving**	**C/VE STANDARD 3** **Critical Thinking and Problem Solving**
Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate technology, tools, and resources.	Career-aware students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate technology, tools, and resources.	College and career-ready students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate technology, tools, and resources.
ADVANCED PERFORMANCE	**ADVANCED PERFORMANCE**	**ADVANCED PERFORMANCE**
Students at the advanced level independently, consistently, and effectively problem solve by gathering data in order to make informed decisions. They evaluate information using appropriate technologies and/or resources to complete a task. Students seek or provide help independently.	Students independently and accurately locate, use, organize, analyze and communicate information in various formats. Students independently and accurately explain how systems operate and impact global society. Advanced students independently plan, manage, troubleshoot and complete projects in a timely manner.	Students independently and accurately locate, use, organize, analyze and communicate different types information through verbal and written means. Students use the appropriate technology, tools and resources to independently and accurately lead, research, manage and complete individual and group projects in a timely manner.
PROFICIENT PERFORMANCE	**PROFICIENT PERFORMANCE**	**PROFICIENT PERFORMANCE**
Students effectively problem solve by gathering data in order to make informed decisions. They organize information using appropriate technologies and/or resources to complete a task. Students seek or provide help with limited guidance.	Students accurately locate, use, organize, analyze and communicate, with minimal guidance, information in various formats. They accurately explain how systems operate and impact global society, with minimal guidance. Proficient students can plan, manage and complete projects in a timely manner.	Students accurately locate, use, organize and communicate information through verbal and written means. Students use technology, tools and resources to lead, research, manage and complete individual and group projects in a timely manner.
BASIC PERFORMANCE	**BASIC PERFORMANCE**	**BASIC PERFORMANCE**
Students demonstrate limited ability and require much assistance to problem solve and gather data in order to make informed decisions. They have limited abilities to organize information, occasionally using appropriate technologies and/or resources to complete a task. Students seek or provide help with a great amount of guidance.	Students locate, use, organize, analyze and communicate, with guidance, information in various formats. With guidance, basic students explain how systems operate. Basic students plan and complete projects with guidance.	Students locate, organize and communicate information with limited verbal and written means. Students can identify and/or use some technology, tools and resources to complete individual and group projects in a timely manner.
BELOW BASIC PERFORMANCE	**BELOW BASIC PERFORMANCE**	**BELOW BASIC PERFORMANCE**
Students require significant assistance to problem solve and gather data in order to make decisions. With significant support, they organize information, use technologies and/or resources to complete a task.	Students require extensive support or provide little or no evidence in meeting the standard.	Students require extensive support or provide little or no evidence in meeting the standard.

ELEMENTARY (K-5)	MIDDLE SCHOOL (6-8)	HIGH SCHOOL (9-12)
C/VE STANDARD 4 **Technical Literary**	**C/VE STANDARD 4** **Technical Literary**	**C/VE STANDARD 4** **Technical Literary**
Students effectively read, evaluate, write, and communicate technical information.	Career-aware students effectively read, evaluate, write, and communicate technical information.	College and career-ready students effectively read, evaluate, write, and communicate technical information.
ADVANCED PERFORMANCE	**ADVANCED PERFORMANCE**	**ADVANCED PERFORMANCE**
Students read, comprehend, and evaluate a variety of functional texts. Students will create products that communicate information by evaluating and selecting the appropriate visual representations. Students will independently communicate understanding of visual representations through oral or written formats.	Students ethically select, interpret, integrate and analyze technical data and apply appropriate format(s) for composition and presentation of said technical data. Students successfully and independently integrate and convert quantitative or technical information into text and/or visual representations.	Students select, read, interpret, evaluate, analyze and communicate technical data in a variety of ways. Students can successfully and independently compose and present different types of technical data using a variety of visual technologies.
PROFICIENT PERFORMANCE	**PROFICIENT PERFORMANCE**	**PROFICIENT PERFORMANCE**
Students read and comprehend a variety of functional texts. Students will create products that communicate information using visual representations. Students will communicate understanding of visual representations through oral or written formats.	Students ethically select, interpret, and integrate technical data and apply appropriate format(s) for composition and presentation of said technical data. Students successfully integrate and convert quantitative or technical information into text and/or visual representations with minimal guidance.	Students effectively select, read, interpret, evaluate and communicate technical data in a variety of ways. Students can independently compose and present different types of technical data using current technologies.
BASIC PERFORMANCE	**BASIC PERFORMANCE**	**BASIC PERFORMANCE**
Students read and comprehend a variety of functional texts with guidance and support. Students demonstrate limited ability to create products that communicate information using visual representations. With prompting, students will communicate understanding of visual representations through oral or written formats.	Students ethically select, interpret and integrate technical data and apply appropriate format(s) for composition and presentation of said technical data with minimal guidance. Students integrate quantitative or technical information into text and/or visual representations with guidance.	With assistance, students read, evaluate, communicate and present different types of technical data using available technologies.
BELOW BASIC PERFORMANCE	**BELOW BASIC PERFORMANCE**	**BELOW BASIC PERFORMANCE**
Students require significant support to read and comprehend functional texts. Students have difficulty producing or communicating understanding of visual representations.	Students require extensive support or provide little or no evidence in meeting the standard.	Students require extensive support or provide little or no evidence in meeting the standard

ELEMENTARY (K-5)	MIDDLE SCHOOL (6-8)	HIGH SCHOOL (9-12)
C/VE STANDARD 5 **Technical Proficiency and Productivity**	**C/VE STANDARD 5** **Technical Proficiency and Productivity**	**C/VE STANDARD 5** **Technical Proficiency and Productivity**
Students safely, ethically, and productively use existing and new technologies and systems.	Career-aware students safely, ethically, and productively use existing and new technologies and systems.	College and career-ready students safely, ethically, and productively use existing and new technologies and systems.
ADVANCED PERFORMANCE	**ADVANCED PERFORMANCE**	**ADVANCED PERFORMANCE**
Students analyze family, community, monetary, and school systems in everyday life. Students evaluate the need for rules within organizational systems and exercise them in daily life. Students explain and apply ethical responsibility for the proper use of technologies. Students are able to independently select appropriate technologies and effectively use the technology to accomplish a task.	Students consistently demonstrate technical knowledge and skills using appropriate tools and resources in a safe and ethical manner. They accurately categorize and analyze technical systems and how they impact other local and global systems.	Students consistently and safely use technology to complete tasks and projects that meet or exceed industry standards. They develop, evaluate and modify systems to most efficiently complete a task.
PROFICIENT PERFORMANCE	**PROFICIENT PERFORMANCE**	**PROFICIENT PERFORMANCE**
Students describe components of family, community, monetary, and school systems in everyday life. Students explain the need for rules within organizational systems and regularly exercise them in daily life. Students understand the ethical responsibility for the proper use of technologies. Students are able to select appropriate technologies and effectively use the technology to accomplish a task with limited guidance.	Students regularly demonstrate a basic level of technical knowledge and skills using appropriate tools and resources in a safe and ethical manner. They accurately identify and explain technical systems and how they impact other systems.	Students successfully and safely use technology to complete assigned tasks and projects without assistance. They evaluate the implications of the technology choices they make.
BASIC PERFORMANCE	**BASIC PERFORMANCE**	**BASIC PERFORMANCE**
Students identify components of family, community, monetary, and school systems in everyday life. Students understand the need for rules within organizational systems. Students have limited understanding of the ethical responsibility for the proper use of technologies. Students are able to select appropriate technologies to accomplish a task with guidance.	Students occasionally demonstrate a basic level of technical knowledge and skill using appropriate tools and resources in a safe manner. They identify and explain technical systems.	Students use technology to complete assigned tasks and projects with assistance. They must also be reminded to demonstrate the safe use of technology. They have a limited understanding of the importance of considering the ethical implications of the technology choices that they make.
BELOW BASIC PERFORMANCE	**BELOW BASIC PERFORMANCE**	**BELOW BASIC PERFORMANCE**
Students require extensive prompting to identify the components of family, community, monetary, and school systems in everyday life. Students recognize there are rules, but cannot explain the purpose of the rules. Students require significant support in ethically and appropriately using technology.	Students require extensive support or provide little or no evidence in meeting the standard	Students require extensive support or provide little or no evidence in meeting the standard

GLOSSARY

The glossary is intended to clarify selected terms and phrases used in the content, benchmark and performance standards which may not be familiar to all readers. Please consult appropriate reference materials for further clarification and definitions of other terms with which you are unfamiliar.

Career-aware students: demonstrate a willingness to explore many career pathways. They examine potential careers including: prerequisites, salary, job requirements, and life-style demands. Throughout this learning process, students constantly revise and modify any false perceptions they may have about the workplace and professionalism. Career-aware students understand how their individual interests and talents may guide the selection of a career.

Career plan: An educational planning document for student use that outlines a coherent sequence of secondary courses and experiences that will prepare a student for his/her post-secondary goals.

College and career ready: students have developed a career plan that demonstrates an understanding of prerequisites and career requirements. They exhibit personal employability skills that enable them to be responsible and contributing citizens and employees.

Global competence: Learning from and working collaboratively with individuals representing diverse cultures, religions and lifestyles in a spirit of mutual respect and open dialogue in personal, work and community contexts.

Diversity: The multiple experiences brought forth by people from a variety of cultures, environments, and races.

Employability skills: Employers need responsible, reliable employees who can solve problems and exhibit the social skills and attitudes which enable them to effectively interact with other employees. These non-technical skills and knowledge, necessary for acceptance and effective participation in the workforce, include; honesty, integrity, adaptability, creativity, ethical behavior, appropriate personal appearance and grooming, punctuality, effective communications and problem solving abilities and accountability for personal actions. Employability skills are teachable skills.

Ethical: Conforming to an established set of principles or accepted professional and/or personal standards of conduct.

Financial literacy: The ability to use knowledge and skills to manage one's financial resources effectively for lifetime financial security.

Global competence: Learning from and working collaboratively with individuals representing diverse cultures, religions and lifestyles in a spirit of mutual respect and open dialogue in personal, work and community contexts.

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Human Resources: Attributes that individuals bring that include knowledge, attitudes, and skills.

Innovation: Involves deliberate application of information, imagination, and initiative in deriving greater or different value from resources.

Industry Standard Tools: Commercial tools and equipment that industry uses on a regular basis to produce custom and/or mass produced products.

Integration: The process of bringing all parts together as a whole.

Interpersonal Skills: The skills and abilities necessary to work well with others.

Leadership: A process by which a person influences others to accomplish an objective and directs the organization/team in a way that makes it more cohesive and coherent.

Maintenance: The work needed to keep something in proper condition; upkeep.

Management: The act of controlling processes and ensuring that they operate efficiently and effectively; also used to direct the design, development, production, and marketing of a product or system.

Mentor: A wise and trusted supervisor, peer, or teacher.

Mentorship: The process of someone assisting another and guiding them in order to develop a thorough understanding.

Monetary Skills: Counting money, providing accurate change, and understanding the value of money and savings.

Personal finance: describes the principles and methods that individuals use to acquire and manage income and assets.

Personal Financial Information: Any monetary information that shows relevance to personal or professional interests.

Productive: The ability to accomplish a given task as defined by a set of criteria.

Safety: Constantly aware of self and surroundings and making choices to eliminate harm, damage and/or loss.

Systems: An organized framework made up of interrelated components acting together as a whole, in which a change in one component may affect the operation of the whole. Examples: family, government, ecosystems, financial, computer, organizational, body, classroom, judicial, electrical, heating, automotive, or plumbing. Effective workers understand social, organizational and technological systems. They understand how parts of systems are connected; anticipate consequences, monitors and correct performance, and design.

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Technology: Technology is the making, modification, usage, and knowledge of tools, machines, techniques, crafts, systems, methods of organization, in order to solve a problem, improve a preexisting solution to a problem, achieve a goal or perform a specific function. It can also refer to the collection of such tools, machinery, modifications, arrangements and procedures.

Troubleshoot: To locate and find the cause of problems.

Workplace: The attributes and skills necessary to enter paid or unpaid employment.

Workplace Resources: The management of devices, tools, and technology to accomplish the tasks needed in the classroom or workplace.

Workplace Readiness: The setting where productive activity takes place including school, community, home, and job.

Work Space: The space in which they are performing their work (i.e., school).

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All Standards Documents can be found on the Wyoming Department of Education Standards Page at http://edu.wyoming.gov/Programs/standards.aspx.

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2013 WYOMING SOCIAL STUDIES
CONTENT AND PERFORMANCE STANDARDS

RATIONALE

The Wyoming Social Studies Content and Performance Standards represent the cooperative effort of school district, University, community college, and business participants. The State Social Studies Standards Committee recognizes that social studies is the integrated study of the social sciences and humanities to promote civic competence. The mission of social studies is to help young people develop the ability to make informed and reasoned decisions as citizens of a culturally diverse, democratic society in an interdependent world. Students develop a core of knowledge and skills drawn from many academic disciplines, learn how to analyze their own and others' opinions on important issues, and become motivated to participate in civic and community life as active, informed citizens.

In the summer of 2012, a standards review committee was convened to review the Wyoming Social Studies Content and Performance Standards. *Subcommittees were formed and it was decided that an additional social studies standard would be added to address the Framework for 21st Century Skills for technology integration and make a connection to literacy through the Common Core State Standards for Literacy in History/Social Studies, Science, & Technical Subjects*. It was also decided that an additional grade band division would be added to better meet the demand for increased rigor at all grade levels and prepare students by introducing social studies concepts at the earliest grade levels. The committee recognizes that regardless of the variations of course sequences throughout the state, the knowledge and skills identified upon graduation are intended for all students.

ORGANIZATION OF STANDARDS

Standards specify the essential learning that students must master providing a K-12 framework to assist school districts, schools, and communities in developing and strengthening curriculum. *It is not intended to prescribe courses, materials, or instructional methodology.* Content and performance standards are identified for grade spans K-2, 3-5, 6-8, and 9-12 with benchmarks at grades two, five, eight, and twelve.

Teachers, parents, and students work toward the achievement of the benchmarks at the completion of each grade band level. Success at these benchmark levels requires the effort and commitment of **all** who are involved at that level.

- K-2
- 3-5
- 6-8
- 9-12

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Content Standards: what students are expected to know and be able to do by the time they graduate

Benchmarks: specify the skills and content students must master in order to meet the content standards by the time they graduate

Performance Level Descriptors: determine student performance of the benchmarks

Descriptors help teachers assess where students are performing in relation to the benchmarks, and ultimately, the content standards.

Advanced: Students at the advanced level *independently* use their knowledge of social studies in complex and abstract situations and can analyze, synthesize, and communicate information and ideas.

Proficient: Students at the proficient level *consistently* use their knowledge of social studies in complex and abstract situations. This is the minimum level required to demonstrate mastery of the skills.

Basic: Students at the basic level demonstrate *partial mastery* of knowledge and skills to acquire and communicate information and ideas.

Below Basic: Students at the below basic level are *unwilling or do not address* the expectations of the basic level.

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2013 Wyoming Social Studies Content and Performance Standards

Content Standard 1 - Citizenship, Government, and Democracy - Students analyze how people create and change structures of power, authority, and governance to understand the continuing evolution of governments and to demonstrate civic responsibility.

Content Standard 2 - Culture and Cultural Diversity - Students demonstrate an understanding of the contributions and impacts of human interaction and cultural diversity on societies.

Content Standard 3 - Production, Distribution, and Consumption - Students describe the influence of economic factors on societies and make decisions based on economic principles.

Content Standard 4 - Time, Continuity, and Change - Students analyze events, people, problems, and ideas within their historical contexts.

Content Standard 5 - People, Places, and Environments - Students apply their knowledge of the geographic themes (location, place, movement, region, and human/environment interactions) and skills to demonstrate an understanding of interrelationships among people, places, and environment.

Content Standard 6 - Technology, Literacy, and Global Connections - Students use technology and literacy skills to access, synthesize, and evaluate information to communicate and apply social studies knowledge to global situations.

All Standards Documents can be found on the Wyoming Department of Education Standards Page at http://edu.wyoming.gov/Programs/standards.aspx.

Social Studies Content Standard 1 - Citizenship, Government, and Democracy

Students analyze how people create and change structures of power, authority, and governance to understand the continuing evolution of governments and to demonstrate civic responsibility.

Rationale

The vitality and continuation of a democratic republic depends upon the education and participation of informed citizens. All students should have opportunities to apply their knowledge and skills and participate in the workings of the various levels of power, authority, and governance, which should be applied to the rights and responsibilities of good citizenship.

Benchmarks

Students will:

End of Grade 2	End of Grade 5	End of Grade 8	Upon Graduation Grade 12
SS2.1.1 Understand that schools, communities, and the United States have rules that have to be followed.	**SS5.1.1** Describe the basic rights and responsibilities of citizenship.	**SS8.1.1** Explain the rights, duties, and responsibilities of a United States citizen.	**SS12.1.1** Analyze unique freedoms, rights, and responsibilities of living in a democratic society and explain their interrelationships.
SS2.1.2 Identify the symbols and traditional practices that honor patriotism in the United States.	**SS5.1.2** Understand the basic local, state, and national political processes (e.g., campaigning and voting).	**SS8.1.2** Explain how to participate in the political process.	**SS12.1.2** Explain and/or demonstrate how to participate in the political process and form personal opinions.
SS2.1.3 Identify people and events that are honored on United States holidays.	**SS5.1.3** Understand the basic origins of the United States Constitution (e.g., Declaration of Independence).	**SS8.1.3** Explain the historical development of the United States Constitution and treaties and how they have shaped the United States and Wyoming Government.	**SS12.1.3** Analyze the historical development of the United States Constitution and treaties and how it has shaped the United States and Wyoming Government (tribal, local, state, federal).
SS2.1.4 Understand that the rules in the United States are called laws.	**SS5.1.4** Understand the purpose of the legal system.	**SS8.1.4** Understand the difference between United States civil and criminal legal systems.	**SS12.1.4** Demonstrate an understanding of the United States civil and criminal legal systems and distinguish differences between those systems.
Not assessed at this time.	**SS5.1.5** Understand the purposes of the three branches of government.	**SS5.1.5** Describe the structures of the United States and Wyoming Constitutions (e.g., Articles, Bill of Rights, amendments).	**SS12.1.5** Demonstrate an understanding of the structures of both the United States and Wyoming Constitutions.
Not assessed at this time.	Not assessed at this time.	**SS5.1.6** Understand the basic structures of various political systems (e.g., tribal, local, national, and world).	**SS12.1.6** Compare and contrast various world political systems (e.g., ideologies, structure, and institutions) with that of the United States.

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Social Studies Content Standard 1 - Citizenship, Government, and Democracy Performance Level Descriptors

GRADE 2

Advanced: A second-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) demonstrate the importance of rules/laws in schools and communities;
b) demonstrate knowledge of good citizenship within their school and communities;
c) identify and explain symbols, traditions, people, and events that are honored within the United States.

Proficient: A second-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) demonstrate the importance of rules/laws in schools and communities;
b) demonstrate knowledge of good citizenship within their school and communities;
c) identify and explain symbols, traditions, people, and events that are honored within the United States.

Basic: A second-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The student will:

a) demonstrate the importance of rules/laws in schools and communities;
b) demonstrate knowledge of good citizenship within their school and communities;
c) identify and explain symbols, traditions, people, and events that are honored within the United States.

Below Basic: A second-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

GRADE 5

Advanced: A fifth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) demonstrate knowledge of citizenship rights and responsibilities across various communities;
b) describe the purpose and various levels of government in our lives;
c) locate and apply information of historical events and issues from a variety of sources to effectively explain connections between past and present.

Proficient: A fifth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) demonstrate knowledge of citizenship rights and responsibilities across various communities;
b) describe the purpose and various levels of government in our lives;
c) locate and apply information of historical events and issues from a variety of sources to effectively explain connections between past and present.

Basic: A fifth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The student will:

a) demonstrate knowledge of citizenship rights and responsibilities across various communities;
b) describe the purpose and various levels of government in our lives;
c) locate and apply information of historical events and issues from a variety of sources to effectively explain connections between past and present.

Below Basic: A fifth-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

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GRADE 8

Advanced: An eighth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) describe and compare the principles and structures of power, authority, and governance;
b) demonstrate knowledge of citizenship, rights, and responsibilities across various communities;
c) conduct research to draw unique parallels between historical and current events and issues.

Proficient: An eighth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) describe and compare the principles and structures of power, authority, and governance;
b) demonstrate knowledge of citizenship, rights, and responsibilities across various communities;
c) conduct research to draw unique parallels between historical and current events and issues.

Basic: An eighth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The student will:

a) describe and compare the principles and structures of power, authority, and governance;
b) demonstrate knowledge of citizenship, rights, and responsibilities across various communities;
c) conduct research to draw unique parallels between historical and current events and issues.

Below Basic: An eighth-grade student at below basic is ***unwilling* or *does not address*** the expectations of the basic level.

GRADE 12

Advanced: A twelfth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) analyze and critique the principles and structure of power, authority, and governance;
b) demonstrate civic responsibility by participating as a citizen in the process;
c) analyze historical and political developments and conducts research to thoroughly and effectively create and defend a position on an issue.

Proficient: A twelfth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) analyze and critique the principles and structure of power, authority, and governance;
b) demonstrate civic responsibility by participating as a citizen in the process;
c) analyze historical and political developments and conducts research to thoroughly and effectively create and defend a position on an issue.

Basic: A twelfth -grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The student will:

a) analyze and critique the principles and structure of power, authority, and governance;
b) demonstrate civic responsibility by participating as a citizen in the process;
c) analyze historical and political developments and conducts research to thoroughly and effectively create and defend a position on an issue.

Below Basic: A twelfth-grade student at below basic is ***unwilling* or *does not address*** the expectations of the basic level.

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Social Studies Content Standard 2 - Culture and Cultural Diversity

Students demonstrate an understanding of the contributions and impacts of human interaction and cultural diversity on societies.

Rationale

Culture helps us to understand ourselves as both individuals and members of various groups. In a multicultural society, students need to understand multiple perspectives that derive from different cultural vantage points. As citizens, students need to know how institutions are maintained or changed and how they influence individuals, cultures, and societies. This understanding allows students to relate to peoples of local, tribal, state, national, and global communities.

Benchmarks

Students will:

End of Grade 2	End of Grade 5	End of Grade 8	Upon Graduation Grade 12
SS2.2.1 Name the ways groups (e.g., families and schools) meet human needs and concerns (e.g., belonging and personal safety) and contribute to personal identity and daily life.	**SS.5.2.1** Identify and describe the ways groups (e.g., families, communities, schools, and social organizations) meet human needs and concerns (e.g., belonging, self worth, and personal safety) and contribute to personal identity and daily life.	**SS8.2.1** Compare and contrast the ways various groups (e.g., cliques, clubs, ethnic communities, and American Indian tribes) meet human needs and concerns (e.g., self esteem, friendship, and heritage) and contribute to identity, situations, and events.	**SS12.2.1** Analyze and evaluate the ways various groups (e.g., social, political, and cultural) meet human needs and concerns (e.g., individual needs and common good) and contribute to identity (e.g., group, national, and global), situations, and events.
SS2.2.2 Recognize ways in which expressions of culture influence people (e.g., language, stories, music, and art).	**SS5.2.2** Identify and describe ways in which expressions of culture influence people (e.g., language, spirituality, stories, folktales, music, art, and dance).	**SS8.2.2** Examine and evaluate how human expression (e.g., language, literature, arts, architecture, traditions, beliefs, and spirituality) contributes to the development and transmission of culture.	**SS12.2.2** Analyze human experience and cultural expression (e.g., language, literature, arts, traditions, beliefs, spirituality, values, and behavior) and illustrate integrated views of a specific culture.
Assessed in SS2.2.1.	**SS5.2.3** Identify and describe characteristics and contributions of local and state cultural groups in Wyoming.	**SS8.2.3** Compare and contrast the unique cultural characteristics of various groups within Wyoming and the nation.	**SS12.2.3** Evaluate how the unique characteristics of cultural groups have contributed and continue to influence Wyoming's history and contemporary life (e.g., tribes, explorers, early settlers, and immigrants).
Assessed in SS2.2.2.	**SS5.2.4** Identify and describe the tensions between cultural groups, social classes and/or individuals in Wyoming and the United States (e.g., Martin Luther King Jr., Helen Keller, Sacagawea, and Chief Washakie).	**SS8.2.4** Explain the cultural contributions of and tensions between groups in Wyoming, the United States, and the World (e.g., racial, ethnic, social and institutional).	**SS12.2.4** Analyze and critique the conflicts resulting from cultural assimilation and cultural preservation in Wyoming, the United States, and the World (e.g., racial, ethnic, social, and institutional).

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Social Studies Content Standard 2 - Culture and Cultural Diversity
Performance Level Descriptors

GRADE 2

Advanced: A second-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) name ways groups and cultures meet human needs;
b) list ways people contribute to personal identity in daily life.

Proficient: A second-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) name ways groups and cultures meet human needs;
b) list ways people contribute to personal identity in daily life.

Basic: A second-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The student will:

a) name ways groups and cultures meet human needs;
b) list ways people contribute to personal identity in daily life.

Below Basic: A second-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

GRADE 5

Advanced: A fifth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) identify and describe ways groups and cultures meet human needs;
b) identify and describe ways people contribute to personal identity in daily life;
c) identify and describe characteristics, contributions, and possible tensions between cultural groups.

Proficient: A fifth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) identify and describe ways groups and cultures meet human needs;
b) identify and describe ways people contribute to personal identity in daily life;
c) identify and describe characteristics, contributions, and possible tensions between cultural groups.

Basic: A fifth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The student will:

a) identify and describe way groups and cultures meet human needs;
b) identify and describe ways people contribute to personal identity in daily life;
c) identify and describe characteristics, contributions, and possible tensions between cultural groups.

Below Basic: A fifth-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

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GRADE 8

Advanced: An eighth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) compare and contrast the ways various groups meet human needs;
b) evaluate and examine the transmission of cultural ideas;
c) compare and contrast a group's unique cultural characteristics and explain their contributions and possible tensions they may cause.

Proficient: An eighth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) compare and contrast the ways various groups meet human needs;
b) evaluate and examine the transmission of cultural ideas;
c) compare and contrast a group's unique cultural characteristics and explain their contributions and possible tensions they may cause.

Basic: An eighth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The student will:

a) compare and contrast the ways various groups meet human needs;
b) evaluate and examine the transmission of cultural ideas;
c) compare and contrast a group's unique cultural characteristics and explain their contributions and possible tensions they may cause.

Below Basic: An eighth-grade student at below basic is ***unwilling* or *does not address*** the expectations of the basic level.

GRADE 12

Advanced: A twelfth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) analyze and evaluate the way various cultural groups meet human needs and contribute to or influence contemporary life;
b) analyze human experience that integrates views of cultural expression;
c) analyze the conflicts resulting from cultural assimilation and preservation.

Proficient: A twelfth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) analyze and evaluate the way various cultural groups meet human needs and contribute to or influence contemporary life;
b) analyze human experience that integrates views of cultural expression;
c) analyze the conflicts resulting from cultural assimilation and preservation.

Basic: A twelfth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The student will:

a) analyze and evaluate the way various cultural groups meet human needs and contribute to or influence contemporary life;
b) analyze human experience that integrates views of cultural expression;
c) analyze the conflicts resulting from cultural assimilation and preservation.

Below Basic: A twelfth-grade student at below basic is ***unwilling* or *does not address*** the expectations of the basic level.

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Social Studies Content Standard 3 - Production, Distribution, and Consumption

Students describe the influence of economic factors on societies and make decisions based on economic principles.

Rationale

In a global economy marked by rapid technological, political, and economic change, students will examine how people organize for the production, distribution, and consumption of goods and services.

Benchmarks

Students will:

End of Grade 2	End of Grade 5	End of Grade 8	Upon Graduation Grade 12
SS2.3.1 Give examples of and/or identify needs, wants, goods, and services.	**SS5.3.1** Give examples of needs, wants, goods, services, scarcity, and choice.	**SS8.3.1** Identify and apply basic economic concepts (e.g., supply, demand, production, exchange and consumption, labor, wages, scarcity, prices, incentives, competition, and profits).	**SS12.3.1** Analyze the impact of supply, demand, scarcity, prices, incentives, competition, and profits on what is produced, distributed, and consumed.
SS2.3.2 Identify how price may affect buying, selling, and saving decisions.	**SS5.3.2** Identify basic economic concepts (e.g., supply, demand, price, and trade).	**SS8.3.2** Compare and contrast how people organize for the production, distribution, and consumption of goods and services in various economic systems (e.g., characteristics of market, command, and mixed economies).	**SS12.3.2** Analyze and evaluate how people organize for the production, distribution, and consumption of goods and services in various economic systems (e.g., capitalism, communism, and socialism).
SS2.3.3 Identify how science or technology affects production (e.g., assembly line, robots, and video streaming).	**SS5.3.3** Identify and describe how science and technology have affected production and distribution locally, nationally, and globally (e.g., trains and natural resources).	**SS8.3.3** Describe the impact of technological advancements on production, distribution, and consumption. (e.g., businesses and/or corporations in the United States and the world).	**SS12.3.3** Analyze and evaluate the impact of current and emerging technologies at the micro and macroeconomic levels (e.g., jobs, education, trade, and infrastructure) and their impact on global economic interdependence.
Assessed in SS2.3.2.	**SS5.3.4** Explain the roles and effect of money, banking, savings, and budgeting in personal life and society.	**SS8.3.4** Explain or illustrate how money is used by individuals, groups, and financial institutions.	**SS12.3.4** Explain how financial and government institutions make economic decisions (e.g., banking, investment, credit, regulation, and debt).
Assessed in SS2.3.2.	Assessed in SS5.3.4.	**SS8.3.5** Describe how values and beliefs influence individual, family, and business decisions (microeconomics).	**SS12.3.5** Evaluate how values and beliefs influence microeconomic and macroeconomic decisions.

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Social Studies Content Standard 3 - Production, Distribution, and Consumption
Performance Level Descriptors

GRADE 2

Advanced: A second-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) identify currency;
b) explain the purpose of money;
c) explain how science and technology affect economic production.

Proficient: A second-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) identify currency;
b) explain the purpose of money;
c) explain how science and technology affect economic production.

Basic: A second-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) identify currency;
b) explain the purpose of money;
c) explain how science and technology affect economic production.

Below Basic: A second-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

GRADE 5

Advanced: A fifth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) identify economic concepts to needs, wants, goods, services, scarcity, and choice;
b) explain the influence of banking on their personal life and society;
c) identify and describe the impact of science and technology on production and distribution.

Proficient: A fifth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) identify economic concepts and provide examples of needs, wants, goods, services, scarcity, and choice;
b) explain the influence of banking on their personal life and society;
c) identify and describe the impact of science and technology on production and distribution.

Basic: A fifth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The student will:

a) identify economic concepts to needs, wants, goods, services, scarcity, and choice;
b) explain the influence of banking on their personal life and society;
c) identify and describe the impact of science and technology on production and distribution.

Below Basic: A fifth-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

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GRADE 8

Advanced: An eighth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) identify and apply basic economic concepts;
b) compare and contrast economic systems;
c) describe factors influencing economic decisions.

Proficient: An eighth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) identify and apply basic economic concepts;
b) compare and contrast economic systems;
c) describe factors influencing economic decisions.

Basic: An eighth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The student will:

a) identify and apply basic economic concepts;
b) compare and contrast economic systems;
c) describe factors influencing economic decisions.

Below Basic: An eighth-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

GRADE 12

Advanced: A twelfth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) explain how economic factors influence societies and how decisions are based on economic principles;
b) explain connections between economic principles and government;
c) describe economic systems and concepts.

Proficient: A twelfth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) explain how economic factors influence societies and how decisions are based on economic principles;
b) explain connections between economic principles and government;
c) describe economic systems and concepts.

Basic: A twelfth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The student will:

a) explain how economic factors influence societies and how decisions are based on economic principles;
b) explain connections between economic principles and government;
c) describe economic systems and concepts.

Below Basic: A twelfth-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

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Social Studies Content Standard 4 - Time, Continuity, and Change

Students analyze events, people, problems, and ideas within their historical contexts.

Rationale

Students need to understand their historical roots and how events shape the past, present, and future. Students must know what life was like in the past to comprehend how things change and develop over time. Students gain historical understanding through inquiry of history by researching and interpreting events affecting individual, local, tribal, state, national, and global histories.

Benchmarks

Students will:

End of Grade 2	End of Grade 5	End of Grade 8	Upon Graduation Grade 12
SS2.4.1 Identify how an event could change the future (e.g., moving to a new town means going to a new school or learning to ride a bike could mean getting to a friend's house faster).	**SS5.4.1** Describe how small changes can lead to big changes (cause and effect) (e.g., discovery of electricity).	**SS8.4.1** Describe how historical events impact the future (cause and effect) and how change spreads to other places (e.g., spread of industrial revolution or causes of the Civil War).	**SS12.4.1** Describe patterns of change (cause and effect) and evaluate how past events impacted future events and the modern world.
SS2.4.2 Identify tools and technologies that make life easier (e.g., cars for getting one place to another, washing machines for washing clothes, or flashlights to see in the dark).	**SS5.4.2** Describe how tools and technology makes life easier; describe how one tool or technology evolves into another (e.g., telegraph to telephone to cell phone or horse-drawn wagon to railroad to car); identify a tool or technology that impacted history (e.g., ships allowed for discovery of new lands or boiling water prevented spread of disease).	**SS8.4.2** Describe how tools and technology in different historical periods impacted the way people lived, made decisions, and saw the world.	**SS12.4.2** Analyze the development and impact of tools and technology and how it shaped history and influenced the modern world.
SS2.4.3 Describe a "current event."	**SS5.4.3** Select current events for relevance and apply understanding of cause and effect to determine how current events impact people or groups (e.g., the building of a new school means that younger students will have new classrooms to learn in or war in another country means that some children's parents will have to leave to fight).	**SS8.4.3** Analyze the way people and/or groups react to current events; suggest alternative ways such events may have played out.	**SS12.4.3** Given a significant current event, critique the actions of the people or groups involved; hypothesize how this event would have played out in another country.

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Social Studies Content Standard 4 - Time, Continuity, and Change
(continued)

End of Grade 2	End of Grade 5	End of Grade 8	Upon Graduation Grade 12
Not assessed at this time.	**SS5.4.4** Discuss different groups that a person may belong to (e.g., family, neighborhood, cultural/ethnic, and workplace) and how those roles and/or groups have changed over time.	**SS8.4.4** Identify historical interactions between and among individuals, groups, and/or institutions (e.g., family, neighborhood, political, economic, religious, social, cultural, and workplace).	**SS12.4.4** Describe the historical interactions between and among individuals, groups, and/or institutions (e.g., family, neighborhood, political, economic, religious, social, cultural, and workplace) and their impact on significant historical events.
Not assessed at this time.	**SS5.4.5** Identify differences between primary and secondary sources. Find primary and secondary sources about an historical event. Summarize central ideas in primary and secondary resources.	**SS8.4.5** Identify relevant primary and secondary sources for research. Compare and contrast treatment of the same topic in several primary and secondary sources.	**SS12.4.5** Using primary and secondary sources, apply historical research methods to interpret and evaluate important historical events from multiple perspectives.

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Social Studies Content Standard 4 - Time, Continuity, and Change Performance Level Descriptors

GRADE 2

Advanced: A second-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) identify different social groups and their interactions;
b) identify how an event could change the future;
c) identify tools and technology.

Proficient: A second-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) identify different social groups and their interactions;
b) identify how an event could change the future;
c) identify tools and technology.

Basic: A second-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) identify different social groups and their interactions;
b) identify how an event could change the future;
c) identify tools and technology.

Below Basic: A second-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

GRADE 5

Advanced: A fifth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) identify historical interactions and the impact of change;
b) study current events and apply understanding of cause and effect;
c) describe the evolution of tools and technology.

Proficient: A fifth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) identify historical interactions and the impact of change;
b) study current events and apply understanding of cause and effect;
c) describe the evolution of tools and technology.

Basic: A fifth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) identify historical interactions and the impact of change;
b) study current events and apply understanding of cause and effect;
c) describe the evolution of tools and technology.

Below Basic: A fifth-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

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GRADE 8

Advanced: An eighth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) describe events, people, problems, and ideas within their historical contexts;

b) analyze the way people react to current events and make connections between the past and present;

c) describe the impact of tools and technology in different historical settings.

Proficient: An eighth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) describe events, people, problems, and ideas within their historical contexts;

b) analyze the way people react to current events and make connections between the past and present;

c) describe the impact of tools and technology in different historical settings.

Basic: An eighth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) describe events, people, problems, and ideas within their historical contexts;

b) analyze the way people react to current events and make connections between the past and present;

c) describe the impact of tools and technology in different historical settings.

Below Basic: An eighth-grade student at below basic is ***unwilling* or *does not address*** the expectations of the basic level.

GRADE 12

Advanced: A twelfth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) accurately examine events, people, problems, and ideas within their historical contexts;

b) make comparisons, describe cause and effect, and make connections between the past and current events;

c) analyze the development and impact of tools and technology.

Proficient: A twelfth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) accurately examine events, people, problems, and ideas within their historical contexts;

b) make comparisons, describe cause and effect, and make connections between the past and current events;

c) analyze the development and impact of tools and technology.

Basic: A twelfth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) accurately examine events, people, problems, and ideas within their historical contexts;

b) make comparisons, describe cause and effect, and make connections between the past and current events;

c) analyze the development and impact of tools and technology.

Below Basic: A twelfth-grade student at below basic is ***unwilling* or *does not address*** the expectations of the basic level.

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Social Studies Content Standard 5 - People, Places, and Environments

Students apply their knowledge of the geographic themes (location, place, movement, region, and human/environment interactions) and skills to demonstrate an understanding of interrelationships among people, places, and environment.

Rationale

Students gain geographical perspectives of the community, state, nation, and world by studying the Earth and how humans interact with people, places, and environments. Their knowledge of geography allows students to make local and global connections. Students develop increasingly abstract thought as they use data and apply skills to analyze human behavior in relation to its physical and cultural environment.

Benchmarks

Students will:

End of Grade 2	End of Grade 5	End of Grade 8	Upon Graduation Grade 12
Spatial	**Spatial**	**Spatial**	**Spatial**
SS2.5.1 Use a map, globe, and mental mapping to identify familiar areas and simple patterns and create maps using various media.	**SS5.5.1** Apply mental mapping skills and use different representations of the Earth to demonstrate an understanding of human and physical patterns and how local decisions may create global impacts.	**SS8.5.1** Use and create models of the Earth to analyze the interactions of physical and human systems to demonstrate global interconnectedness.	**SS12.5.1** Use geographic tools and reference materials to interpret, analyze, evaluate, and synthesize historical and geographic data to demonstrate an understanding of global patterns and interconnectedness.
Physical Place and Region	**Physical Place and Region**	**Physical Place and Region**	**Physical Place and Region**
SS2.5.2 Identify, describe, and use local physical and human characteristics to discuss the similarities and differences between parts of the community.	**SS5.5.2** Explain how physical features, patterns, and systems impact different regions and how these features may help us generalize and compare areas within the state, nation, or world.	**SS8.5.2** Analyze and evaluate how physical changes influenced historical events and participate in collaborative problem solving and decision making in the selection of professional and personal choices.	**SS12.5.2** Describe regionalization and analyze how physical characteristics distinguish a place, influence human trends, political and economic development, and solve immediate and long-range problems.

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Social Studies Content Standard 5 - People, Places, and Environments (continued)

Human Place and Movement	Human Place and Movement	Human Place and Movement	Human Place and Movement
SS2.5.3 Use the human features of a community to describe what makes that community special (e.g., cultural, language, religion, food, clothing political, economic, population, and types of jobs in an area) and why others want to move there or move away from there.	**SS5.5.3** Describe the human features of an area (e.g., language, religion, political and economic systems, population distribution, and quality of life), past and present settlement patterns (e.g., American Indians and the Oregon Trail), and how ideas, goods, and/or people move from one area to another.	**SS8.5.3** Explain how communities' current and past demographics, migrations, and settlement patterns influence place (e.g., culture, needs, and political and economic systems) and use this analysis to predict future settlement patterns.	**SS12.5.3** Analyze, interpret, and evaluate how conflict, demographics, movement, trade, transportation, communication, and technology affect humans' sense of place.
Environment and Society	**Environment and Society**	**Environment and Society**	**Environment and Society**
SS2.5.4 Identify how people may adjust to and/or change their environment in order to survive (e.g., clothing, houses, foods, and natural resources).	**SS5.5.4** Describe how the environment influences people in Wyoming and how we adjust to and/or change our environment in order to survive (e.g., natural resources, housing, and food).	**SS8.5.4** Analyze the changes to and consequences of human, natural, and technological impacts on the physical environment.	**SS12.5.4** Analyze how environmental changes and modifications positively and negatively affect communities and the world both economically and socially.

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Social Studies Content Standard 5 - People, Places, and Environments Performance Level Descriptor

GRADE 2

Advanced: A second-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) use a map, globe, and mental mapping to identify familiar areas, simple patterns, and create maps using various media;

b) identify, describe, and use local physical and human characteristics to discuss the similarities and differences between parts of the community and identify how people may adjust to and/or change their environment in order to survive;

c) use the human features of a community to describe what makes that community special and why others want to move there or move away from there.

Proficient: A second-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) use a map, a globe and mental mapping to identify familiar areas, simple patterns, and create maps using various media;

b) identify, describe, and use local physical and human characteristics to discuss the similarities and differences between parts of the community and identify how people may adjust to and/or change their environment in order to survive;

c) use the human features of a community to describe what makes that community special and why others want to move there or move away from there.

Basic: A second-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) use a map, a globe and mental mapping to identify familiar areas, simple patterns, and create maps using various media;

b) identify, describe, and use local physical and human characteristics to discuss the similarities and differences between parts of the community and identify how people may adjust to and/or change their environment in order to survive;

c) use the human features of a community to describe what makes that community special and why others want to move there or move away from there.

Below Basic: A second-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

GRADE 5

Advanced: A fifth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) apply mental mapping skills and use different representations of the Earth to demonstrate an understanding of human and physical patterns and how local decisions may create global impacts;

b) explain how physical features, patterns, and systems have impacted different regions and how we adjust to and/or change our environment in order to survive;

c) describe the human features of an area, past and present settlement patterns, and how ideas, goods, and/or people move from one area to another.

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Proficient: A fifth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) apply mental mapping skills and use different representations of the Earth to demonstrate an understanding of human and physical patterns and how local decisions may create global impacts;

b) explain how physical features, patterns, and systems have impacted different regions and how we adjust to and/or change our environment in order to survive;

c) describe the human features of an area, past and present settlement patterns, and how ideas, goods, and/or people move from one area to another.

Basic: A fifth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) apply mental mapping skills and use different representations of the Earth to demonstrate an understanding of human and physical patterns and how local decisions may create global impacts;

b) explain how physical features, patterns, and systems have impacted different regions and how we adjust to and/or change our environment in order to survive;

c) describe the human features of an area, past and present settlement patterns, and how ideas, goods, and/or people move from one area to another.

Below Basic: A fifth-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

GRADE 8

Advanced: An eighth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) analyze, use, and create various representations of the Earth to demonstrate global interconnectedness that includes human, natural, and technological impacts on the physical environment;

b) analyze how regionalization influenced historical trends and affects political and economic developments;

c) explain how population distributions, migrations, and settlement patterns impact the creation and change of places and predict patterns of population distribution and growth.

Proficient: An eighth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) analyze, use, and create various representations of the Earth to demonstrate global interconnectedness that includes human, natural, and technological impacts on the physical environment;

b) analyze how regionalization influenced historical trends and affects political and economic developments;

c) explain how population distributions, migrations, and settlement patterns impact the creation and change of places and predict patterns of population distribution and growth.

Basic: An eighth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) analyze, use, and create various representations of the Earth to demonstrate global interconnectedness that includes human, natural, and technological impacts on the physical environment;

b) analyze how regionalization influenced historical trends and affects political and economic developments;

c) explain how population distributions, migrations, and settlement patterns impact the creation and change of places and predict patterns of population distribution and growth.

Below Basic: An eighth-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

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GRADE 12

Advanced: A twelfth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) analyze and evaluate geographic data, historical and current events, the interaction of physical and human systems, and geographical patterns;

b) use geographical or regional knowledge and analysis of environmental modification(s) to participate in both collaborative problem solving and informed decision making;

c) evaluate how conflict, demographics, and movement impact global interdependence and human identification with place.

Proficient: A twelfth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) analyze and evaluate geographic data, historical and current events, the interaction of physical and human systems, and geographical patterns;

b) use geographical or regional knowledge and analysis of environmental modification(s) to participate in both collaborative problem solving and informed decision making;

c) evaluate how conflict, demographics, and movement impact global interdependence and human identification with place.

Basic: A twelfth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) analyze and evaluate geographic data, historical and current events, the interaction of physical and human systems, and geographical patterns;

b) use geographical or regional knowledge and analysis of environmental modification(s) to participate in both collaborative problem solving and informed decision making;

c) evaluate how conflict, demographics, and movement impact global interdependence and human identification with place.

Below Basic: A twelfth-grade student at below basic is ***unwilling* or *does not address*** the expectations of the basic level.

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Social Studies Content Standard 6 - Technology, Literacy, and Global Connections

Students use technology and literacy skills to access, synthesize, and evaluate information to communicate and apply social studies knowledge to global situations.

Rationale

*Using a variety of resources, students will apply the inquiry process to locate, interpret, and evaluate multiple primary and secondary sources. Students will use this information to become critical thinkers and decision makers in a global community. Social Studies Content Standard 6 was written around the Framework for 21st Century Skills and the Common Core Literacy Standards for History and Social Studies.**

Benchmarks

Students will:

End of Grade 2	End of Grade 5	End of Grade 8	Upon Graduation Grade 12
SS2.6.1 Identify what kinds of information can be found in different resources (e.g., library, computer, atlas, and dictionary).	**SS5.6.1** Use various media resources in order to address a question or solve a problem.	**SS8.6.1** Use and evaluate multiple sources of information in diverse formats and media in order to address a question or solve a problem.	**SS12.6.1** Analyze, evaluate, and/or synthesize multiple sources of information in diverse formats and media in order to address a question or solve a problem.
SS2.6.2 Distinguish between fiction and non-fiction.	**SS5.6.2** Identify validity of information (e.g., accuracy, relevancy, fact, or fiction).	**SS8.6.2** Distinguish among fact, opinion, and reasoned judgment in a text.	**SS12.6.2** Assess the extent to which the reasoning and evidence in a text supports the author's claims.
SS2.6.3 Use digital tools to learn about social studies concepts.	**SS5.6.3** Use digital tools to research, design, and present social studies concepts (e.g., understand how individual responsibility applies in usage of digital media). https://www.iste.org/standards/nets-for-students	**SS8.6.3** Use digital tools to research, design, and present social studies concepts (e.g., understand how individual responsibility applies in usage of digital media). https://www.iste.org/standards/nets-for-students	**SS12.6.3** Use digital tools to research, design, and present social studies concepts (e.g., understand how individual responsibility applies in usage of digital media). https://www.iste.org/standards/nets-for-students
Not assessed at this time.	**SS5.6.4** Identify the difference between primary and secondary sources.	**SS8.6.4** Use accurate, sufficient, and relevant information from primary and secondary sources to support writing.	**SS12.6.4** Evaluate and integrate accurate, sufficient, and relevant information from primary and secondary sources to support writing

*Wyoming Social Studies teachers are responsible for the Reading and Writing ELA Standards for Literacy in History/Social Studies found on pp. 60-66 at http://edu.wyoming.gov/sf-docs/standards/final-2012-ela-standards.pdf.

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Social Studies Content Standard 6 - Technology, Literacy, and Global Connections
Performance Level Descriptors

GRADE 2

Advanced: A second-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) identify an inquiry process to locate information;
b) identify fiction and nonfiction sources.

Proficient: A second-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) identify an inquiry process to locate information;
b) identify fiction and nonfiction sources.

Basic: A second-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) identify an inquiry process to locate information;
b) identify fiction and nonfiction sources.

Below Basic: A second-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

GRADE 5

Advanced: A fifth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) choose an appropriate inquiry process to locate information from a variety of sources;
b) use digital tools to research, design, and present social studies concepts;
c) explain the differences between primary and secondary sources.

Proficient: A fifth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) choose an appropriate inquiry process to locate information from a variety of sources;
b) use digital tools to research, design, and present social studies concepts;
c) explain the differences between primary and secondary sources.

Basic: A fifth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) choose an appropriate inquiry process to locate information from a variety of sources;
b) use digital tools to research, design, and present social studies concepts;
c) explain the differences between primary and secondary sources.

Below Basic: A fifth-grade student at below basic is ***unwilling*** **or** ***does not address*** the expectations of the basic level.

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GRADE 8

Advanced: An eighth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) evaluate multiple sources of information in diverse formats in order to address a question or solve a problem;
b) use digital tools to research, design, and present social studies concepts;
c) use accurate, sufficient, and relevant information from primary and secondary sources to support writing.

Proficient: An eighth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) evaluate multiple sources of information in diverse formats in order to address a question or solve a problem;
b) use digital tools to research, design, and present social studies concepts;
c) use accurate, sufficient, and relevant information from primary and secondary sources to support writing.

Basic: An eighth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) evaluate multiple sources of information in diverse formats in order to address a question or solve a problem;
b) use digital tools to research, design, and present social studies concepts;
c) use accurate, sufficient, and relevant information from primary and secondary sources to support writing.

Below Basic: An eighth-grade student at below basic is ***unwilling* or *does not address*** the expectations of the basic level.

GRADE 12

Advanced: A twelfth-grade student meets expectations at the proficient level and ***independently*** demonstrates superior performance in the following. The student will:

a) analyze or synthesize multiple sources of information in diverse formats in order to address a question or solve a problem;
b) use digital tools to research, design, and present social studies concepts;
c) analyze and critique primary and secondary sources to support writing.

Proficient: A twelfth-grade student at the proficient level ***consistently*** demonstrates performance in the following. The student will:

a) analyze or synthesize multiple sources of information in diverse formats in order to address a question or solve a problem;
b) use digital tools to research, design, and present social studies concepts;
c) analyze and critique primary and secondary sources to support writing.

Basic: A twelfth-grade student at the basic level demonstrates ***partial mastery*** of knowledge and skills. The students will:

a) analyze or synthesize multiple sources of information in diverse formats in order to address a question or solve a problem;
b) use digital tools to research, design, and present social studies concepts;
c) analyze and critique primary and secondary sources to support writing.

Below Basic: A twelfth-grade student at below basic is ***unwilling* or *does not address*** the expectations of the basic level.

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2013 Wyoming Social Studies Content and Performance Standards

GLOSSARY

Assimilation: Assimilation is the absorption and integration of people, ideas, and/or culture into a wider society or group.

Example: Assimilation would include the melting pot theory as well as indigenous people being sent to boarding schools to acquire Western culture.

Budget: A budget is a spending and saving plan based on expected income and expenses. An orderly program for spending, saving, and investing the money earned to achieve desired goals; also called a financial plan or spending plan.

Example: Budgets can include the federal budget, state budget, or personal budget.

Cause and Effect: Cause and effect is a way of describing what happens and why. The cause is the reason that the effect took place. The effect is the event that took place as a result of the cause.

Example: The invention of the automobile led to drive through restaurants.

Civic Responsibility (Good Citizenship): Civic responsibility is comprised of actions and attitudes associated with democratic governance and social participation.

Example: Civic responsibility can include participation in government, church, volunteers and memberships of voluntary associations. Actions of good citizenship can be displayed in advocacy for various causes include political, economic, civil, environmental, or quality of life issues. It is also reflected in a general willingness to sacrifice personal desires for the common good.

Collaboration: Collaboration is the working of one with another; cooperating on a common product.

Example: Collaboration in government would be bi-partisanship or the United Nations.

Command Economy: Command Economy is an economic system in which a central authority is in command of the economy; a centrally planned economy.

Example: Although most economies today are market-based mixed economies (which are partially planned), fully command economies of the Soviet-type continue to exist in Cuba, North Korea and Laos.

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Community: Community is a group of people with a common characteristic or interest living together within a larger society.

Example: Chinatown, Little Italy, communes, reservations, neighborhoods, schools, and classrooms are all communities.

Consumption: In economics, consumption is the final using up of goods and services. The term excludes the use of intermediate products in the production of other goods (e.g., the purchase of buildings and machinery by a business). Economists use statistical information on income and purchases to trace trends in consumption, seeking to map consumer demand for goods and services.

Example: The consumption of renewable energy has increased steadily. Renewable energy currently accounts for about 8.20% of the United States energy consumption. Most of that comes from biomass and hydroelectric sources.

Continuity and Change: In studying the past we can see that some things remain continuous or steady, while other things change. Thinking about continuity and change requires us to compare different points in time-either two points in time from the past or one point from the past with one from the present. Sometimes what changes and what stays the same are surprising or obscure. Sometimes change brings progress, other time decline.

Example: The advent of electricity and household technology brought major changes to family life in the United States, but there were continuities as well. Doing laundry was much easier and less physically strenuous with washing machines, but laundry remained a household task that was almost always done by women and the amount of clothing that most people owned increase, so the time taken to do laundry did not decrease significantly.

Cultural Diversity: Cultural diversity is the cultural variety and cultural differences that exist in the world, a society, or an institution. Cultural diversity is based on the idea that cultural identities should not be discarded or ignored, but rather maintained and valued. The foundation of this belief is that every culture and race has made a substantial contribution to American history.

Example: Dying languages and urbanization are threats to cultural diversity.

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Cultural Groups: These groups are socially defined categories based on common culture or nationality. Culture can, but does not have to, include common ancestry, appearance, cuisine, dressing style, heritage, history, language or dialect, religion, symbols, traditions, or other cultural factor.

Example: Cultural Groups are referenced when people speak of Italian, Samoan, or Japanese culture. They are referring to the shared language, traditions, and beliefs that set each of these peoples apart from others. In most cases, those who share your culture do so because they acquired it as they were raised by parents and other family members who have it.

Cultural Preservation: To preserve culture is to maintain the beliefs values, customs, and norms of a group of people.

Example: Means of cultural preservation would include teaching languages spoken at home, creating museums, and collecting oral histories.

Culture: Culture is evidence of a human institution and is manifested in the learned behavior of people, which includes their belief systems, languages, social relations, technologies, institutions and organizations, and their development and use of material goods.

Example: There are many features of a people's culture like language, religion, traditions, clothing, or food used or consumed by a group of people.

Current Event: Current events are news items: important political and social events or issues of the present time.

Example: Current events can be found in places like the newspaper which includes news, events, highlights, and feature stories from around the world that are significant to students' lives.

Democratic Society (Democracy): A democratic society is one in which the people have ultimate political authority.

Example: A democratic society contrasts with other societies where power is either held by one, as in a monarchy, or where power is held by a small number of individuals, as in an oligarchy.

Demographics: The statistical study of human populations especially with reference to size and density, distribution, and vital statistics.

Example: Demographics include statistical data like distribution of wealth and population. When moving to a new city or visiting a new area it is helpful to look at demographics to learn about the people who live in that area.

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Distribution: Distribution is the process of making a product or service available for use or consumption by a consumer or business user, using direct or indirect means (such as a third party go between).

Example: Product distribution gives you a way to get your product to the consumer. There are many methods you can use to distribute your product. When choosing the most cost-effective distribution method, be sure to consider costs associated with direct selling, as well as any retailer, wholesaler or broker fees, commissions, and shipping.

Economic Principle: Economic Principle is the interrelated economic factors that explain what may cause what, or what may happen under certain circumstances in economics.

Example: Scarcity, opportunity cost, and efficiency are all considered factors of how the economy works (or should work); hence, they refer to economic factors.

Environment: Environment is defined as all the external factors influencing the life and activities of people, plants, and animals. Environment is the social and cultural forces that shape the life of a person or a population.

Example: Your surroundings, classroom, town, community, or neighborhood are all environments.

Environmental Modification: Environment modifications are any changes made to the environment.

Example: Environment modifications are usually made for the purposes of farming. The use of pesticides to grow crops and the effects it has on the soil and environment would be an environmental modification.

Geographical Patterns: Geographical patterns are the spatial distributions explainable as a repetitive distribution.

Example: Sand dunes, the Interstate Highway System, the Great Migration, settlements by water, and westward expansion are all geographical patterns.

Global Interconnectedness/Interdependence: Global interconnectedness is a state of being connected reciprocally.

Example: As China is dependent on US consumers to purchase its goods and the US debt to China steadily increases, the two superpowers demonstrate global interconnectedness.

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Globalization: Globalization is the development of an increasingly integrated global economy marked especially by free trade, free flow of capital, and the tapping of cheaper foreign labor markets.

Example: NAFTA, McDonalds in other countries, social media, outsourcing of jobs, or OPEC

Government: Government is the important political institutions and the customs, laws, and rules that are used to interact with each other and to govern society.

Example: The government of the United States of America is the federal government of the constitutional republic of fifty states, as well as one capital district, and several other territories. The federal government is composed of three distinct branches: legislative, executive and judicial.

Human Characteristics: Human characteristics are the human-designed cultural features of a place (land use, architecture, forms of livelihood, religion, food, transportation, and communication networks).

Example: The human characteristics of Wyoming include cell phone towers, cowboy hats, roads, the Oregon and Mormon Trails, farms, and ranches.

Human/Environment Interaction: Human/Environment Interaction considers how humans adapt to and modify the environment. Humans shape the landscape through their interaction with the land; this has both positive and negative effects on the environment.

Example: Some examples of human/environment interaction are pollution, recycling, planting trees, factories, way of dress, synthetic vs. organic, pest control, and weather patterns.

Location: Location can be absolute or relative. Absolute location provides a definite reference to locate a place. The reference can be latitude and longitude, a street address, or even the Township and Range system. Relative location describes a place with respect to its environment and its connection to other places, or what surrounds a place.

Example: We are north of or south of a relative location. Also, a more specific example would be that the Wyoming capital city of Cheyenne is located at 41.145548N, 104.802042W.

Macroeconomics: Macroeconomics is the study of the economy as a whole, including topics such as inflation, unemployment, and economic growth.

Example: Macroeconomics includes the global economy, e-commerce, and international trade.

Market Economy: A market economy is an economy that relies chiefly on market forces to allocate goods and resources and to determine prices.

Example: The term market economy used by itself can be somewhat misleading. For example, the United States constitutes a mixed economy (substantial market regulation, agricultural subsidies, extensive government-funded research and development, Medicare/Medicaid), yet at the same time it is foundationally rooted in a market economy. Different perspectives exist as to how strong a role the government should have in both guiding the market economy and addressing the inequalities the market produces.

Mental Map: Mental maps are maps we have in our minds of places we have experienced. They are a personal point-of-view perception. They include perceptual images in our mind that provide us with an awareness of the location of places and relationships between direction, distance, size and characteristics of a place.

Example: Simple sketches of maps created from memory of an urban area used to reveal five elements of the city: nodes, edges, districts, paths, and landmarks.

Microeconomics: Microeconomics is the study of the economic behavior and decision making of small units, such as individuals, families, and businesses.

Example: Microeconomics includes personal and business finances.

Migration: Migration is passing from one region or climate to another.

Example: Westward migration, immigration, and the Silk Road are all examples of migration.

Mixed Economy: A mixed economy is an economy in which private enterprise exists in combination with a considerable amount of government regulation and promotion

Example: A mixed economy combines elements of the command and market economies. The definition of mixed economy remains somewhat subjective. The world's developed nations are the most common examples of mixed economies. The United States, Canada, Australia, Japan, Germany, the United Kingdom, and Italy are all examples of mixed economies. Examples in the developing world include Mexico, Slovenia, and South Africa.

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Movement: Movement includes natural and human phenomena change on Earth's surface over time. Humans move, a lot! In addition, ideas, fads, goods, resources, and communication all travel distances. This theme studies movement and migration across the planet.

Example: Natural phenomena such as ocean currents and air masses move across Earth's surface on a continuing basis. Humans interact on Earth from travelling from place to place, communicating across long distances and transporting goods by land, water, and air.

Multicultural: Multicultural societies are ethnically and/or racially diverse.

Example: The United States is a multicultural society since it includes people from many different ethnic groups.

Nation: A territorial division containing a body of people of one or more nationalities and usually characterized by relatively large size and independent states.

Example: A national identity might be American, Arapaho, Shoshone, or German.

Physical Characteristics: Physical characteristics describe the natural environment of the place.

Example: The Rocky Mountains, Ayers Natural Bridge, the Grand Canyon, Sinks Canyon, and Devils Tower are all examples of locations with unique physical characteristics.

Place: Place describes the human and physical characteristics of a location.

Example: Physical characteristics include a description such things as the mountains, rivers, beaches, topography, and animal and plant life of a place. Human characteristics include the human-designed cultural features of a place (land use, architecture, forms of livelihood, religion, food, transportation, and communication networks).

Political Process: Political process is the process followed to resolve important issues that concern a large number of people.

Example: Political process refers to those legal activities where citizens are capable of a change in public policy.

Political System: A political system is a system of politics and government. It is usually compared to the legal system, economic system, cultural system, and/or other social systems.

Example: A country's political system includes who should have authority, how religious questions should be handled, and what the government's influence on its people and economy should be.

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Population Distribution: Population distribution is the arrangement or spread of people living in a given area; also, how the population of an area is arranged according to variables such as age, race, or sex.

Example: An examples of locations with variances in population distribution would be urban vs. rural.

Primary Source: If you are seeking to learn about the past, primary sources of information are those that provide first-hand accounts of the events, practices, or conditions you are researching. In general, these are documents that were created by the witnesses or first recorders of these events at about the time they occurred, and include diaries, letters, reports, photographs, creative works, financial records, memos, and newspaper articles (to name just a few types).

Example:
Examples of primary sources include:

- Diary of Anne Frank - Experiences of a Jewish family during WWII
- The Constitution of Canada - Canadian History
- A journal article reporting NEW research or findings
- Native American beadwork and treaties - Native American history
- Plato's Republic - Women in Ancient Greece

Production: Production is the act of creating output, a good or service which has value and contributes to the utility of individuals. The act may or may not include factors of production other than labor. The function of production, to some extent, is to try to meet the unlimited wants of consumers.

Example: In a democratic society, production is determined by individuals. People choose the goods and services they consume and produce, although advertising and consumer demand influence both. The concept of exchange of money is related to economic production: consumers use money to purchase goods and services.

Reasoned Judgment: Reasoned judgment is a decision that requires time and effort and results from careful information gathering, generation of alternatives, and evaluation of alternatives.

Example: Reasoned judgment is reached once a student has taken the time to research a topic and come to a belief based on evidence.

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Region: Regions divide the world into manageable units for geographic study. Regions have some sort of characteristic that unifies the area. Regions can be formal, functional, or vernacular.

Example: Formal regions are those that are designated by official boundaries, such as cities, states, counties, and countries. For the most part, they are clearly indicated and publicly known. Functional regions are defined by their connections. For example, the circulation area for a major city area is the functional region of that paper. Vernacular regions are perceived regions, such as "The South," "The Midwest," or the "Middle East;" they have no formal boundaries but are understood in our mental maps of the world.

Regionalization: Regionalization is to divide into regions or administrative districts: arrange regionally.

Example: Regionalization has occurred in the United States as Republicans and Democrats migrate to common communities and create polarized states.

Scarcity: Scarcity is the economic situation where needs or wants exceeds means. Therefore, people have to make choices.

Example: Scarcity impacts natural resources like uranium and fresh water.

Secondary Source: In contrast to a primary source, a secondary source of information is one that was created *later* by someone who *did not* experience first-hand or participate in the events or conditions you're researching. For the purposes of a historical research project, secondary sources are generally scholarly books and articles. Also included would be reference sources like encyclopedias.

Example:
Examples of secondary sources include:

- A journal/magazine article which interprets or reviews previous findings
- A history textbook
- A book about the effects of WWI

Tribe: A tribe is a social division in a traditional society consisting of families or communities linked by social, economic, religious, or blood ties, with a common culture and dialect, typically having a recognized leader.

Example: In contemporary contexts, it is problematic when used to refer to a community living within a traditional society. It is strongly associated with past attitudes of white colonists toward so-called primitive or uncivilized peoples living in remote undeveloped places. For this reason it is generally preferable to use alternative terms such as community or people (Eastern Shoshone, Northern Arapaho).

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HISTORICAL BACKGROUND

The Wyoming Social Studies Content and Performance Standards represent a cooperative effort. In 1998-1999, representatives from each of the districts participated in regional groups along with community college, University, and business representatives. The process began with regional meetings where the participants compiled drafts using local district standards. The state committee, consisting of regional representatives, utilized the regional documents to draft the state standards. National standards and several states' standards were referenced to establish the rigor of the Wyoming Social Studies Content and Performance Standards. These documents are listed below:

- National Council for the Social Studies, Curriculum Standards For Social Studies - ISBN 0-87986-065-0.
- National Center for History in the Schools, National Standards for History - ISBN 0-9633218-4-6.
- Center for Civic Education - National Standards For Civics And Government, ISBN 0-89818-155-0.
- Alaska, Content Standards for Alaska Students, http://www.educ.state.ak.us.
- Arkansas, Social Studies Curriculum Framework, http://www.arkedu.k12.ar.us.
- California, The Challenge Initiative, History and Social Science Standards, California State Department of Education.
- Colorado Model Geography Standards
- Florida, Sunshine State Standards – http://www.firn.edu/doe/curric/prek12.
- Indiana, The Social Studies Proficiency Guide, Indiana Department of Education.
- Massachusetts, History & Social Science Curriculum Framework, http://www.doe.mass.edu.
- New York, Social Studies Resources Guide, http://www.nysed.gov.
- Texas, TEKS for Social Studies, Texas Education Agency.
- Virginia, History & Social Studies Standards of Learning, http://www.pen.k12.va.us.

In 2002-2003, writing committees were convened to review and revise these standards.

In 2008, consistent with its responsibility to evaluate and review the uniformity and quality of the standards at least every five years, the Wyoming State Board of Education Board directed the Wyoming Department of Education (WDE), working in consultation and coordination with local school districts, to formulate and implement a process to evaluate and review the uniformity and quality of the standards by November, 2008.

In order to accomplish the goal of reviewing the standards, a steering committee was convened to guide the review process. It met in early 2008 to develop the process to be used by Content Review Committees in each content area with representation from as many Wyoming school

districts as possible. Members of the Standards Review Steering Committee nominated eight to twelve expert educators in each of the ten content areas represented in the Standards. These committees were balanced geographically and represented preschool, elementary, secondary, special education, and higher education teachers.

The reviewers who agreed to serve on a committee met in spring, 2008 to participate in a systematic evaluation of the uniformity and quality of the standards in their content area. Among the aspects of the Standards reviewed were:

a. The cognitive complexity of the standards.
b. The degree of integration of the Common Core of Skills, 21st Century Skills, and technology in the standards.
c. How Wyoming Standards compare to national curriculum standards and other states' standards.
d. How the format of standards documents might be improved to make them more uniform, more understandable, and more useful.
e. How urgent the need for substantive revision of the standards is in each content area.

The 2008 standards reflect formatting rather than substantive changes. Substantive revisions to standards in all content areas will be recommended based on conclusions from the 2008 standards review and continuing work by content review committees and other stakeholder groups between 2008 and 2013.

In the summer of 2012, a standards review committee was convened to review the Wyoming Social Studies Content and Performance Standards. Subcommittees were formed and it was decided that an additional social studies standard would be added addressing the Framework for 21st Century Skills for technology integration and a connection to literacy through the Common Core State Standards for Literacy in History/Social Studies, Science, & Technical Subjects. It was also decided that an additional grade band division would be added to better meet the demand for increased rigor at all grade levels and prepare students by introducing social studies concepts at the earliest grade levels. The committee recognizes that regardless of the variations of course sequences throughout the state, the knowledge and skills identified upon graduation are intended for all students.

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REFERENCES

During the 2012-2013 revision, National standards and several states' standards were referenced to establish the rigor of the Wyoming Social Studies Content and Performance Standards. These documents are listed below:

- National Council for the Social Studies, National Curriculum Standards for Social Studies - ISBN 0-87986-105-6.
- National Council for Geographic Education, National Geography Standards, http://education.nationalgeographic.com/education/standards/national-geography-standards.
- Common Core State Standard Initiative, Common Core State Standards for Literacy in History/Social Studies, Science, & Technical Subjects, http://www.corestandards.org/ELA-Literacy/RH/introduction.
- International Society for Technology in Education, National Education Technology Standards for Students – ISBN 9781564842374.
- Partnership for 21st Century Skills, Framework for 21st Century Learning, http://www.p21.org/overview/skills-framework.
- Alaska, Content and Performance Standards for Alaska Students, http://www.eed.state.ak.us/standards/pdf/standards.pdf.
- Idaho, Social Studies Content Standards, http://www.sde.idaho.gov/site/content_standards/ss_standards.htm.
- Montana, Standards for Social Studies, http://opi.mt.gov/pdf/standards/ContStds-SocSt.pdf.
- New York, Core Curriculum, http://www.p12.nysed.gov/ciai/socst/pub/sscore1.pdf.
- South Dakota, Social Studies Standards, http://doe.sd.gov/contentstandards.

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Adopted on XXX, XX, 2013

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2013 WYOMING PHYSICAL EDUCATION CONTENT AND PERFORMANCE STANDARDS

RATIONALE

The goal of physical education is to develop physically literate individuals who have the knowledge, skills, and confidence to enjoy a lifetime of healthful physical activity. The Wyoming Physical Education Standards Committee recognizes that a physically literate individual: (a) has learned the skills necessary to perform a variety of physical activities; (b) is physically fit; (c) does participate regularly in physical activity; (d) knows the implications of and benefits from involvement in physical activities; and (e) values physical activity and its contribution to a healthful lifestyle. These five major areas of focus that define what students should know and be able to do in physical education are key ingredients of quality physical education programs. Standards, as determined by the Committee, integrate the essential content, processes, and skills that students will need to master to become lifelong movers.

The Wyoming Physical Education Standards include 1) Movement Skills, 2) Fitness, and 3) Personal and Social Behavior. Basic movement skills, essential knowledge and understanding of physical activity and fitness, and the building blocks of personal and social behavior are introduced at the kindergarten-second grade span. Competency in movement skills and patterns for successful movement performance and the understanding of the benefits of physical activity and fitness, while developing responsible interactions with others, are further emphasized at the third-fifth grade span. Students who do not master these skills by the fifth grade level are unlikely to become lifelong movers. While developmental differences will result in some variance among young children, a failure to achieve these skills by the end of fifth grade is an occurrence of serious educational and health concerns.

At both the sixth-eighth and ninth-twelfth grade levels students are extending their understanding of movement, fitness literacy, and personal and social responsibilities related to physical activity. They are taking the basic skills learned by fifth grade and applying them in more complex movement settings. By the twelfth grade, it is expected that students master the skills and acquire the knowledge to participate in a variety of physical activities that will enhance health-related physical fitness.

In 2012, a committee of teachers was formed to begin a two year revision process of the Physical Education Standards. Because the changes to the 2008 standards document were not substantive, diligence was taken to fully evaluate and revise the entire document during the 2012 revision process. Updates reflected the same aspects reviewed in 2008 (see Historical Background, pg. 44).

The following occurred:

- The decision was made to separate the grade spans into K-2, 3-5, 6-8, and 9-12.
- The same three standards were retained for overarching review.
- The National Physical Education Standards were presented by Dr. Tristan Wallhead, Ph.D., University of Wyoming. He informed the committee of the trends and changes at the national level and where the Wyoming standards fit into the National Standards.
- Since Common Core Literacy Standards are required in each content area, the group identified the benchmarks that may apply.

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- Vertical and horizontal alignment was assured for the entire document.
- Suggested activities were provided in each benchmark as clarification for where they may fit into the curriculum.
- Performance levels were reduced from four to three.

ORGANIZATION OF STANDARDS

Standards specify the essential learning that students must master. They provide a K-12 framework to assist school districts, schools, and communities in developing and strengthening curriculum rather than prescribing courses, materials, or instructional methodology. Teachers ensure that students achieve standards by using a range of instructional strategies that they select based on their students' needs. The Physical Fitness Content and Performance Standards are identified for grade spans K-2, 3-5, 6-8, and 9-12 with benchmarks at grades two, five, eight, and twelve. Terms used in this document are defined below and in the glossary starting on page 39 of this document.

Content Standards: These statements define what students are expected to know and be able to do by the time they graduate. They do not dictate what methodology or instructional materials should be used, nor how the material is delivered.

Benchmarks: These statements specify what students are expected to know and be able to do at the end of each of the benchmark grade levels, in this document, grades 2, 5, 8, and 12. These benchmark standards specify the skills and content students must master along the way in order to reach the content standards by the time they graduate. An overview of the three standards with benchmarks starts on page 13. A more in-depth look at each standard, the benchmarks with examples, and the performance level descriptors divided into grade spans starts on page 17.

Performance Level Descriptors: These statements describe how well students must perform the benchmark standards. The "proficient" level is required to meet the standards. The level descriptors help teachers judge where students are performing in relation to the standards. A general definition of each level is provided below.

> **Advanced:** Students who perform at the advanced level demonstrate advanced motor skills. Students apply in-depth knowledge and understanding of physical activity and fitness. Students demonstrate high level personal and social behaviors in a variety of physical activities and settings.
>
> **Proficient:** Students who perform at the proficient level demonstrate basic motor skills. Students apply knowledge and understanding of physical activity and fitness. Students demonstrate proficient personal and social behaviors in a variety of physical activities and settings.
>
> **Non-proficient:** Students who perform below the proficient level demonstrate rudimentary motor skills, knowledge of physical activity and fitness, and personal and social behaviors. Students who perform at the non-proficient level may require additional support.

The Committee recognizes that students at the high school level may only enroll in one physical education course during their freshman, sophomore, junior, or senior year. The standards and benchmarks identified at twelfth grade are intended for all students regardless of the number of

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physical education courses taken. Districts need to ensure that students are able to demonstrate mastery of the designated culminating skills and knowledge not later than the end of twelfth grade. For a few students, such mastery will constitute a significant challenge. However, these are the skills and knowledge deemed essential.

Although standards are specified for benchmark levels, all grades prior to those designated are regarded as responsible to the benchmark level above them. For example, kindergarten through second grade teachers, parents, and students work toward the achievement of the second grade benchmark standards. Third grade through fifth grade teachers, parents, and students work toward the achievement of the fifth grade benchmark standards. Sixth grade through eighth grade teachers, parents, and students work toward the achievement of the eighth grade benchmark standards. Ninth grade through twelfth grade teachers, parents, and students work toward the achievement of the twelfth grade benchmark standards. Success at each benchmark level requires the effort and commitment of all who prepare for that level. Local district standards are already specified for grade and course levels leading to these benchmarks. These intervening standards and supporting curricula describe the enabling skills and content necessary to meet the benchmarks. Teachers, parents, and students must be aware of the requirements at the next level even as they prepare for the current level so that prerequisite skills are introduced and experienced over time. They must also be aware of the requirements at the previous level so that they continue to practice and apply the skills that have already been mastered.

STANDARDS

The standards have been organized into three major standards: movement, fitness, and personal and social behavior. Rationale is provided for each of these strands.

MOVEMENT: The physically literate individual demonstrates competency and applies knowledge of a variety of movement skills, movement patterns, concepts, principles, and strategies/tactics as they apply to the learning and performance of physical activities. This standard concerns the development of (a) movement competence and proficiency, and (b) the ability of the learner to use cognitive information to understand and enhance motor skill acquisition and performance. Movement competence/literacy implies the development of sufficient ability to actively participate in physical activities and establishes a foundation to facilitate continued motor skill acquisition and increased ability to engage in appropriate motor patterns in daily physical activities. The development of proficiency in a few movement forms gives the student the capacity for successful and advanced levels of performance to further increase the likelihood of participation. In the primary years, students develop maturity and versatility in the use of fundamental skills (e.g., running, skipping, throwing, and striking) that are further refined, combined, and varied during the middle school years. These motor patterns, now having evolved into specialized skills (e.g., a specific dance step, chest pass, and catching with a glove) are used in increasingly more complex movement environments (e.g., more players or participants, rules, and strategies) through the middle school years. High school students regularly participate in a variety of activities, including creating their own movement patterns for regular participation within which proficiency will be developed. In preparation for adulthood, students should have acquired the basic skills to participate in a wide variety of leisure and work-related physical activities and advanced skills in at least two or three areas.

The second part of the standard is about the learner using cognitive information to understand and enhance motor skill acquisition and performance including the application of concepts from

disciplines such as motor learning and development, sport psychology and sociology, biomechanics, and exercise physiology. Specifically, this would include concepts like increasing force production through the summation of forces, effects of anxiety on performance, and the principle of specificity of training. Knowledge of such concepts and practice applying these concepts enhances the likelihood of independent learning; and therefore more regular and effective participation in physical activity. During the lower elementary years, emphasis is placed on establishing a movement vocabulary and initial application of introductory concepts (e.g., space, effort, relationships, and fundamental manipulative skills). Through the upper elementary and middle school years an emphasis is placed on applying and generalizing these concepts to real life physical activity situations (e.g., body control and movement patterns, use of manipulative and locomotor skills, and basic tactics and principles). During the high school years, the student should possess sufficient knowledge of concepts to independently and routinely use and evaluate a wide variety of increasingly complex activities (e.g., performance trends associated with learning specialized motor skills, movement patterns, and individual, dual, and lifetime activities). By graduation, the students should have developed sufficient knowledge and ability to independently use their knowledge to develop and evaluate new skills while continuing to refine existing ones.

FITNESS: The physically literate individual demonstrates the knowledge and skills to achieve and maintain a health-enhancing level of physical activity and fitness. The intent of this standard is for the student to achieve (a) a health-enhancing level of physical fitness and (b) to establish patterns of regular participation in meaningful physical activity. Students should be encouraged to develop higher levels of basic fitness and physical competence as needed for personal health, work situations, and active leisure participation. Health-related fitness components include cardio-respiratory endurance, muscular strength and endurance, flexibility, and body composition. Expectations for students' fitness levels should be established on a personal basis, taking into account variation in entry levels, rather than setting a single standard for all children at a given grade level. For elementary children, the emphasis is on an awareness of fitness components and having fun while participating in health-enhancing activities that promote physical fitness. Middle school students gradually acquire a greater understanding of the fitness components, how each is developed and maintained, the importance of each in overall fitness, and will begin creating a physical fitness plan. Secondary students are able to design, develop, and evaluate an appropriate personal fitness program that enables them to achieve desired levels of fitness. The student thus should have both the ability and willingness to accept responsibility for personal fitness leading to an active, healthy lifestyle.

The second part of this standard is about establishing patterns of regular participation in meaningful physical activity. This should connect what is done in the physical education class with the lives of students outside of physical education. While participation within the physical education class is important, what the student does outside the physical education class is critical to developing an active, healthy lifestyle. Students are more likely to participate if they have opportunities to develop interests that are personally meaningful to them. Young children should learn to enjoy physical activity. They should participate in developmentally appropriate activities that help them develop movement competence. They should also be encouraged to participate in vigorous and unstructured play. As students get older, the structure of activity tends to increase and the opportunities for participation in different types of activity increase outside of the physical education class. Attainment of this standard should develop an awareness of those opportunities and encourage a broad level of participation. Cognitive understandings develop from an initial awareness of cause and effect relationships between activity and its immediate and identifiable effects on the body to an increased understanding of the role of

physical activity on the physiological body, social opportunities and relationships, and emotional well being; and a comprehensive perspective on the meaning of the idea of a healthy lifestyle.

PERSONAL AND SOCIAL BEHAVIOR: The physically literate individual exhibits responsible personal and social behavior that respects self and others and recognizes the value of physical activity for challenge, self expression, and/or social interaction. The intent of this standard is achievement of self-initiated behaviors that promote personal and group success amongst people of diverse characteristics and backgrounds in physical activity settings and the development of an awareness of the intrinsic values and benefits of participation in physical activity that provides personal meaning. Promoting personal and group success in activity settings includes safe practices, adherence to rules and procedures, etiquette, cooperation and teamwork, ethical behavior in sport, and positive social interaction. Achievement of a learner's personal and social development in the lower elementary grades begins with recognition of classroom rules and procedures and a focus on safety. Students learn to work independently and with a partner. In the upper elementary levels, students learn to work independently, with a partner, and in small groups. In the middle school, students identify the purposes of rules and procedures for specific activity situations. High school students initiate responsible behavior, function independently and responsibly, and positively influence the behavior of others in physical activity settings.

This standard also addresses the need for learners to develop respect for individual similarities and differences through positive interaction among participants in physical activity. Similarities and differences include characteristics of culture, ethnicity, motor performance, disabilities, physical characteristics (e.g., strength, size, and shape), gender, race, and socioeconomic status. Elementary school students begin to recognize individual similarities and differences and participate cooperatively in physical activity. By middle school, students participate cooperatively in physical activity with persons of diverse characteristics and background. High school students are expected to be able to participate with all people, recognize the value of diversity in physical activity, and develop strategies for inclusion of others.

Developing an awareness of the intrinsic values and benefits of participation in physical activity that provides personal meaning is the third thread of this standard. Physical activity can provide opportunity for self-expression and social interaction and can be enjoyable, challenging, and fun. These benefits entice people to continue participation in activity throughout the lifespan. Elementary school children derive pleasure from movement sensations and experience challenge and joy as they sense a growing competence in movement ability. At the middle school level, participation in physical activity provides important opportunities for continued personal growth in physical skills and their applied settings. Participation at the high school level continues to provide enjoyment and challenge as well as opportunities for self-expression and social interaction. As a result of these intrinsic benefits of participation, students will begin to actively pursue lifelong physical activities that meet their own needs.

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PERFORMANCE LEVEL DESCRIPTORS

Grade 2

Advanced: Students at the advanced level consistently identify and demonstrate movement concepts and critical cues/characteristics of fundamental movement skills and independently apply them in developmentally appropriate movement activities. They consistently identify current levels of health-related fitness, health benefits of physical activity, and the health-related fitness components. Students consistently are actively engaged in physical activities that meet most requirements for improving health. They consistently follow procedures and safe practices in physical activity settings. Students independently demonstrate socially responsible behavior and actively engage themselves in a variety of physical activities. They explain self benefits and positive social interactions through actively participating in physical activity.

Proficient: Students at the proficient performance level frequently identify and demonstrate movement concepts and critical cues/characteristics of fundamental movement skills and usually apply them in developmentally appropriate movement activities. They frequently identify current levels of health-related fitness, health benefits of physical activity, and the health-related fitness components. Students are generally actively engaged in physical activities that meet most requirements for improving health. They frequently follow procedures and safe practices in physical activity settings. Students generally demonstrate socially responsible behavior and engage themselves in a variety of physical activities. They express self benefits and positive social interactions through actively participating in physical activity.

Non-proficient: Students at the non-proficient performance level inconsistently identify and demonstrate movement concepts and critical cues/characteristics of fundamental movement skills and rarely apply them in developmentally appropriate movement activities. They rarely identify current levels of health-related fitness, health benefits of physical activity, and the health-related fitness components. Students are rarely engaged in physical activities that meet most requirements for improving health. They inconsistently or fail to follow procedures and safe practices in physical activity settings. Students are unable or unwilling to demonstrate socially responsible behavior and engage themselves in a variety of physical activities. They are unable to express self benefits and positive social interactions through participating in physical activity.

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PERFORMANCE LEVEL DESCRIPTORS

Grade 5

Advanced: Students at the advanced level consistently identify and demonstrate movement concepts and critical cues/characteristics of fundamental movement skills and independently apply them in developmentally appropriate movement activities while in an open environment. They consistently demonstrate and explain basic tactics and principles in a variety of activities. They consistently assess current levels of health-related fitness and analyze fitness results in terms of health-related components. They consistently describe the relationship between types of physical activities and health benefits. They consistently are actively engaged in physical activities that meet most requirements for improving health and identify a wide variety of technological and fitness resources that improve personal fitness. Students demonstrate an in-depth understanding of rules and procedures and independently apply those rules and procedures in physical activity settings. They consistently demonstrate positive intrapersonal characteristics and constructive interpersonal relationships while engaging in physical activities.

Proficient: Students at the proficient level frequently identify and demonstrate movement concepts and critical cues/characteristics of fundamental movement skills and usually apply them in developmentally appropriate movement activities while in an open environment. They regularly demonstrate and explain basic tactics and principles in a variety of activities. Students frequently assess current levels of health-related fitness and analyze fitness results in terms of health-related components. They usually describe the relationship between types of physical activities and health benefits. They generally are actively engaged in physical activities that meet most requirements for improving health and identify a variety of technological and fitness resources that improve personal fitness. Students demonstrate an understanding of rules and procedures and apply those rules and procedures in physical activity settings. They frequently demonstrate positive intrapersonal characteristics and constructive interpersonal relationships while engaging in physical activities.

Non-proficient: Students at the non-proficient level inconsistently identify and demonstrate movement concepts and critical cues/characteristics of fundamental movement skills and rarely apply them in developmentally appropriate movement activities while in an open environment. They inconsistently demonstrate and explain basic tactics and principles in a variety of activities. They rarely assess current levels of health-related fitness and analyze fitness results in terms of health-related components. They seldom describe the relationship between types of physical activities and health benefits. They rarely are actively engaged in physical activities that meet most requirements for improving health and identify a variety of technological and fitness resources that improve personal fitness. They fail to demonstrate understanding of rules and procedures and/or apply those rules and procedures in physical activity settings. Students seldom demonstrate positive intrapersonal characteristics and constructive interpersonal relationships while engaging in physical activities.

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PERFORMANCE LEVEL DESCRIPTORS

Grade 8

Advanced: Students at the advanced performance level consistently make connections between movement skills, rules, strategies, and tactics of modified specialized skill activities. They demonstrate all specialized movement skills in a variety of developmentally appropriate physical activities. They consistently analyze a person's skills, tactics, and strategies in a modified activity (individual, dual, or lifetime). They independently create and monitor a personal fitness plan. Students consistently differentiate the benefits of an individual, team, indoor, or outdoor activity as it relates to personal fitness. They consistently apply the FITT principle to short-term fitness goals. Valid characteristics of fitness products and technology are recognized and an explanation of the use and purpose is expressed in-depth. They consistently are actively engaged in physical activity that meets requirements for improving health. They demonstrate an in-depth understanding of rules and procedures and independently apply those rules and procedures in physical activity settings. They independently exhibit positive intrapersonal characteristics and consistently engage constructively in appropriate interpersonal relationships appropriate for a variety of physical activity settings.

Proficient: Students at the proficient level usually make connections between movement skills, rules, strategies, and tactics of modified specialized skill activities. They demonstrate most critical skill cues when performing specialized movement skills in a variety of developmentally appropriate physical activities. Students frequently analyze a person's skills, tactics, and strategies in a modified activity (individual, dual, or lifetime). They create and monitor a personal fitness plan in terms of health-related fitness components, with assistance. They consistently differentiate the benefits of an individual, team, indoor, or outdoor activity as it relates to personal fitness. Students frequently apply the FITT principle to short-term fitness goals. Some valid characteristics of fitness products and technology are recognized and an explanation of use and purpose is accurately expressed. They generally are actively engaged in physical activity that meets requirements for improving health. They demonstrate an understanding of rules and procedures and apply those rules and procedures in physical activity settings. They regularly exhibit positive intrapersonal characteristics and engage constructively in appropriate interpersonal relationships appropriate for a variety of physical activity settings.

Non-proficient: Students at the non-proficient level inconsistently make connections between movement skills, rules, strategies, and tactics of modified specialized skill activities. They rarely demonstrate critical skill cues when performing specialized movement skills in a variety of developmentally appropriate physical activities. They rarely compare and contrast different movement patterns for a variety of activities. They inconsistently analyze a person's skills, tactics, and strategies in a modified activity (individual, dual, or lifetime). Students performing at the non-proficient level are unable or unwilling to create and monitor a personal fitness plan in terms of health-related fitness components. They fail to differentiate the benefits of an individual, team, indoor, or outdoor activity as it relates to personal fitness. Students rarely apply the FITT principle to short-term fitness goals. Some valid characteristics of fitness products and technology are recognized, but an explanation of use and purpose is inaccurately expressed. They are rarely engaged in physical activity that meets requirements for improving health. Students fail to demonstrate understanding or apply rules and procedures in physical activity settings. They inconsistently or are unable to exhibit positive intrapersonal characteristics and rarely engage constructively in appropriate interpersonal relationships appropriate for a variety of physical activity settings.

PERFORMANCE LEVEL DESCRIPTORS

Grade 12

Advanced: Students at the advanced level consistently explain specialized movement skills, concepts, rules, strategies, and tactics and apply them while performing specialized movement activities. They apply complex rules and strategies in specialized skill activities. An in-depth practice plan (what, when, where, and how) is presented to facilitate performance improvement. They consistently evaluate a person's skills, tactics, and strategies in a modified activity (individual, dual, or lifetime). Students independently create, monitor, and evaluate a personal fitness plan in terms of the health-related fitness components and principles. They consistently identify the health benefits from various physical activities. They provide an in-depth critique on the value and validity of technological fitness products and resources related to fitness literacy. Students consistently are actively engaged in physical activity that meets requirements for improving health. They independently model and monitor adherence to protocol in physical activity settings. Students consistently use physical activity to improve positive intrapersonal characteristics and independently initiate constructive interpersonal relationships appropriate for a variety of physical activity settings.

Proficient: Students at the proficient performance level frequently explain specialized movement skills, concepts, rules, and strategies and apply them while performing specialized movement activities. They apply most complex rules and strategies in a few specialized skill activities. A basic practice plan is presented to facilitate performance improvement. Students frequently evaluate a person's skills, tactics, and strategies in a modified activity (individual, dual, or lifetime). With assistance, students create, monitor, and evaluate a personal fitness plan in terms of the health-related fitness components and principles. They generally identify the health benefits from various physical activities. They usually critique the value and validity of technological fitness products and resources related to fitness literacy. They are actively engaged in physical activity that meets requirements for improving health. Students usually model and monitor adherence to protocol in physical activity settings. They generally use physical activity to improve positive intrapersonal characteristics and frequently initiate constructive interpersonal relationships appropriate for a variety of physical activity settings.

Non-proficient: Students at the non-proficient level have difficulty explaining fundamental movement skills, concepts, rules, and strategies and rarely apply them while performing specialized movement activities. They have difficulty applying complex rules and strategies in a few specialized skill activities. A limited practice plan is presented to facilitate performance improvement. Students rarely evaluate a person's skills, tactics, and strategies in a modified activity (individual, dual, or lifetime). Students are unable to create, monitor, and evaluate a personal fitness plan in terms of the health-related fitness components and principles. They rarely identify the health benefits from various physical activities. They fail to critique the value and validity of technological fitness products and resources related to fitness literacy. Students rarely engage in physical activity that meets requirements for improving health. They fail to model or monitor and/or adhere to protocol in physical activity settings. They seldom use physical activity to improve positive intrapersonal characteristics and rarely initiate constructive interpersonal relationships appropriate for a variety of physical activity settings.

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Connections to the Common Core State Standards for Literacy in History, Science, and Technical Subjects: Standards Coding for English/Language Arts & Math

Content Standard	CCSS Coding	Stands for	Where You'll Find It
ELA	R.CCR.9 W.CCR.1	Reading / Writing College- and Career-Ready Anchor Standard **Example:** R.CCR.9 = Reading, Individual College and Career Readiness (CCR) Anchor Standard, Standard 9	Language Arts Standards - CCSS ELA pages, after the introduction (Reading - CCR, K-5 pg. 10; Gr. 6-12 pg. 35) (Writing - CCR, K-5 pg. 18; Gr. 6-12 pg. 41)
Reading	RL.3.2 RI.4.3	Reading of Literature, Gr. 3 Reading for Information, Gr. 4 **Example:** RI.4.3 = Reading, Informational Text, Grade 4, Standard 3	Language Arts Standards - CCSS ELA pages, after the introduction (K-5 pp. 11-12; Gr. 6-12 pp. 36-38) (K-5 pp.13-14; Gr. 6-12 pp. 39-40)
Writing	W.5.1a	Writing, Gr. 5 **Example:** W.5.1a Writing, Grade 5, Standard 1a	Language Arts Standards - CCSS ELA pages, after the introduction (K-5 pp. 19-21; Gr. 6-12 pp. 42-47)
Literacy Standards for History, Science, & Technical Subjects	RHST.CCR.2 RH.9-10.3 RST.11-12.3 WHST.CCR.2 WHST.9-10.3	Reading for History/S.S., Science, & Technical Subjects), CCR Anchor Standard #2 Reading Lit. in History, Gr. 9-10 Reading Lit. in Science & Technical Subjects, Gr. 11-12 **Example:** RST.6-8.3 = Reading, Science and Technical Text, Grade 6-8, Standard 3	Language Arts Standards - CCSS ELA pages, after the introduction (Gr. 6-12) (Reading - CCR pg. 60) (Reading - History pg. 61) (Reading - Science & Technical Subjects (RST) pg. 62) (Writing - CCR pg. 63) (Writing for Literacy in History, Science, & Technical Subjects (WHST) pp. 64-66)
Math	MP.2 7.G.A.2	Math Practice #2 7th Grade Geometry **Example:** 4.MD.A.2 = 4th Grade Math, Measurement & Data Domain, 1st Cluster Heading, Standard 2	Mathematics Standards – CCSS Math pages, after the introduction (K-12 pp. 10-83)

All Standards Documents can be found on the Wyoming Department of Education Standards Page at http://edu.wyoming.gov/Programs/standards.aspx.

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WYOMING PHYSICAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD 1. MOVEMENT			
The physically literate individual demonstrates competency and applies knowledge of a variety of movement skills, movement patterns, concepts, principles, and strategies/tactics as they apply to the learning and performance of physical activities.			
GRADE SPAN BENCHMARKS			
GRADE K-2	**GRADE 3-5**	**GRADE 6-8**	**GRADE 9-12**
PE 2.1.1 Students demonstrate fundamental locomotor skills.	PE 5.1.1 Students combine locomotor and body control skills into movement patterns.	PE 8.1.1 Students demonstrate movement skills and patterns in a variety of activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	PE 12.1.1 Students demonstrate combined movement skills and patterns in specialized settings. *(CCSS ELA-Literacy RST.9-12.3,4,9)
PE 2.1.2 Students demonstrate fundamental body control skills.	PE 5.1.2 Students demonstrate a combination of body control skills.	PE 8.1.2 Students demonstrate critical elements of specialized manipulative skills in modified team activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	PE 12.1.2 Students demonstrate specialized manipulative skills in team activities. *(CCSS ELA-Literacy RST.9-12.3,4,9)
PE 2.1.3 Students demonstrate developing control of fundamental manipulative skills.	PE 5.1.3 Students apply fundamental manipulative skills in a variety of physical activities.	PE 8.1.3 Students demonstrate critical elements of specialized skills in modified individual, dual, or lifetime activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	PE 12.1.3 Students demonstrate specialized skills in individual, dual, or lifetime activities. *(CCSS ELA-Literacy RST.9-12.3,4,9)
PE 2.1.4 Students demonstrate fundamental movement concepts related to space, effort, and relationships.	PE 5.1.4 Students demonstrate and apply basic tactics and principles of movement.	PE 8.1.4 Students apply tactical concepts and performance principles in modified team activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	PE 12.1.4 Students apply specialized tactical concepts and performance principles in team activities. *(CCSS ELA-Literacy RST.9-12.3,4,9)
PE 2.1.5 Students identify critical elements of fundamental locomotor skills.	PE 5.1.5 Students explain critical elements of locomotor skills.	PE 8.1.5 Students apply tactical concepts and performance principles in individual, dual, or lifetime activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	PE 12.1.5 Students apply specialized tactical concepts and performance principles in individual, dual, or lifetime activities. *(CCSS ELA-Literacy RST.9-12.3,4,9)

*This coding refers to the Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects. See Language Arts Standards, pages 60-66, after the introduction.

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WYOMING PHYSICAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD 1. MOVEMENT (continued)			
PE 2.1.6 Students identify critical elements of fundamental body control skills.	PE 5.1.6 Students explain critical elements of body control skills.	PE 8.1.6 S Students compare and contrast skills used for different movement patterns. *(CCSS ELA-Literacy RST.6-8.3,4,9)	PE 12.1.6 Students evaluate specialized skills used by self/others in team activities. *(CCSS ELA-Literacy RST.9-12.3,4,7,9)
PE 2.1.7 Students identify critical elements of fundamental manipulative skills.	PE 5.1.7 Students explain critical elements of fundamental manipulative skills.	PE 8.1.7 Students analyze critical elements of specialized skills in a variety of activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	PE 12.1.7 Students evaluate specialized skills used by self/others in individual, dual, or lifetime activities. *(CCSS ELA-Literacy RST.9-12.3,4,9)
PE 2.1.8 Students identify critical elements of fundamental movement concepts related to space, effort, and relationships.	PE 5.1.8 Students explain basic tactics and principles of movement.	PE 8.1.8 Students analyze the use of strategies and tactics in a variety of physical activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	PE 12.1.8 Students evaluate the use of specialized strategies and tactics in a variety of physical activities. *(CCSS ELA-Literacy RST.9-12.3,4,9)

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WYOMING PHYSICAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD 2. FITNESS			
The physically literate individual demonstrates the knowledge and skills to achieve and maintain a health-enhancing level of physical activity and fitness.			
GRADE SPAN BENCHMARKS			
GRADE K-2	**GRADE 3-5**	**GRADE 6-8**	**GRADE 9-12**
PE 2.2.1 Students identify current levels of personal health-related fitness.	PE 5.2.1 Students assess current levels of personal health-related fitness.	PE 8.2.1 Students create and monitor a personal plan using current levels of fitness and physical activity. *(CCSS ELA-Literacy WHST.6-8.2,4,5,6,7,8,9) (CCSS ELA-Literacy RST.6-8.3)	PE 12.2.1 Students create, monitor, and evaluate a personal plan using current levels of fitness and physical activity. *(CCSS ELA-Literacy WHST.9-12.2,4,5,6,7,8,9) (CCSS ELA-Literacy RST.9-12.3)
PE 2.2.2 Students identify the health benefits of physical activity.	PE 5.2.2 Students define the health benefits of physical activity.	PE 8.2.2 Students differentiate the health benefits associated with a variety of physical activities. *(CCSS ELA-Literacy WHST.6-8.7,8,9) (CCSS ELA-Literacy RST.6-8.4)	PE 12.2.2 Students evaluate the health benefits of a variety of physical activities *(CCSS ELA-Literacy WHST.9-12.7,8,9) (CCSS ELA-Literacy RST.9-12.4)
PE 2.2.3 Students identify the principles, components, and practices of health-related fitness.	PE 5.2.3 Students explain the principles, components, and practices of health-related fitness.	PE. 8.2.3 Students apply the principles, components, and practices of health-related fitness to improve short-term fitness goals. *(CCSS ELA-Literacy RST.6-8.4)	PE 12.2.3 Students create, monitor, and evaluate a plan applying the principals and components of health-related fitness. *(CCSS ELA-Literacy WHST.9-12.2,4,5,6,7,8,9) (CCSS ELA-Literacy RST.9-12.4)
PE 2.2.4 Students engage in a variety of physical activities that will enhance health-related fitness.	PE 5.2.4 Students engage in a variety of physical activities that will enhance health-related fitness (inside and/or outside of school).	PE 8.2.4 Students engage in a variety of physical activities that will enhance health-related fitness (inside and/or outside of school).	PE 12.2.4 Students engage in a variety of physical activities that will enhance health-related fitness (inside and/or outside of school).
	PE 5.2.5 Students recognize valid characteristics of fitness-related products technology and resources.	PE 8.2.5 Students explain valid characteristics of fitness-related products, technology, and resources related to fitness literacy. *(CCSS ELA-Literacy WHST.6-8.4,6,7,8,9) (CCSS ELA-Literacy RST.6-8.4,8,9)	PE 12.2.5 Students will use criteria to critique fitness-related products, technology, and resources related to fitness literacy. *(CCSS ELA-Literacy WHST.9-12.4,6,7,8,9) (CCSS ELA-Literacy RST.9-12.4,8,9)

*This coding refers to the Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects. See Language Arts Standards, pages 60-66, after the introduction.

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WYOMING PHYSICAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD **3. PERSONAL AND SOCIAL BEHAVIOR**			
The physically literate individual exhibits responsible personal and social behavior that respects self and others and recognizes the value of physical activity for challenge, self-expression, and/or social interaction.			
GRADE SPAN BENCHMARKS			
GRADE K-2	**GRADE 3-5**	**GRADE 6-8**	**GRADE 9-12**
PE 2.3.1 Students know and follow procedures and safe practices.	PE 5.3.1 Students understand the purpose of and apply appropriate rules, procedures, and safe practices in physical activity setting.	PE 8.3.1 Students develop and apply appropriate rules, safe practices, and procedures in physical activity settings.	PE 12.3.1 Students demonstrate leadership by holding self and others responsible for following safe practices, rules, procedures, and etiquette in physical activity settings.
PE 2.3.2 Students demonstrate socially responsible behavior in physical activity settings.	PE 5.3.2 Students interact and communicate positively with others.	PE 8.3.2 Students communicate effectively with others to promote respect and conflict resolution in physical activity settings.	PE 12.3.2 Students initiate responsible personal social behavior and positively influence the behavior of others in physical activity settings.
PE 2.3.3 Students exhibit persistence when participating in a variety of physical activities.	PE 5.3.3 Students participate in and explain physical activities that promote self challenge and enjoyment.	PE 8.3.3 Students engage in challenging experiences that develop confidence and independence. *(CCSS ELA-Literacy WHST.6-8.10)	PE 12.3.3 Students use physical activity to promote personal growth, goal setting, and enjoyment. *(CCSS ELA-Literacy WHST.9-10.10)
PE 2.3.4 Students discover that physical activities promote self-expression and positive social interaction.	PE 5.3.4 Students participate in physical activities that promote self-expression and social and group interaction.	PE 8.3.4 Students engage in physical activities that promote self-expression and provide opportunities for social and group interaction. *(CCSS ELA-Literacy WHST.6-8.10)	PE 12.3.4 Students pursue physical activities that promote self-expression and provide opportunities for social and group interaction. *(CCSS ELA-Literacy WHST.9-10.10)

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WYOMING PHYSICAL EDUCATION CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD 1. MOVEMENT The physically literate individual demonstrates competency and applies knowledge of a variety of movement skills, movement patterns, concepts, principles, and strategies/tactics as they apply to the learning and performance of physical activities.		
CODE	**GRADE 2 BENCHMARKS**	**EXAMPLES**
PE 2.1.1	Students demonstrate fundamental locomotor skills.	• Walk and run • Leap, hop, and jump • Skip, gallop, and slide • Chase, flee, and dodge
PE 2.1.2	Students demonstrate fundamental body control skills.	• Turn, twist, and roll • Balance, transfer weight, and land • Stretch and curl • Move on, over, under, and around equipment/apparatus with purpose, control, and balance • Perform combinations or rolling and balance skills
PE 2.1.3	Students demonstrate developing control of fundamental manipulative skills.	• Throw to a stationary target • Catch a ball before it bounces twice • Kick a stationary object • Volley an object • Roll a ball at a stationary object • Dribble in place
PE 2.1.4	Students demonstrate fundamental movement concepts related to space, effort, and relationships.	• Location, direction, level, pathway, and extension • Time, force, and flow • With objects and with people
PE 2.1.5	Students identify critical elements of fundamental locomotor skills.	• Walk and run • Leap, hop, and jump • Skip, gallop, and slide • Chase, flee, and dodge
PE 2.1.6	Students identify critical elements of fundamental body control skills.	• Turn, twist, and roll • Balance, transfer weight, and land • Stretch and curl
PE 2.1.7	Students identify critical elements of fundamental manipulative skills.	• Throw to a stationary target • Catch a ball before it bounces twice • Kick a stationary object • Volley an object • Roll a ball at a stationary object • Dribble in place
PE 2.1.8	Students identify critical elements of fundamental movement concepts related to space, effort, and relationships.	• Location, direction, level, pathway, and extension • Time, force, and flow • With objects and with people

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GRADE 2 PERFORMANCE LEVEL DESCRIPTORS
1. MOVEMENT

ADVANCED PERFORMANCE

Second grade students at the advanced performance level consistently identify and demonstrate movement concepts and critical cues or characteristics of fundamental movement skills. Students independently apply skill cues and movement concepts in the performance of locomotor, manipulative, and body control skills. Students consistently combine two or more body control skills individually or with a partner/object.

PROFICIENT PERFORMANCE

Second grade students at the proficient performance level frequently identify and demonstrate movement concepts and critical cues or characteristics of fundamental movement skills. Students usually apply skill cues and movement concepts in the performance of locomotor, manipulative, and body control skills. Students usually combine two or more body control skills individually or with a partner/object.

NON-PROFICIENT PERFORMANCE

Second grade students at the non-proficient performance level inconsistently identify and demonstrate movement concepts and critical cues or characteristics of fundamental movement skills. Students rarely apply skill cues and movement concepts in the performance of locomotor, manipulative, and body control skills. Students rarely combine two or more body control skills individually or with a partner/object.

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WYOMING PHYSICAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD **2. FITNESS** The physically literate individual demonstrates the knowledge and skills to achieve and maintain a health-enhancing level of physical activity and fitness.		
CODE	**GRADE 2 BENCHMARKS**	**EXAMPLES**
PE 2.2.1	Students identify current levels of personal health-related fitness.	• Chart current levels of cardio fitness and their progress. • Body Composition (BMI) • Cardiovascular Endurance (Pacer, Mile Run) • Flexibility (Sit and Reach) • Muscular Endurance (Sit-ups) • Strength (Push-ups)
PE 2.2.2	Students identify the health benefits of physical activity.	• Discuss that performing push-ups will result in stronger upper body strength. • Describe large motor and/or manipulative physical activities for participation outside of school. • Identify physical activities that contribute to fitness.
PE 2.2.3	Students identify the principles, components, and practices of health-related fitness.	• Recognize that health-related fitness consists of several different components. • Distinguish between exercises that improve endurance, flexibility, and muscle strength.
PE 2.2.4	Students engage in a variety of physical activities that will enhance health-related fitness.	• Actively engage in physical education class in response to instruction and practice. • Choose to participate in a variety of physical activities on a regular basis inside and outside of school to improve health.

GRADE 2 PERFORMANCE LEVEL DESCRIPTORS
2. FITNESS

ADVANCED PERFORMANCE

Second grade students performing at the advanced performance level consistently identify current levels of health-related fitness. They consistently identify health benefits of physical activity and the health-related fitness components. Students consistently are actively engaged in physical activities that meet most requirements for improving health.

PROFICIENT PERFORMANCE

Second grade students performing at the proficient performance level frequently identify current levels of health-related fitness. They usually identify health benefits of physical activity and the health-related fitness components. Students are generally actively engaged in physical activities that meet most requirements for improving health.

NON-PROFICIENT PERFORMANCE

Second grade students performing at the non-proficient performance level rarely identify current levels of health-related fitness. They seldom identify health benefits of physical activity and the health-related fitness components. Students are rarely engaged in physical activities that meet most requirements for improving health.

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WYOMING PHYSICAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD **3. PERSONAL AND SOCIAL BEHAVIOR** The physically literate individual exhibits responsible personal and social behavior that respects self and others and recognizes the value of physical activity for challenge, self-expression, and/or social interaction.		
CODE	**GRADE 2 BENCHMARKS**	**EXAMPLES**
PE 2.3.1	Students know and follow procedures and safe practices.	• Respond positively to reminders of appropriate safety procedures. • Follow directions and handle equipment safely. • Explain rules related to safety and activity-specific procedures.
PE 2.3.2	Students demonstrate socially responsible behavior in physical activity settings.	• Demonstrate cooperation with others when resolving conflicts. • Take turns using equipment or performing a task. • Interact positively with others in partner and small group activities without regard to individual differences.
PE 2.3.3	Students exhibit persistence when participating in a variety of physical activities.	• Continue to participate when not successful on the first try. • Practice to refine the performance of a movement pattern. • Encourage someone to try to perform a movement task, skill, or sequence. • Participate with others to accomplish a movement challenge.
PE 2.3.4	Students discover that physical activities promote self-expression and positive social interaction.	• Demonstrate and describe a new way to accomplish a movement task. • Express an idea, concept, or emotion through movement. • Express personal feelings about progress made learning a new skill or improving a previously learned skill. • Participate with others to accomplish a movement challenge or achieve a physical activity goal.

GRADE 2 PERFORMANCE LEVEL DESCRIPTORS
3. PERSONAL AND SOCIAL BEHAVIOR

ADVANCED PERFORMANCE

Second grade students at the advanced performance level consistently follow procedures and safe practices in physical activity settings. Students independently demonstrate socially responsible behavior and actively engage themselves in a variety of physical activities. Students explain self benefits and positive social interactions through actively participating in physical activity.

PROFICIENT PERFORMANCE

Second grade students at the proficient performance level frequently follow procedures and safe practices in physical activity settings. Students generally demonstrate socially responsible behavior and engage themselves in a variety of physical activities. Students express self benefits and positive social interactions through actively participating in physical activity.

NON-PROFICIENT PERFORMANCE

Second grade students at the non-proficient performance level inconsistently or fail to follow procedures and safe practices in physical activity settings. Students are unable or unwilling to demonstrate socially responsible behavior and engage themselves in a variety of physical activities. Students are unable to express self benefits and positive social interactions through participating in physical activity.

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CONTENT STANDARD 1. MOVEMENT The physically literate individual demonstrates competency and applies knowledge of a variety of movement skills, movement patterns, concepts, principles, and strategies/tactics as they apply to the learning and performance of physical activities.		
CODE	**GRADE 5 BENCHMARKS**	**EXAMPLES**
PE 5.1.1	Students combine locomotor and body control skills into movement patterns.	• Small-sided practice tasks • Dance, jump rope, and gymnastics • Run to avoid defenders • Skip while swinging a partner in dance • Hop while jumping rope • Walk into a forwards roll
PE 5.1.2	Students demonstrate a combination of body control skills.	• Small-sided practice tasks • Dance, jump rope, and gymnastics
PE 5.1.3	Students apply fundamental manipulative skills in a variety of physical activities.	• Throw to a moving target • Catch while moving • Strike a moving object • Volley a moving object • Roll a ball at a moving object • Dribble while moving
PE 5.1.4	Students demonstrate and apply basic tactics and principles of movement.	• Return to base position • Move to get open • Recognize when to use a specific type of throw
PE 5.1.5	Students explain critical elements of locomotor skills.	• Walk and run • Leap, hop, and jump • Skip, gallop, and slide • Chase, flee, and dodge
PE 5.1.6	Students explain critical elements of body control skills.	• Turn, twist, and roll • Balance, transfer weight, and land • Stretch and curl
PE 5.1.7	Students explain critical elements of fundamental manipulative skills.	• Throw, roll ball, dribble, and kick • Strike a stationary object
PE 5.1.8	Students explain basic tactics and principles of movement.	• Return to base position • Move to get open • Recognize when to use a specific type of throw

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GRADE 5 PERFORMANCE LEVEL DESCRIPTORS
1. MOVEMENT

ADVANCED PERFORMANCE

Fifth grade students at the advanced performance level consistently identify and explain movement concepts and critical cues or characteristics of fundamental movement skills. Students consistently apply skill cues and movement concepts in the performance of locomotor, manipulative, and body control skills while in an open environment. Students consistently demonstrate and explain basic tactics and principles in a variety of activities.

PROFICIENT PERFORMANCE

Fifth grade students at the proficient performance level frequently identify and explain movement concepts and critical cues or characteristics of fundamental movement skills. Students usually apply skill cues and movement concepts in the performance of locomotor, manipulative, and body control skills while in an open environment. Students regularly demonstrate and explain basic tactics and principles in a variety of activities.

NON-PROFICIENT PERFORMANCE

Fifth grade students at the non-proficient performance level inconsistently identify and explain movement concepts and critical cues or characteristics of fundamental movement skills. Students rarely apply skill cues and movement concepts in the performance of locomotor, manipulative, and body control skills while in an open environment. Students inconsistently demonstrate and explain basic tactics and principles in a variety of activities.

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CONTENT STANDARD 2. FITNESS The physically literate individual demonstrates the knowledge and skills to achieve and maintain a health-enhancing level of physical activity and fitness.		
CODE	**GRADE 5 BENCHMARKS**	**EXAMPLES**
PE 5.2.1	Students assess current levels of personal health-related fitness.	• Participate in health related assessments • Meet criterion-referenced standards for the components of health-related fitness. • Analyze results of fitness assessments and compare results to fitness components for good health.
PE 5.2.2	Students define the health benefits of physical activity.	• Identify several moderate to vigorous activities. • Share physical activities participated in. • Explain that running improves cardiovascular endurance. • Differentiate between skill-related and health-related fitness.
PE 5.2.3	Students explain the principles, components, and practices of health-related fitness.	• Relate performance on fitness assessment with criteria for good health. • Identify activities or exercises that might improve or maintain a component of health-related fitness. • Understand the benefits of warm-up/cool down and design a warm-up/cool down for a variety of health-related fitness components.
PE 5.2.4	Students engage in a variety of physical activities that will enhance health-related fitness (inside and/or outside of school).	• Choose to participate in a variety of physical activities on a regular basis inside and outside of school to improve health.
PE 5.2.5	Students recognize valid characteristics of fitness-related products technology and resources.	• Identify a variety of technology (pedometers, heart rate monitors, etc.) that can assist in improving fitness. • Identify a variety of resources (apps, internet, smart phones, etc.) that can improve fitness.

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GRADE 5 PERFORMANCE LEVEL DESCRIPTORS
2. FITNESS

ADVANCED PERFORMANCE

Fifth grade students performing at the advanced level consistently assess current levels of health-related fitness after completing a fitness assessment and use a criterion-referenced chart to analyze fitness results in terms of health-related components. They consistently describe the relationship between types of physical activities and health benefits. Students consistently are actively engaged in physical activities that meet most requirements for improving health. Students identify a wide variety of technological and fitness resources that improve personal fitness.

PROFICIENT PERFORMANCE

Fifth grade students performing at the proficient level frequently assess current levels of health-related fitness after completing a fitness assessment and use a criterion-referenced chart to analyze fitness results in terms of health-related components. They usually describe the relationship between types of physical activities and health benefits. Students generally are actively engaged in physical activities that meet most requirements for improving health. Students identify a variety of technological and fitness resources that improve personal fitness.

NON-PROFICIENT PERFORMANCE

Fifth grade students performing at the non-proficient level rarely assess current levels of health-related fitness after completing a fitness assessment and use a criterion-referenced chart to analyze fitness results in terms of health-related components. They seldom describe the relationship between types of physical activities and health benefits. Students rarely engage in physical activities that meet most requirements for improving health. Students identify some technological and fitness resources that improve personal fitness.

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CONTENT STANDARD 3. PERSONAL AND SOCIAL BEHAVIOR The physically literate individual exhibits responsible personal and social behavior that respects self and others and recognizes the value of physical activity for challenge, self-expression, and/or social interaction.		
CODE	**GRADE 5 BENCHMARKS**	**EXAMPLES**
PE 5.3.1	Students understand the purpose of and apply appropriate rules, procedures, and safe practices in physical activity setting.	• Adhere to class and activity-specific rules and safe practices. • Adjust performance to characteristics of the environment to ensure safe play (e.g., space and equipment).
PE 5.3.2	Students interact and communicate positively with others.	• Lead, follow, and support group members to improve play in cooperative and competitive settings. • Evaluate personal behavior to ensure positive effects on others. • Demonstrate respectful and responsible behavior toward peers different from oneself. • Demonstrate cooperation with others when resolving conflict.
PE 5.3.3	Students participate in and explain physical activities that promote self challenge and enjoyment.	• Explain reasons for choosing to participate in a selected physical activity. • Select and practice physically challenging activities to improve a skill and/or to experience success. • Share feelings with others in class about personal success, challenges, or failure during an activity. • Explain how practice increases the level of personal success that leads to increased enjoyment. • Celebrate personal success and achievement, and that of others, due to effort and practice.
PE5.3.4	Students participate in physical activities that promote self-expression and social and group interaction.	• Participate in physical activities that allow for self-expression (e.g., create a dance sequence, a routine or game that reflects personal feelings, thoughts and ideas). • Participate in a variety of physical activities that provide opportunities for social and group interaction. • Interact positively with partners or small groups through physical activities.

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GRADE 5 PERFORMANCE LEVEL DESCRIPTORS
3. PERSONAL AND SOCIAL BEHAVIOR

ADVANCED PERFORMANCE

Fifth grade students at the advanced performance level demonstrate an in-depth understanding of rules and procedures and independently apply those rules and procedures in physical activity settings. Students consistently demonstrate positive intrapersonal characteristics and constructive interpersonal relationships while engaging in physical activities.

PROFICIENT PERFORMANCE

Fifth grade students at the proficient performance level demonstrate an understanding of rules and procedures and apply those rules and procedures in physical activity settings. Students frequently demonstrate positive intrapersonal characteristics and constructive interpersonal relationships while engaging in physical activities.

NON-PROFICIENT PERFORMANCE

Fifth grade students at the non-proficient performance level fail to demonstrate understanding of rules and procedures and/or apply those rules and procedures in physical activity settings. Students seldom demonstrate positive intrapersonal characteristics and constructive interpersonal relationships while engaging in physical activities.

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WYOMING PHYSICAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD **1. MOVEMENT** The physically literate individual demonstrates competency and applies knowledge of a variety of movement skills, movement patterns, concepts, principles, and strategies/tactics as they apply to the learning and performance of physical activities.		
CODE	**GRADE 8 BENCHMARKS**	**EXAMPLES**
PE 8.1.1	Students demonstrate movement skills and patterns in a variety of activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	• Rhythms and dance • Gymnastics and jump rope sequences
PE 8.1.2	Students demonstrate critical elements of specialized manipulative skills in modified team activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	• 4 vs. 4 rugby • 3 vs. 3 basketball • 6 vs. 6 kickball
PE 8.1.3	Students demonstrate critical elements of specialized skills in modified individual, dual, or lifetime activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	• Swimming, bicycling, and tennis
PE 8.1.4	Students apply tactical concepts and performance principles in modified team activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	• Return to base position • Move to an open area • Small-sided team activities and dual activities • Offense, defense, and objective of activity
PE 8.1.5	Students apply tactical concepts and performance principles in individual, dual, or lifetime activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	• Rhythms and dance • Gymnastics and jump rope sequence
PE 8.1.6	Students compare and contrast skills used for different movement patterns. *(CCSS ELA-Literacy RST.6-8.3,4,9)	• 4 vs. 4 rugby • 3 vs. 3 basketball • 6 vs. 6 kickball
PE 8.1.7	Students analyze critical elements of specialized skills in a variety of activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	• Swimming, bicycling, and tennis
PE 8.1.8	Students analyze the use of strategies and tactics in a variety of physical activities. *(CCSS ELA-Literacy RST.6-8.3,4,9)	• Small-sided team activities and dual activities. • Detect and correct errors in personal performance based on knowledge and results. • Understand tactics such as moving opponents or ball, in games, or activities.

*This coding refers to the Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects. See Language Arts Standards, pages 60-66, after the introduction.

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GRADE 8 PERFORMANCE LEVEL DESCRIPTORS
1. MOVEMENT

ADVANCED PERFORMANCE

Eighth grade students at the advanced performance level consistently make connections between movement skills, rules, strategies, and tactics of modified specialized skill activities, including rhythms or dance, modified team activities, individual or dual activities, and lifetime activities. They demonstrate all critical skill cues when performing specialized movement skills in a variety of developmentally appropriate rhythms or dance, modified team, individual or dual, and lifetime activities. Students independently compare and contrast different movement patterns for a variety of activities. Students consistently analyze a person's skills, tactics, and strategies in a modified activity (individual, dual, or lifetime).

PROFICIENT PERFORMANCE

Eighth grade students at the proficient performance level usually make connections between movement skills, rules, strategies, and tactics of modified specialized skill activities, including rhythms or dance, modified team activities, individual or dual activities, and lifetime activities. They demonstrate most critical skill cues when performing specialized movement skills in a variety of developmentally appropriate rhythms or dance, modified team, individual or dual, and lifetime activities. Students usually compare and contrast different movement patterns for a variety of activities. Students frequently analyze a person's skills, tactics, and strategies in a modified activity (individual, dual, or lifetime).

NON-PROFICIENT PERFORMANCE

Eighth grade students at the non-proficient performance level inconsistently make connections between movement skills, rules, strategies, and tactics of modified specialized skill activities, including rhythms or dance, modified team activities, individual or dual activities, and lifetime activities. They rarely demonstrated critical skill cues when performing specialized movement skills in a variety of developmentally appropriate rhythms or dance, modified team, individual or dual, and lifetime activities. Students rarely compare and contrast different movement patterns for a variety of activities. Students inconsistently analyze a person's skills, tactics, and strategies in a modified activity (individual, dual, or lifetime).

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WYOMING PHYSICAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD **2. FITNESS** The physically literate individual demonstrates the knowledge and skills to achieve and maintain a health-enhancing level of physical activity and fitness.		
CODE	**GRADE 8 BENCHMARKS**	**EXAMPLES**
PE 8.2.1	Students create and monitor a personal plan using current levels of fitness and physical activity. *(CCSS ELA-Literacy WHST.6-8.2,4,5,6,7,8,9) (CCSS ELA-Literacy RST.6-8.3)	• Evaluate results of fitness assessment and develop a program of remediation to improve the three areas of fitness. • Set realistic goals assessment tools. • Develop a time-management schedule that emphasizes physical activity and active recreational activities. • Monitor progress toward goals and plan for continued physical activity.
PE 8.2.2	Students differentiate the health benefits associated with a variety of physical activities. *(CCSS ELA-Literacy WHST.6-8.7,8,9) (CCSS ELA-Literacy RST.6-8.4)	• Describe how running at different intensity levels will result in different levels of cardiovascular endurance levels. • Compare the benefits an individual activity to a team activity. • Compare an indoor activity to an outdoor activity.
PE 8.2.3	Students apply the principles, components, and practices of health-related fitness to improve short-term fitness goals. *(CCSS ELA-Literacy RST.6-8.4)	• Plan a workout that incorporates the FITT principle to improve cardiovascular endurance. • Use the five components of fitness to explain the connections between fitness and overall physical and mental health. • Use the Rated Perceived Exertion (RPE) scale to adjust workout intensity during physical activity.
PE 8.2.4	Students engage in a variety of physical activities that will enhance health-related fitness (inside and/or outside of school).	• Participate in a variety of moderate or vigorous physical activities to meet national recommendations for physical activity. • Participate in areas of interest from school and community resources that can fulfill physical activity needs.
PE 8.2.5	Students explain valid characteristics of fitness-related products, technology, and resources related to fitness literacy. *(CCSS ELA-Literacy WHST.6-8.4,6,7,8,9) (CCSS ELA-Literacy RST.6-8.4,8,9)	• Use and explain the purpose of a variety of technology (pedometers, heart rate monitors, and/or mobile applications) to self-monitor aerobic intensity.

*This coding refers to the Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects. See Language Arts Standards, pages 60-66, after the introduction.

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GRADE 8 PERFORMANCE LEVEL DESCRIPTORS
2. FITNESS

ADVANCED PERFORMANCE

Eighth grade students performing at the advanced level independently create and monitor a personal fitness plan in terms of health-related fitness components. Students consistently differentiate the benefits of an individual, team, indoor, or outdoor activity as it relates to personal fitness. Students consistently apply the FITT principle to short-term fitness goals. Valid characteristics of fitness products and technology are recognized and an explanation of the use and purpose is expressed in-depth. Students consistently actively engage in physical activity that meets requirements for improving health.

PROFICIENT PERFORMANCE

Eighth grade students performing at the proficient level create and monitor a personal fitness plan in terms of health-related fitness components, with assistance. Students consistently differentiate the benefits of an individual, team, indoor, or outdoor activity as it relates to personal fitness. Students frequently apply the FITT principle to short-term fitness goals. Some valid characteristics of fitness products and technology are recognized and an explanation of use and purpose is accurately expressed. Students generally are actively engaged in physical activity that meets requirements for improving health.

NON-PROFICIENT PERFORMANCE

Eighth grade students performing at the non-proficient level are unable or unwilling to create and monitor a personal fitness plan in terms of health-related fitness components. Students fail to differentiate the benefits of an individual, team, indoor, or outdoor activity as it relates to personal fitness. Students rarely apply the FITT principle to short-term fitness goals. Valid characteristics of fitness products and technology are rarely recognized and/or an explanation of use and purpose is inaccurately expressed. Students are rarely engaged in physical activity that meets requirements for improving health.

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WYOMING PHYSICAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD **3. PERSONAL AND SOCIAL BEHAVIOR** The physically literate individual exhibits responsible personal and social behavior that respects self and others and recognizes the value of physical activity for challenge, self-expression, and/or social interaction.		
CODE	**GRADE 8 BENCHMARKS**	**EXAMPLES**
PE 8.3.1	Students develop and apply appropriate rules, safe practices, and procedures in physical activity settings.	• Work cooperatively with peers of differing skill to promote a safe school environment. • Recognize causes and demonstrate possible solutions to issues related to a safe school environment and physical activity setting.
PE 8.3.2	Students communicate effectively with others to promote respect and conflict resolution in physical activity settings.	• Provide support or positive suggestions to facilitate group progress or success. • Demonstrate and encourage respect for individual similarities and differences through positive interaction. • Resolve conflict with sensitivity to the rights and feelings of others. • Accept and respect decisions made by the designated official.
PE 8.3.3	Students engage in challenging experiences that develop confidence and independence. *(CCSS ELA-Literacy WHST.6-8.10)	• Assess personal ability and practice to become a more skilled performer. • Determine appropriate level of challenge for own ability and select tasks to maximize performance. • Participate regularly in physical activities of personal interest and enjoyment. • Encourage others to participate in physical activities that one finds enjoyable.
PE8.3.4	Students engage in physical activities that promote self-expression and provide opportunities for social and group interaction. *(CCSS ELA-Literacy WHST.6-8.10)	• Describe how engaging in physical activity promotes awareness of self and others. • Identify and describe personal feelings that result from participating in physical activity (e.g., journals, class discussions, and/or activity calendars). • Engage in cooperative and competitive physical activities voluntarily and regularly. • Assume a variety of roles as a team member (leader, record keeper, and/or equipment manager). • Invite peers to become group members in physical activities.

*This coding refers to the Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects. See Language Arts Standards, pages 60-66, after the introduction.

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GRADE 8 PERFORMANCE LEVEL DESCRIPTORS
3. PERSONAL AND SOCIAL BEHAVIORS

ADVANCED PERFORMANCE

Eighth grade students at the advanced performance level demonstrate an in-depth understanding of rules and procedures and independently apply those rules and procedures in physical activity settings. Students independently exhibit positive intrapersonal characteristics and consistently engage constructively in appropriate interpersonal relationships fitting for a variety of physical activity settings.

PROFICIENT PERFORMANCE

Eighth grade students at the proficient performance level demonstrate an understanding of rules and procedures and apply those rules and procedures in physical activity settings. Students regularly exhibit positive intrapersonal characteristics and engage constructively in appropriate interpersonal relationships fitting for a variety of physical activity settings.

NON-PROFICIENT PERFORMANCE

Eighth grade students at the non-proficient performance level fail to demonstrate understanding or apply rules and procedures in physical activity settings. Students inconsistently or are unable to exhibit positive intrapersonal characteristics and rarely engage constructively in appropriate interpersonal relationships fitting for a variety of physical activity settings.

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WYOMING PHYSICAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD **1. MOVEMENT** The physically literate individual demonstrates competency and applies knowledge of a variety of movement skills, movement patterns, concepts, principles, and strategies/tactics as they apply to the learning and performance of physical activities.		
CODE	**GRADE 12 BENCHMARKS**	**EXAMPLES**
PE 12.1.1	Students demonstrate combined movement skills and patterns in specialized settings. *(CCSS ELA-Literacy RST.9-12.3,4,9)	• Rhythms and dance • Gymnastics and jump rope sequences
PE 12.1.2	Students demonstrate specialized manipulative skills in team activities. *(CCSS ELA-Literacy RST.9-12.3,4,9)	• 6 vs. 6 volleyball • 5 vs. 5 basketball • 11 vs. 11 baseball
PE 12.1.3	Students demonstrate specialized skills in individual, dual, or lifetime activities. *(CCSS ELA-Literacy RST.9-12.3,4,9)	• Swimming, bicycling, and tennis
PE 12.1.4	Students apply specialized tactical concepts and performance principles in team activities. *(CCSS ELA-Literacy RST.9-12.3,4,9)	• Large-sided team activities and dual activities • Basic and advanced skills such as maintaining possession, scoring, and defending • Scoring in games, striking, and fielding in authentic settings
PE 12.1.5	Students apply specialized tactical concepts and performance principles in individual, dual, or lifetime activities. *(CCSS ELA-Literacy RST.9-12.3,4,9)	• Rhythms and dance • Gymnastics and jump rope sequences
PE 12.1.6	Students evaluate specialized skills used by self/others in team activities. *(CCSS ELA-Literacy RST.9-12.3,4,7,9)	• 6 vs. 6 volleyball • 5 vs. 5 basketball • 11 vs. 11 baseball
PE 12.1.7	Students evaluate specialized skills used by self/others in individual, dual, or lifetime activities. *(CCSS ELA-Literacy RST.9-12.3,4,9)	• Swimming, bicycling, and tennis
PE 12.1.8	Students evaluate the use of specialized strategies and tactics in a variety of physical activities. *(CCSS ELA-Literacy RST.9-12.3,4,9)	• Large-sided team and dual activities. • Describe effective strategies for successful performance in movement forms. • Evaluate the performance of self and others across movement forms. • Use information from a variety of sources to design a practice plan to improve performance.

*This coding refers to the Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects. See Language Arts Standards, pages 60-66, after the introduction.

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GRADE 12 PERFORMANCE LEVEL DESCRIPTORS
1. MOVEMENT

ADVANCED PERFORMANCE

Twelfth grade students at the advanced performance level consistently explain specialized movement skills, concepts, rules, strategies, and tactics and apply them while performing specialized movement activities, including rhythms or dance, regulation form team activities, regulation form individual or dual activities, and lifetime activities. They apply complex rules and strategies in specialized skill activities. An in-depth practice plan (what, when, where, and how) is presented to facilitate performance improvement. Students consistently evaluate a person's skills, tactics, and strategies in a modified activity (individual, dual, or lifetime).

PROFICIENT PERFORMANCE

Twelfth grade students at the proficient performance level frequently explain specialized movement skills, concepts, rules, and strategies and apply them while performing specialized movement activities, including rhythms or dance, regulation form team activities, regulation form individual or dual activities, and lifetime activities. They apply most complex rules and strategies in a few specialized skill activities. A basic practice plan is presented to facilitate performance improvement. Students frequently evaluate a person's skills, tactics, and strategies in a modified activity (individual, dual, or lifetime).

NON-PROFICIENT PERFORMANCE

Twelfth grade students at the non-proficient performance level have difficulty explaining fundamental movement skills, concepts, rules, and strategies and rarely apply them while performing specialized movement activities, including rhythms or dance, regulation form team activities, regulation form individual or dual activities, and lifetime activities. They have difficulty applying complex rules and strategies in a few specialized skill activities. A limited practice plan is presented to facilitate performance improvement. Students rarely evaluate a person's skills, tactics, and strategies in a modified activity (individual, dual, or lifetime).

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WYOMING PHYSICAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD **2. FITNESS** The physically literate individual demonstrates the knowledge and skills to achieve and maintain a health-enhancing level of physical activity and fitness.		
CODE	**GRADE 12 BENCHMARKS**	**EXAMPLES**
PE 12.2.1	Students create, monitor, and evaluate a personal plan using current levels of fitness and physical activity. *(CCSS ELA-Literacy WHST.9-12.2,4,5,6,7,8,9) (CCSS ELA-Literacy RST.9-12.3)	• Monitor physical activity and intensity levels using heart rate monitors, pedometers, or activity logs. • Keep an activity log to evaluate progress in achieving personal goals.
PE 12.2.2	Students evaluate the health benefits of a variety of physical activities *(CCSS ELA-Literacy WHST.9-12.7,8,9) (CCSS ELA-Literacy RST.9-12.4)	• Create a chart that evaluates several different activities as related to health benefits.
PE 12.2.3	Students create, monitor, and evaluate a plan applying the principals and components of health-related fitness. *(CCSS ELA-Literacy WHST.9-12.2,4,5,6,7,8,9) (CCSS ELA-Literacy RST.9-12.4)	• Apply the overload, specificity, progression, and FITT principles to a personal fitness program.
PE 12.2.4	Students engage in a variety of physical activities that will enhance health-related fitness (inside and/or outside of school).	• Participate in self-selected lifetime dance, sports, or fitness activities outside of school several times a week.
PE 12.2.5	Students will use criteria to critique fitness-related products, technology, and resources related to fitness literacy. *(CCSS ELA-Literacy WHST.9-12.4,6,7,8,9) (CCSS ELA-Literacy RST.9-12.4,8,9)	• Evaluate a fitness and/or recreational opportunity; focusing on access, affordability, quality of facility, equipment, and staffing. • Analyze and apply technology and social media as a tool to support a healthy active lifestyle.

*This coding refers to the Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects. See Language Arts Standards, pages 60-66, after the introduction.

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GRADE 12 PERFORMANCE LEVEL DESCRIPTORS
2. FITNESS

ADVANCED PERFORMANCE

Twelfth grade students performing at the advanced level independently create, monitor, and evaluate a personal fitness plan in terms of the health-related fitness components and principles. Students consistently identify the health benefits from various physical activities. Students provide an in-depth critique on the value and validity of technological fitness products and resources related to fitness literacy. Students consistently are actively engaged in physical activity that meets requirements for improving health.

PROFICIENT PERFORMANCE

Twelfth grade students performing at the proficient level create, monitor, and evaluate a personal fitness plan in terms of the health-related fitness components and principles, with assistance. Students generally identify the health benefits from various physical activities. Students usually critique the value and validity of technological fitness products and resources related to fitness literacy. Students are actively engaged in physical activity that meets requirements for improving health.

NON-PROFICIENT PERFORMANCE

Twelfth grade students performing at the non-proficient level are unable to create, monitor, and evaluate a personal fitness plan in terms of the health-related fitness components and principles. Students rarely identify the health benefits from various physical activities. Students fail to critique the value and validity of technological fitness products and resources related to fitness literacy. Students rarely engage in physical activity that meets requirements for improving health.

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WYOMING PHYSICAL EDUCATION
CONTENT AND PERFORMANCE STANDARDS

CONTENT STANDARD **3. PERSONAL AND SOCIAL BEHAVIOR** The physically literate individual exhibits responsible personal and social behavior that respects self and others and recognizes the value of physical activity for challenge, self-expression, and/or social interaction.		
CODE	**GRADE 12 BENCHMARKS**	**EXAMPLES**
PE 12.3.1	Students demonstrate leadership by holding self and others responsible for following safe practices, rules, procedures, and etiquette in physical activity settings.	• Contribute to the development of rules that provide for safe participation in physical activities. • Follow the rules, procedures, and etiquette in physical activity settings. • Demonstrate leadership in physical activity settings (e.g., officiate a game, make own calls, and/or resolve conflicts). • Recognize unsafe conditions in an athletic venue and independently take steps to correct them.
PE 12.3.2	Students initiate responsible personal social behavior and positively influence the behavior of others in physical activity settings.	• Communicate effectively with others to promote respect and conflict resolution in cooperative and competitive physical activities. • Modify group activities or game expectations to accommodate individuals with lesser or greater skills or special needs. • Encourage appropriate etiquette and socially responsible behavior of participants and audience. • Accept decisions made by the designated official and respond to winning or losing with dignity and respect.
PE 12.3.3	Students use physical activity to promote personal growth, goal setting, and enjoyment. *(CCSS ELA-Literacy WHST.9-10.10)	• Reflect on motivations and goals that determine physical activity participation. • Choose an appropriate level of challenge to experience success and desire to participate in physical activity for a lifetime. • Participate in activities that provide enjoyment and challenge.
PE12.3.4	Students pursue physical activities that promote self-expression and provide opportunities for social and group interaction. *(CCSS ELA-Literacy WHST.9-10.10)	• Actively pursue goals and needs related to lifetime participation in physical activity. • Identify participation factors in physical activities that contribute to personal enjoyment and self-expression. • Recognize that physical activities can provide a positive social atmosphere for interaction with others.

*This coding refers to the Common Core State Standards for English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects. See Language Arts Standards, pages 60-66, after the introduction.

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GRADE 12 PERFORMANCE LEVEL DESCRIPTORS
3. PERSONAL AND SOCIAL BEHAVIOR

ADVANCED PERFORMANCE

Twelfth grade students at the advanced performance level independently model and monitor adherence to protocol in physical activity settings. Students consistently use physical activity to improve positive intrapersonal characteristics and independently initiate constructive interpersonal relationships appropriate for a variety of physical activity settings.

PROFICIENT PERFORMANCE

Twelfth grade students at the proficient performance level usually model and monitor adherence to protocol in physical activity settings. Students generally use physical activity to improve positive intrapersonal characteristics and frequently initiate constructive interpersonal relationships appropriate for a variety of physical activity settings.

NON-PROFICIENT PERFORMANCE

Twelfth grade students at the non-proficient performance level fail to model or monitor and/or adhere to protocol in physical activity settings. Students seldom use physical activity to improve positive intrapersonal characteristics and rarely initiate constructive interpersonal relationships appropriate for a variety of physical activity settings.

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GLOSSARY

Developmental Basis for Standards: Sound knowledge of the developmental aspects of human behavior is critical to the success of the educational process. Educators who are developmentally based provide learning experiences and administer assessments that are appropriate not only for the chronological age, but also for the developmental levels of the students being taught. Developmental appropriateness is articulated in the physical education benchmarks at each grade level. The performance descriptors located at the beginning of this document, as well as after each grade level benchmark table, differentiate between the various degrees of benchmark achievement. The following list of terms is provided in an effort to further clarify what is expected from students if they are to achieve the grade level benchmarks.

Content Specific Definitions

Activity Categories in Physical Education: Secondary physical education activities are categorized as follows:

- **Individual or Dual Activity** – Physical activities that require one or two participants (e.g., badminton, swimming, golf, handball, and weight lifting).
- **Lifetime Activity** – Physical activities that can be used for a lifetime and are not dependent upon group of participants. Frequently lifetime activities are done individually or with a partner. Examples include (a) lifetime sports (e.g., bowling, Frisbee, racquetball, and tennis), (b) outdoor adventure activities (e.g., backpacking, rock climbing, orienteering, and bicycling), and (c) fitness activities (e.g., dance aerobics, weight training, jogging, and kick boxing).
- **Rhythms or Dance Activities** – Physical activities that allow for students to express themselves rhythmically (e.g., creative movement, folk dance, square dance, and interpretive dance).
- **Team Sports** – Physical activities that require a group of participants (e.g., basketball, speedball, soccer, and volleyball).

Body Control Skills: Are performed in place without appreciable spatial movement (non-manipulative) (e.g., turning, twisting, rolling, balancing, transferring weight, landing, stretching, and curling).

Closed Environment: A stable and unchanging environment (e.g., throwing at a stationary target, shooting an arrow at a stationary target, striking a ball off of a batting tee, and kicking an immobile object).

Critical Skill Cue: Critical skill elements/skill cues/key observation points are simply short phrases or words that focus the learner on the salient aspects of the skill to be practiced.

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FITT Principles: Interrelated and interdependent rules for gaining and maintaining physical fitness. They include:

Warm up - To prepare game, sports, fitness, dance, etc., by moderate exercise or activity beforehand.

Cool down- To bring the body back to its normal physiological level after exercise or activity by gradually slowing the pace of activity or gently exercises and stretches.

Progression- Moving at an appropriate pace from one succession to the next.

Frequency: The number of times a person engages in physical activity that is moderate to vigorous in nature. The *Council on Physical Education for Children* recommends that students engage in moderate physical activity nearly every day.

Intensity: The speed or workload used in a given period of physical activity. The *Surgeon General's Report on Physical Activity and Health* and a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine on *Physical Activity and Health* emphasize the value of **moderate** physical activity to **good health**. Depending on a student's initial level of fitness, the intensity of the activity may need to be increased to further enhance **physical fitness**.

Time: Refers to the duration or amount of time spent doing the activity. In adults, thirty minutes of accumulated physical activity has been shown to enhance **health**. In order to increase **fitness** levels, a minimum twenty to thirty continuous minutes of physical activity is recommended by the American College of Sports Medicine. The *Council on Physical Education for Children* recommends that children engage in 30 to 60 accumulated minutes of moderate to vigorous physical activity every day.

Type: The type or specificity of training is the physiological adaptation to exercise that is specific to the system being worked or stressed during exercise. For example, the specific training exercises students do for flexibility do not increase their cardiovascular endurance.

Health: Health is optimal well-being that contributes to quality of life. It is more than freedom from disease and illness. Optimal health includes high-level mental, social, emotional, spiritual, and physical wellness within the limits of one's heredity and personal abilities.

Health-Related Physical Fitness: Health-related physical fitness consists of those components of physical fitness that have a relationship with good health. The components are commonly defined as body composition, cardiovascular fitness, flexibility, muscular endurance, and strength.

Intrapersonal Characteristics: Individuals' personal attributes that influence their involvement in physical activity (e.g., personal/social responsibility, work ethic, respect for individual differences, and awareness of the intrinsic value of physical activity).

Interpersonal Relationships: Self and group initiated behaviors that lead to positive interactions among participants in physical activities (e.g., cooperation, teamwork, etiquette, safe practices, and adherence to rules).

Locomotor Skills: The basic patterns used to travel (walking, running, leaping, jumping, hopping, skipping, galloping, and sliding). Loco-motor skills develop naturally in children; this is unlike other skills such as throwing, catching, and striking that develop through practice.

Modified Specialized Motor Skills: Fundamental movement patterns that have been refined, combined, and elaborated upon for use in increasingly demanding situations.

Modified Specialized Physical Activities: Sport-related and specialized movement activities that require the use of modified specialized motor skills, usually involving fewer rules/strategies than regulation form activities.

Movement Concepts: The ideas used to modify or enrich the range and effectiveness of skill employment (e.g., running, skipping, jumping, galloping, side slide, relationships, effort, awareness, flow, and space).

Object Control Skills (Manipulative skills): Skills developed when a child handles or manipulates some kind of object with the hands, feet, or other parts of the body. Object control skills include throwing, catching, kicking, trapping, striking, volleying, ball rolling, and dribbling.

Open Environment: An unpredictable and constantly changing environment. Examples of movement skills that are performed in the open environment include catching a fly ball, throwing at a moving target, kicking a soccer ball while running, and striking a pitched ball.

Psychomotor Complexity: A developmental progression of motor skills that moves from simple to complex (e.g., Fundamental Movement Skills in Closed Environment, Fundamental Movement Skills in Open Environment, Specialized Movement Skills in Closed Environment, Specialized Movement Skills in Modified Activities in Open Environment, and Specialized Movement Skills in Official/Regulation Form Activities).

Physically Literate: The ability to move with competence and confidence in a wide variety of physical activities in multiple environments that benefit the healthy development of the whole person.

Physical Fitness: A state of well-being with low risk of premature health problems and energy to participate in a variety of physical activities. Experts indicate that the model of physical fitness includes morphological fitness, bone strength, muscular fitness, flexibility, motor fitness, cardiovascular fitness, and metabolic fitness (see Figure 1).

Figure 1: Five Components of Fitness

Body Composition: The amount of body fat you have versus the amount of lean muscle, organs, and bones.
Cardiovascular Endurance: The ability of your heart and lungs to work together to fuel the body with oxygen.
Flexibility: The ability of a joint to move through a full range of motion.
Muscular Endurance: The ability of the muscles to repeat a movement many times or hold a particular position for a particular time.
Muscular Strength: The amount of force a muscle can exert in single effort.

Regulation Form: An activity that is performed as it has been designed to be performed, that is, as close to its fullest form maintaining the integrity of developmental and instructional appropriateness. For example, the game of basketball in its fullest form could be represented by 2 versus 2, 3 versus 3, 4 versus 4, or 5 versus 5.

Strategy: Strategy refers to a plan of action designed to achieve a particular goal.

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Tactic: Tactic(s) may refer to a plan, procedure, or expedient for promoting a desired goal or end result.

Cognitive Complexity Glossary of Terms

Apply: Put into practice.
Analyze: Separate into components and to examine closely and critically.
Assess: Create or set a certain standard upon.
Compare: Examine in order to discover likeness and unlikeness.
Conclude: Reach a decision or form an opinion.
Contrast: Describe the differences**.**
Critique: Judge the merits or faults of something**.**
Create: Bring into existence, originate, or to make.
Define: State the exact meaning of.
Demonstrate: Teach by example, show and tell.
Describe: Represent by words or drawings.
Develop: Advance from one stage to another or to unfold gradually.
Differentiate: Distinguish between.
Evaluate: Find or place a value on.
Explain: State clearly the causes and motives.
Identify: Recognition of.
Implement: Carry out; put into effect.
Name: Call by a single word or two.
List: Itemize or an inventory of books, names, or facts.
Perform: The physical demonstration of a skill.
Recognize: Know the identity of; recall as having been previously known.
Synthesize: Ability to put parts together to form a new whole- usually involves producing a product.

Skill Related Fitness Glossary of terms

Agility: The ability to perform a series of explosive power movements in rapid succession in opposing directions.
Balance: The ability to control the body's position either stationary or in one position.
Coordination: The ability to control the movement of the body in cooperation with the body's sensory functions.
Power: The ability to exert maximum muscular contraction instantly in an explosive burst of movements.
Speed: The ability to move all or part of the body quickly.
Reaction time: The interval of time between the introduction of a stimulus and the muscle response to that stimulus.

Education Definitions

Alternative Assessment: Teacher, self, or peer assessments using journals, task or criteria sheets, checklists, scales, or rubrics.

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Authentic Assessment: Assessing the students performing the skill in real-life situations.

Benchmark: Describes behavior that indicates progress toward achieving a performance standard. Benchmarks can be used as checkpoints for progress.

Cognitive Complexity: A developmental progression of cognitive skills that moves from simple to complex. Bloom's Taxonomy of Educational Objectives (i.e., Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation) and Webb's Depth of Knowledge (i.e., Recall, Basic Application of Skill/Concept, Strategic Thinking, and Extended Thinking) are models of cognitive complexity and are frequently used to align instruction and assessment for developmental appropriateness.

Content Standard: What students should know and be able to do.

Curriculum Alignment: Teaching knowledge and skills that are assessed by tests designed largely around standards.

Performance Standard: Indicates levels of achievement that students are expected to attain in the content standard. Acceptable quality of student performance is described.

Portfolio Assessment: Systematic collection of student work that shows progress and achievement. Students select, evaluate, and do self-reflection of their own work.

Performance Level Measurement Qualifiers

Performance Level	Complexity Words	Suggested Percentage of Task Accomplished
Advanced	• In-depth • Independently • Consistently • All	90-100%
Proficient	• Fundamentally • Generally • Frequently • Repeatedly • Regularly • Usually • Most	70-89%
Non-Proficient	• Inconsistently • Unable • Unwilling • Seldom • Fail to • Rarely • Infrequently • Some	Below 70%

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Wyoming Physical Education Content and Performance Standards

HISTORICAL BACKGROUND

These standards represent a consensus of the local district standards. In 1997-1998, representatives from each of the districts participated in regional groups along with community college, University, and business representatives, as well as students. A district representative was selected by each of the regional groups to participate on the state committee. The state committee then drafted standards that represented consensus of the regional groups. In reviewing and refining the resulting standards, several national and state standard documents were referenced to establish that the rigor of the Wyoming standards was consistent with these documents, and adjustments were made as deemed appropriate by the state committee.

In 2002-2003, review and revision committees met to evaluate the documents created by the initial contingent. The Wyoming State Board of Education directed the Wyoming Department of Education (WDE), working in consultation and coordination with local school districts, to formulate and implement a process to evaluate and review the uniformity and quality of the standards by November, 2008. Consistent with its responsibility to evaluate and review the uniformity and quality of the standards at least every five years, WDE established committees to continue the review and revision process.

In order to accomplish the goal of reviewing the standards, a steering committee was convened to guide the review process. It met in early 2008 to develop the process to be used by Content Review Committees in each content area with representation from as many Wyoming school districts as possible. Members of the Standards Review Steering Committee nominated 8-12 expert educators in each of the 10 content areas represented in the Standards. These committees were balanced geographically and represented pre-school, elementary, secondary, special education, and higher education teachers.

The reviewers who agreed to serve on a committee met in spring, 2008 to participate in a systematic evaluation of the uniformity and quality of the standards in their content area. Among the aspects of the Standards reviewed were

- The cognitive complexity of the standards.
- The degree of integration of the Common Core of Skills, 21st Century Skills, and Technology in the standards.
- How Wyoming Standards compare to national curriculum standards and other state standards.
- How the format of standards documents might be improved to make them more uniform, more understandable, and more useful.
- How urgent the need for substantive revision of the standards is in each content area.

The 2008 standards reflect formatting rather than substantive changes. Substantive revisions to standards in all content areas were recommended based on conclusions from the 2008 standards review and continuing work by content review committees and other stakeholder groups between 2008 and 2013.

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In 2012, a committee of teachers was formed to begin a two year revision process of the Physical Education Standards. Because the changes to the 2008 standards document were not substantive, diligence was taken to fully evaluate and revise the entire document during the 2012 revision process. Updates reflected the same aspects reviewed in 2008 (see above).

The following occurred:

- The decision was made to separate the grade spans into K-2, 3-5, 6-8, and 9-12.
- The same three standards were retained for overarching review.
- The National Physical Education Standards were presented by Dr. Tristan Wallhead, Ph.D., University of Wyoming. He informed the committee of the trends and changes at the national level and where the Wyoming standards fit into the National Standards.
- Since Common Core Literacy Standards are required in each content area, the group identified the benchmarks that may apply.
- Vertical and horizontal alignment was assured for the entire document.
- Suggested activities were provided in each benchmark as clarification for where they may fit into the curriculum.
- Performance levels were reduced from four to three.

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REFERENCES

National standards and several states' standards, along with other reference materials, were referenced to establish the rigor for the Wyoming Physical Education Content and Performance Standards. These documents are listed below.

- BrianMac Sports Coach - http://www.brianmac.co.uk/index.htm
- California, Physical Education Model Content Standards for California Public Schools, http://www.cde.ca.gov/be/st/ss/documents/pestandards.pdf
- National Association for Sport and Physical Education, National Standards & Grade-Level Outcomes for K-12 Physical Education – ISBN 978-0-88314-931-7
- North Carolina, North Carolina Essential Standards Physical Education, http://www.ncpublicschools.org/docs/acre/standards/new-standards/healthful-living/khs.pdf
- South Dakota, South Dakota Physical Education Standards, A Comprehensive Physical Education Program Resource Guide, http://doe.sd.gov/schoolhealth/documents/csh_PEStandards.pdf

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2013 WYOMING SCIENCE
CONTENT AND PERFORMANCE STANDARDS

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Why Science? There is no doubt that science—and, therefore, science education—is central to our lives. Science, engineering, and technology permeate nearly every facet of modern life and hold the key to solving many of humanity's most pressing current and future challenges. All people, regardless of career direction, make decisions about issues which have underlying scientific principles, and therefore must have a solid K–12 science education.

Quality science education is based on standards that are rich in content and practice, with aligned learning progressions, pedagogy, assessment, and ongoing professional development to improve student learning. Scientific practices include critical thinking, communication skills, and scientific habits that students need for postsecondary success and a scientifically literate citizenship in a world fueled by innovations in science and technology. To be competitive in the 21st century, Wyoming students must have the scientific knowledge and skills to succeed in a diversifying economy.

RATIONALE FOR CHANGE

This rationale, with careful consideration, is based on foundations from prior Wyoming standards and the *Framework* for the Next Generation Science Standards (NGSS). The 2008 Wyoming Standards preamble states, “At no time in human history has change been as rapid as we see today." There are many industries in Wyoming that depend on core science skill sets. It is imperative that we have high school and college graduates qualified to fill these roles.

Although the rationale of the 2008 standards says, “The mission of science education is to help young people develop the ability to reason, think creatively, make responsible decisions, and solve problems,” those standards did not meet these criteria. Science education in the United States has become stagnant. More than a third of 8th graders score below basic on science assessments, and fewer students choose to pursue science-based careers every year. We need to move from a linear process of using the scientific method, to a continuous cycle involving both scientific and engineering practices. We believe the move to the NGSS as the Wyoming State Science and Content Standards will provide the foundation for success.

ORGANIZATION OF STANDARDS

The Wyoming Science and Content Standards describe what all students should know, understand, and be able to apply in science. There are four domains addressed in the standards: physical science; life science; earth and space science; and engineering, technology, and application of science. Along with the four domains, there are 3 dimensions (practices, crosscutting concepts, and disciplinary core ideas-DCI), connections to other DCI’s in the grade band, articulation across grade bands, and common core connections to ELA and Math. A brief description is provided for each of these dimensions and areas of connection.

Science and Engineering Practices: This dimension focuses on asking questions and defining problems; developing and using models; planning and carrying out investigations; analyzing and

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interpreting data; using mathematical and computational thinking; constructing explanations and designing solutions; engaging in argument from evidence; and obtaining, evaluating, and communicating information. This dimension will provide the opportunity for students to develop problem solving skills and understanding of the world through inquiry based and problem solving applications and investigations. Students will examine, analyze, and evaluate their own knowledge and ideas and critique those of others. *Framework: The Three Dimensions of the Framework Box S-1 pg. 3*

Crosscutting Concepts: This dimension focuses on bridging boundaries between the various sciences and engineering. There are seven crosscutting concepts addressed in this dimension: patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter: flows, cycles, and conservation; structure and function; and stability and change. *Framework: The Three Dimensions of the Framework Box S-1 pg.3*

Disciplinary Core Ideas (DCI): This dimension focuses on the four domains addressed in the performance expectations: physical science (4 PE's), life science (4 PE's), earth and space science (3 PE's), and engineering, technology, and application of science (2 PE's). *Framework: The Three Dimensions of the Framework Box S-1 pg.3*

Connections to other DCI's in current grade level: This section of the document shows how a disciplinary core idea can be developed using particular practices and linked to particular crosscutting concepts for each grade level. It also describes some of the ways in which students might be asked to use specific practices to demonstrate their understanding of core ideas. Finally, it incorporates boundary statements that make explicit what is not expected of students at a given level. *Framework: Integrating the Dimensions pg. 219*

Articulation across grade levels: This section of the document shows how making connections across grade levels, with appropriate learning experiences, allows students' conceptual knowledge to increase in depth and sophistication, as does the nature of the practices. Thus performance expectations at the higher grades should reflect deeper understanding, more highly developed practices, and more complex reasoning. *Framework: Integrating the Dimensions pg. 228*

Standards specify the essential learning that students must master. They provide a K-12 framework to assist school districts, schools, and communities in developing and strengthening curriculum rather than prescribing courses, materials, or instructional methodology. Teachers ensure that students achieve standards by using a range of instructional strategies that they select based on their students' needs. Content and performance expectations are identified for grade spans K-5, 6-8, and 9-12. Grades K-5 have outlined performance expectations at each grade level that build on the previous grades' learning progressions. The middle school and high school performance expectations are grouped by grade band, with accompanying models for course mapping provided in Appendix K.

The Wyoming Science Standards (adopted from the NGSS), are distinct from prior science standards in that they integrate three dimensions within each standard and have intentional connections across standards, grade bands, and subjects. The three dimensions: practices, crosscutting concepts, and disciplinary core ideas were designed to meet at least two of the following four core ideas presented below:

1. Have broad importance across science and engineering disciplines or within a single discipline.
2. Provide a key tool for understanding or investigating more complex ideas and solving problems.

3. Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge.
4. Be teachable and learnable over multiple grades at increasing levels of depth and sophistication.

INTRODUCTION TO THE STANDARDS

The science performance expectations (PE) are grouped into four major domains: physical science; life science; earth and space science; and engineering, technology and applications of science. (NGSS Exec Summary-pg. 3)

Content Standards: Content standards (called performance expectations (PE) in the architecture of the standards) are statements that define what students are expected to know and be able to do. These were developed based on the foundation concepts listed in the boxes below the standard/performance expectation. They do not dictate what methodology or instructional materials should be used, nor how the material is to be delivered.

Science & Engineering Practice, Disciplinary Core Ideas, and Crosscutting Concepts: These are combined practices, ideas and concepts relating to a "big idea" used to construct the performance expectations/standards. They provide guidance and clarification for understanding the performance expectation.

Performance Level Descriptors: The expectation of the Wyoming Science Standards is that all students will be held accountable for demonstrating achievement on all performance expectations at a proficient level.

Course Maps: A description of the course maps is provided below. Grades K-5 have outlined performance expectations at each grade that build on the previous grades' learning progressions. Models for course mapping for the middle and high school levels listing performance expectations with classes are provided in appendix K.

1. Conceptual Progressions Model (grades 6–8 and 9–12): This model maps performance expectations into integrated courses that build across the grade levels.
2. Science Domains Model (grades 6–8 and 9–12): The grade banded performance expectations are organized into content-specific courses that match the three science domains of the Framework: Physical Science, Life Science, and Earth and Space Science.
3. Modified Science Domains Model (grades 9–12): The 9–12 grade band performance expectations are organized into content-specific courses that match a common high school course sequence of biology, chemistry, and physics. To ensure all students have access to all standards, the performance expectations connected to the Earth and Space Science domain of the Framework are divided among these courses.

Appendix K - Model Course Mapping in Middle and High School for the Next Generation Science Standards/Wyoming State Science Standards

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Wyoming ELA and Math Standards Connections: Appendix L and the body of the NGSS address the connections to the Common Core Standards for Mathematics. Appendix M and the body of the NGSS address the connections to the Common Core State Standards for Literacy in Science and Technical subjects.

Connections to the Common Core State Standards (CCSS) for Literacy in History, Science, and Technical Subjects: Standards Coding for English/Language Arts & Math

Content Standard	CCSS Coding	Stands for	Where You'll Find It
ELA	R.CCR.9 W.CCR.1	Reading / Writing College- and Career-Ready Anchor Standard **Example:** R.CCR.9 = Reading, Individual College and Career Readiness (CCR) Anchor Standard, Standard 9	Language Arts Standards - CCSS ELA pages, after the introduction (Reading - CCR, K-5 pg. 10; Gr. 6-12 pg. 35) (Writing - CCR, K-5 pg. 18; Gr. 6-12 pg. 41)
Reading	RL.3.2 RI.4.3	Reading of Literature, Gr. 3 Reading for Information, Gr. 4 **Example:** RI.4.3 = Reading, Informational Text, Grade 4, Standard 3	Language Arts Standards - CCSS ELA pages, after the introduction (K-5 pp. 11-12; Gr. 6-12 pp. 36-38) (K-5 pp.13-14; Gr. 6-12 pp. 39-40)
Writing	W.5.1a	Writing, Gr. 5 **Example:** W.5.1a Writing, Grade 5, Standard 1a	Language Arts Standards - CCSS ELA pages, after the introduction (K-5 pp. 19-21; Gr. 6-12 pp. 42-47)
Literacy Standards for History, Science, & Technical Subjects	RHST.CCR.2 RH.9-10.3 RST.11-12.3 WHST.CCR.2 WHST.9-10.3	Reading for History/S.S., Science, & Technical Subjects), CCR Anchor Standard #2 Reading Lit. in History, Gr. 9-10 Reading Lit. in Science & Technical Subjects, Gr. 11-12 **Example:** RST.6-8.3 = Reading, Science and Technical Text, Grade 6-8, Standard 3	Language Arts Standards - CCSS ELA pages, after the introduction (Gr. 6-12) (Reading - CCR pg. 60) (Reading - History pg. 61) (Reading - Science & Technical Subjects (RST) pg. 62) (Writing - CCR pg. 63) (Writing for Literacy in History, Science, & Technical Subjects (WHST) pp. 64-66)
Math	MP.2 7.G.A.2	Math Practice #2 7th Grade Geometry **Example:** 4.MD.A.2 = 4th Grade Math, Measurement & Data Domain, 1st Cluster Heading, Standard 2	Mathematics Standards – CCSS Math pages, after the introduction (K-12 pp. 10-83)

All Standards Documents can be found on the Wyoming Department of Education Standards Page at http://edu.wyoming.gov/Programs/standards.aspx.

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HISTORICAL CONTEXT

Twenty-six states and their broad-based teams worked together for two years with a 41-member writing team and partners to develop the standards which identify science and engineering practices and content that all K-12 students should master in order to be fully prepared for college, careers and citizenship. The NGSS were built upon a vision for science education established by the *Framework for K-12 Science Education*, published by the National Academies' National Research Council in 2011. The NGSS endured three revisions of the standards with public and professional input changing the document with each iteration.

The creation of the NGSS was entirely state-driven, with no federal funds or incentives to create or adopt the standards. The process was primarily funded by the Carnegie Corporation of New York, a leading philanthropy dedicated to improving science education in the U.S. The NGSS are grounded in a sound, evidence-based foundation of current scientific research - including research on the ways students learn science effectively- and identify the science all K-12 students should know. Historically, Wyoming has utilized national science education frameworks to develop standards.

The overarching goal of our committee is the same as the original goal for the Framework, "to ensure that by the end of 12th grade, all students have some appreciation of the beauty and wonder of science; possess sufficient knowledge of science and engineering to engage in public discussions on related issues; are careful consumers of scientific and technological information related to their everyday lives; are able to continue to learn about science outside school; and have the skills to enter careers of their choice, including (but not limited to) careers in science, engineering, and technology" —From the Executive Summary of *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.*

The committee believes that the NGSS will, by design, enable teachers to deliver science instruction that will engage students from the earliest grades through graduation and beyond to become informed citizens. It will empower teachers to creatively incorporate science education that is linked to the current Wyoming math and language arts standards, coherent across disciplines and grades, and focused on deep understanding and application of content.

"Science, engineering, and technology permeate nearly every facet of modern life, and they also hold the key to meeting many of humanity's most pressing current and future challenges. Yet too few U.S. workers have strong backgrounds in these fields and many people lack even fundamental knowledge of them. This national trend has created a widespread call for a new approach to K–12 science education in the United States."
—From the Executive Summary of *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.*

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DCI Arrangements of the Next Generation Science Standards

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Elementary Standards

Students in kindergarten through fifth grade begin to develop an understanding of the four disciplinary core ideas: physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science. In the earlier grades, students begin by recognizing patterns and formulating answers to questions about the world around them. By the end of fifth grade, students are able to demonstrate grade-appropriate proficiency in gathering, describing, and using information about the natural and designed world(s). The performance expectations in elementary school grade bands develop ideas and skills that will allow students to explain more complex phenomena in the four disciplines as they progress to middle school and high school. While the performance expectations shown in kindergarten through fifth grade couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.

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Kindergarten

The performance expectations in kindergarten help students formulate answers to questions such as: “What happens if you push or pull an object harder? Where do animals live and why do they live there? What is the weather like today and how is it different from yesterday?” Kindergarten performance expectations include PS2, PS3, LS1, ESS2, ESS3, and ETS1 Disciplinary Core Ideas from the *NRC Framework*. Students are expected to develop understanding of patterns and variations in local weather and the purpose of weather forecasting to prepare for, and respond to, severe weather. Students are able to apply an understanding of the effects of different strengths or different directions of pushes and pulls on the motion of an object to analyze a design solution. Students are also expected to develop understanding of what plants and animals (including humans) need to survive and the relationship between their needs and where they live. The crosscutting concepts of patterns; cause and effect; systems and system models; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the kindergarten performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

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K-PS2 Motion and Stability: Forces and Interactions

K-PS2 Motion and Stability: Forces and interactions

Students who demonstrate understanding can:

K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. [Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.]

K-PS2-2. Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.* [Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
- With guidance, plan and conduct an investigation in collaboration with peers. (K-PS2-1)

Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Analyze data from tests of an object or tool to determine if it works as intended. (K-PS2-2)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods
- Scientists use different ways to study the world. (K-PS2-1)

Disciplinary Core Ideas

PS2.A: Forces and Motion
- Pushes and pulls can have different strengths and directions. (K-PS2-1),(K-PS2-2)
- Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2-1),(K-PS2-2)

PS2.B: Types of Interactions
- When objects touch or collide, they push on one another and can change motion. (K-PS2-1)

PS3.C: Relationship Between Energy and Forces
- A bigger push or pull makes things speed up or slow down more quickly. *(secondary to K-PS2-1)*

ETS1.A: Defining Engineering Problems
- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. *(secondary to K-PS2-2)*

Crosscutting Concepts

Cause and Effect
- Simple tests can be designed to gather evidence to support or refute student ideas about causes. (K-PS2-1),(K-PS2-2)

Connections to other DCIs in kindergarten: **K.ETS1.A** (K-PS2-2); **K.ETS1.B** (K-PS2-2)

Articulation of DCIs across grade-levels: **2.ETS1.B** (K-PS2-2); **3.PS2.A** (K-PS2-1),(K-PS2-2); **3.PS2.B** (K-PS2-1); **4.PS3.A** (K-PS2-1); **4.ETS1.A** (K-PS2-2)

Common Core State Standards Connections:

ELA/Literacy –

RI.K.1 With prompting and support, ask and answer questions about key details in a text. *(K-PS2-2)*
W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-PS2-1)
SL.K.3 Ask and answer questions in order to seek help, get information, or clarify something that is not understood. *(K-PS2-2)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(K-PS2-1)*
K.MD.A.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. *(K-PS2-1)*
K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-PS2-1)

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*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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K-PS3 Energy

K-PS3 Energy

Students who demonstrate understanding can:

K-PS3-1. Make observations to determine the effect of sunlight on Earth's surface. [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water] [Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.]

K-PS3-2. Use tools and materials to design and build a structure that will reduce the warming effect of sunlight on an area.* [Clarification Statement: Examples of structures could include umbrellas, canopies, and tents that minimize the warming effect of the sun.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Make observations (firsthand or from media) to collect data that can be used to make comparisons. (K-PS3-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Use tools and materials provided to design and build a device that solves a specific problem or a solution to a specific problem. (K-PS3-2)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Scientists use different ways to study the world. (K-PS3-1)

Disciplinary Core Ideas

PS3.B: Conservation of Energy and Energy Transfer

- Sunlight warms Earth's surface. (K-PS3-1),(K-PS3-2)

Crosscutting Concepts

Cause and Effect

- Events have causes that generate observable patterns. (K-PS3-1),(K-PS3-2)

Connections to other DCIs in kindergarten: **K.ETS1.A** (K-PS3-2); **K.ETS1.B** (K-PS3-2)

Articulation of DCIs across grade-levels: **1.PS4.B** (K-PS3-1),(K-PS3-2); **2.ETS1.B** (K-PS3-2), **3.ESS2.D** (K-PS3-1); **4.ETS1.A** (K-PS3-2)

Common Core State Standards Connections:

ELA/Literacy –

W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-PS3-1),*(K-PS3-2)*

Mathematics –

K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-PS3-1),(K-PS3-2)

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*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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K-LS1 From Molecules to Organisms: Structures and Processes

K-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

K-LS1-1. Use observations to describe patterns of what plants and animals (including humans) need to survive. [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. ▪ Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K-LS1-1) ---------- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** ▪ Scientists look for patterns and order when making observations about the world. (K-LS1-1)	**LS1.C: Organization for Matter and Energy Flow in Organisms** ▪ All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (K-LS1-1)	**Patterns** ▪ Patterns in the natural and human designed world can be observed and used as evidence. (K-LS1-1)

Connections to other DCIs in kindergarten: N/A

Articulation of DCIs across grade-levels: **1.LS1.A** (K-LS1-1); **2.LS2.A** (K-LS1-1); **3.LS2.C** (K-LS1-1); **3.LS4.B** (K-LS1-1); **5.LS1.C** (K-LS1-1); **5.LS2.A** (K-LS1-1)

Common Core State Standards Connections:

ELA/Literacy –

W.K.7 Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-LS1-1)

Mathematics –

K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. *(K-LS1-1)*

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K-ESS2 Earth's Systems

K-ESS2 Earth's Systems

Students who demonstrate understanding can:

K-ESS2-1. Use and share observations of local weather conditions to describe patterns over time. [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.]

K-ESS2-2. Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs. [Clarification Statement: Examples of plants and animals changing their environment could include a squirrel digs in the ground to hide its food and tree roots can break concrete.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (K-ESS2-1)

Engaging in Argument from Evidence
Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).
- Construct an argument with evidence to support a claim. (K-ESS2-2)

Connections to Nature of Science

Science Knowledge is Based on Empirical Evidence
- Scientists look for patterns and order when making observations about the world. (K-ESS2-1)

Disciplinary Core Ideas

ESS2.D: Weather and Climate
- Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time. (K-ESS2-1)

ESS2.E: Biogeology
- Plants and animals can change their environment. (K-ESS2-2)

ESS3.C: Human Impacts on Earth Systems
- Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. *(secondary to K-ESS2-2)*

Crosscutting Concepts

Patterns
- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (K-ESS2-1)

Systems and System Models
- Systems in the natural and designed world have parts that work together. (K-ESS2-2)

Connections to other DCIs in kindergarten: N/A

Articulation of DCIs across grade-levels: **2.ESS2.A** (K-ESS2-1); **3.ESS2.D** (K-ESS2-1); **4.ESS2.A** (K-ESS2-1); **4.ESS2.E** (K-ESS2-2); **5.ESS2.A** (K-ESS2-2)

Common Core State Standards Connections:

ELA/Literacy –

RI.K.1	With prompting and support, ask and answer questions about key details in a text. (K-ESS2-2)
W.K.1	Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic or the name of the book they are writing about and state an opinion or preference about the topic or book. (K-ESS2-2)
W.K.2	Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic. *(K-ESS2-2)*
W.K.7	Participate in shared research and writing projects (e.g., explore a number of books by a favorite author and express opinions about them). (K-ESS2-1)

Mathematics –

MP.2	Reason abstractly and quantitatively. (K-ESS2-1)
MP.4	Model with mathematics. (K-ESS2-1)
K.CC.A	Know number names and the count sequence. (K-ESS2-1)
K.MD.A.1	Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. (K-ESS2-1)
K.MD.B.3	Classify objects into given categories; count the number of objects in each category and sort the categories by count. (K-ESS2-1)

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K-ESS3 Earth and Human Activity

K-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

K-ESS3-1. Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live. [Clarification Statement: Examples of relationships could include that deer eat buds and leaves, therefore, they usually live in forested areas; and, grasses need sunlight so they often grow in meadows. Plants, animals, and their surroundings make up a system.]

K-ESS3-2. Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.* [Clarification Statement: Emphasis is on local forms of severe weather.]

K-ESS3-3. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.* [Clarification Statement: Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.
- Ask questions based on observations to find more information about the designed world. (K-ESS3-2)

Developing and Using Models
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions.
- Use a model to represent relationships in the natural world. (K-ESS3-1)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.
- Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world. (K-ESS3-2)
- Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. (K-ESS3-3)

Disciplinary Core Ideas

ESS3.A: Natural Resources
- Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. (K-ESS3-1)

ESS3.B: Natural Hazards
- Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. (K-ESS3-2)

ESS3.C: Human Impacts on Earth Systems
- Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (K-ESS3-3)

ETS1.A: Defining and Delimiting an Engineering Problem
- Asking questions, making observations, and gathering information are helpful in thinking about problems. *(secondary to K-ESS3-2)*

ETS1.B: Developing Possible Solutions
- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. *(secondary to K-ESS3-3)*

Crosscutting Concepts

Cause and Effect
- Events have causes that generate observable patterns. (K-ESS3-2),(K-ESS3-3)

Systems and System Models
- Systems in the natural and designed world have parts that work together. (K-ESS3-1)

Connections to Engineering, Technolog y and Applications of Science

Interdependence of Science, Engineering, and Technology
- People encounter questions about the natural world every day. (K-ESS3-2)

Influence of Engineering, Technology, and Science on Society and the Natural World
- People depend on various technologies in their lives; human life would be very different without technology. (K-ESS3-2)

Connections to other DCIs in kindergarten: **K.ETS1.A** (K-ESS3-2),(K-ESS3-3)

Articulation of DCIs across grade-levels: **1.LS1.A** (K-ESS3-1); **2.ESS1.C** (K-ESS3-2); **2.ETS1.B** (K-ESS3-3); **3.ESS3.B** (K-ESS3-2); **4.ESS3.A** (K-ESS3-3); **4.ESS3.B** (K-ESS3-2); **5.LS2.A** (K-ESS3-1); **5.ESS2.A** (K-ESS3-1); **5.ESS3.C** (K-ESS3-3)

Common Core State Standards Connections:

ELA/Literacy –

RI.K.1 With prompting and support, ask and answer questions about key details in a text. (K-ESS3-2)

W.K.2 Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic. *(K-ESS3-3)*

SL.K.3 Ask and answer questions in order to seek help, get information, or clarify something that is not understood. (K-ESS3-2)

SL.K.5 Add drawings or other visual displays to descriptions as desired to provide additional detail. *(K-ESS3-1)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(K-ESS3-1)*

MP.4 Model with mathematics. *(K-ESS3-1),(K-ESS3-2)*

K.CC Counting and Cardinality *(K-ESS3-1),(K-ESS3-2)*

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First Grade

The performance expectations in first grade help students formulate answers to questions such as: “What happens when materials vibrate? What happens when there is no light? What are some ways plants and animals meet their needs so that they can survive and grow? How are parents and their children similar and different? What objects are in the sky and how do they seem to move?” First grade performance expectations include PS4, LS1, LS3, and ESS1 Disciplinary Core Ideas from the *NRC Framework*. Students are expected to develop understanding of the relationship between sound and vibrating materials as well as between the availability of light and ability to see objects. The idea that light travels from place to place can be understood by students at this level through determining the effect of placing objects made with different materials in the path of a beam of light. Students are also expected to develop understanding of how plants and animals use their external parts to help them survive, grow, and meet their needs as well as how behaviors of parents and offspring help the offspring survive. The understanding is developed that young plants and animals are like, but not exactly the same as, their parents. Students are able to observe, describe, and predict some patterns of the movement of objects in the sky. The crosscutting concepts of patterns; cause and effect; structure and function; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the first grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

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1-PS4 Waves and their Applications in Technologies for Information Transfer

1-PS4 Waves and their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]

1-PS4-2. Make observations to construct an evidence-based account that objects can be seen only when illuminated. [Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]

1-PS4-3. Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light. [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.]

1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.* [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [Assessment Boundary: Assessment does not include technological details for how communication devices work.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
- Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question. (1-PS4-1),(1-PS4-3)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.
- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (1-PS4-2)
- Use tools and materials provided to design a device that solves a specific problem. (1-PS4-4)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods
- Science investigations begin with a question. (1-PS4-1)
- Scientists use different ways to study the world. (1-PS4-1)

Disciplinary Core Ideas

PS4.A: Wave Properties
- Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)

PS4.B: Electromagnetic Radiation
- Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2)
- Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1-PS4-3)

PS4.C: Information Technologies and Instrumentation
- People also use a variety of devices to communicate (send and receive information) over long distances. (1-PS4-4)

Crosscutting Concepts

Cause and Effect
- Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-1),(1-PS4-2),(1-PS4-3)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science, on Society and the Natural World
- People depend on various technologies in their lives; human life would be very different without technology. (1-PS4-4)

Connections to other DCIs in first grade: N/A

Articulation of DCIs across grade-levels: **K.ETS1.A** (1-PS4-4); **2.PS1.A** (1-PS4-3); **2.ETS1.B** (1-PS4-4); **4.PS4.C** (1-PS4-4); **4.PS4.B** (1-PS4-2); **4.ETS1.A** (1-PS4-4)

Common Core State Standards Connections:

ELA/Literacy –

W.1.2	Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure. *(1-PS4-2)*
W.1.7	Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-PS4-1),(1-PS4-2),(1-PS4-3),(1-PS4-4)
W.1.8	With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-PS4-1),(1-PS4-2),(1-PS4-3)
SL.1.1	Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. *(1-PS4-1),(1-PS4-2),(1-PS4-3)*

Mathematics –

MP.5	Use appropriate tools strategically. *(1-PS4-4)*
1.MD.A.1	Order three objects by length; compare the lengths of two objects indirectly by using a third object. *(1-PS4-4)*
1.MD.A.2	Express the length of an object as a whole number of length units, by layering multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. *(1-PS4-4)*

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1-LS1 From Molecules to Organisms: Structures and Processes

1-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

1-LS1-1. Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.* [Clarification Statement: Examples of human problems that can be solved by mimicking plant or animal solutions could include designing clothing or equipment to protect bicyclists by mimicking turtle shells, acorn shells, and animal scales; stabilizing structures by mimicking animal tails and roots on plants; keeping out intruders by mimicking thorns on branches and animal quills; and, detecting intruders by mimicking eyes and ears.]

1-LS1-2. Read texts and use media to determine patterns in behavior of parents and offspring that help offspring survive. [Clarification Statement: Examples of patterns of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Use materials to design a device that solves a specific problem or a solution to a specific problem. (1-LS1-1)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.

- Read grade-appropriate texts and use media to obtain scientific information to determine patterns in the natural world. (1-LS1-2)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Scientists look for patterns and order when making observations about the world. (1-LS1-2)

Disciplinary Core Ideas

LS1.A: Structure and Function

- All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. (1-LS1-1)

LS1.B: Growth and Development of Organisms

- Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring to survive. (1-LS1-2)

LS1.D: Information Processing

- Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. (1-LS1-1)

Crosscutting Concepts

Patterns

- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (1-LS1-2)

Structure and Function

- The shape and stability of structures of natural and designed objects are related to their function(s). (1-LS1-1)

Connections to Engineering, Technology , and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

- Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. (1-LS1-1)

Connections to other DCIs in first grade: N/A

Articulation of DCIs across grade-levels: **K.ETS1.A** (1-LS1-1); **3.LS2.D** (1-LS1-2); **4.LS1.A** (1-LS1-1); **4.LS1.D** (1-LS1-1); **4.ETS1.A** (1-LS1-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.1.1 Ask and answer questions about key details in a text. (1-LS1-2)
RI.1.2 Identify the main topic and retell key details of a text. (1-LS1-2)
RI.1.10 With prompting and support, read informational texts appropriately complex for grade. (1-LS1-2)
W.1.7 Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-LS1-1)

Mathematics –

1.NBT.B.3 Compare two two-digit numbers based on the meanings of the tens and one digits, recording the results of comparisons with the symbols >, =, and <. *(1-LS1-2)*
1.NBT.C.4 Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning uses. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten. *(1-LS1-2)*
1.NBT.C.5 Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used. *(1-LS1-2)*
1.NBT.C.6 Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. *(1-LS1-2)*

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1-LS3 Heredity: Inheritance and Variation of Traits

1-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

1-LS3-1. Make observations to construct an evidence-based account that young plants and animals are like, but not exactly like, their parents. [Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.] [Assessment Boundary: Assessment does not include inheritance or animals that undergo metamorphosis or hybrids.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. ▪ Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (1-LS3-1)	**LS3.A: Inheritance of Traits** ▪ Young animals are very much, but not exactly like, their parents. Plants also are very much, but not exactly, like their parents. (1-LS3-1) **LS3.B: Variation of Traits** ▪ Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways. (1-LS3-1)	**Patterns** ▪ Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (1-LS3-1)

Connections to other DCIs in first grade: N/A

Articulation of DCIs across grade-levels: **3.LS3.A** (1-LS3-1); **3.LS3.B** (1-LS3-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.1.1 Ask and answer questions about key details in a text. (1-LS3-1)

W.1.7 Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-LS3-1)

W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-LS3-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. *(1-LS3-1)*

MP.5 Use appropriate tools strategically. *(1-LS3-1)*

1.MD.A.1 Order three objects by length; compare the lengths of two objects indirectly by using a third object. *(1-LS3-1)*

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1-ESS1 Earth's Place in the Universe

1-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted. [Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.] [Assessment Boundary: Assessment of star patterns is limited to stars being seen at night and not during the day.]

1-ESS1-2. Make observations at different times of year to relate the amount of daylight to the time of year. [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.] [Assessment Boundary: Assessment is limited to relative amounts of daylight, not quantifying the hours or time of daylight.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Make observations (firsthand or from media) to collect data that can be used to make comparisons. (1-ESS1-2)

Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.

- Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. (1-ESS1-1)

Disciplinary Core Ideas

ESS1.A: The Universe and its Stars

- Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted. (1-ESS1-1)

ESS1.B: Earth and the Solar System

- Seasonal patterns of sunrise and sunset can be observed, described, and predicted. (1-ESS1-2)

Crosscutting Concepts

Patterns

- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. (1-ESS1-1),(1-ESS1-2)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes natural events happen today as they happened in the past. (1-ESS1-1)
- Many events are repeated. (1-ESS1-1)

Connections to other DCIs in first grade: N/A

Articulation of DCIs across grade-levels: **3.PS2.A** (1-ESS1-1); **5.PS2.B** (1-ESS1-1),(1-ESS1-2); **5-ESS1.B** (1-ESS1-1),(1-ESS1-2)

Common Core State Standards Connections:

ELA/Literacy –

W.1.7 Participate in shared research and writing projects (e.g., explore a number of "how-to" books on a given topic and use them to write a sequence of instructions). (1-ESS1-1),(1-ESS1-2)

W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question. (1-ESS1-1),(1-ESS1-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. *(1-ESS1-2)*

MP.4 Model with mathematics. *(1-ESS1-2)*

MP.5 Use appropriate tools strategically. *(1-ESS1-2)*

1.OA.A.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations to represent the problem. *(1-ESS1-2)*

1.MD.C.4 Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another. *(1-ESS1-2)*

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Second Grade

The performance expectations in second grade help students formulate answers to questions such as: “How does land change and what are some things that cause it to change? What are the different kinds of land and bodies of water? How are materials similar and different from one another, and how do the properties of the materials relate to their use? What do plants need to grow? How many types of living things live in a place?” Second grade performance expectations include PS1, LS2, LS4, ESS1, ESS2, and ETS1 Disciplinary Core Ideas from the *NRC Framework*. Students are expected to develop an understanding of what plants need to grow and how plants depend on animals for seed dispersal and pollination. Students are also expected to compare the diversity of life in different habitats. An understanding of observable properties of materials is developed by students at this level through analysis and classification of different materials. Students are able to apply their understanding of the idea that wind and water can change the shape of the land to compare design solutions to slow or prevent such change. Students are able to use information and models to identify and represent the shapes and kinds of land and bodies of water in an area and where water is found on Earth. The crosscutting concepts of patterns; cause and effect; energy and matter; structure and function; stability and change; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the second grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

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2-PS1 Matter and its Interactions

2-PS1 Matter and its Interactions

Students who demonstrate understanding can:

2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]

2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]

2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot. [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-PS1-1)

Analyzing and Interpreting Data
Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations.
- Analyze data from tests of an object or tool to determine if it works as intended. (2-PS1-2)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.
- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (2-PS1-3)

Engaging in Argument from Evidence
Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s).
- Construct an argument with evidence to support a claim. (2-PS1-4)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
- Scientists search for cause and effect relationships to explain natural events. (2-PS1-4)

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter
- Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties. (2-PS1-1)
- Different properties are suited to different purposes. (2-PS1-2),(2-PS1-3)
- A great variety of objects can be built up from a small set of pieces. (2-PS1-3)

PS1.B: Chemical Reactions
- Heating or cooling a substance may cause changes that can be observed. Sometimes these changes are reversible, and sometimes they are not. (2-PS1-4)

Crosscutting Concepts

Patterns
- Patterns in the natural and human designed world can be observed. (2-PS1-1)

Cause and Effect
- Events have causes that generate observable patterns. (2-PS1-4)
- Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2)

Energy and Matter
- Objects may break into smaller pieces and be put together into larger pieces, or change shapes. (2-PS1-3)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World
- Every human-made product is designed by applying some knowledge of the natural world and is built using materials derived from the natural world. (2-PS1-2)

Connections to other DCIs in second grade: N/A

Articulation of DCIs across grade-levels: **4.ESS2.A** (2-PS1-3); **5.PS1.A** (2-PS1-1),(2-PS1-2),(2-PS1-3); **5.PS1.B** (2-PS1-4); **5.LS2.A** (2-PS1-3)

Common Core State Standards Connections:

ELA/Literacy –

RI.2.1 Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. *(2-PS1-4)*

RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-PS1-4)

RI.2.8 Describe how reasons support specific points the author makes in a text. *(2-PS1-2),*(2-PS1-4)

W.2.1 Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., *because*, *and*, *also*) to connect opinion and reasons, and provide a concluding statement or section. (2-PS1-4)

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-PS1-1),(2-PS1-2),(2-PS1-3)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-PS1-1),(2-PS1-2),(2-PS1-3)

Mathematics –

MP.2 Reason abstractly and quantitatively. *(2-PS1-2)*

MP.4 Model with mathematics. *(2-PS1-1),(2-PS1-2)*

MP.5 Use appropriate tools strategically. *(2-PS1-2)*

2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. *(2-PS1-1),(2-PS1-2)*

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2-LS2 Ecosystems: Interactions, Energy, and Dynamics

2-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow. [Assessment Boundary: Assessment is limited to testing one variable at a time.]

2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.
- Develop a simple model based on evidence to represent a proposed object or tool. (2-LS2-2)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question. (2-LS2-1)

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems
- Plants depend on water and light to grow. (2-LS2-1)
- Plants depend on animals for pollination or to move their seeds around. (2-LS2-2)

ETS1.B: Developing Possible Solutions
- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. *(secondary to 2-LS2-2)*

Crosscutting Concepts

Cause and Effect
- Events have causes that generate observable patterns. (2-LS2-1)

Structure and Function
- The shape and stability of structures of natural and designed objects are related to their function(s). (2-LS2-2)

Connections to other DCIs in second grade: N/A

Articulation of DCIs across grade-levels: **K.LS1.C** (2-LS2-1); **K-ESS3.A** (2-LS2-1); **K.ETS1.A** (2-LS2-2); **5.LS1.C** (2-LS2-1); **5.LS2.A** (2-LS2-2)

Common Core State Standards Connections:

ELA/Literacy –

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-LS2-1)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-LS2-1)

SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. *(2-LS2-2)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(2-LS2-1)*

MP.4 Model with mathematics. *(2-LS2-1),(2-LS2-2)*

MP.5 Use appropriate tools strategically. *(2-LS2-1)*

2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems. *(2-LS2-2)*

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2-LS4 Biological Evolution: Unity and Diversity

2-LS4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats. [Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions. ▪ Make observations (firsthand or from media) to collect data which can be used to make comparisons. (2-LS4-1) ---------- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** ▪ Scientists look for patterns and order when making observations about the world. (2-LS4-1)	**LS4.D: Biodiversity and Humans** ▪ There are many different kinds of living things in any area, and they exist in different places on land and in water. (2-LS4-1)	

Connections to other DCIs in second grade: N/A

Articulation of DCIs across grade-levels: **3.LS4.C** (2-LS4-1); **3.LS4.D** (2-LS4-1); **5.LS2.A** (2-LS4-1)

Common Core State Standards Connections:

ELA/Literacy –

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-LS4-1)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-LS4-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. *(2-LS4-1)*

MP.4 Model with mathematics. *(2-LS4-1)*

2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems. *(2-LS4-1)*

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2-ESS1 Earth's Place in the Universe

2-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.

[Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly and erosion of rocks, which occurs slowly.] [Assessment Boundary: Assessment does not include quantitative measurements of timescales.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions. ▪ Make observations from several sources to construct an evidence-based account for natural phenomena. (2-ESS1-1)	**ESS1.C: The History of Planet Earth** ▪ Some events happen very quickly; others occur very slowly, over a time period much longer than one can observe. (2-ESS1-1)	**Stability and Change** ▪ Things may change slowly or rapidly. (2-ESS1-1)

Connections to other DCIs in second grade: N/A

Articulation of DCIs across grade-levels: **3.LS2.C** (2-ESS1-1); **4.ESS1.C** (2-ESS1-1); **4.ESS2.A** (2-ESS1-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.2.1 Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. *(2-ESS1-1)*

RI.2.3 Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. (2-ESS1-1)

W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. *(2-ESS1-1)*

W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (2-ESS1-1)

W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (2-ESS1-1)

SL.2.2 Recount or describe key ideas or details from a text read aloud or information presented orally or through other media. (2-ESS1-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. *(2-ESS1-1)*

MP.4 Model with mathematics. *(2-ESS1-1)*

2.NBT.A Understand place value. (2-ESS1-1)

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2-ESS2 Earth's Systems

2-ESS2 Earth's Systems

Students who demonstrate understanding can:

2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*
[Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees to hold back the land.]

2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area. [Assessment Boundary: Assessment does not include quantitative scaling in models.]

2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.
- Develop a model to represent patterns in the natural world. (2-ESS2-2)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.
- Compare multiple solutions to a problem. (2-ESS2-1)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information.
- Obtain information using various texts, text features (e.g., headings, tables of contents, glossaries, electronic menus, icons), and other media that will be useful in answering a scientific question. (2-ESS2-3)

Disciplinary Core Ideas

ESS2.A: Earth Materials and Systems
- Wind and water can change the shape of the land. (2-ESS2-1)

ESS2.B: Plate Tectonics and Large-Scale System Interactions
- Maps show where things are located. One can map the shapes and kinds of land and water in any area. (2-ESS2-2)

ESS2.C: The Roles of Water in Earth's Surface Processes
- Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. (2-ESS2-3)

ETS1.C: Optimizing the Design Solution
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs. *(secondary to 2-ESS2-1)*

Crosscutting Concepts

Patterns
- Patterns in the natural world can be observed. (2-ESS2-2),(2-ESS2-3)

Stability and Change
- Things may change slowly or rapidly. (2-ESS2-1)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World
- Developing and using technology has impacts on the natural world. (2-ESS2-1)

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World
- Scientists study the natural and material world. (2-ESS2-1)

Connections to other DCIs in second grade: **2.PS1.A** (2-ESS2-3)

Articulation of DCIs across grade-levels: **K.ETS1.A** (2-ESS2-1); **4.ESS2.A** (2-ESS2-1); **4.ESS2.B** (2-ESS2-2); **4.ETS1.A** (2-ESS2-1); **4.ETS1.B** (2-ESS2-1); **4.ETS1.C** (2-ESS2-1); **5.ESS2.A** (2-ESS2-1); **5.ESS2.C** (2-ESS2-2),(2-ESS2-3)

Common Core State Standards Connections:

ELA/Literacy –

RI.2.3	Describe the connection between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text. *(2-ESS2-1)*
RI.2.9	Compare and contrast the most important points presented by two texts on the same topic. (2-ESS2-1)
W.2.6	With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. *(2-ESS2-3)*
W.2.8	Recall information from experiences or gather information from provided sources to answer a question. (2-ESS2-3)
SL.2.5	Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. *(2-ESS2-2)*

Mathematics –

MP.2	Reason abstractly and quantitatively. *(2-ESS2-1),(2-ESS2-2)*
MP.4	Model with mathematics. *(2-ESS2-1),(2-ESS2-2)*
MP.5	Use appropriate tools strategically. *(2-ESS2-1)*
2.NBT.A.3	Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. *(2-ESS2-2)*
2.MD.B.5	Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem. *(2-ESS2-1)*

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K-2-ETS1 Engineering Design

K-2-ETS1 Engineering Design

Students who demonstrate understanding can:

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions. ▪ Ask questions based on observations to find more information about the natural and/or designed world(s). (K-2-ETS1-1) ▪ Define a simple problem that can be solved through the development of a new or improved object or tool. (K-2-ETS1-1) **Developing and Using Models** Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions. ▪ Develop a simple model based on evidence to represent a proposed object or tool. (K-2-ETS1-2) **Analyzing and Interpreting Data** Analyzing data in K–2 builds on prior experiences and progresses to collecting, recording, and sharing observations. ▪ Analyze data from tests of an object or tool to determine if it works as intended. (K-2-ETS1-3)	**ETS1.A: Defining and Delimiting Engineering Problems** ▪ A situation that people want to change or create can be approached as a problem to be solved through engineering. (K-2-ETS1-1) ▪ Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1) ▪ Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1) **ETS1.B: Developing Possible Solutions** ▪ Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (K-2-ETS1-2) **ETS1.C: Optimizing the Design Solution** ▪ Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)	**Structure and Function** ▪ The shape and stability of structures of natural and designed objects are related to their function(s). (K-2-ETS1-2)

Connections to K-2-ETS1.A: Defining and Delimiting Engineering Problems include:
Kindergarten: K-PS2-2, K-ESS3-2
Connections to K-2-ETS1.B: Developing Possible Solutions to Problems include:
Kindergarten: K-ESS3-3, **First Grade:** 1-PS4-4, **Second Grade:** 2-LS2-2
Connections to K-2-ETS1.C: Optimizing the Design Solution include:
Second Grade: 2-ESS2-1

Articulation of DCIs across grade-bands: **3-5.ETS1.A** (K-2-ETS1-1),(K-2-ETS1-2),(K-2-ETS1-3); **3-5.ETS1.B** (K-2-ETS1-2),(K-2-ETS1-3); **3-5.ETS1.C** (K-2-ETS1-1),(K-2-ETS1-2),(K-2-ETS1-3)

Common Core State Standards Connections:
ELA/Literacy –

RI.2.1 Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text. (K-2-ETS1-1)
W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. *(K-2-ETS1-1),(K-2-ETS1-3)*
W.2.8 Recall information from experiences or gather information from provided sources to answer a question. (K-2-ETS1-1),*(K-2-ETS1-3)*
SL.2.5 Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings. *(K-2-ETS1-2)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(K-2-ETS1-1),(K-2-ETS1-3)*
MP.4 Model with mathematics. *(K-2-ETS1-1),(K-2-ETS1-3)*
MP.5 Use appropriate tools strategically. *(K-2-ETS1-1),(K-2-ETS1-3)*
2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. *(K-2-ETS1-1),(K-2-ETS1-3)*

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Third Grade

The performance expectations in third grade help students formulate answers to questions such as: “What is typical weather in different parts of the world and during different times of the year? How can the impact of weather-related hazards be reduced? How do organisms vary in their traits? How are plants, animals, and environments of the past similar or different from current plants, animals, and environments? What happens to organisms when their environment changes? How do equal and unequal forces on an object affect the object? How can magnets be used?” Third grade performance expectations include PS2, LS1, LS2, LS3, LS4, ESS2, and ESS3 Disciplinary Core Ideas from the *NRC Framework*. Students are able to organize and use data to describe typical weather conditions expected during a particular season. By applying their understanding of weather-related hazards, students are able to make a claim about the merit of a design solution that reduces the impacts of such hazards. Students are expected to develop an understanding of the similarities and differences of organisms’ life cycles. An understanding that organisms have different inherited traits, and that the environment can also affect the traits that an organism develops, is acquired by students at this level. In addition, students are able to construct an explanation using evidence for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. Students are expected to develop an understanding of types of organisms that lived long ago and also about the nature of their environments. Third graders are expected to develop an understanding of the idea that when the environment changes some organisms survive and reproduce, some move to new locations, some move into the transformed environment, and some die. Students are able to determine the effects of balanced and unbalanced forces on the motion of an object and the cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. They are then able to apply their understanding of magnetic interactions to define a simple design problem that can be solved with magnets. The crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; systems and system models; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the third grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions and defining problems; developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

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3-PS2 Motion and Stability: Forces and Interactions

3-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. [Clarification Statement: Examples could include an unbalanced force on one side of a ball can make it start moving; and, balanced forces pushing on a box from both sides will not produce any motion at all.] [Assessment Boundary: Assessment is limited to one variable at a time: number, size, or direction of forces. Assessment does not include quantitative force size, only qualitative and relative. Assessment is limited to gravity being addressed as a force that pulls objects down.]

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. [Clarification Statement: Examples of motion with a predictable pattern could include a child swinging in a swing, a ball rolling back and forth in a bowl, and two children on a see-saw.] [Assessment Boundary: Assessment does not include technical terms such as period and frequency.]

3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. [Clarification Statement: Examples of an electric force could include the force on hair from an electrically charged balloon and the electrical forces between a charged rod and pieces of paper; examples of a magnetic force could include the force between two permanent magnets, the force between an electromagnet and steel paperclips, and the force exerted by one magnet versus the force exerted by two magnets. Examples of cause and effect relationships could include how the distance between objects affects strength of the force and how the orientation of magnets affects the direction of the magnetic force.] [Assessment Boundary: Assessment is limited to forces produced by objects that can be manipulated by students, and electrical interactions are limited to static electricity.]

3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.* [Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.
- Ask questions that can be investigated based on patterns such as cause and effect relationships. (3-PS2-3)
- Define a simple problem that can be solved through the development of a new or improved object or tool. (3-PS2-4)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-PS2-1)
- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (3-PS2-2)

Connections to Nature of Science

Science Knowledge is Based on Empirical Evidence
- Science findings are based on recognizing patterns. (3-PS2-2)

Scientific Investigations Use a Variety of Methods
- Science investigations use a variety of methods, tools, and techniques. (3-PS2-1)

Disciplinary Core Ideas

PS2.A: Forces and Motion
- Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1)
- The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)

PS2.B: Types of Interactions
- Objects in contact exert forces on each other. (3-PS2-1)
- Electric, and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3),(3-PS2-4)

Crosscutting Concepts

Patterns
- Patterns of change can be used to make predictions. (3-PS2-2)

Cause and Effect
- Cause and effect relationships are routinely identified. (3-PS2-1)
- Cause and effect relationships are routinely identified, tested, and used to explain change. (3-PS2-3)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
- Scientific discoveries about the natural world can often lead to new and improved technologies, which are developed through the engineering design process. (3-PS2-4)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **K.PS2.A** (3-PS2-1); **K.PS2.B** (3-PS2-1); **K.PS3.C** (3-PS2-1); **K.ETS1.A** (3-PS2-4); **1.ESS1.A** (3-PS2-2); **4.PS4.A** (3-PS2-2); **4.ETS1.A** (3-PS2-4); **5.PS2.B** (3-PS2-1); **MS.PS2.A** (3-PS2-1),(3-PS2-2); **MS.PS2.B** (3-PS2-3),(3-PS2-4); **MS.ESS1.B** (3-PS2-1),(3-PS2-2); **MS.ESS2.C** (3-PS2-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-PS2-1),*(3-PS2-3)

RI.3.3 Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-PS2-3)

RI.3.8 Describe the logical connection between particular sentences and paragraphs in a text (e.g., comparison, cause/effect, first/second/third in a sequence). *(3-PS2-3)*

W.3.7 Conduct short research projects that build knowledge about a topic. (3-PS2-1),(3-PS2-2)

W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-PS2-1)*,(3-PS2-2)*

SL.3.3 Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. *(3-PS2-3)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(3-PS2-1)*

MP.5 Use appropriate tools strategically. *(3-PS2-1)*

3.MD.A.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. *(3-PS2-1)*

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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3-LS1 From Molecules to Organisms: Structures and Processes

3-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death. [Clarification Statement: Changes organisms go through during their life form a pattern.] [Assessment Boundary: Assessment of plant life cycles is limited to those of flowering plants. Assessment does not include details of human reproduction.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ▪ Develop models to describe phenomena. (3-LS1-1) ---------- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** ▪ Science findings are based on recognizing patterns. (3-LS1-1)	**LS1.B: Growth and Development of Organisms** ▪ Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3-LS1-1)	**Patterns** ▪ Patterns of change can be used to make predictions. (3-LS1-1)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **MS.LS1.B** (3-LS1-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.3.7 Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur). *(3-LS1-1)*

SL.3.5 Create engaging audio recordings of stories or poems that demonstrate fluid reading at an understandable pace; add visual displays when appropriate to emphasize or enhance certain facts or details. *(3-LS1-1)*

Mathematics –

MP.4 Model with mathematics. *(3-LS1-1)*

3.NBT Number and Operations in Base Ten *(3-LS1-1)*

3.NF Number and Operations—Fractions *(3-LS1-1)*

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3-LS2 Ecosystems: Interactions, Energy, and Dynamics

3-LS2 Ecosystems: Interactions, Energy, and Dynamics		
Students who demonstrate understanding can: **3-LS2-1. Construct an argument that some animals form groups that help members survive.**		
The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). ▪ Construct an argument with evidence, data, and/or a model. (3-LS2-1)	**LS2.D: Social Interactions and Group Behavior** ▪ Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size *(Note: Moved from K–2)*. (3-LS2-1)	**Cause and Effect** ▪ Cause and effect relationships are routinely identified and used to explain change. (3-LS2-1)
Connections to other DCIs in third grade: N/A		
Articulation of DCIs across grade-levels: **1.LS1.B** (3-LS2-1); **MS.LS2.A** (3-LS2-1); **MS.LS2.D** (3-LS2-1)		
Common Core State Standards Connections: *ELA/Literacy –* **RI.3.1** Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-LS2-1)* **RI.3.3** Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. *(3-LS2-1)* **W.3.1** Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-LS2-1) *Mathematics –* **MP.4** Model with mathematics. (3-LS2-1) **3.NBT** Number and Operations in Base Ten (3-LS2-1)		

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3-LS3 Heredity: Inheritance and Variation of Traits

3-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms. [Clarification Statement: Patterns are the similarities and differences in traits shared between offspring and their parents, or among siblings. Emphasis is on organisms other than humans.] [Assessment Boundary: Assessment does not include genetic mechanisms of inheritance and prediction of traits. Assessment is limited to non-human examples.]

3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment. [Clarification Statement: Examples of the environment affecting a trait could include normally tall plants grown with insufficient water are stunted; and, a pet dog that is given too much food and little exercise may become overweight.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations.
When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS3-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Use evidence (e.g., observations, patterns) to support an explanation. (3-LS3-2)

Disciplinary Core Ideas

LS3.A: Inheritance of Traits

- Many characteristics of organisms are inherited from their parents. (3-LS3-1)
- Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment. (3-LS3-2)

LS3.B: Variation of Traits

- Different organisms vary in how they look and function because they have different inherited information. (3-LS3-1)
- The environment also affects the traits that an organism develops. (3-LS3-2)

Crosscutting Concepts

Patterns

- Similarities and differences in patterns can be used to sort and classify natural phenomena. (3-LS3-1)

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (3-LS3-2)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **1.LS3.A** (3-LS3-1); **1.LS3.B** (3-LS3-1); **MS.LS1.B** (3-LS3-2); **MS.LS3.A** (3-LS3-1); **MS.LS3.B** (3-LS3-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.3.1	Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-LS3-1),(3-LS3-2)
RI.3.2	Determine the main idea of a text; recount the key details and explain how they support the main idea. *(3-LS3-1),(3-LS3-2)*
RI.3.3	Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. (3-LS3-1),*(3-LS3-2)*
W.3.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly. *(3-LS3-1),*(3-LS3-2)
SL.3.4	Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. *(3-LS3-1),(3-LS3-2)*

Mathematics –

MP.2	Reason abstractly and quantitatively. *(3-LS3-1),(3-LS3-2)*
MP.4	Model with mathematics. *(3-LS3-1),(3-LS3-2)*
3.MD.B.4	Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. *(3-LS3-1),(3-LS3-2)*

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3-LS4 Biological Evolution: Unity and Diversity

3-LS4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

3-LS4-1. Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago. [Clarification Statement: Examples of data could include type, size, and distributions of fossil organisms. Examples of fossils and environments could include marine fossils found on dry land, tropical plant fossils found in Arctic areas, and fossils of extinct organisms.] [Assessment Boundary: Assessment does not include identification of specific fossils or present plants and animals. Assessment is limited to major fossil types and relative ages.]

3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing. [Clarification Statement: Examples of cause and effect relationships could be plants that have larger thorns than other plants may be less likely to be eaten by predators; and, animals that have better camouflage coloration than other animals may be more likely to survive and therefore more likely to leave offspring.]

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.* [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.
- Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS4-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.
- Use evidence (e.g., observations, patterns) to construct an explanation. (3-LS4-2)

Engaging in Argument from Evidence
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).
- Construct an argument with evidence. (3-LS4-3)
- Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-LS4-4)

Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. *(secondary to 3-LS4-4)*

LS4.A: Evidence of Common Ancestry and Diversity
- Some kinds of plants and animals that once lived on Earth are no longer found anywhere. *(Note: moved from K-2)* (3-LS4-1)
- Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1)

LS4.B: Natural Selection
- Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. (3-LS4-2)

LS4.C: Adaptation
- For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)

LS4.D: Biodiversity and Humans
- Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)

Crosscutting Concepts

Cause and Effect
- Cause and effect relationships are routinely identified and used to explain change. (3-LS4-2),(3-LS4-3)

Scale, Proportion, and Quantity
- Observable phenomena exist from very short to very long time periods. (3-LS4-1)

Systems and System Models
- A system can be described in terms of its components and their interactions. (3-LS4-4)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
- Knowledge of relevant scientific concepts and research findings is important in engineering. (3-LS4-3)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science assumes consistent patterns in natural systems. (3-LS4-1)

Connections to other DCIs in third grade: **3.LS4.C** (3-LS4-2); **3.ESS2.D** (3-LS4-3); **3.ESS3.B** (3-LS4-4)

Articulation of DCIs across grade-levels: **K.ESS3.A** (3-LS4-3)(3-LS4-4); **K.ETS1.A** (3-LS4-4); **1.LS3.A** (3-LS4-2); **2.LS2.A** (3-LS4-3),(3-LS4-4); **2.LS4.D** (3-LS4-3),(3-LS4-4); **4.ESS1.C** (3-LS4-1); **4.ESS3.B** (3-LS4-4); **4.ETS1.A** (3-LS4-4); **MS.LS2.A** (3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4); **MS.LS2.C** (3-LS4-4); **MS.LS3.B** (3-LS4-2); **MS.LS4.A** (3-LS4-1); **MS.LS4.B** (3-LS4-2),(3-LS4-3); **MS.LS4.C** (3-LS4-3),(3-LS4-4); **MS.ESS1.C** (3-LS4-1),(3-LS4-3),(3-LS4-4); **MS.ESS2.B** (3-LS4-1); **MS.ESS3.C** (3-LS4-4)

Common Core State Standards Connections:

ELA/Literacy –

RI.3.1	Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-LS4-1),(3-LS4-2),(3-LS4-3)(3-LS4-4)*
RI.3.2	Determine the main idea of a text; recount the key details and explain how they support the main idea. *(3-LS4-1),(3-LS4-2),(3-LS4-3),(3LS4-4)*
RI.3.3	Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause/effect. *(3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4)*
W.3.1	Write opinion pieces on topics or texts, supporting a point of view with reasons. *(3-LS4-1),*(3-LS4-3),*(3-LS4-4)*
W.3.2	Write informative/explanatory texts to examine a topic and convey ideas and information clearly. *(3-LS4-1)*,(3-LS4-2),*(3-LS4-3),(3-LS4-4)*
W.3.9	Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-LS4-1)
SL.3.4	Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace. *(3-LS4-2),(3-LS4-3),(3-LS4-4)*

Mathematics –

MP.2	Reason abstractly and quantitatively. *(3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4)*
MP.4	Model with mathematics. *(3-LS4-1),(3-LS4-2),(3-LS4-3),(3-LS4-4)*
MP.5	Use appropriate tools strategically. *(3-LS4-1)*
3.MD.B.3	Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. *(3-LS4-2),(3-LS4-3)*
3.MD.B.4	Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. *(3-LS4-1)*

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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3-ESS2 Earth's Systems

3-ESS2 Earth's Systems

Students who demonstrate understanding can:

3-ESS2-1. Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season. [Clarification Statement: Examples of data could include average temperature, precipitation, and wind direction.] [Assessment Boundary: Assessment of graphical displays is limited to pictographs and bar graphs. Assessment does not include climate change.]

3-ESS2-2. Obtain and combine information to describe climates in different regions of the world.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Represent data in tables and various graphical displays (bar graphs and pictographs) to reveal patterns that indicate relationships. (3-ESS2-1)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- Obtain and combine information from books and other reliable media to explain phenomena. (3-ESS2-2)

Disciplinary Core Ideas

ESS2.D: Weather and Climate

- Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. (3-ESS2-1)
- Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years. (3-ESS2-2)

Crosscutting Concepts

Patterns

- Patterns of change can be used to make predictions. (3-ESS2-1),(3-ESS2-2)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: **K.ESS2.D** (3-ESS2-1); **4.ESS2.A** (3-ESS2-1); **5.ESS2.A** (3-ESS2-1); **MS.ESS2.C** (3-ESS2-1),(3-ESS2-2); **MS.ESS2.D** (3-ESS2-1),(3-ESS2-2)

Common Core State Standards Connections:

ELA/Literacy –

RI.3.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. *(3-ESS2-2)*

RI.3.9 Compare and contrast the most important points and key details presented in two texts on the same topic. (3-ESS2-2)

W.3.9 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-ESS2-2)

Mathematics –

MP.2 Reason abstractly and quantitatively. (3-ESS2-1),(3-ESS2-2)

MP.4 Model with mathematics. (3-ESS2-1),(3-ESS2-2)

MP.5 Use appropriate tools strategically. *(3-ESS2-1)*

3.MD.A.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. *(3-ESS2-1)*

3.MD.B.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in bar graphs. (3-ESS2-1)

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Students who demonstrate understanding can:

[Clarification Statement: Examples of design solutions to weather-related hazards could include barriers to prevent flooding, wind resistant roofs, and lightning rods.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). ▪ Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-ESS3-1)	▪ A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts. (3-ESS3-1) *(Note: This Disciplinary Core Idea is also addressed by 4-ESS3-2.)*	▪ Cause and effect relationships are routinely identified, tested, and used to explain change. (3-ESS3-1) ▪ Engineers improve existing technologies or develop new ones to increase their benefits (e.g., better artificial limbs), decrease known risks (e.g., seatbelts in cars), and meet societal demands (e.g., cell phones). (3-ESS3-1) ▪ Science affects everyday life. (3-ESS3-1)

Connections to other DCIs in third grade: N/A

Articulation of DCIs across grade-levels: (3-ESS3-1); (3-ESS3-1); (3-ESS3-1); (3-ESS3-1); (3-ESS3-1)

Common Core State Standards Connections:

ELA/Literacy –

Write opinion pieces on topics or texts, supporting a point of view with reasons. *(3-ESS3-1)*
Conduct short research projects that build knowledge about a topic. *(3-ESS3-1)*

Mathematics –

Reason abstractly and quantitatively. *(3-ESS3-1)*
Model with mathematics. *(3-ESS3-1)*

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Fourth Grade

The performance expectations in fourth grade help students formulate answers to questions such as: “What are waves and what are some things they can do? How can water, ice, wind and vegetation change the land? What patterns of Earth’s features can be determined with the use of maps? How do internal and external structures support the survival, growth, behavior, and reproduction of plants and animals? What is energy and how is it related to motion? How is energy transferred? How can energy be used to solve a problem?” Fourth grade performance expectations include PS3, PS4, LS1, ESS1, ESS2, ESS3, and ETS1 Disciplinary Core Ideas from the *NRC Framework*. Students are able to use a model of waves to describe patterns of waves in terms of amplitude and wavelength, and that waves can cause objects to move. Students are expected to develop understanding of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. They apply their knowledge of natural Earth processes to generate and compare multiple solutions to reduce the impacts of such processes on humans. In order to describe patterns of Earth’s features, students analyze and interpret data from maps. Fourth graders are expected to develop an understanding that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. By developing a model, they describe that an object can be seen when light reflected from its surface enters the eye. Students are able to use evidence to construct an explanation of the relationship between the speed of an object and the energy of that object. Students are expected to develop an understanding that energy can be transferred from place to place by sound, light, heat, and electric currents or from object to object through collisions. They apply their understanding of energy to design, test, and refine a device that converts energy from one form to another. The crosscutting concepts of patterns; cause and effect; energy and matter; systems and system models; interdependence of science, engineering, and technology; and influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the fourth grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Students are expected to use these practices to demonstrate understanding of the core ideas.

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4-PS3 Energy

4-PS3 Energy

Students who demonstrate understanding can:

4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object. [Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.]

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents. [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide. [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [Assessment Boundary: Assessment does not include quantitative measurements of energy.]

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.* [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.
- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.
- Use evidence (e.g., measurements, observations, patterns) to construct an explanation. (4-PS3-1)
- Apply scientific ideas to solve design problems. (4-PS3-4)

Disciplinary Core Ideas

PS3.A: Definitions of Energy
- The faster a given object is moving, the more energy it possesses. (4-PS3-1)
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2),(4-PS3-3)

PS3.B: Conservation of Energy and Energy Transfer
- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2),(4-PS3-3)
- Light also transfers energy from place to place. (4-PS3-2)
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2),(4-PS3-4)

PS3.C: Relationship Between Energy and Forces
- When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3)

PS3.D: Energy in Chemical Processes and Everyday Life
- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)

ETS1.A: Defining Engineering Problems
- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. *(secondary to 4-PS3-4)*

Crosscutting Concepts

Energy and Matter
- Energy can be transferred in various ways and between objects. (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4)

Connections to Engineering, Technology , and Applications of Science

Influence of Science, Engineering and Technology on Society and the Natural World
- Engineers improve existing technologies or develop new ones. (4-PS3-4)

Connections to Nature of Science

Science is a Human Endeavor
- Most scientists and engineers work in teams. (4-PS3-4)
- Science affects everyday life. (4-PS3-4)

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels: **K.PS2.B** (4-PS3-3); **K.ETS1.A** (4-PS3-4); **2.ETS1.B** (4-PS3-4); **3.PS2.A** (4-PS3-3); **5.PS3.D** (4-PS3-4); **5.LS1.C** (4-PS3-4); **MS.PS2.A** (4-PS3-3); **MS.PS2.B** (4-PS3-2); **MS.PS3.A** (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4); **MS.PS3.B** (4-PS3-2),(4-PS3-3),(4-PS3-4); **MS.PS3.C** (4-PS3-3); **MS.PS4.B** (4-PS3-2); **MS.ETS1.B** (4-PS3-4); **MS.ETS1.C** (4-PS3-4)

Common Core State Standards Connections:

ELA/Literacy –

RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-PS3-1)

RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text. (4-PS3-1)

RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. *(4-PS3-1)*

W.4.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly. (4-PS3-1)

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-PS3-2),(4-PS3-3),(4-PS3-4)

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4)

W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (4-PS3-1)

Mathematics –

4.OA.A.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. *(4-PS3-4)*

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4-PS4 Waves and their Applications in Technologies for Information Transfer

4-PS4 Waves and their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

4-PS4-1. Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move. [Clarification Statement: Examples of models could include diagrams, analogies, and physical models using wire to illustrate wavelength and amplitude of waves.] [Assessment Boundary: Assessment does not include interference effects, electromagnetic waves, non-periodic waves, or quantitative models of amplitude and wavelength.]

4-PS4-2. Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. [Assessment Boundary: Assessment does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision, or how the retina works.]

4-PS4-3. Generate and compare multiple solutions that use patterns to transfer information.* [Clarification Statement: Examples of solutions could include drums sending coded information through sound waves, using a grid of 1's and 0's representing black and white to send information about a picture, and using Morse code to send text.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
- Develop a model using an analogy, example, or abstract representation to describe a scientific principle. (4-PS4-1)
- Develop a model to describe phenomena. (4-PS4-2)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.
- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-PS4-3)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science findings are based on recognizing patterns. (4-PS4-1)

Disciplinary Core Ideas

PS4.A: Wave Properties
- Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. *(Note: This grade band endpoint was moved from K–2.)* (4-PS4-1)
- Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks). (4-PS4-1)

PS4.B: Electromagnetic Radiation
- An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)

PS4.C: Information Technologies and Instrumentation
- Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3)

ETS1.C: Optimizing The Design Solution
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. *(secondary to 4-PS4-3)*

Crosscutting Concepts

Patterns
- Similarities and differences in patterns can be used to sort and classify natural phenomena. (4-PS4-1)
- Similarities and differences in patterns can be used to sort and classify designed products. (4-PS4-3)

Cause and Effect
- Cause and effect relationships are routinely identified. (4-PS4-2)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
- Knowledge of relevant scientific concepts and research findings is important in engineering. (4-PS4-3)

Connections to other DCIs in fourth grade: **4.PS3.A** (4-PS4-1); **4.PS3.B** (4-PS4-1); **4.ETS1.A** (4-PS4-3)

Articulation of DCIs across grade-levels: **K.ETS1.A** (4-PS4-3); **1.PS4.B** (4-PS4-2); **1.PS4.C** (4-PS4-3); **2.ETS1.B** (4-PS4-3); **2.ETS1.C** (4-PS4-3); **3.PS2.A** (4-PS4-3); **MS.PS4.A** (4-PS4-1); **MS.PS4.B** (4-PS4-2); **MS.PS4.C** (4-PS4-3); **MS.LS1.D** (4-PS4-2); **MS.ETS1.B** (4-PS4-3)

Common Core State Standards Connections:

ELA/Literacy –

RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. *(4-PS4-3)*

RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-PS4-3)

SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. *(4-PS4-1),(4-PS4-2)*

Mathematics –

MP.4 Model with mathematics. *(4-PS4-1),(4-PS4-2)*

4.G.A.1 Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. *(4-PS4-1),(4-PS4-2)*

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4-LS1 From Molecules to Organisms: Structures and Processes

4-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. [Clarification Statement: Examples of structures could include thorns, stems, roots, colored petals, heart, stomach, lung, brain, and skin.] [Assessment Boundary: Assessment is limited to macroscopic structures within plant and animal systems.]

4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. [Clarification Statement: Emphasis is on systems of information transfer.] [Assessment Boundary: Assessment does not include the mechanisms by which the brain stores and recalls information or the mechanisms of how sensory receptors function.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
- Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)

Engaging in Argument from Evidence
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).
- Construct an argument with evidence, data, and/or a model. (4-LS1-1)

Disciplinary Core Ideas

LS1.A: Structure and Function
- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)

LS1.D: Information Processing
- Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)

Crosscutting Concepts

Systems and System Models
- A system can be described in terms of its components and their interactions. (4-LS1-1),(4-LS1-2)

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels: **1.LS1.A** (4-LS1-1); **1.LS1.D** (4-LS1-2); **3.LS3.B** (4-LS1-1); **MS.LS1.A** (4-LS1-1),(4-LS1-2); **MS.LS1.D** (4-LS1-2)

Common Core State Standards Connections:

ELA/Literacy –

W.4.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (4-LS1-1)

SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes. *(4-LS1-2)*

Mathematics –

4.G.A.3 Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. *(4-LS1-1)*

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4-ESS1 Earth's Place in the Universe

4-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

4-ESS1-1. Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.] [Assessment Boundary: Assessment does not include specific knowledge of the mechanism of rock formation or memorization of specific rock formations and layers. Assessment is limited to relative time.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. ▪ Identify the evidence that supports particular points in an explanation. (4-ESS1-1)	**ESS1.C: The History of Planet Earth** ▪ Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed. (4-ESS1-1)	**Patterns** ▪ Patterns can be used as evidence to support an explanation. (4-ESS1-1) ---------- ***Connections to Nature of Science*** **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** ▪ Science assumes consistent patterns in natural systems. (4-ESS1-1)

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels: **2.ESS1.C** (4-ESS1-1); **3.LS4.A** (4-ESS1-1); **MS.LS4.A** (4-ESS1-1); **MS.ESS1.C** (4-ESS1-1) **MS.ESS2.A** (4-ESS1-1); **MS.ESS2.B** (4-ESS1-1)

Common Core State Standards Connections:

ELA/Literacy –

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS1-1)

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS1-1)

W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. *(4-ESS1-1)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(4-ESS1-1)*

MP.4 Model with mathematics. *(4-ESS1-1)*

4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. *(4-ESS1-1)*

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4-ESS2 Earth's Systems

4-ESS2 Earth's Systems

Students who demonstrate understanding can:

4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. [Clarification Statement: Examples of variables to test could include angle of slope in the downhill movement of water, amount of vegetation, speed of wind, relative rate of deposition, cycles of freezing and thawing of water, cycles of heating and cooling, and volume of water flow.] [Assessment Boundary: Assessment is limited to a single form of weathering or erosion.]

4-ESS2-2. Analyze and interpret data from maps to describe patterns of Earth's features. [Clarification Statement: Maps can include topographic maps of Earth's land and ocean floor, as well as maps of the locations of mountains, continental boundaries, volcanoes, and earthquakes.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)

Analyzing and Interpreting Data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.

- Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)

Disciplinary Core Ideas

ESS2.A: Earth Materials and Systems

- Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around. (4-ESS2-1)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)

ESS2.E: Biogeology

- Living things affect the physical characteristics of their regions. (4-ESS2-1)

Crosscutting Concepts

Patterns

- Patterns can be used as evidence to support an explanation. (4-ESS2-2)

Cause and Effect

- Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS2-1)

Connections to other DCIs in fourth grade: N/A

Articulation of DCIs across grade-levels: **2.ESS1.C** (4-ESS2-1); **2.ESS2.A** (4-ESS2-1); **2.ESS2.B** (4-ESS2-2); **2.ESS2.C** (4-ESS2-2); **5.ESS2.A** (4-ESS2-1); **5.ESS2.C** (4-ESS2-2); **MS.ESS1.C** (4-ESS2-2); **MS.ESS2.A** (4-ESS2-2); **MS.ESS2.B** (4-ESS2-2)

Common Core State Standards Connections:

ELA/Literacy –

RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears. (4-ESS2-2)

W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. (4-ESS2-1)

W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS2-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. (4-ESS2-1)

MP.4 Model with mathematics. (4-ESS2-1)

MP.5 Use appropriate tools strategically. (4-ESS2-1)

4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. *(4-ESS2-1)*

4.MD.A.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. *(4-ESS2-1),(4-ESS2-2)*

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4-ESS3 Earth and Human Activity

4-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

4-ESS3-2. Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.* [Clarification Statement: Examples of solutions could include designing an earthquake resistant building and improving monitoring of volcanic activity.] [Assessment Boundary: Assessment is limited to earthquakes, floods, tsunamis, and volcanic eruptions.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution. (4-ESS3-2)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.

- Obtain and combine information from books and other reliable media to explain phenomena. (4-ESS3-1)

Disciplinary Core Ideas

ESS3.A: Natural Resources

- Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)

ESS3.B: Natural Hazards

- A variety of hazards result from natural processes (e.g., earthquakes, tsunamis, volcanic eruptions). Humans cannot eliminate the hazards but can take steps to reduce their impacts. (4-ESS3-2) *(Note: This Disciplinary Core Idea can also be found in 3.WC.)*

ETS1.B: Designing Solutions to Engineering Problems

- Testing a solution involves investigating how well it performs under a range of likely conditions. *(secondary to 4-ESS3-2)*

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)
- Cause and effect relationships are routinely identified, tested, and used to explain change. (4-ESS3-2)

Connections to Engineering, Technology , and Applications of Science

Interdependence of Science, Engineering, and Technology

- Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1)

Influence of Science, Engineering and Technology on Society and the Natural World

- Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1)
- Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands. (4-ESS3-2)

Connections to other DCIs in fourth grade: **4.ETS1.C** (4-ESS3-2)

Articulation of DCIs across grade-levels: **K.ETS1.A** (4-ESS3-2); **2.ETS1.B** (4-ESS3-2); **2.ETS1.C** (4-ESS3-2); **5.ESS3.C** (4-ESS3-1); **MS.PS3.D** (4-ESS3-1); **MS.ESS2.A** (4-ESS3-1),(4-ESS3-2); **MS.ESS3.A** (4-ESS3-1); **MS.ESS3.B** (4-ESS3-2); **MS.ESS3.C** (4-ESS3-1); **MS.ESS3.D** (4-ESS3-1); **MS.ETS1.B** (4-ESS3-2)

Common Core State Standards Connections:

ELA/Literacy –

RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. (4-ESS3-2)
RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. (4-ESS3-2)
W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic. *(4-ESS3-1)*
W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources. (4-ESS3-1)
W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. *(4-ESS3-1)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(4-ESS3-1),(4-ESS3-2)*
MP.4 Model with mathematics. *(4-ESS3-1),(4-ESS3-2)*
4.OA.A.1 Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. (4-ESS3-1),*(4-ESS3-2)*

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Fifth Grade

The performance expectations in fifth grade help students formulate answers to questions such as: “When matter changes, does its weight change? How much water can be found in different places on Earth? Can new substances be created by combining other substances? How does matter cycle through ecosystems? Where does the energy in food come from and what is it used for? How do lengths and directions of shadows or relative lengths of day and night change from day to day, and how does the appearance of some stars change in different seasons?” Fifth grade performance expectations include PS1, PS2, PS3, LS1, LS2, ESS1, ESS2, and ESS3 Disciplinary Core Ideas from the *NRC Framework*. Students are able to describe that matter is made of particles too small to be seen through the development of a model. Students develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved. Students determine whether the mixing of two or more substances results in new substances. Through the development of a model using an example, students are able to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. They describe and graph data to provide evidence about the distribution of water on Earth. Students develop an understanding of the idea that plants get the materials they need for growth chiefly from air and water. Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment and that energy in animals’ food was once energy from the sun. Students are expected to develop an understanding of patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. The crosscutting concepts of patterns; cause and effect; scale, proportion, and quantity; energy and matter; and systems and systems models are called out as organizing concepts for these disciplinary core ideas. In the fifth grade performance expectations, students are expected to demonstrate grade-appropriate proficiency in developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, engaging in argument from evidence, and obtaining, evaluating, and communicating information; and to use these practices to demonstrate understanding of the core ideas.

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5-PS1 Matter and Its Interactions

5-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen. [Clarification Statement: Examples of evidence could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]

5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. [Clarification Statement: Examples of reactions or changes could include phase changes, dissolving, and mixing that form new substances.] [Assessment Boundary: Assessment does not include distinguishing mass and weight.]

5-PS1-3. Make observations and measurements to identify materials based on their properties. [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility; density is not intended as an identifiable property.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]

5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
- Develop a model to describe phenomena. (5-PS1-1)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (5-PS1-4)
- Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (5-PS1-3)

Using Mathematics and Computational Thinking
Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.
- Measure and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter
- Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects. (5-PS1-1)
- The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. (5-PS1-2)
- Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (5-PS1-3)

PS1.B: Chemical Reactions
- When two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4)
- No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.) (5-PS1-2)

Crosscutting Concepts

Cause and Effect
- Cause and effect relationships are routinely identified, tested, and used to explain change. (5-PS1-4)

Scale, Proportion, and Quantity
- Natural objects exist from the very small to the immensely large. (5-PS1-1)
- Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume. (5-PS1-2),(5-PS1-3)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science assumes consistent patterns in natural systems. (5-PS1-2)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-levels: **2.PS1.A** (5-PS1-1),(5-PS1-2),(5-PS1-3); **2.PS1.B** (5-PS1-2),(5-PS1-4); **MS.PS1.A** (5-PS1-1),(5-PS1-2),(5-PS1-3),(5-PS1-4); **MS.PS1.B** (5-PS1-2),(5-PS1-4)

Common Core State Standards Connections:

ELA/Literacy –

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-PS1-1)*

W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. *(5-PS1-2),(5-PS1-3),*(5-PS1-4)

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. *(5-PS1-2),(5-PS1-3),*(5-PS1-4)

W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. *(5-PS1-2),(5-PS1-3),(5-PS1-4)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(5-PS1-1),*(5-PS1-2),(5-PS1-3)

MP.4 Model with mathematics. *(5-PS1-1),*(5-PS1-2),(5-PS1-3)

MP.5 Use appropriate tools strategically. (5-PS1-2),(5-PS1-3)

5.NBT.A.1 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. (*5-PS1-1)*

5.NF.B.7 Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (*5-PS1-1)*

5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems. *(5-PS1-2)*

5.MD.C.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement. *(5-PS1-1)*

5.MD.C.4 Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. *(5-PS1-1)*

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5-PS2 Motion and Stability: Forces and Interactions

5-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down. [Clarification Statement: "Down" is a local description of the direction that points toward the center of the spherical Earth.] [Assessment Boundary: Assessment does not include mathematical representation of gravitational force.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). ▪ Support an argument with evidence, data, or a model. (5-PS2-1)	**PS2.B: Types of Interactions** ▪ The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center. (5-PS2-1)	**Cause and Effect** ▪ Cause and effect relationships are routinely identified and used to explain change. (5-PS2-1)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-levels: **3.PS2.A** (5-PS2-1); **3.PS2.B** (5-PS2-1); **MS.PS2.B** (5-PS2-1); **MS.ESS1.B** (5-PS2-1); **MS.ESS2.C** (5-PS2-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(5-PS2-1)*

RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-PS2-1)

W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-PS2-1)

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5-PS3 Energy

5-PS3 Energy		
Students who demonstrate understanding can: **5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.** [Clarification Statement: Examples of models could include diagrams, and flow charts.]		
The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Developing and Using Models Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions. ▪ Use models to describe phenomena. (5-PS3-1)	**PS3.D: Energy in Chemical Processes and Everyday Life** ▪ The energy released [from] food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water). (5-PS3-1) **LS1.C: Organization for Matter and Energy Flow in Organisms** ▪ Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. *(secondary to 5-PS3-1)*	**Energy and Matter** ▪ Energy can be transferred in various ways and between objects. (5-PS3-1)
Connections to other DCIs in fifth grade: N/A		
Articulation of DCIs across grade-levels: **K.LS1.C** (5-PS3-1); **2.LS2.A** (5-PS3-1); **4.PS3.A** (5-PS3-1); **4.PS3.B** (5-PS3-1); **4.PS3.D** (5-PS3-1); **MS.PS3.D** (5-PS3-1); **MS.PS4.B** (5-PS3-1); **MS.LS1.C** (5-PS3-1); **MS.LS2.B** (5-PS3-1)		
Common Core State Standards Connections: *ELA/Literacy –* **RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-PS3-1)* **SL.5.5** Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. *(5-PS3-1)*		

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5-LS1 From Molecules to Organisms: Structures and Processes

5-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water. [Clarification Statement: Emphasis is on the idea that plant matter comes mostly from air and water, not from the soil.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). ▪ Support an argument with evidence, data, or a model. (5-LS1-1)	**LS1.C: Organization for Matter and Energy Flow in Organisms** ▪ Plants acquire their material for growth chiefly from air and water. (5-LS1-1)	**Energy and Matter** ▪ Matter is transported into, out of, and within systems. (5-LS1-1)

Connections to other DCIs in fifth grade: **5.PS1.A** (5-LS1-1)

Articulation of DCIs across grade-levels: **K.LS1.C** (5-LS1-1); **2.LS2.A** (5-LS1-1); **MS.LS1.C** (5-LS1-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(5-LS1-1)*

RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-LS1-1)

W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-LS1-1)

Mathematics –

MP.2 Reason abstractly and quantitatively. *(5-LS1-1)*

MP.4 Model with mathematics. *(5-LS1-1)*

MP.5 Use appropriate tools strategically. *(5-LS1-1)*

5.MD.A.1 Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. *(5-LS1-1)*

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5-LS2 Ecosystems: Interactions, Energy, and Dynamics

5-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

[Clarification Statement: Emphasis is on the idea that matter that is not food (air, water, decomposed materials in soil) is changed by plants into matter that is food. Examples of systems could include organisms, ecosystems, and the Earth.] [Assessment Boundary: Assessment does not include molecular explanations.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 3–5 builds on K–2 models and progresses to building and revising simple models and using models to represent events and design solutions.

- Develop a model to describe phenomena. (5-LS2-1)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Science explanations describe the mechanisms for natural events. (5-LS2-1)

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems

- The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem. (5-LS2-1)

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems

- Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment. (5-LS2-1)

Crosscutting Concepts

Systems and System Models

- A system can be described in terms of its components and their interactions. (5-LS2-1)

Connections to other DCIs in fifth grade: **5.PS1.A** (5-LS2-1); **5.ESS2.A** (5-LS2-1)

Articulation of DCIs across grade-levels: **2.PS1.A** (5-LS2-1); **2.LS4.D** (5-LS2-1); **4.ESS2.E** (5-LS2-1); **MS.PS3.D** (5-LS2-1); **MS.LS1.C** (5-LS2-1); **MS.LS2.A** (5-LS2-1); **MS.LS2.B** (5-LS2-1)

Common Core State Standards Connections:

ELA/Literacy –

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-LS2-1)*

SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. *(5-LS2-1)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(5-LS2-1)*

MP.4 Model with mathematics. *(5-LS2-1)*

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5-ESS1 Earth's Place in the Universe

5-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. [Assessment Boundary: Assessment is limited to relative distances, not sizes, of stars. Assessment does not include other factors that affect apparent brightness (such as stellar masses, age, stage).]

5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. [Clarification Statement: Examples of patterns could include the position and motion of Earth with respect to the sun and selected stars that are visible only in particular months.] [Assessment Boundary: Assessment does not include causes of seasons.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.
- Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships. (5-ESS1-2)

Engaging in Argument from Evidence
Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).
- Support an argument with evidence, data, or a model. (5-ESS1-1)

Disciplinary Core Ideas

ESS1.A: The Universe and its Stars
- The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. (5-ESS1-1)

ESS1.B: Earth and the Solar System
- The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year. (5-ESS1-2)

Crosscutting Concepts

Patterns
- Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena. (5-ESS1-2)

Scale, Proportion, and Quantity
- Natural objects exist from the very small to the immensely large. (5-ESS1-1)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-levels: **1.ESS1.A** (5-ESS1-2); **1.ESS1.B** (5-ESS1-2); **3.PS2.A** (5-ESS1-2); **MS.ESS1.A** (5-ESS1-1),(5-ESS1-2); **MS.ESS1.B** (5-ESS1-1),(5-ESS1-2)

Common Core State Standards Connections:

ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(5-ESS1-1)*
RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-ESS1-1)*
RI.5.8 Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s). *(5-ESS1-1)*
RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS1-1)
W.5.1 Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (5-ESS1-1)
SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. *(5-ESS1-2)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(5-ESS1-1),*(5-ESS1-2)
MP.4 Model with mathematics. *(5-ESS1-1),*(5-ESS1-2)
5.NBT.A.2 Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. *(5-ESS1-1)*
5.G.A.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. (5-ESS1-2)

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5-ESS2 Earth's Systems

5-ESS2 Earth's Systems

Students who demonstrate understanding can:

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]

5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. [Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
- Develop a model using an example to describe a scientific principle. (5-ESS2-1)

Using Mathematics and Computational Thinking
Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions.
- Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)

Disciplinary Core Ideas

ESS2.A: Earth Materials and Systems
- Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. (5-ESS2-1)

ESS2.C: The Roles of Water in Earth's Surface Processes
- Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)

Crosscutting Concepts

Scale, Proportion, and Quantity
- Standard units are used to measure and describe physical quantities such as weight and volume. (5-ESS2-2)

Systems and System Models
- A system can be described in terms of its components and their interactions. (5-ESS2-1)

Connections to other DCIs in fifth grade: N/A

Articulation of DCIs across grade-levels: **2.ESS2.A** (5-ESS2-1); **2.ESS2.C** (5-ESS2-2); **3.ESS2.D** (5-ESS2-1); **4.ESS2.A** (5-ESS2-1); **MS.ESS2.A** (5-ESS2-1); **MS.ESS2.C** (5-ESS2-1),(5-ESS2-2); **MS.ESS2.D** (5-ESS2-1); **MS.ESS3.A** (5-ESS2-2)

Common Core State Standards Connections:

ELA/Literacy –

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(5-ESS2-1),(5-ESS2-2)*

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (*5-ESS2-2)*

SL.5.5 Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. *(5-ESS2-1),(5-ESS2-2)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(5-ESS2-1),*(5-ESS2-2)

MP.4 Model with mathematics. *(5-ESS2-1),*(5-ESS2-2)

5.G.A.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. *(5-ESS2-1)*

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*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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5-ESS3 Earth and Human Activity

5-ESS3 Earth and Human Activity		
Students who demonstrate understanding can: **5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.**		
The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. ▪ Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1)	**ESS3.C: Human Impacts on Earth Systems** ▪ Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)	**Systems and System Models** ▪ A system can be described in terms of its components and their interactions. (5-ESS3-1) ---------- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World.** ▪ Science findings are limited to questions that can be answered with empirical evidence. (5-ESS3-1)
Connections to other DCIs in fifth grade: N/A		
Articulation of DCIs across grade-levels: **MS.ESS3.A** (5-ESS3-1); **MS.ESS3.C** (5-ESS3-1); **MS.ESS3.D** (5-ESS3-1)		
Common Core State Standards Connections: *ELA/Literacy –* **RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(5-ESS3-1)* **RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.(5-ESS3-1) **RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1) **W.5.8** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS3-1) **W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. *(5-ESS3-1)* *Mathematics –* **MP.2** Reason abstractly and quantitatively. *(5-ESS3-1)* **MP.4** Model with mathematics. *(5-ESS3-1)*		

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3-5-ETS1 Engineering Design

3-5-ETS1 Engineering Design

Students who demonstrate understanding can:

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.

- Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-5-ETS1-3)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

ETS1.B: Developing Possible Solutions

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)
- Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

ETS1.C: Optimizing the Design Solution

- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. (3-5-ETS1-3)

Crosscutting Concepts

Influence of Engineering, Technology, and Science on Society and the Natural World

- People's needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)
- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

Connections to 3-5-ETS1.A: Defining and Delimiting Engineering Problems include:
Fourth Grade: 4-PS3-4
Connections to 3-5-ETS1.B: Designing Solutions to Engineering Problems include:
Fourth Grade: 4-ESS3-2
Connections to 3-5-ETS1.C: Optimizing the Design Solution include:
Fourth Grade: 4-PS4-3

Articulation of DCIs across grade-bands: **K-2.ETS1.A** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **K-2.ETS1.B** (3-5-ETS1-2); **K-2.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3); **MS.ETS1.A** (3-5-ETS1-1); **MS.ETS1.B** (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3); **MS.ETS1.C** (3-5-ETS1-2),(3-5-ETS1-3)

Common Core State Standards Connections:

ELA/Literacy –

RI.5.1 Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. *(3-5-ETS-2)*
RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. *(3-5-ETS-2)*
RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (3-5-ETS-2)
W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (3-5-ETS1-1),(3-5-ETS1-3)
W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. *(3-5-ETS1-1),(3-5-ETS1-3)*
W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. *(3-5-ETS1-1),(3-5-ETS1-3)*

Mathematics –

MP.2 Reason abstractly and quantitatively. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
MP.4 Model with mathematics. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
MP.5 Use appropriate tools strategically. *(3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)*
3-5.OA Operations and Algebraic Thinking *(3-5-ETS1-1),(3-5-ETS1-2)*

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Middle School Physical Science

Students in middle school continue to develop understanding of four core ideas in the physical sciences. The middle school performance expectations in the Physical Sciences build on the K – 5 ideas and capabilities to allow learners to explain phenomena central to the physical sciences but also to the life sciences and earth and space science. The performance expectations in physical science blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge to explain real world phenomena in the physical, biological, and earth and space sciences. In the physical sciences, performance expectations at the middle school level focus on students developing understanding of several scientific practices. These include developing and using models, planning and conducting investigations, analyzing and interpreting data, using mathematical and computational thinking, and constructing explanations; and to use these practices to demonstrate understanding of the core ideas. Students are also expected to demonstrate understanding of several of engineering practices including design and evaluation.

The performance expectations in **PS1: Matter and its Interactions** help students to formulate an answer to the question, "How do atomic and molecular interactions explain the properties of matter that we see and feel?" by building understanding of what occurs at the atomic and molecular scale. In middle school, the PS1 Disciplinary Core Idea from the *NRC Framework* is broken down into two sub-ideas: the structure and properties of matter, and chemical reactions. By the end of middle school, students will be able to apply understanding that pure substances have characteristic physical and chemical properties and are made from a single type of atom or molecule. They will be able to provide molecular level accounts to explain states of matters and changes between states, that chemical reactions involve regrouping of atoms to form new substances, and that atoms rearrange during chemical reactions. Students are also able to apply an understanding of the design and the process of optimization in engineering to chemical reaction systems. The crosscutting concepts of patterns; cause and effect; scale, proportion and quantity; energy and matter; structure and function; interdependence of science, engineering, and technology; and influence of science, engineering and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas. In the PS1 performance expectations, students are expected to demonstrate proficiency in developing and using models, analyzing and interpreting data, designing solutions, and obtaining, evaluating, and communicating information. Students use these scientific and engineering practices to demonstrate understanding of the disciplinary core ideas.

The performance expectations in **PS2: Motion and Stability: Forces and Interactions** focuses on helping students understand ideas related to why some objects will keep moving, why objects fall to the ground and why some materials are attracted to each other while others are not. Students answer the question, "How can one describe physical interactions between objects and within systems of objects?" At the middle school level, the PS2 Disciplinary Core Idea from the *NRC Framework* is broken down into two sub-ideas: Forces and Motion and Types of interactions. By the end of middle school, students will be able to apply Newton's Third Law of Motion to relate forces to explain the motion of objects. Students also apply ideas about gravitational, electrical, and magnetic forces to explain a variety of phenomena including beginning ideas about why some materials attract each other while others repel. In particular, students will develop understanding that gravitational interactions are always attractive but that

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electrical and magnetic forces can be both attractive and negative. Students also develop ideas that objects can exert forces on each other even though the objects are not in contact, through fields. Students are also able to apply an engineering practice and concept to solve a problem caused when objects collide. The crosscutting concepts of cause and effect; system and system models; stability and change; and the influence of science, engineering, and technology on society and the natural world serve as organizing concepts for these disciplinary core ideas. In the PS2 performance expectations, students are expected to demonstrate proficiency in asking questions, planning and carrying out investigations, and designing solutions, and engaging in argument; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **PS3: Energy** help students formulate an answer to the question, "How can energy be transferred from one object or system to another?" At the middle school level, the PS3 Disciplinary Core Idea from the *NRC Framework* is broken down into four sub-core ideas: Definitions of Energy, Conservation of Energy and Energy Transfer, the Relationship between Energy and Forces, and Energy in Chemical Process and Everyday Life. Students develop their understanding of important qualitative ideas about energy including that the interactions of objects can be explained and predicted using the concept of transfer of energy from one object or system of objects to another, and the total change of energy in any system is always equal to the total energy transferred into or out of the system. Students understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions. Students will also come to know the difference between energy and temperature, and begin to develop an understanding of the relationship between force and energy. Students are also able to apply an understanding of design to the process of energy transfer. The crosscutting concepts of scale, proportion, and quantity; systems and system models; and energy are called out as organizing concepts for these disciplinary core ideas. The performance expectations in PS3 expect students to demonstrate proficiency in developing and using models, planning investigations, analyzing and interpreting data, and designing solutions, and engaging in argument from evidence; and to use these practices to demonstrate understanding of the core ideas in PS3.

The performance expectations in **PS4: Waves and Their Applications in Technologies for Information Transfer** help students formulate an answer to the question, "What are the characteristic properties of waves and how can they be used?" At the middle school level, the PS4 Disciplinary Core Idea from the *NRC Framework* is broken down into Wave Properties, Electromagnetic Radiation, and Information Technologies and Instrumentation. Students are able to describe and predict characteristic properties and behaviors of waves when the waves interact with matter. Students can apply an understanding of waves as a means to send digital information. The crosscutting concepts of patterns and structure and function are used as organizing concepts for these disciplinary core ideas. The performance expectations in PS4 focus on students demonstrating proficiency in developing and using models, using mathematical thinking, and obtaining, evaluating and communicating information; and to use these practices to demonstrate understanding of the core ideas.

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Middle School Life Science

Students in middle school develop understanding of key concepts to help them make sense of life science. The ideas build upon students' science understanding from earlier grades and from the disciplinary core ideas, science and engineering practices, and crosscutting concepts of other experiences with physical and earth sciences. There are four life science disciplinary core ideas in middle school: *1) From Molecules to Organisms: Structures and Processes, 2) Ecosystems: Interactions, Energy, and Dynamics, 3) Heredity: Inheritance and Variation of Traits, 4) Biological Evolution: Unity and Diversity*. The performance expectations in middle school blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge across the science disciplines. While the performance expectations in middle school life science couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many science and engineering practices integrated in the performance expectations.

The performance expectations in **LS1:** ***From Molecules to Organisms: Structures and Processes*** help students formulate an answer to the question, "How can one explain the ways cells contribute to the function of living organisms." The LS1 Disciplinary Core Idea from the *NRC Framework* is organized into four sub-ideas: Structure and Function, Growth and Development of Organisms, Organization for Matter and Energy Flow in Organisms, and Information Processing. Students can gather information and use this information to support explanations of the structure and function relationship of cells. They can communicate understanding of cell theory. They have a basic understanding of the role of cells in body systems and how those systems work to support the life functions of the organism. The understanding of cells provides a context for the plant process of photosynthesis and the movement of matter and energy needed for the cell. Students can construct an explanation for how environmental and genetic factors affect growth of organisms. They can connect this to the role of animal behaviors in reproduction of animals as well as the dependence of some plants on animal behaviors for their reproduction. Crosscutting concepts of cause and effect, structure and function, and matter and energy are called out as organizing concepts for the core ideas about processes of living organisms.

The performance expectations in **LS2:** ***Interactions, Energy, and Dynamics Relationships in Ecosystems*** help students formulate an answer to the question, "How does a system of living and non-living things operate to meet the needs of the organisms in an ecosystem?" The LS2 Disciplinary Core Idea is divided into three sub-ideas: Interdependent Relationships in Ecosystems; Cycles of Matter and Energy Transfer in Ecosystems; and Ecosystem Dynamics, Functioning, and Resilience. Students can analyze and interpret data, develop models, and construct arguments and demonstrate a deeper understanding of resources and the cycling of matter and the flow of energy in ecosystems. They can also study patterns of the interactions among organisms within an ecosystem. They consider biotic and abiotic factors in an ecosystem and the effects these factors have on population. They evaluate competing design solutions for maintaining biodiversity and ecosystem services.

The performance expectations in **LS3: Heredity: Inheritance and Variation of Traits** help students formulate an answer to the question, "How do living organisms pass traits from one generation to the next?" The LS3 Disciplinary Core Idea from the *NRC Framework* includes two sub-ideas: Inheritance of Traits, and Variation of Traits. Students can use models to describe

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ways gene mutations and sexual reproduction contribute to genetic variation. Crosscutting concepts of cause and effect and structure and function provide students with a deeper understanding of how gene structure determines differences in the functioning of organisms.

The performance expectations in **LS4: Biological Evolution: Unity and Diversity** help students formulate an answer to the question, "How do organisms change over time in response to changes in the environment?" The LS4 Disciplinary Core Idea is divided into four sub-ideas: Evidence of Common Ancestry and Diversity, Natural Selection, Adaptation, and Biodiversity and Humans. Students can construct explanations based on evidence to support fundamental understandings of natural selection and evolution. They can use ideas of genetic variation in a population to make sense of organisms surviving and reproducing, hence passing on the traits of the species. They are able to use fossil records and anatomical similarities of the relationships among organisms and species to support their understanding. Crosscutting concepts of patterns and structure and function contribute to the evidence students can use to describe biological evolution.

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Middle School Earth and Space Sciences

Students in middle school develop understanding of a wide range of topics in Earth and space science (ESS) that build upon science concepts from elementary school through more advanced content, practice, and crosscutting themes. There are six ESS standard topics in middle school: *Space Systems*, *History of Earth*, *Earth's Interior Systems*, *Earth's Surface Systems*, *Weather and Climate*, and *Human Impacts*. The content of the performance expectations are based on current community-based geoscience literacy efforts such as the Earth Science Literacy Principles (Wysession et al., 2012), and is presented with a greater emphasis on an Earth Systems Science approach. The performance expectations strongly reflect the many societally relevant aspects of ESS (resources, hazards, environmental impacts) as well as related connections to engineering and technology. While the performance expectations shown in middle school ESS couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.

The performance expectations in **MS.Space Systems** help students formulate answers to the questions: "What is Earth's place in the Universe?" and "What makes up our solar system and how can the motion of Earth explain seasons and eclipses?" Two sub-ideas from the NRC *Framework* are addressed in these performance expectations: ESS1.A and ESS1.B. Middle school students can examine the Earth's place in relation to the solar system, Milky Way galaxy, and universe. There is a strong emphasis on a systems approach, using models of the solar *system* to explain astronomical and other observations of the cyclic patterns of eclipses, tides, and seasons. There is also a strong connection to engineering through the instruments and technologies that have allowed us to explore the objects in our solar system and obtain the data that support the theories that explain the formation and evolution of the universe. The crosscutting concepts of patterns; scale, proportion, and quantity; systems and system models; and interdependence of science, engineering, and technology are called out as organizing concepts for these disciplinary core ideas. In the MS.Space Systems performance expectations, students are expected to demonstrate proficiency in developing and using models and analyzing and interpreting data; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **MS.History of Earth** help students formulate answers to the questions: "How do people figure out that the Earth and life on Earth have changed over time?" and "How does the movement of tectonic plates impact the surface of Earth?" Four sub-ideas from the NRC *Framework* are addressed in these performance expectations: ESS1.C, ESS2.A, ESS2.B, and ESS2.C. Students can examine geoscience data in order to understand the processes and events in Earth's history. Important concepts in this topic are "Scale, Proportion, and Quantity" and "Stability and Change," in relation to the different ways geologic processes operate over the long expanse of geologic time. An important aspect of the history of Earth is that geologic events and conditions have affected the evolution of life, but different life forms have also played important roles in altering Earth's systems. In the MS.History of Earth performance expectations, students are expected to demonstrate proficiency in analyzing and

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interpreting data, and constructing explanations; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **MS.Earth's Systems** help students formulate answers to the questions: "How do the materials in and on Earth's crust change over time?" and "How does water influence weather, circulate in the oceans, and shape Earth's surface?" Three sub-ideas from the NRC *Framework* are addressed in these performance expectations: ESS2.A, ESS2.C, and ESS3.A. Students understand how Earth's geosystems operate by modeling the flow of energy and cycling of matter within and among different systems. Students can investigate the controlling properties of important materials and construct explanations based on the analysis of real geoscience data. Of special importance in both topics are the ways that geoscience processes provide resources needed by society but also cause natural hazards that present risks to society; both involve technological challenges, for the identification and development of resources and for the mitigation of hazards. The crosscutting concepts of cause and effect, energy and matter, and stability and change are called out as organizing concepts for these disciplinary core ideas. In the MS.Earth's Systems performance expectations, students are expected to demonstrate proficiency in developing and using models and constructing explanations; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **MS.Weather and Climate** help students formulate an answer to the question: "What factors interact and influence weather and climate?" Three sub-ideas from the NRC *Framework* are addressed in these performance expectations: ESS2.C, ESS2.D, and ESS3.D. Students can construct and use models to develop understanding of the factors that control weather and climate. A systems approach is also important here, examining the feedbacks between systems as energy from the sun is transferred between systems and circulates though the ocean and atmosphere. The crosscutting concepts of cause and effect, systems and system models, and stability and change are called out as organizing concepts for these disciplinary core ideas. In the MS.Weather and Climate performance expectations, students are expected to demonstrate proficiency in asking questions, developing and using models, and planning and carrying out investigations; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **MS.Human Impacts** help students formulate answers to the questions: "How can natural hazards be predicted?" and "How do human activities affect Earth systems?" Two sub-ideas from the NRC *Framework* are addressed in these performance expectations: ESS3.B and ESS3.C. Students understand the ways that human activities impacts Earth's other systems. Students can use many different practices to understand the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts of their development. The crosscutting concepts of patterns; cause and effect; and interdependence of science, engineering, and technology are called out as organizing concepts for these disciplinary core ideas.

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Middle School Engineering Design Storylines

By the time students reach middle school they should have had numerous experiences in engineering design. The goal for middle school students is to define problems more precisely, to conduct a more thorough process of choosing the best solution, and to optimize the final design.

Defining the problem with "precision" involves thinking more deeply than is expected in elementary school about the needs a problem is intended to address, or the goals a design is intended to reach. How will the end user decide whether or not the design is successful? Also at this level students are expected to consider not only the end user, but also the broader society and the environment. Every technological change is likely to have both intended and unintended effects. It is up to the designer to try to anticipate the effects it may have, and to behave responsibly in developing a new or improved technology. These considerations may take the form of either criteria or constraints on possible solutions.

Developing possible solutions does not explicitly address generating design ideas since students were expected to develop the capability in elementary school. The focus in middle school is on a two stage process of evaluating the different ideas that have been proposed: by using a systematic method, such as a tradeoff matrix, to determine which solutions are most promising, and by testing different solutions, and then combining the best ideas into new solution that may be better than any of the preliminary ideas.

Improving designs at the middle school level involves an iterative process in which students test the best design, analyze the results, modify the design accordingly, and then re-test and modify the design again. Students may go through this cycle two, three, or more times in order to reach the optimal (best possible) result.

Connections with other science disciplines help students develop these capabilities in various contexts. For example, in the life sciences students apply their engineering design capabilities to evaluate plans for maintaining biodiversity and ecosystem services (MS-LS2-5). In the physical sciences students define and solve problems involving a number of core ideas in physical science, including: chemical processes that release or absorb energy (MS-PS1-6), Newton's third law of motion (MS-PS2-1), and energy transfer (MS-PS3-3). In the Earth and space sciences students apply their engineering design capabilities to problems related the impacts of humans on Earth systems (MS-ESS3-3).

By the end of 8th grade students are expected to achieve all four performance expectations (MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, and MS-ETS1-4) related to a single problem in order to understand the interrelated processes of engineering design. These include defining a problem by precisely specifying criteria and constraints for solutions as well as potential impacts on society and the natural environment, systematically evaluating alternative solutions, analyzing data from tests of different solutions and combining the best ideas into an improved solution, and developing a model and iteratively testing and improving it to reach an optimal solution. While the performance expectations shown in Middle School Engineering Design couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.

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MS-PS1 Matter and Its Interactions

MS-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]

MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]

MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]

MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to predict and/or describe phenomena. (MS-PS1-1),(MS-PS1-4)
- Develop a model to describe unobservable mechanisms. (MS-PS1-5)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.
- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods.
- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science knowledge is based upon logical and conceptual connections between evidence and

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter
- Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)
- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2),(MS-PS1-3)
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)

PS1.B: Chemical Reactions
- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2),(MS-PS1-3),(MS-PS1-5)
- The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)
- Some chemical reactions release energy, others store energy. (MS-PS1-6)

PS3.A: Definitions of Energy
- The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. *(secondary to MS-PS1-4)*
- The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends

Crosscutting Concepts

Patterns
- Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2)

Cause and Effect
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)

Scale, Proportion, and Quantity
- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1)

Energy and Matter
- Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5)
- The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)

Structure and Function
- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS1-3)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-PS1-3)

Influence of Science, Engineering and Technology on Society and the Natural World
- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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explanations. (MS-PS1-2) **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ▪ Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5)	jointly on the temperature, the total number of atoms in the system, and the state of the material. *(secondary to MS-PS1-4)* **ETS1.B: Developing Possible Solutions** ▪ A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. *(secondary to MS-PS1-6)* **ETS1.C: Optimizing the Design Solution** ▪ Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. *(secondary to MS-PS1-6)* ▪ The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. *(secondary to MS-PS1-6)*	resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-PS1-3)

Connections to other DCIs in this grade-band: **MS.PS3.D** (MS-PS1-2),(MS-PS1-6); **MS.LS1.C** (MS-PS1-2),(MS-PS1-5); **MS.LS2.A** (MS-PS1-3); **MS.LS2.B** (MS-PS1-5); **MS.LS4.D** (MS-PS1-3); **MS.ESS2.A** (MS-PS1-2),(MS-PS1-5); **MS.ESS2.C** (MS-PS1-1),(MS-PS1-4); **MS.ESS3.A** (MS-PS1-3); **MS.ESS3.C** (MS-PS1-3)

Articulation across grade-bands: **5.PS1.A** (MS-PS1-1); **5.PS1.B** (MS-PS1-2),(MS-PS1-5); **HS.PS1.A** (MS-PS1-1),(MS-PS1-3),(MS-PS1-4),(MS-PS1-6); **HS.PS1.B** (MS-PS1-2),(MS-PS1-4),(MS-PS1-5),(MS-PS1-6); **HS.PS3.A** (MS-PS1-4),(MS-PS1-6); **HS.PS3.B** (MS-PS1-6); **HS.PS3.D** (MS-PS1-6); **HS.LS2.A** (MS-PS1-3); **HS.LS4.D** (MS-PS1-3); **HS.ESS1.A** (MS-PS1-1); **HS.ESS3.A** (MS-PS1-3)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions *(MS-PS1-2),*(MS-PS1-3)
RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). *(MS-PS1-1),*(MS-PS1-2),*(MS-PS1-4),(MS-PS1-5)*
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS1-6)
WHST.6-8.8	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-3)

Mathematics –

MP.2	Reason abstractly and quantitatively. (MS-PS1-1),(MS-PS1-2),(MS-PS1-5)
MP.4	Model with mathematics. *(MS-PS1-1),*(MS-PS1-5)
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems. *(MS-PS1-1),(MS-PS1-2),*(MS-PS1-5)
6.NS.C.5	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4)
8.EE.A.3	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *(MS-PS1-1)*
6.SP.B.4	Display numerical data in plots on a number line, including dot plots, histograms, and box plots. *(MS-PS1-2)*
6.SP.B.5	Summarize numerical data sets in relation to their context (MS-PS1-2)

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MS-PS2 Motion and Stability: Forces and Interactions

MS-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.* [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]

MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]

MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]

MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]

MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
- Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.
- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS2-2)
- Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. (MS-PS2-5)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
- Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1)

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.
- Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS2-2),(MS-PS2-4)

Disciplinary Core Ideas

PS2.A: Forces and Motion
- For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1)
- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2)
- All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. (MS-PS2-2)

PS2.B: Types of Interactions
- Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3)
- Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4)
- Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5)

Crosscutting Concepts

Cause and Effect
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3),(MS-PS2-5)

Systems and System Models
- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1),(MS-PS2-4),

Stability and Change
- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS-PS2-2)

Connections to Engineering, Technology and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-PS2-1)

Connections to other DCIs in this grade-band: **MS.PS3.A** (MS-PS2-2); **MS.PS3.B** (MS-PS2-2); **MS.PS3.C** (MS-PS2-1); **MS.ESS1.A** (MS-PS2-4); **MS.ESS1.B** (MS-PS2-4); **MS.ESS2.C** (MS-PS2-2),(MS-PS2-4)

Articulation across grade-bands: **3.PS2.A** (MS-PS2-1),(MS-PS2-2); **3.PS2.B** (MS-PS2-3),(MS-PS2-5); **5.PS2.B** (MS-PS2-4); **HS.PS2.A** (MS-PS2-1),(MS-PS2-2); **HS.PS2.B** (MS-PS2-3),(MS-PS2-4),(MS-PS2-5); **HS.PS3.A** (MS-PS2-5); **HS.PS3.B** (MS-PS2-2),(MS-PS2-5); **HS.PS3.C** (MS-PS2-5); **HS.ESS1.B** (MS-PS2-2),(MS-PS2-4)

Common Core State Standards Connections:
ELA/Literacy –

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MS-PS2 Motion and Stability: Forces and Interactions

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions *(MS-PS2-1),(MS-PS2-3)*
RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. *(MS-PS2-1),(*MS-PS2-2)*,(MS-PS2-5)*
WHST.6-8.1	Write arguments focused on *discipline-specific content*. (MS-PS2-4)
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. *(MS-PS2-1),*(MS-PS2-2),*(MS-PS2-5)*
Mathematics –	
MP.2	Reason abstractly and quantitatively. (MS-PS2-1),(MS-PS2-2),(MS-PS2-3)
6.NS.C.5	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS2-1)
6.EE.A.2	Write, read, and evaluate expressions in which letters stand for numbers. *(MS-PS2-1),(MS-PS2-2)*
7.EE.B.3	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *(MS-PS2-1),(MS-PS2-2)*
7.EE.B.4	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-PS2-1),(MS-PS2-2)*

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MS-PS3 Energy

MS-PS3 Energy

Students who demonstrate understanding can:

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.]

MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]

MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.* [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to describe unobservable mechanisms. (MS-PS3-2)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.
- Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS-PS3-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
- Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3)

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds.
- Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS-PS3-5)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science knowledge is based upon logical and conceptual connections between evidence and explanations (MS-PS3-4),(MS-PS3-5)

Disciplinary Core Ideas

PS3.A: Definitions of Energy
- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1)
- A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2)
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3-4)

PS3.B: Conservation of Energy and Energy Transfer
- When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5)
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4)
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3)

PS3.C: Relationship Between Energy and Forces
- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)

ETS1.A: Defining and Delimiting an Engineering Problem
- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. *(secondary to MS-PS3-3)*

ETS1.B: Developing Possible Solutions
- A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. *(secondary to MS-PS3-3)*

Crosscutting Concepts

Scale, Proportion, and Quantity
- Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3-1),(MS-PS3-4)

Systems and System Models
- Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2)

Energy and Matter
- Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3-5)
- The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3)

Connections to other DCIs in this grade-band: **MS.PS1.A** (MS-PS3-4); **MS.PS1.B** (MS-PS3-3); **MS.PS2.A** (MS-PS3-1),(MS-PS3-4),(MS-PS3-5); **MS.ESS2.A** (MS-PS3-3); **MS.ESS2.C** (MS-PS3-3),(MS-PS3-4); **MS.ESS2.D** (MS-PS3-3),(MS-PS3-4); **MS.ESS3.D** (MS-PS3-4)

Articulation across grade-bands: **4.PS3.B** (MS-PS3-1),(MS-PS3-3); **4.PS3.C** (MS-PS3-4),(MS-PS3-5); **HS.PS1.B** (MS-PS3-4); **HS.PS2.B** (MS-PS3-2); **HS.PS3.A** (MS-PS3-1),(MS-PS3-4),(MS-PS3-5); **HS.PS3.B** (MS-PS3-1),(MS-PS3-2),(MS-PS3-3),(MS-PS3-4),(MS-PS3-5); **HS.PS3.C** (MS-PS3-2)

Common Core State Standards Connections:

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MS-PS3 Energy

ELA/Literacy –	
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions *(MS-PS3-1),(MS-PS3-5)*
RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. *(MS-PS3-3),*(MS-PS3-4*)*
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS3-1)
WHST.6-8.1	Write arguments focused on discipline content. *(MS-PS3-5)*
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-PS3-3)*,(MS-PS3-4)*
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-PS3-2)*
Mathematics –	
MP.2	Reason abstractly and quantitatively. (MS-PS3-1),(MS-PS3-4),(MS-PS3-5)
6.RP.A.1	Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3-1),*(MS-PS3-5)*
6.RP.A.2	Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship. *(MS-PS3-1)*
7.RP.A.2	Recognize and represent proportional relationships between quantities. (MS-PS3-1),*(MS-PS3-5)*
8.EE.A.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1)
8.EE.A.2	Use square root and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational. *(MS-PS3-1)*
8.F.A.3	Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. (MS-PS3-1),*(MS-PS3-5)*
6.SP.B.5	Summarize numerical data sets in relation to their context. *(MS-PS3-4)*

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*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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MS-PS4 Waves and Their Applications in Technologies for Information Transfer

MS-PS4 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

MS-PS4-1. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.]

MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.]

MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. [Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop and use a model to describe phenomena. (MS-PS4-2)

Using Mathematics and Computational Thinking
Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.
- Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods.
- Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS4-1)

Disciplinary Core Ideas

PS4.A: Wave Properties
- A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1)
- A sound wave needs a medium through which it is transmitted. (MS-PS4-2)

PS4.B: Electromagnetic Radiation
- When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2)
- The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2)
- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2)
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)

PS4.C: Information Technologies and Instrumentation
- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)

Crosscutting Concepts

Patterns
- Graphs and charts can be used to identify patterns in data. (MS-PS4-1)

Structure and Function
- Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS4-2)
- Structures can be designed to serve particular functions. (MS-PS4-3)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
- Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3)

Connections to Nature of Science

Science is a Human Endeavor
- Advances in technology influence the progress of science and science has influenced advances in technology. (MS-PS4-3)

Connections to other DCIs in this grade-band: **MS.LS1.D** (MS-PS4-2)

Articulation across grade-bands: **4.PS3.A** (MS-PS4-1); **4.PS3.B** (MS-PS4-1); **4.PS4.A** (MS-PS4-1); **4.PS4.B** (MS-PS4-2); **4.PS4.C** (MS-PS4-3); **HS.PS4.A** (MS-PS4-1),(MS-PS4-2),(MS-PS4-3); **HS.PS4.B** (MS-PS4-1),(MS-PS4-2); **HS.PS4.C** (MS-PS4-3); **HS.ESS1.A** (MS-PS4-2); **HS.ESS2.A** (MS-PS4-2); **HS.ESS2.C** (MS-PS4-2); **HS.ESS2.D** (MS-PS4-2)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-PS4-3)
RST.6-8.2	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. *(MS-PS4-3)*
RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-PS4-3)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-PS4-3)
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-PS4-1),(MS-PS4-2)*

Mathematics –

MP.2	Reason abstractly and quantitatively. (MS-PS4-1)
MP.4	Model with mathematics. (MS-PS4-1)
6.RP.A.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS4-1)
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS4-1)
7.RP.A.2	Recognize and represent proportional relationships between quantities. (MS-PS4-1)
8.F.A.3	Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *(MS-PS4-1)*

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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MS-LS1 From Molecules to Organisms: Structures and Processes

MS-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living cells, and understanding that living things may be made of one cell or many and varied cells.]

MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]

MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]

MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds, and creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]

MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]

MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. [Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]

MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]

MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]

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The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop and use a model to describe phenomena. (MS-LS1-2)
- Develop a model to describe unobservable mechanisms. (MS-LS1-7)

Planning and Carrying Out Investigations
Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.
- Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.
- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-5),(MS-LS1-6)

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing

Disciplinary Core Ideas

LS1.A: Structure and Function
- All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)
- Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)
- In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)

LS1.B: Growth and Development of Organisms
- Animals engage in characteristic behaviors that increase the odds of reproduction. (MS-LS1-4)
- Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (MS-LS1-4)
- Genetic factors as well as local conditions affect the growth of the adult plant. (MS-LS1-5)

LS1.C: Organization for Matter and Energy Flow in Organisms
- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6)

Crosscutting Concepts

Cause and Effect
- Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8)
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS1-4),(MS-LS1-5)

Scale, Proportion, and Quantity
- Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1)

Systems and System Models
- Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (MS-LS1-3)

Energy and Matter
- Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7)
- Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6)

Structure and Function
- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS1-2)

Connections to Engineering, Technology, and Applications of Science

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).

- Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon. (MS-LS1-3)
- Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS1-4)

Obtaining, Evaluating, and Communicating Information

Obtaining, evaluating, and communicating information in 6-8 builds on K-5 experiences and progresses to evaluating the merit and validity of ideas and methods.

- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS1-8)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical connections between evidence and explanations. (MS-LS1-6)

- Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)

LS1.D: Information Processing

- Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8)

PS3.D: Energy in Chemical Processes and Everyday Life

- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. *(secondary to MS-LS1-6)*
- Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. *(secondary to MS-LS1-7)*

Interdependence of Science, Engineering, and Technology

- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1-1)

Connections to Nature of Science

Science is a Human Endeavor

- Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. (MS-LS1-3)

Connections to other DCIs in this grade-band: **MS.PS1.B** (MS-LS1-6),(MS-LS1-7); **MS.LS2.A** (MS-LS1-4),(MS-LS1-5); **MS.LS3.A** (MS-LS1-2); **MS.ESS2.A** (MS-LS1-6)

Articulation to DCIs across grade-bands: **3.LS1.B** (MS-LS1-4),(MS-LS1-5); **3.LS3.A** (MS-LS1-5); **4.LS1.A** (MS-LS1-2); **4.LS1.D** (MS-LS1-8); **5.PS3.D** (MS-LS1-6),(MS-LS1-7); **5.LS1.C** (MS-LS1-6),(MS-LS1-7); **5.LS2.A** (MS-LS1-6); **5.LS2.B** (MS-LS1-6),(MS-LS1-7); **HS.PS1.B** (MS-LS1-6),(MS-LS1-7); **HS.LS1.A** (MS-LS1-1),(MS-LS1-2),(MS-LS1-3),(MS-LS1-8); **HS.LS1.C** (MS-LS1-6),(MS-LS1-7); **HS.LS2.A** (MS-LS1-4),(MS-LS1-5); **HS.LS2.B** (MS-LS1-6),(MS-LS1-7); **HS.LS2.D** (MS-LS1-4); **HS.ESS2.D** (MS-LS1-6)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-LS1-3),(MS-LS1-4),(MS-LS1-5),(MS-LS1-6)
RST.6-8.2	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. *(MS-LS1-5),(MS-LS1-6)*
RI.6.8	Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not. (MS-LS1-3),(MS-LS1-4)
WHST.6-8.1	Write arguments focused on discipline content. (MS-LS1-3),(MS-LS1-4)
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. *(MS-LS1-5),*(MS-LS1-6)
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-LS1-1)
WHST.6-8.8	Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-LS1-8)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-5),(MS-LS1-6)
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-LS1-2),(MS-LS1-7)*

Mathematics –

6.EE.C.9	Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *(MS-LS1-1),(MS-LS1-2),(MS-LS1-3),(MS-LS1-6)*
6.SP.A.2	Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. *(MS-LS1-4),(MS-LS1-5)*
6.SP.B.4	Summarize numerical data sets in relation to their context. *(MS-LS1-4),(MS-LS1-5)*

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MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. [Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. [Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.* [Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to describe phenomena. (MS-LS2-3)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
- Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2)

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).
- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4)
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems
- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)
- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1)
- Growth of organisms and population increases are limited by access to resources. (MS-LS2-1)
- Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2)

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems
- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4)
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5)

LS4.D: Biodiversity and Humans
- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (*secondary to MS-LS2-5*)

ETS1.B: Developing Possible Solutions
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. *(secondary to MS-LS2-5)*

Crosscutting Concepts

Patterns
- Patterns can be used to identify cause and effect relationships. (MS-LS2-2)

Cause and Effect
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)

Energy and Matter
- The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)

Stability and Change
- Small changes in one part of a system might cause large changes in another part. (MS-LS2-4),(MS-LS2-5)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
- The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-LS2-5)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS2-3)

Science Addresses Questions About the Natural and Material World
- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5)

Connections to other DCIs in this grade-band: **MS.PS1.B** (MS-LS2-3); **MS.LS1.B** (MS-LS2-2); **MS.LS4.C** (MS-LS2-4); **MS.LS4.D** (MS-LS2-4); **MS.ESS2.A** (MS-LS2-3),(MS-LS2-4); **MS.ESS3.A** (MS-LS2-1),(MS-LS2-4); **MS.ESS3.C** (MS-LS2-1),(MS-LS2-4),(MS-LS2-5)

Articulation across grade-bands: **3.LS1.B** (MS-LS2-2); **3.LS2.C** (MS-LS2-1),(MS-LS2-4); **3.LS4.D** (MS-LS2-1),(MS-LS2-4); **5.LS2.A** (MS-LS2-1),(MS-LS2-3); **5.LS2.B** (MS-LS2-3); **HS.PS3.B** (MS-LS2-3); **HS.LS1.C** (MS-LS2-3); **HS.LS2.A** (MS-LS2-1),(MS-LS2-2),(MS-LS2-5); **HS.LS2.B** (MS-LS2-2),(MS-LS2-3); **HS.LS2.C** (MS-LS2-4),(MS-LS2-5); **HS.LS2.D** (MS-LS2-2); **HS.LS4.C** (MS-LS2-1),(MS-LS2-4); **HS.LS4.D** (MS-LS2-1),(MS-LS2-4),(MS-LS2-5); **HS.ESS2.A** (MS-LS2-3); **HS.ESS2.E** (MS-LS2-4); **HS.ESS3.A** (MS-LS2-1),(MS-LS2-5);

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

HS.ESS3.B (MS-LS2-4); **HS.ESS3.C** (MS-LS2-4),(MS-LS2-5); **HS.ESS3.D** (MS-LS2-5)	
Common Core State Standards Connections:	
ELA/Literacy –	
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-1),(MS-LS2-2),(MS-LS2-4)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS2-1)
RST.6-8.8	Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5)
RI.8.8	Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS-4),(MS-LS2-5)
WHST.6-8.1	Write arguments to support claims with clear reasons and relevant evidence. (MS-LS2-4)
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS2-2)
WHST.6-8.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2),(MS-LS2-4)
SL.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. *(MS-LS2-2)*
SL.8.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. *(MS-LS2-2)*
SL.8.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-LS2-3)*
Mathematics –	
MP.4	Model with mathematics. *(MS-LS2-5)*
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems. *(MS-LS2-5)*
6.EE.C.9	Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *(MS-LS2-3)*
6.SP.B.5	Summarize numerical data sets in relation to their context. *(MS-LS2-2)*

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MS-LS3 Heredity: Inheritance and Variation of Traits

MS-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]

MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)

Disciplinary Core Ideas

LS1.B: Growth and Development of Organisms

- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)*

LS3.A: Inheritance of Traits

- Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)

LS3.B: Variation of Traits

- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)
- In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)

Structure and Function

- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

Connections to other DCIs in this grade-band: **MS.LS1.A** (MS-LS3-1); **MS.LS4.A** (MS-LS3-1)

Articulation across grade-bands: **3.LS3.A** (MS-LS3-1),(MS-LS3-2); **3.LS3.B** (MS-LS3-1),(MS-LS3-2); **HS.LS1.A** (MS-LS3-1); **HS.LS1.B** (MS-LS3-1),(MS-LS3-2); **HS.LS3.A** (MS-LS3-1),(MS-LS3-2); **HS.LS3-B** (MS-LS3-1),(MS-LS3-2)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. *(MS-LS3-1),(MS-LS3-2)*
RST.6-8.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. *(MS-LS3-1),(MS-LS3-2)*
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1),(MS-LS3-2)
SL.8.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-LS3-1),(MS-LS3-2)*

Mathematics –

MP.4	Model with mathematics. *(MS-LS3-2)*
6.SP.B.5	Summarize numerical data sets in relation to their context. *(MS-LS3-2)*

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*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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MS-LS4 Biological Evolution: Unity and Diversity

MS-LS4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. [Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.]

MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]

MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. [Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.]

MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]

MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]

MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze displays of data to identify linear and nonlinear relationships. (MS-LS4-3)
- Analyze and interpret data to determine similarities and differences in findings. (MS-LS4-1)

Using Mathematics and Computational Thinking
Mathematical and computational thinking in 6–8 builds on K–5 experiences and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments.
- Use mathematical representations to support scientific conclusions and design solutions. (MS-LS4-6)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
- Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. (MS-LS4-2)
- Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 6–8 builds on K–5 experiences and progresses to evaluating the merit and validity of ideas and methods.
- Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-LS4-5)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-LS4-1)

Disciplinary Core Ideas

LS4.A: Evidence of Common Ancestry and Diversity
- The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1)
- Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2)
- Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3)

LS4.B: Natural Selection
- Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)
- In *artificial* selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. (MS-LS4-5)

LS4.C: Adaptation
- Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)

Crosscutting Concepts

Patterns
- Patterns can be used to identify cause and effect relationships. (MS-LS4-2)
- Graphs, charts, and images can be used to identify patterns in data. (MS-LS4-1),(MS-LS4-3)

Cause and Effect
- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4),(MS-LS4-5),(MS-LS4-6)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
- Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS4-5)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS4-1),(MS-LS4-2)

Science Addresses Questions About the Natural and Material World
- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS4-5)

Connections to other DCIs in this grade-band: **MS.LS2.A** (MS-LS4-4),(MS-LS4-6); **MS.LS2.C** (MS-LS4-6); **MS.LS3.A** (MS-LS4-2),(MS-LS4-4); **MS.LS3.B** (MS-LS4-2),(MS-LS4-4),(MS-LS4-6); **MS.ESS1.C** (MS-LS4-1),(MS-LS4-2),(MS-LS4-6); **MS.ESS2.B** (MS-LS4-1)

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MS-LS4 Biological Evolution: Unity and Diversity

Articulation across grade-bands: **3.LS3.B** (MS-LS4-4); **3.LS4.A** (MS-LS4-1),(MS-LS4-2); **3. LS4.B** (MS-LS4-4); **3.LS4.C** (MS-LS4-6); **HS.LS2.A** (MS-LS4-4),(MS-LS4-6); **HS.LS2.C** (MS-LS4-6); **HS.LS3.B** (MS-LS4-4),(MS-LS4-5),(MS-LS4-6); **HS.LS4.A** (MS-LS4-1),(MS-LS4-2),(MS-LS4-3); **HS.LS4.B** (MS-LS4-4),(MS-LS4-6); **HS.LS4.C** (MS-LS4-4),(MS-LS4- 5),(MS-LS4-6); **HS.ESS1.C** (MS-LS4-1),(MS-LS4-2)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions *(MS-LS4-1),*(MS-LS4-2)*,(MS-LS4-3),(MS-LS4-4),*(MS-LS4-5)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS4-1),(MS-LS4-3)
RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. *(MS-LS4-3),(MS-LS4-4)*
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS4-2),(MS-LS4-4)
WHST.6-8.8	Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. *(MS-LS4-5)*
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2),(MS-LS4-4)
SL.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. *(MS-LS4-2),(MS-LS4-4)*
SL.8.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. *(MS-LS4-2),(MS-LS4-4)*

Mathematics –

MP.4	Model with mathematics. (MS-LS4-6)
6.RP.A.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *(MS-LS4-4),(MS-LS4-6)*
6.SP.B.5	Summarize numerical data sets in relation to their context. *(MS-LS4-4),(MS-LS4-6)*
6.EE.B.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-LS4-1),(MS-LS4-2)*
7.RP.A.2	Recognize and represent proportional relationships between quantities. *(MS-LS4-4),(MS-LS4-6)*

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MS-ESS1 Earth's Place in the Universe

MS-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. [Clarification Statement: Examples of models can be physical, graphical, or conceptual.]

MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. [Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions within them. Examples of models can be physical (such as the analogy of distance along a football field or computer visualizations of elliptical orbits) or conceptual (such as mathematical proportions relative to the size of familiar objects such as students' school or state).] [Assessment Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.]

MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system. [Clarification Statement: Emphasis is on the analysis of data from Earth-based instruments, space-based telescopes, and spacecraft to determine similarities and differences among solar system objects. Examples of scale properties include the sizes of an object's layers (such as crust and atmosphere), surface features (such as volcanoes), and orbital radius. Examples of data include statistical information, drawings and photographs, and models.] [Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.]

MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop and use a model to describe phenomena. (MS-ESS1-1),(MS-ESS1-2)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to determine similarities and differences in findings. (MS-ESS1-3)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS1-4)

Disciplinary Core Ideas

ESS1.A: The Universe and Its Stars
- Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)
- Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2)

ESS1.B: Earth and the Solar System
- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS-ESS1-3)
- This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year. (MS-ESS1-1)
- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2)

ESS1.C: The History of Planet Earth
- The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale. (MS-ESS1-4)

Crosscutting Concepts

Patterns
- Patterns can be used to identify cause-and-effect relationships. (MS-ESS1-1)

Scale, Proportion, and Quantity
- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS1-3),(MS-ESS1-4)

Systems and System Models
- Models can be used to represent systems and their interactions. (MS-ESS1-2)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
- Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-ESS1-3)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-ESS1-1),(MS-ESS1-2)

Connections to other DCIs in this grade-band: **MS.PS2.A** (MS-ESS1-1),(MS-ESS1-2); **MS.PS2.B** (MS-ESS1-1),(MS-ESS1-2); **MS.LS4.A** (MS-ESS1-4); **MS.LS4.C** (MS-ESS1-4); **MS.ESS2.A** (MS-ESS1-3)

Articulation of DCIs across grade-bands: **3.PS2.A** (MS-ESS1-1),(MS-ESS1-2); **3.LS4.A** (MS-ESS1-4); **3.LS4.C** (MS-ESS1-4); **3.LS4.D** (MS-ESS1-4); **4.ESS1.C** (MS-ESS1-4); **5.PS2.B** (MS-ESS1-1),(MS-ESS1-2); **5.ESS1.A** (MS-ESS1-2); **5.ESS1.B** (MS-ESS1-1),(MS-ESS1-2),(5-ESS1-3); **HS.PS1.C** (MS-ESS1-4); **HS.PS2.A** (MS-ESS1-1),(MS-ESS1-2); **HS.PS2.B** (MS-ESS1-1),(MS-ESS1-2); **HS.LS4.A** (MS-ESS1-4); **HS.LS4.C** (MS-ESS1-4); **HS.ESS1.A** (MS-ESS1-2); **HS.ESS1.B** (MS-ESS1-1),(MS-ESS1-2),(MS-ESS1-3); **HS.ESS1.C** (MS-ESS1-4); **HS.ESS2.A** (MS-ESS1-3),(MS-ESS1-4)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-3),(MS-ESS1-4)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS1-3)
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS1-4)
SL.8.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-ESS1-1),(MS-ESS1-2)*

Mathematics –

MP.2	Reason abstractly and quantitatively. (MS-ESS1-3)
MP.4	Model with mathematics. *(MS-ESS1-1),(MS-ESS1-2)*
6.RP.A.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *(MS-ESS1-1),(MS-ESS1-2)*,(MS-ESS1-3)

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MS-ESS1 Earth's Place in the Universe

7.RP.A.2	Recognize and represent proportional relationships between quantities. *(MS-ESS1-1),(MS-ESS1-2),*(MS-ESS1-3)
6.EE.B.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-ESS1-2),(MS-ESS1-4)*
7.EE.B.4	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-ESS1-2),(MS-ESS1-4)*

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MS-ESS2 Earth's Systems

MS-ESS2 Earth's Systems

Students who demonstrate understanding can:

MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]

MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]

MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.]

MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.]

MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. [Clarification Statement: Emphasis is on how air masses flow from regions of high pressure to low pressure, causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time, and how sudden changes in weather can result when different air masses collide. Emphasis is on how weather can be predicted within probabilistic ranges. Examples of data can be provided to students (such as weather maps, diagrams, and visualizations) or obtained through laboratory experiments (such as with condensation).] [Assessment Boundary: Assessment does not include recalling the names of cloud types or weather symbols used on weather maps or the reported diagrams from weather stations.]

MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. [Clarification Statement: Emphasis is on how patterns vary by latitude, altitude, and geographic land distribution. Emphasis of atmospheric circulation is on the sunlight-driven latitudinal banding, the Coriolis effect, and resulting prevailing winds; emphasis of ocean circulation is on the transfer of heat by the global ocean convection cycle, which is constrained by the Coriolis effect and the outlines of continents. Examples of models can be diagrams, maps and globes, or digital representations.] [Assessment Boundary: Assessment does not include the dynamics of the Coriolis effect.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop and use a model to describe phenomena. (MS-ESS2-1),(MS-ESS2-6)
- Develop a model to describe unobservable mechanisms. (MS-ESS2-4)

Planning and Carrying Out Investigations
Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions.
- Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions. (MS-ESS2-5)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to provide evidence for phenomena. (MS-ESS2-3)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe nature operate today as they did in the past and will continue to do so in the future. (MS-ESS2-2)

Connections to Nature of Science

Scientific Knowledge is Open to Revision in Light of New Evidence

Disciplinary Core Ideas

ESS1.C: The History of Planet Earth
- Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches. *(HS.ESS1.C GBE) (secondary to MS-ESS2-3)*

ESS2.A: Earth's Materials and Systems
- All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. (MS-ESS2-1)
- The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future. (MS-ESS2-2)

ESS2.B: Plate Tectonics and Large-Scale System Interactions
- Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. (MS-ESS2-3)

ESS2.C: The Roles of Water in Earth's Surface Processes
- Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)
- The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. (MS-ESS2-5)
- Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)
- Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6)
- Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations. (MS-ESS2-2)

ESS2.D: Weather and Climate
- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. (MS-ESS2-6)
- Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5)
- The ocean exerts a major influence on weather and climate by

Crosscutting Concepts

Patterns
- Patterns in rates of change and other numerical relationships can provide information about natural systems. (MS-ESS2-3)

Cause and Effect
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5)

Scale Proportion and Quantity
- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2-2)

Systems and System Models
- Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. (MS-ESS2-6)

Energy and Matter
- Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)

Stability and Change
- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale. (MS-ESS2-1)

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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MS-ESS2 Earth's Systems

▪ Science findings are frequently revised and/or reinterpreted based on new evidence. (MS-ESS2-3)	absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6)	

Connections to other DCIs in this grade-band: **MS.PS1.A** (MS-ESS2-1),(MS-ESS2-4),(MS-ESS2-5); **MS.PS1.B** (MS-ESS2-1),(MS-ESS2-2); **MS.PS2.A** (MS-ESS2-5),(MS-ESS2-6); **MS.PS2.B** (MS-ESS2-4); **MS.PS3.A** (MS-ESS2-4),(MS-ESS2-5); **MS.PS3.B** (MS-ESS2-1),(MS-ESS2-5),(MS-ESS2-6); **MS.PS3.D** (MS-ESS2-4); **MS.PS4.B** (MS-ESS2-6); **MS.LS2.B** (MS-ESS2-1),(MS-ESS2-2); **MS.LS2.C** (MS-ESS2-1); **MS.LS4.A** (MS-ESS2-3); **MS.ESS1.B** (MS-ESS2-1); **MS.ESS3.C** (MS-ESS2-1)

Articulation of DCIs across grade-bands: **3.PS2.A** (MS-ESS2-4),(MS-ESS2-6); **3.LS4.A** (MS-ESS2-3); **3.ESS2.D** (MS-ESS2-5),(MS-ESS2-6); **3.ESS3.B** (MS-ESS2-3); **4.PS3.B** (MS-ESS2-1),(MS-ESS2-4); **4.ESS1.C** (MS-ESS2-2),(MS-ESS2-3); **4.ESS2.A** (MS-ESS2-1),(MS-ESS2-2); **4.ESS2.B** (MS-ESS2-3); **4.ESS2.E** (MS-ESS2-2); **4.ESS3.B** (MS-ESS2-3); **5.PS2.B** (MS-ESS2-4); **5.ESS2.A** (MS-ESS2-1),(MS-ESS2-2),(MS-ESS2-5),(MS-ESS2-6); **5.ESS2.C** (MS-ESS2-4); **HS.PS1.B** (MS-ESS2-1); **HS.PS2.B** (MS-ESS2-4),(MS-ESS2-6); **HS.PS3.B** (MS-ESS2-1),(MS-ESS2-4),(MS-ESS2-6); **HS.PS3.D** (MS-ESS2-2),(MS-ESS2-6); **HS.PS4.B** (MS-ESS2-4); **HS.LS1.C** (MS-ESS2-1); **HS.LS2.B** (MS-ESS2-1),(MS-ESS2-2); **HS.LS4.A** (MS-ESS2-3); **HS.LS4.C** (MS-ESS2-3); **HS.ESS1.B** (MS-ESS2-6); **HS.ESS1.C** (MS-ESS2-2),(MS-ESS2-3); **HS.ESS2.A** (MS-ESS2-1),(MS-ESS2-2),(MS-ESS2-3),(MS-ESS2-4),(MS-ESS2-6); **HS.ESS2.B** (MS-ESS2-2),(MS-ESS2-3); **HS.ESS2.C** (MS-ESS2-1),(MS-ESS2-2),(MS-ESS2-4),(MS-ESS2-5); **HS.ESS2.D** (MS-ESS2-2),(MS-ESS2-4),(MS-ESS2-5),(MS-ESS2-6); **HS.ESS2.E** (MS-ESS2-1),(MS-ESS2-2); **HS.ESS3.D** (MS-ESS2-2)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS2-2),*(MS-ESS2-3),*(MS-ESS2-5)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS2-3)
RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ESS2-3),(MS-ESS2-5)
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS2-2)
WHST.6-8.8	Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. *(MS-ESS2-5)*
SL.8.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-ESS2-1),(MS-ESS2-2),(MS-ESS2-6)*

Mathematics –

MP.2	Reason abstractly and quantitatively. (MS-ESS2-2),(MS-ESS2-3),(MS-ESS2-5)
6.NS.C.5	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-ESS2-5)
6.EE.B.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-ESS2-2),(MS-ESS2-3)*
7.EE.B.4	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-ESS2-2),(MS-ESS2-3)*

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MS-ESS3 Earth and Human Activity

MS-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).]

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.* [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. [Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.]

MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
- Ask questions to identify and clarify evidence of an argument. (MS-ESS3-5)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to determine similarities and differences in findings. (MS-ESS3-2)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-ESS3-1)
- Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3)

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s).
- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-ESS3-4)

Disciplinary Core Ideas

ESS3.A: Natural Resources
- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)

ESS3.B: Natural Hazards
- Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)

ESS3.C: Human Impacts on Earth Systems
- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3)
- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3),(MS-ESS3-4)

ESS3.D: Global Climate Change
- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)

Crosscutting Concepts

Patterns
- Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)

Cause and Effect
- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-1),(MS-ESS3-4)

Stability and Change
- Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World
- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1),(MS-ESS3-4)
- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-ESS3-2),(MS-ESS3-3)

Connections to Nature of Science

Science Addresses Questions About the Natural and Material World
- Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-ESS3-4)

Connections to other DCIs in this grade-band: **MS.PS1.A** (MS-ESS3-1); **MS.PS1.B** (MS-ESS3-1); **MS.PS3.A** (MS-ESS3-5); **MS.PS3.C** (MS-ESS3-2); **MS.LS2.A** (MS-ESS3-3),(MS-ESS3-4); **MS.LS2.C** (MS-ESS3-3),(MS-ESS3-4); **MS.LS4.D** (MS-ESS3-3),(MS-ESS3-4); **MS.ESS2.D** (MS-ESS3-1)

Articulation of DCIs across grade-bands: **3.LS2.C** (MS-ESS3-3),(MS-ESS3-4); **3.LS4.D** (MS-ESS3-3),(MS-ESS3-4); **3.ESS3.B** (MS-ESS3-2); **4.PS3.D** (MS-ESS3-1); **4.ESS3.A** (MS-ESS3-1); **4.ESS3.B** (MS-ESS3-2); **5.ESS3.C** (MS-ESS3-3),(MS-ESS3-4); **HS.PS3.B** (MS-ESS3-1),(MS-ESS3-5); **HS.PS4.B** (MS-ESS3-5); **HS.LS1.C** (MS-ESS3-1); **HS.LS2.A** (MS-ESS3-4); **HS.LS2.C**

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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(MS-ESS3-3),(MS-ESS3-4); **HS.LS4.C** (MS-ESS3-3),(MS-ESS3-4); **HS.LS4.D** (MS-ESS3-3),(MS-ESS3-4); **HS.ESS2.A** (MS-ESS3-1),(MS-ESS3-5); **HS.ESS2.B** (MS-ESS3-1),(MS-ESS3-2); **HS.ESS2.C** (MS-ESS3-1),(MS-ESS3-3); **HS.ESS2.D** (MS-ESS3-2),(MS-ESS3-3),(MS-ESS3-5); **HS.ESS2.E** (MS-ESS3-3),(MS-ESS3-4); **HS.ESS3.A** (MS-ESS3-1),(MS-ESS3-4); **HS.ESS3.B** (MS-ESS3-2); **HS.ESS3.C** (MS-ESS3-3),(MS-ESS3-4),(MS-ESS3-5); **HS.ESS3.D** (MS-ESS3-2);(MS-ESS3-3),(MS-ESS3-5)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1),*(MS-ESS3-2),*(MS-ESS3-4),(MS-ESS3-5)
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS3-2)
WHST.6-8.1	Write arguments focused on discipline content. (MS-ESS3-4)
WHST.6-8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS3-1)
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3)
WHST.6-8.8	Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ESS3-3)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1),(MS-ESS3-4)

Mathematics –

MP.2	Reason abstractly and quantitatively. (MS-ESS3-2),*(MS-ESS3-5)*
6.RP.A.1	Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *(MS-ESS3-3),(MS-ESS3-4)*
7.RP.A.2	Recognize and represent proportional relationships between quantities. *(MS-ESS3-3),(MS-ESS3-4)*
6.EE.B.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. *(MS-ESS3-1),(MS-ESS3-2),(MS-ESS3-3),(MS-ESS3-4),(MS-ESS3-5)*
7.EE.B.4	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. *(MS-ESS3-1),(MS-ESS3-2),(MS-ESS3-3),(MS-ESS3-4),(MS-ESS3-5)*

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MS-ETS1 Engineering Design

MS-ETS1 Engineering Design

Students who demonstrate understanding can:

MS-ETS1-1. **Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**

MS-ETS1-2. **Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**

MS-ETS1-3. **Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.**

MS-ETS1-4. **Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.**

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.
- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.
- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems
- The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)

ETS1.B: Developing Possible Solutions
- A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)
- Models of all kinds are important for testing solutions. (MS-ETS1-4)

ETS1.C: Optimizing the Design Solution
- Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)
- The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World
- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1)
- The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include:
Physical Science: MS-PS3-3
Connections to MS-ETS1.B: Developing Possible Solutions Problems include:
Physical Science: MS-PS1-6, MS-PS3-3, **Life Science:** MS-LS2-5
Connections to MS-ETS1.C: Optimizing the Design Solution include:
Physical Science: MS-PS1-6

Articulation of DCIs across grade-bands: **3-5.ETS1.A** (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3); **3-5.ETS1.B** (MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4); **3-5.ETS1.C** (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4); **HS.ETS1.A** (MS-ETS1-1),(MS-ETS1-2); **HS.ETS1.B** (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4); **HS.ETS1.C** (MS-ETS1-3),(MS-ETS1-4)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1),*(MS-ETS1-2),(MS-ETS1-3)*
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (*MS-ETS1-3)*
RST.6-8.9	Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3)
WHST.6-8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2)
WHST.6-8.8	Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources. (MS-ETS1-1)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. *(MS-ETS1-2)*
SL.8.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-ETS1-4)*

Mathematics –

MP.2	Reason abstractly and quantitatively. *(MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4)*
7.EE.3	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *(MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)*
7.SP	Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. *(MS-ETS1-4)*

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High School Physical Sciences

Students in high school continue to develop their understanding of the four core ideas in the physical sciences. These ideas include the most fundamental concepts from chemistry and physics, but are intended to leave room for expanded study in upper-level high school courses. The high school performance expectations in Physical Science build on the middle school ideas and skills and allow high school students to explain more in-depth phenomena central not only to the physical sciences, but to life and earth and space sciences as well. These performance expectations blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge to explain ideas across the science disciplines. In the physical science performance expectations at the high school level, there is a focus on several scientific practices. These include developing and using models, planning and conducting investigations, analyzing and interpreting data, using mathematical and computational thinking, and constructing explanations; and to use these practices to demonstrate understanding of the core ideas. Students are also expected to demonstrate understanding of several engineering practices including design and evaluation.

The performance expectations in **PS1: Matter and its interactions** help students formulate an answer to the question, "How can one explain the structure, properties, and interactions of matter?" The PS1 Disciplinary Core Idea from the *NRC Framework* is broken down into three sub-ideas: the structure and properties of matter, chemical reactions, and nuclear processes. Students are expected to develop understanding of the substructure of atoms and to provide more mechanistic explanations of the properties of substances. Chemical reactions, including rates of reactions and energy changes, can be understood by students at this level in terms of the collisions of molecules and the rearrangements of atoms. Students are able to use the periodic table as a tool to explain and predict the properties of elements. Using this expanded knowledge of chemical reactions, students are able to explain important biological and geophysical phenomena. Phenomena involving nuclei are also important to understand, as they explain the formation and abundance of the elements, radioactivity, the release of energy from the sun and other stars, and the generation of nuclear power. Students are also able to apply an understanding of the process of optimization in engineering design to chemical reaction systems. The crosscutting concepts of patterns, energy and matter, and stability and change are called out as organizing concepts for these disciplinary core ideas. In the PS1 performance expectations, students are expected to demonstrate proficiency in developing and using models, planning and conducting investigations, using mathematical thinking, and constructing explanations and designing solutions; and to use these practices to demonstrate understanding of the core ideas.

The Performance Expectations associated with **PS2: Motion and Stability: Forces and Interactions** support students' understanding of ideas related to why some objects will keep moving, why objects fall to the ground and why some materials are attracted to each other while others are not. Students should be able to answer the question, "How can one explain and predict interactions between objects and within systems of objects?" The disciplinary core idea expressed in the *Framework* for PS2 is broken down into the sub ideas of Forces and Motion and Types of Interactions. The performance expectations in PS2 focus on students building understanding of forces and interactions and Newton's Second Law. Students also develop understanding that the total momentum of a system of objects is conserved when there is no net force on the system. Students are able to use Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. Students are able to apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a

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macroscopic object during a collision. The crosscutting concepts of patterns, cause and effect, systems and system models, and structure and function are called out as organizing concepts for these disciplinary core ideas. In the PS2 performance expectations, students are expected to demonstrate proficiency in planning and conducting investigations, analyzing data and using math to support claims, applying scientific ideas to solve design problems, and communicating scientific and technical information; and to use these practices to demonstrate understanding of the core ideas.

The Performance Expectations associated with **PS3: Energy** help students formulate an answer to the question, "How is energy transferred and conserved?" The Core Idea expressed in the *Framework* for PS3 is broken down into four sub-core ideas: Definitions of Energy, Conservation of Energy and Energy Transfer, the Relationship between Energy and Forces, and Energy in Chemical Process and Everyday Life. Energy is understood as quantitative property of a system that depends on the motion and interactions of matter and radiation within that system, and the total change of energy in any system is always equal to the total energy transferred into or out of the system. Students develop an understanding that energy at both the macroscopic and the atomic scale can be accounted for as either motions of particles or energy associated with the configuration (relative positions) of particles. In some cases, the energy associated with the configuration of particles can be thought of as stored in fields. Students also demonstrate their understanding of engineering principles when they design, build, and refine devices associated with the conversion of energy. The crosscutting concepts of cause and effect; systems and system models; energy and matter; and the influence of science, engineering, and technology on society and the natural world are further developed in the performance expectations associated with PS3. In these performance expectations, students are expected to demonstrate proficiency in developing and using models, planning and carry out investigations, using computational thinking and designing solutions; and to use these practices to demonstrate understanding of the core ideas.

The Performance Expectations associated with **PS4: Waves and Their Applications in Technologies for Information Transfer** are critical to understand how many new technologies work. As such, this core idea helps students answer the question, "How are waves used to transfer energy and send and store information?" The disciplinary core idea in PS4 is broken down into Wave Properties, Electromagnetic Radiation, and Information Technologies and Instrumentation. Students are able to apply understanding of how wave properties and the interactions of electromagnetic radiation with matter can transfer information across long distances, store information, and investigate nature on many scales. Models of electromagnetic radiation as either a wave of changing electric and magnetic fields or as particles are developed and used. Students understand that combining waves of different frequencies can make a wide variety of patterns and thereby encode and transmit information. Students also demonstrate their understanding of engineering ideas by presenting information about how technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. The crosscutting concepts of cause and effect; systems and system models; stability and change; interdependence of science, engineering, and technology; and the influence of engineering, technology, and science on society and the natural world are highlighted as organizing concepts for these disciplinary core ideas. In the PS3 performance expectations, students are expected to demonstrate proficiency in asking questions, using mathematical thinking, engaging in argument from evidence and obtaining, evaluating and communicating information; and to use these practices to demonstrate understanding of the core ideas.

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High School Life Sciences

Students in high school develop understanding of key concepts that will help them make sense of life science. The ideas are built upon students' science understanding of disciplinary core ideas, science and engineering practices, and crosscutting concepts from earlier grades. There are four life science disciplinary core ideas in high school: *1) From Molecules to Organisms: Structures and Processes, 2) Ecosystems: Interactions, Energy, and Dynamics, 3) Heredity: Inheritance and Variation of Traits, 4) Biological Evolution: Unity and Diversity*. The performance expectations for high school life science blend core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge that can be applied across the science disciplines. While the performance expectations in high school life science couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices underlying the performance expectations.

The performance expectations in **LS1:** ***From Molecules to Organisms: Structures and Processes*** help students formulate an answer to the question, "How do organisms live and grow?" The LS1 Disciplinary Core Idea from the *NRC Framework* is presented as three sub-ideas: Structure and Function, Growth and Development of Organisms, and Organization for Matter and Energy Flow in Organisms. In these performance expectations, students demonstrate that they can use investigations and gather evidence to support explanations of cell function and reproduction. They understand the role of proteins as essential to the work of the cell and living systems. Students can use models to explain photosynthesis, respiration, and the cycling of matter and flow of energy in living organisms. The cellular processes can be used as a model for understanding of the hierarchical organization of organism. Crosscutting concepts of matter and energy, structure and function, and systems and system models provide students with insights to the structures and processes of organisms.

The performance expectations in **LS2*: Ecosystems: Interactions, Energy, and Dynamics*** help students formulate an answer to the question, "How and why do organisms interact with their environment, and what are the effects of these interactions?" The LS2 Disciplinary Core Idea includes four sub-ideas: Interdependent Relationships in Ecosystems, Cycles of Matter and Energy Transfer in Ecosystems, Ecosystem Dynamics, Functioning, and Resilience, and Social Interactions and Group Behavior. High school students can use mathematical reasoning to demonstrate understanding of fundamental concepts of carrying capacity, factors affecting biodiversity and populations, and the cycling of matter and flow of energy among organisms in an ecosystem. These mathematical models provide support of students' conceptual understanding of systems and their ability to develop design solutions for reducing the impact of human activities on the environment and maintaining biodiversity. Crosscutting concepts of systems and system models play a central role in students' understanding of science and engineering practices and core ideas of ecosystems.

The performance expectations in **LS3: Heredity: Inheritance and Variation of Traits** help students formulate answers to the questions: "How are characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics?" The LS3 Disciplinary Core Idea from the *NRC Framework* includes two sub-ideas: Inheritance of Traits, and Variation of Traits. Students are able to ask questions, make and defend a claim, and use concepts of probability to explain the genetic variation in a

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population. Students demonstrate understanding of why individuals of the same species vary in how they look, function, and behave. Students can explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expression. Crosscutting concepts of patterns and cause and effect are called out as organizing concepts for these core ideas.

The performance expectations in **LS4: Biological Evolution: Unity and Diversity** help students formulate an answer to the question, "What evidence shows that different species are related? The LS4 Disciplinary Core Idea involves four sub-ideas: Evidence of Common Ancestry and Diversity, Natural Selection, Adaptation, and Biodiversity and Humans. Students can construct explanations for the processes of natural selection and evolution and communicate how multiple lines of evidence support these explanations. Students can evaluate evidence of the conditions that may result in new species and understand the role of genetic variation in natural selection. Additionally, students can apply concepts of probability to explain trends in populations as those trends relate to advantageous heritable traits in a specific environment. The crosscutting concepts of cause and effect and systems and system models play an important role in students' understanding of the evolution of life on Earth.

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High School Earth and Space Sciences

Students in high school continue to develop their understanding of the three disciplinary core ideas in the Earth and Space Sciences. The high school performance expectations in Earth and Space Science build on the middle school ideas and skills and allow high school students to explain more in-depth phenomena central not only to the earth and space sciences, but to life and physical sciences as well. These performance expectations blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge to explain ideas across the science disciplines. While the performance expectations shown in high school earth and space science couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.

The performance expectations in **ESS1: Earth's Place in the Universe**, help students formulate an answer to the question: "What is the universe, and what is Earth's place in it?" The ESS1 Disciplinary Core Idea from the *NRC Framework* is broken down into three sub-ideas: the universe and its stars, Earth and the solar system and the history of planet Earth. Students examine the processes governing the formation, evolution, and workings of the solar system and universe. Some concepts studied are fundamental to science, such as understanding how the matter of our world formed during the Big Bang and within the cores of stars. Others concepts are practical, such as understanding how short-term changes in the behavior of our sun directly affect humans. Engineering and technology play a large role here in obtaining and analyzing the data that support the theories of the formation of the solar system and universe. The crosscutting concepts of patterns, scale, proportion, and quantity, energy and matter, and stability and change are called out as organizing concepts for these disciplinary core ideas. In the ESS1 performance expectations, students are expected to demonstrate proficiency in developing and using models, using mathematical and computational thinking, constructing explanations and designing solutions, engaging in argument, and obtaining, evaluating and communicating information; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **ESS2: Earth's Systems**, help students formulate an answer to the question: "How and why is Earth constantly changing?" The ESS2 Disciplinary Core Idea from the *NRC Framework* is broken down into five sub-ideas: Earth materials and systems, plate tectonics and large-scale system interactions, the roles of water in Earth's surface processes, weather and climate, and biogeology. For the purpose of the NGSS, biogeology has been addressed within the life science standards. Students develop models and explanations for the ways that feedbacks between different Earth systems control the appearance of Earth's surface. Central to this is the tension between internal systems, which are largely responsible for creating land at Earth's surface, and the sun-driven surface systems that tear down the land through weathering and erosion. Students begin to examine the ways that human activities cause feedbacks that create changes to other systems. Students understand the system interactions that control weather and climate, with a major emphasis on the mechanisms and implications of climate change. Students model the flow of energy between different components of the weather system and how this affects chemical cycles such as the carbon cycle. The crosscutting concepts of cause and effect, energy and matter, structure and function and stability and change are called out as organizing concepts for these disciplinary core ideas. In the ESS2 performance expectations, students are expected to demonstrate proficiency in

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developing and using models, planning and carrying out investigations, analyzing and interpreting data, and engaging in argument; and to use these practices to demonstrate understanding of the core ideas.

The performance expectations in **ESS3: Earth and Human Activity** help students formulate an answer to the question: "How do Earth's surface processes and human activities affect each other?" The ESS3 Disciplinary Core Idea from the *NRC Framework* is broken down into four sub-ideas: natural resources, natural hazards, human impact on Earth systems, and global climate change. Students understand the complex and significant interdependencies between humans and the rest of Earth's systems through the impacts of natural hazards, our dependencies on natural resources, and the significant environmental impacts of human activities. Engineering and technology figure prominently here, as students use mathematical thinking and the analysis of geoscience data to examine and construct solutions to the many challenges facing long-term human sustainability on Earth. The crosscutting concepts of cause and effect, systems and system models, and stability and change are called out as organizing concepts for these disciplinary core ideas. In the ESS3 performance expectations, students are expected to demonstrate proficiency in developing and using analyzing and interpreting data, mathematical and computational thinking, constructing explanations and designing solutions and engaging in argument; and to use these practices to demonstrate understanding of the core ideas.

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High School Engineering Design Storylines

At the high school level students are expected to engage with major global issues at the interface of science, technology, society and the environment, and to bring to bear the kinds of analytical and strategic thinking that prior training and increased maturity make possible. As in prior levels, these capabilities can be thought of in three stages—defining the problem, developing possible solutions, and improving designs.

Defining the problem at the high school level requires both qualitative and quantitative analysis. For example, the need to provide food and fresh water for future generations comes into sharp focus when considering the speed at which world population is growing, and conditions in countries that have experienced famine. While high school students are not expected to solve these challenges, they are expected to begin thinking about them as problems that can be addressed, at least in part, through engineering.

Developing possible solutions for major global problems begins by breaking them down into smaller problems that can be tackled with engineering methods. To evaluate potential solutions students are expected to not only consider a wide range of criteria, but to also recognize that criteria need to be prioritized. For example, public safety or environmental protection may be more important than cost or even functionality. Decisions on priorities can then guide tradeoff choices.

Improving designs at the high school level may involve sophisticated methods, such as using computer simulations to model proposed solutions. Students are expected to use such methods to take into account a range of criteria and constraints, to try and anticipate possible societal and environmental impacts, and to test the validity of their simulations by comparison to the real world.

Connections with other science disciplines help high school students develop these capabilities in various contexts. For example, in the life sciences students are expected to design, evaluate, and refine a solution for reducing human impact on the environment (HS-LS2-7) and to create or revise a simulation to test solutions for mitigating adverse impacts of human activity on biodiversity (HS-LS4-6). In the physical sciences students solve problems by applying their engineering capabilities along with their knowledge of conditions for chemical reactions (HS-PS1-6), forces during collisions (HS-PS2-3), and conversion of energy from one form to another (HS-PS3-3). In the Earth and space sciences students apply their engineering capabilities to reduce human impacts on Earth systems, and improve social and environmental cost-benefit ratios (HS-ESS3-2, HS-ESS3-4).

By the end of 12th grade students are expected to achieve all four HS-ETS1 performance expectations (HS-ETS1-1, HS-ETS1-2, HS-ETS1-3, and HS-ETS1-4) related to a single problem in order to understand the interrelated processes of engineering design. These include analyzing major global challenges, quantifying criteria and constraints for solutions; breaking down a complex problem into smaller, more manageable problems, evaluating alternative solutions based on prioritized criteria and trade-offs, and using a computer simulation to model the impact of proposed solutions. While the performance expectations shown in High School Engineering Design couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations.

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HS-PS1 Matter and Its Interactions

HS-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.]

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.]

HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult's law calculations of vapor pressure.]

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. [Clarification Statement: Emphasis is on the idea that a chemical reaction is a system that affects the energy change. Examples of models could include molecular-level drawings and diagrams of reactions, graphs showing the relative energies of reactants and products, and representations showing energy is conserved.] [Assessment Boundary: Assessment does not include calculating the total bond energy changes during a chemical reaction from the bond energies of reactants and products.]

HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. [Clarification Statement: Emphasis is on student reasoning that focuses on the number and energy of collisions between molecules.] [Assessment Boundary: Assessment is limited to simple reactions in which there are only two reactants; evidence from temperature, concentration, and rate data; and qualitative relationships between rate and temperature.]

HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.* [Clarification Statement: Emphasis is on the application of Le Chatlier's Principle and on refining designs of chemical reaction systems, including descriptions of the connection between changes made at the macroscopic level and what happens at the molecular level. Examples of designs could include different ways to increase product formation including adding reactants or removing products.] [Assessment Boundary: Assessment is limited to specifying the change in only one variable at a time. Assessment does not include calculating equilibrium constants and concentrations.]

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction. [Clarification Statement: Emphasis is on using mathematical ideas to communicate the proportional relationships between masses of atoms in the reactants and the products, and the translation of these relationships to the macroscopic scale using the mole as the conversion from the atomic to the macroscopic scale. Emphasis is on assessing students' use of mathematical thinking and not on memorization and rote application of problem-solving techniques.] [Assessment Boundary: Assessment does not include complex chemical reactions.]

HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. [Clarification Statement: Emphasis is on simple qualitative models, such as pictures or diagrams, and on the scale of energy released in nuclear processes relative to other kinds of transformations.] [Assessment Boundary: Assessment does not include quantitative calculation of energy released. Assessment is limited to alpha, beta, and gamma radioactive decays.]

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The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8)
- Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)

Planning and Carrying Out Investigations
Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.
- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3)

Using Mathematics and Computational Thinking
Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter
- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1),(HS-PS1-2)
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),*(secondary to HS-PS2-6)*
- A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)

PS1.B: Chemical Reactions
- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4),(HS-PS1-5)
- In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6)
- The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical

Crosscutting Concepts

Patterns
- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-5)

Energy and Matter
- In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-PS1-8)
- The total amount of energy and matter in closed systems is conserved. (HS-PS1-7)
- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4)

Stability and Change
- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS1-7)

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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▪ Use mathematical representations of phenomena to support claims. (HS-PS1-7) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. ▪ Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5) ▪ Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2) ▪ Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS1-6)	reactions. (HS-PS1-2),(HS-PS1-7) **PS1.C: Nuclear Processes** ▪ Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. (HS-PS1-8) **ETS1.C: Optimizing the Design Solution** ▪ Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. *(secondary to HS-PS1-6)*	

Connections to other DCIs in this grade-band: **HS.PS3.A** (HS-PS1-4),(HS-PS1-5),(HS-PS1-8); **HS.PS3.B** (HS-PS1-4),(HS-PS1-6),(HS-PS1-7),(HS-PS1-8); **HS.PS3.C** (HS-PS1-8); **HS.PS3.D** (HS-PS1-4),(HS-PS1-8); **HS.LS1.C** (HS-PS1-1),(HS-PS1-2),(HS-PS1-4),(HS-PS1-7); **HS.LS2.B** (HS-PS1-7); **HS.ESS1.A** (HS-PS1-8); **HS.ESS1.C** (HS-PS1-8); **HS.ESS2.C** (HS-PS1-2),(HS-PS1-3)

Articulation to DCIs across grade-bands: **MS.PS1.A** (HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-4),(HS-PS1-5),(HS-PS1-7),(HS-PS1-8); **MS.PS1.B** (HS-PS1-1),(HS-PS1-2),(HS-PS1-4),(HS-PS1-5),(HS-PS1-6),(HS-PS1-7),(HS-PS1-8); **MS.PS1.C** (HS-PS1-8); **MS.PS2.B** (HS-PS1-3),(HS-PS1-4),(HS-PS1-5); **MS.PS3.A** (HS-PS1-5); **MS.PS3.B** (HS-PS1-5); **MS.PS3.D** (HS-PS1-4); **MS.LS1.C** (HS-PS1-4),(HS-PS1-7); **MS.LS2.B** (HS-PS1-7); **MS.ESS2.A** (HS-PS1-7),(HS-PS1-8)

Common Core State Standards Connections:

ELA/Literacy –

RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. *(HS-PS1-1)*
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS1-3),(HS-PS1-5)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS1-2),*(HS-PS1-5)*
WHST.9-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-PS1-2)
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS1-3),*(HS-PS1-6)*
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS1-3)
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. *(HS-PS1-3)*
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-PS1-4)*

Mathematics –

MP.2	Reason abstractly and quantitatively. (HS-PS1-5),(HS-PS1-7)
MP.4	Model with mathematics. *(HS-PS1-4),(HS-PS1-8)*
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-2),*(HS-PS1-3),(HS-PS1-4),(HS-PS1-5)*,(HS-PS1-7),(HS-PS1-8)
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. (HS-PS1-4),*(HS-PS1-7)*,(HS-PS1-8)
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *(HS-PS1-2),(HS-PS1-3),(HS-PS1-4),(HS-PS1-5),(HS-PS1-7),(HS-PS1-8)*

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HS-PS2 Motion and Stability: Forces and Interactions

HS-PS2 Motion and Stability: Forces and Interactions

Students who demonstrate understanding can:

HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. [Clarification Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force.] [Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.]

HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. [Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.] [Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension.]

HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.* [Clarification Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.] [Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.]

HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. [Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields.] [Assessment Boundary: Assessment is limited to systems with two objects.]

HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. [Assessment Boundary: Assessment is limited to designing and conducting investigations with provided materials and tools.]

HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.* [Clarification Statement: Emphasis is on the attractive and repulsive forces that determine the functioning of the material. Examples could include why electrically conductive materials are often made of metal, flexible but durable materials are made up of long chained molecules, and pharmaceuticals are designed to interact with specific receptors.] [Assessment Boundary: Assessment is limited to provided molecular structures of specific designed materials.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.
- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS2-5)

Analyzing and Interpreting Data
Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)

Using Mathematics and Computational Thinking
Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
- Use mathematical representations of phenomena to describe explanations. (HS-PS2-2),(HS-PS2-4)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
- Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.
- Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats

Disciplinary Core Ideas

PS2.A: Forces and Motion
- Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)
- Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2)
- If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2),(HS-PS2-3)

PS2.B: Types of Interactions
- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4)
- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5)
- Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS2-6),*(secondary to HS-PS1-1),(secondary to HS-PS1-3)*

PS3.A: Definitions of Energy
- "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. *(secondary to HS-PS2-5)*

ETS1.A: Defining and Delimiting Engineering Problems
- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. *(secondary to HS-PS2-3)*

ETS1.C: Optimizing the Design Solution
- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. *(secondary to HS-PS2-3)*

Crosscutting Concepts

Patterns
- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS2-4)

Cause and Effect
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1),(HS-PS2-5)
- Systems can be designed to cause a desired effect. (HS-PS2-3)

Systems and System Models
- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2)

Structure and Function
- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-PS2-6)

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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(including orally, graphically, textually, and mathematically). (HS-PS2-6)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Theories and laws provide explanations in science. (HS-PS2-1),(HS-PS2-4)
- Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1),(HS-PS2-4)

Connections to other DCIs in this grade-band: **HS.PS3.A** (HS-PS2-4),(HS-PS2-5); **HS.PS3.C** (HS-PS2-1); **HS.PS4.B** (HS-PS2-5); **HS.ESS1.A** (HS-PS2-1),(HS-PS2-2),(HS-PS2-4); **HS.ESS1.B** (HS-PS2-4); **HS.ESS1.C** (HS-PS2-1),(HS-PS2-2),(HS-PS2-4); **HS.ESS2.A** (HS-PS2-5); **HS.ESS2.C** (HS-PS2-1),(HS-PS2-4); **HS.ESS3.A** (HS-PS2-4),(HS-PS2-5)

Articulation to DCIs across grade-bands: **MS.PS1.A** (HS-PS2-6); **MS.PS2.A** (HS-PS2-1),(HS-PS2-2),(HS-PS2-3); **MS.PS2.B** (HS-PS2-4),(HS-PS2-5),(HS-PS2-6); **MS.PS3.C** (HS-PS2-1),(HS-PS2-2),(HS-PS2-3); **MS.ESS1.B** (HS-PS2-4),(HS-PS2-5)

Common Core State Standards Connections:

ELA/Literacy –

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-PS2-1),(HS-PS2-6)*
RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-PS2-1)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. *(HS-PS2-6)*
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS2-3),(HS-PS2-5)
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. *(HS-PS2-5)*
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. *(HS-PS2-1),(HS-PS2-5)*

Mathematics –

MP.2	Reason abstractly and quantitatively. (HS-PS2-1),(HS-PS2-2),(HS-PS2-4)
MP.4	Model with mathematics. (HS-PS2-1),(HS-PS2-2),(HS-PS2-4)
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS2-1),(HS-PS2-2),(HS-PS2-4),*(HS-PS2-5),(HS-PS2-6)*
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. *(HS-PS2-1),(HS-PS2-2),(HS-PS2-4),(HS-PS2-5),(HS-PS2-6)*
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS2-1),(HS-PS2-2),(HS-PS2-4),*(HS-PS2-5),(HS-PS2-6)*
HSA-SSE.A.1	Interpret expressions that represent a quantity in terms of its context. (HS-PS2-1),(HS-PS2-4)
HSA-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS2-1),(HS-PS2-4)
HSA-CED.A.1	Create equations and inequalities in one variable and use them to solve problems. (HS-PS2-1),(HS-PS2-2)
HSA-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. *(HS-PS2-1),(HS-PS2-2)*
HSA-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *(HS-PS2-1),(HS-PS2-2)*
HSF-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by in hand in simple cases and using technology for more complicated cases. *(HS-PS2-1)*
HSS-ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots). *(HS-PS2-1)*

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HS-PS3 Energy

HS-PS3 Energy

Students who demonstrate understanding can:

HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. [Clarification Statement: Emphasis is on explaining the meaning of mathematical expressions used in the model.] [Assessment Boundary: Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.]

HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). [Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.]

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.* [Clarification Statement: Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency.] [Assessment Boundary: Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.]

HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] [Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.]

HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. [Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.] [Assessment Boundary: Assessment is limited to systems containing two objects.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2),(HS-PS3-5)

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS3-4)

Using Mathematics and Computational Thinking

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Design, evaluate, and/or refine a solution to a

Disciplinary Core Ideas

PS3.A: Definitions of Energy

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1),(HS-PS3-2)
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3)
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)

PS3.B: Conservation of Energy and Energy Transfer

- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4)
- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)
- The availability of energy limits what can occur in any system. (HS-PS3-1)
- Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4)

PS3.C: Relationship Between Energy and Forces

- When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)

PS3.D: Energy in Chemical Processes

- Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS3-5)

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-PS3-4)
- Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. (HS-PS3-1)

Energy and Matter

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS3-3)
- Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2)

Connections to Engineering, Technology, and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-PS3-3)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS3-3)	surrounding environment. (HS-PS3-3),(HS-PS3-4) **ETS1.A: Defining and Delimiting Engineering Problems** ▪ Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. *(secondary to HS-PS3-3)*	▪ Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS3-1)

Connections to other DCIs in this grade-band: **HS.PS1.A** (HS-PS3-2); **HS.PS1.B** (HS-PS3-1),(HS-PS3-2); **HS.PS2.B** (HS-PS3-2),(HS-PS3-5); **HS.LS2.B** (HS-PS3-1); **HS.ESS1.A** (HS-PS3-1),(HS-PS3-4); **HS.ESS2.A** (HS-PS3-1),(HS-PS3-2),(HS-PS3-4); **HS.ESS2.D** (HS-PS3-4); **HS.ESS3.A** (HS-PS3-3)

Articulation to DCIs across grade-bands: **MS.PS1.A** (HS-PS3-2); **MS.PS2.B** (HS-PS3-2),(HS-PS3-5); **MS.PS3.A** (HS-PS3-1),(HS-PS3-2),(HS-PS3-3); **MS.PS3.B** (HS-PS3-1),(HS-PS3-3),(HS-PS3-4); **MS.PS3.C** (HS-PS3-2),(HS-PS3-5); **MS.ESS2.A** (HS-PS3-1),(HS-PS3-3)

Common Core State Standards Connections:

ELA/Literacy –

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-PS3-4)*
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. *(HS-PS3-3),* (HS-PS3-4),*(HS-PS3-5)*
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS3-4),*(HS-PS3-5)*
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. *(HS-PS3-4),(HS-PS3-5)*
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-PS3-1),(HS-PS3-2),(HS-PS3-5)*

Mathematics –

MP.2	Reason abstractly and quantitatively. (HS-PS3-1),(HS-PS3-2),(HS-PS3-3),(HS-PS3-4),(HS-PS3-5)
MP.4	Model with mathematics. (HS-PS3-1),(HS-PS3-2),(HS-PS3-3),*(HS-PS3-4),*(HS-PS3-5)
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS3-1),(HS-PS3-3)
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. (HS-PS3-1),(HS-PS3-3)
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS3-1),(HS-PS3-3)

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HS-PS4 Waves and Their Applications in Technologies for Information Transfer

HS-PS4 Waves and Their Applications in Technologies for Information Transfer

Students who demonstrate understanding can:

HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. [Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.] [Assessment Boundary: Assessment is limited to algebraic relationships and describing those relationships qualitatively.]

HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information. [Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.]

HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. [Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [Assessment Boundary: Assessment does not include using quantum theory.]

HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. [Clarification Statement: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.] [Assessment Boundary: Assessment is limited to qualitative descriptions.]

HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.* [Clarification Statement: Examples could include solar cells capturing light and converting it to electricity; medical imaging; and communications technology.] [Assessment Boundary: Assessments are limited to qualitative information. Assessments do not include band theory.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 9–12 builds from grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.
- Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. (HS-PS4-2)

Using Mathematics and Computational Thinking
Mathematical and computational thinking at the 9-12 level builds on K-8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
- Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1)

Engaging in Argument from Evidence
Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.
- Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS4-3)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.
- Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. (HS-PS4-4)
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS4-5)

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-

Disciplinary Core Ideas

PS3.D: Energy in Chemical Processes
- Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. *(secondary to HS-PS4-5)*

PS4.A: Wave Properties
- The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)
- Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2),(HS-PS4-5)
- [From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3)

PS4.B: Electromagnetic Radiation
- Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3)
- When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4)
- Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5)

PS4.C: Information Technologies and Instrumentation
- Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)

Crosscutting Concepts

Cause and Effect
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS4-1)
- Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS4-4)
- Systems can be designed to cause a desired effect. (HS-PS4-5)

Systems and System Models
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-PS4-3)

Stability and Change
- Systems can be designed for greater or lesser stability. (HS-PS4-2)

Connections to Engineering, Technology and Applications of Science

Interdependence of Science, Engineering, and Technology
- Science and engineering complement each other in the cycle known as research and development (R&D). (HS-PS4-5)

Influence of Engineering, Technology, and Science on Society and the Natural World
- Modern civilization depends on major technological systems. (HS-PS4-2),(HS-PS4-5)
- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-PS4-2)

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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HS-PS4 Waves and Their Applications in Technologies for Information Transfer

Connections to other DCIs in this grade-band: **HS.PS1.C** (HS-PS4-4); **HS.LS1.C** (HS-PS4-4); **HS.PS3.A** (HS-PS4-4),(HS-PS4-5); **HS.PS3.D** (HS-PS4-3),(HS-PS4-4); **HS.ESS1.A** (HS-PS4-3); **HS.ESS2.A** (HS-PS4-1); **HS.ESS2.D** (HS-PS4-3)	
Articulation to DCIs across grade-bands: **MS.PS3.D** (HS-PS4-4); **MS.PS4.A** (HS-PS4-1),(HS-PS4-2),(HS-PS4-5); **MS.PS4.B** (HS-PS4-1),(HS-PS4-2),(HS-PS4-3),(HS-PS4-4),(HS-PS4-5); **MS.PS4.C** (HS-PS4-2),(HS-PS4-5); **MS.LS1.C** (HS-PS4-4); **MS.ESS2.D** (HS-PS4-4)	
Common Core State Standards Connections:	
ELA/Literacy –	
RST.9-10.8	Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (HS-PS4-2),(HS-PS4-3),(HS-PS4-4)
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-PS4-2),(HS-PS4-3),(HS-PS4-4)*
RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. *(HS-PS4-1),*(HS-PS4-4)
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-PS4-2),(HS-PS4-3),(HS-PS4-4)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. *(HS-PS4-5)*
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS4-4)
Mathematics –	
MP.2	Reason abstractly and quantitatively. (HS-PS4-1),(HS-PS4-3)
MP.4	Model with mathematics. (HS-PS4-1)
HSA-SSE.A.1	Interpret expressions that represent a quantity in terms of its context. (HS-PS4-1),*(HS-PS4-3)*
HSA-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. *(HS-PS4-1),(HS-PS4-3)*
HSA.CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *(HS-PS4-1),(HS-PS4-3)*

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HS-LS1 From Molecules to Organisms: Structures and Processes

HS-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. [Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]

HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]

HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]

HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. [Assessment Boundary: Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.]

HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [Assessment Boundary: Assessment does not include specific biochemical steps.]

HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.]

HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)
- Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-4),(HS-LS1-5),(HS-LS1-7)

Planning and Carrying Out Investigations

Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-LS1-3)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS1-1)
- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS1-6)

Disciplinary Core Ideas

LS1.A: Structure and Function

- Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) *(Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)*
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)

LS1.B: Growth and Development of Organisms

- In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4)

LS1.C: Organization for Matter and Energy Flow in Organisms

- The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)
- The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6)
- As matter and energy flow through different

Crosscutting Concepts

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2), (HS-LS1-4)

Energy and Matter

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-LS1-5), (HS-LS1-6)
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (HS-LS1-7)

Structure and Function

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1)

Stability and Change

- Feedback (negative or positive) can stabilize or destabilize a system. (HS-LS1-3)

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HS-LS1 From Molecules to Organisms: Structures and Processes

---------- *Connections to Nature of Science* **Scientific Investigations Use a Variety of Methods** ▪ Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. (HS-LS1-3)	organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6),(HS-LS1-7) ▪ As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)	

Connections to other DCIs in this grade-band: **HS.PS1.B** (HS-LS1-5),(HS-LS1-6),(HS-LS1-7); **HS.PS2.B** (HS-LS1-7); **HS.LS3.A** (HS-LS1-1); **HS.PS3.B** (HS-LS1-5),(HS-LS1-7)

Articulation to DCIs across grade-bands: **MS.PS1.A** (HS-LS1-6); **MS.PS1.B** (HS-LS1-5),(HS-LS1-6),(HS-LS1-7); **MS.PS3.D** (HS-LS1-5),(HS-LS1-6),(HS-LS1-7); **MS.LS1.A** (HS-LS1-1),(HS-LS1-2),(HS-LS1-3),(HS-LS1-4); **MS.LS1.B** (HS-LS1-4); **MS.LS1.C** (HS-LS1-5),(HS-LS1-6),(HS-LS1-7); **MS.LS2.B** (HS-LS1-5),(HS-LS1-7); **MS.ESS2.E** (HS-LS1-6); **MS.LS3.A** (HS-LS1-1),(HS-LS1-4); **MS.LS3.B** (HS-LS1-1)

Common Core State Standards Connections:

ELA/Literacy –

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS1-1),(HS-LS1-6)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-1),(HS-LS1-6)
WHST.9-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS1-6)
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS1-3)
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. *(HS-LS1-3)*
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS-1-1),(HS-LS1-6)
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-LS1-2),(HS-LS1-4),(HS-LS1-5),(HS-LS1-7)*

Mathematics –

MP.4	Model with mathematics. *(HS-LS1-4)*
HSF-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. *(HS-LS1-4)*
HSF-BF.A.1	Write a function that describes a relationship between two quantities. *(HS-LS1-4)*

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HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. [Clarification Statement: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.] [Assessment Boundary: Assessment does not include deriving mathematical equations to make comparisons.]

HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [Assessment Boundary: Assessment is limited to provided data.]

HS-LS2-3. Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. [Clarification Statement: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments.] [Assessment Boundary: Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.]

HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. [Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem.] [Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.]

HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. [Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]

HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]

HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.* [Clarification Statement: Examples of human activities can include urbanization, building dams, and dissemination of invasive species.]

HS-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce. [Clarification Statement: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show how relationships among variables between systems and their components in the natural and designed worlds.
- Develop a model based on evidence to illustrate the relationships between systems or components of a system. (HS-LS2-5)

Using Mathematics and Computational Thinking
Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
- Use mathematical and/or computational representations of phenomena or design solutions to support explanations. (HS-LS2-1)
- Use mathematical representations of phenomena or design solutions to support and revise explanations. (HS-LS2-2)
- Use mathematical representations of phenomena or design solutions to support claims. (HS-LS2-4)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems
- Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1),(HS-LS2-2)

LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3)
- Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)
- Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5)

LS2.C: Ecosystem Dynamics, Functioning, and Resilience
- A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6)

Crosscutting Concepts

Cause and Effect
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-8)

Scale, Proportion, and Quantity
- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-LS2-1)
- Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. (HS-LS2-2)

Systems and System Models
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS2-5)

Energy and Matter
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (HS-LS2-4)
- Energy drives the cycling of matter within and between systems. (HS-LS2-3)

Stability and Change
- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-6),(HS-LS2-7)

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and will continue to do so in the future. (HS-LS2-3)

- Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-LS2-7)

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

- Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6)
- Evaluate the evidence behind currently accepted explanations to determine the merits of arguments. (HS-LS2-8)

Connections to Nature of Science

Scientific Knowledge is Open to Revision in Light of New Evidence

- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence. (HS-LS2-2),(HS-LS2-3)
- Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation. (HS-LS2-6),(HS-LS2-8)

- Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7)

LS2.D: Social Interactions and Group Behavior

- Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. (HS-LS2-8)

LS4.D: Biodiversity and Humans

- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). *(secondary to HS-LS2-7)*
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. *(secondary to HS-LS2-7) (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)*

PS3.D: Energy in Chemical Processes

- The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis. *(secondary to HS-LS2-5)*

ETS1.B: Developing Possible Solutions

- When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. *(secondary to HS-LS2-7)*

Connections to other DCIs in this grade-band: **HS.PS1.B** (HS-LS2-3),(HS-LS2-5); **HS.PS3.B** (HS-LS2-3),(HS-LS2-4); **HS.PS3.D** (HS-LS2-3),(HS-LS2-4); **HS.ESS2.A** (HS-LS2-3); **HS.ESS2.D** (HS-LS2-5),(HS-LS2-7); **HS.ESS2.E** (HS-LS2-2),(HS-LS2-6),(HS-LS2-7); **HS.ESS3.A** (HS-LS2-2),(HS-LS2-7); **HS.ESS3.C** (HS-LS2-2),(HS-LS2-7); **HS.ESS3.D** (HS-LS2-2)

Articulation across grade-bands: **MS.PS1.B** (HS-LS2-3); **MS.PS3.D** (HS-LS2-3),(HS-LS2-4),(HS-LS2-5); **MS.LS1.B** (HS-LS2-8); **MS.LS1.C** (HS-LS2-3),(HS-LS2-4),(HS-LS2-5); **MS.LS2.A** (HS-LS2-1),(HS-LS2-2),(HS-LS2-6); **MS.LS2.B** (HS-LS2-3),(HS-LS2-4),(HS-LS2-5); **MS.LS2.C** (HS-LS2-1),(HS-LS2-2),(HS-LS2-6),(HS-LS2-7); **MS.ESS2.A** (HS-LS2-5); **MS.ESS2.E** (HS-LS2-6); **MS.ESS3.A** (HS-LS2-1); **MS.ESS3.C** (HS-LS2-1),(HS-LS2-2),(HS-LS2-6),(HS-LS2-7); **MS.ESS3.D** (HS-LS2-7)

Common Core State Standards Connections:

ELA/Literacy –

RST.9-10.8	Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (HS-LS2-6),*(HS-LS2-7),(HS-LS2-8)*
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-LS2-1),(HS-LS2-2),*(HS-LS2-3),(HS-LS2-6),(HS-LS2-8)
RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. *(HS-LS2-6),(HS-LS2-7),(HS-LS2-8)*
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS2-6),(HS-LS2-7),(HS-LS2-8)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. *(HS-LS2-1),(HS-LS2-2),*(HS-LS2-3)
WHST.9-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS2-3)
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS2-7)

Mathematics –

MP.2	Reason abstractly and quantitatively. (HS-LS2-1),(HS-LS2-2),(HS-LS2-4),(HS-LS2-6),*(HS-LS2-7)*
MP.4	Model with mathematics. *(HS-LS2-1),(HS-LS2-2),(HS-LS2-4)*
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-LS2-1),(HS-LS2-2),(HS-LS2-4),*(HS-LS2-7)*
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. *(HS-LS2-1),(HS-LS2-2),(HS-LS2-4),(HS-LS2-7)*
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-LS2-1),(HS-LS2-2),(HS-LS2-4),*(HS-LS2-7)*
HSS-ID.A.1	Represent data with plots on the real number line. *(HS-LS2-6)*
HSS-IC.A.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population. *(HS-LS2-6)*
HSS-IC.B.6	Evaluate reports based on data. (HS-LS2-6)

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HS-LS3 Heredity: Inheritance and Variation of Traits

HS-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]

HS-LS3-2. Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. [Clarification Statement: Emphasis is on using data to support arguments for the way variation occurs.] [Assessment Boundary: Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process.]

HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. [Clarification Statement: Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits.] [Assessment Boundary: Assessment does not include Hardy-Weinberg calculations.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Ask questions that arise from examining models or a theory to clarify relationships. (HS-LS3-1)

Analyzing and Interpreting Data

Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS3-3)

Engaging in Argument from Evidence

Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

- Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence. (HS-LS3-2)

Disciplinary Core Ideas

LS1.A: Structure and Function

- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. *(secondary to HS-LS3-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS1-1.)*

LS3.A: Inheritance of Traits

- Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1)

LS3.B: Variation of Traits

- In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2)
- Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2),(HS-LS3-3)

Crosscutting Concepts

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS3-1),(HS-LS3-2)

Scale, Proportion, and Quantity

- Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (HS-LS3-3)

Connections to Nature of Science

Science is a Human Endeavor

- Technological advances have influenced the progress of science and science has influenced advances in technology. (HS-LS3-3)
- Science and engineering are influenced by society and society is influenced by science and engineering. (HS-LS3-3)

Connections to other DCIs in this grave-band: **HS.LS2.A** (HS-LS3-3); **HS.LS2.C** (HS-LS3-3); **HS.LS4.B** (HS-LS3-3); **HS.LS4.C** (HS-LS3-3)

Articulation across grade-bands: **MS.LS2.A** (HS-LS3-3); **MS.LS3.A** (HS-LS3-1),(HS-LS3-2); **MS.LS3.B** (HS-LS3-1),(HS-LS3-2),(HS-LS3-3); **MS.LS4.C** (HS-LS3-3)

Common Core State Standards Connections:

ELA/Literacy –

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-LS3-1),(HS-LS3-2)*
RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. *(HS-LS3-1)*
WHST.9-12.1	Write arguments focused on *discipline-specific content.* (HS-LS3-2)

Mathematics –

MP.2	Reason abstractly and quantitatively. (HS-LS3-2),(HS-LS3-3)

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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HS-LS4 Biological Evolution: Unity and Diversity

HS-LS4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. [Clarification Statement: Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples of evidence could include similarities in DNA sequences, anatomical structures, and order of appearance of structures in embryological development.]

HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. [Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.]

HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. [Clarification Statement: Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations.] [Assessment Boundary: Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.]

HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations. [Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]

HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. [Clarification Statement: Emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species.]

HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. *
[Clarification Statement: Emphasis is on designing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data
Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS4-3)

Using Mathematics and Computational Thinking
Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
- Create or revise a simulation of a phenomenon, designed device, process, or system. (HS-LS4-6)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS4-2),(HS-LS4-4)

Engaging in Argument from Evidence
Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current or historical episodes in science.
- Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS4-5)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 9–12

Disciplinary Core Ideas

LS4.A: Evidence of Common Ancestry and Diversity
- Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)

LS4.B: Natural Selection
- Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2),(HS-LS4-3)
- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3)

LS4.C: Adaptation
- Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2)
- Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3),(HS-LS4-4)
- Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3)
- Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-5),(HS-LS4-6)

Crosscutting Concepts

Patterns
- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-LS4-1),(HS-LS4-3)

Cause and Effect
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS4-2),(HS-LS4-4),(HS-LS4-5),(HS-LS4-6)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (HS-LS4-1),(HS-LS4-4)

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builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. ▪ Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-LS4-1) ---------- *Connections to Nature of Science* **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ▪ A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-LS4-1)	▪ Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5) **LS4.D: Biodiversity and Humans** ▪ Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (HS-LS4-6) *(Note: This Disciplinary Core Idea is also addressed by HS-LS2-7.)* **ETS1.B: Developing Possible Solutions** ▪ When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. *(secondary to HS-LS4-6)* ▪ Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. *(secondary to HS-LS4-6)*	

Connections to other DCIs in this grade-band: **HS.LS2.A** (HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5); **HS.LS2.D** (HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5); **HS.LS3.A** (HS-LS4-1); **HS.LS3.B** (HS-LS4-1),(HS-LS4-2) (HS-LS4-3),(HS-LS4-5); **HS.ESS1.C** (HS-LS4-1); **HS.ESS2.D** (HS-LS4-6); **HS.ESS2.E** (HS-LS4-2),(HS-LS4-5),(HS-LS4-6); **HS.ESS3.A** (HS-LS4-2),(HS-LS4-5),(HS-LS4-6); **HS.ESS3.C** (HS-LS4-6); **HS.ESS3.D** (HS-LS4-6)

Articulation across grade-bands: **MS.LS2.A** (HS-LS4-2),(HS-LS4-3),(HS-LS4-5); **MS.LS2.C** (HS-LS4-5),(HS-LS4-6); **MS.LS3.A** (HS-LS4-1); **MS.LS3.B** (HS-LS4-1),(HS-LS4-2),(HS-LS4-3); **MS.LS4.A** (HS-LS4-1); **MS.LS4.B** (HS-LS4-2),(HS-LS4-3),(HS-LS4-4); **MS.LS4.C** (HS-LS4-2),(HS-LS4-3),(HS-LS4-4),(HS-LS4-5); **MS.ESS1.C** (HS-LS4-1); **MS.ESS3.C** (HS-LS4-5),(HS-LS4-6)

Common Core State Standards Connections:

ELA/Literacy –

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-LS4-1),*(HS-LS4-2), *(HS-LS4-3),*(HS-LS4-4)
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-LS4-5)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. *(HS-LS4-1),*(HS-LS4-2), *(HS-LS4-3),*(HS-LS4-4)
WHST.9-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. *(HS-LS4-6)*
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-LS4-6)
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. *(HS-LS4-1),*(HS-LS4-2), *(HS-LS4-3),*(HS-LS4-4),(HS-LS4-5)
SL.11-12.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. *(HS-LS4-1),(HS-LS4-2)*

Mathematics –

MP.2	Reason abstractly and quantitatively. *(HS-LS4-1),*(HS-LS4-2),(HS-LS4-3), *(HS-LS4-4),(HS-LS4-5)*
MP.4	Model with mathematics. *(HS-LS4-2)*

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HS-ESS1 Earth's Place in the Universe

HS-ESS1 Earth's Place in the Universe

Students who demonstrate understanding can:

HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. [Clarification Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries.] [Assessment Boundary: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.]

HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. [Clarification Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).]

HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements. [Clarification Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.] [Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.]

HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. [Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.] [Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus.]

HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. [Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust increasing with distance away from a central ancient core (a result of past plate interactions).]

HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. [Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).
- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS1-1)

Using Mathematical and Computational Thinking
Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.
- Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1-4)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS1-2)
- Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. (HS-ESS1-6)

Engaging in Argument from Evidence
Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
- Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-ESS1-5)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 9–12

Disciplinary Core Ideas

ESS1.A: The Universe and Its Stars
- The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1)
- The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-ESS1-3)
- The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2)
- Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2),(HS-ESS1-3)

ESS1.B: Earth and the Solar System
- Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4)

ESS1.C: The History of Planet Earth
- Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. (HS-ESS1-5)
- Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (HS-ESS1-6)

ESS2.B: Plate Tectonics and Large-Scale System Interactions
- Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. *(ESS2.B Grade 8 GBE) (secondary to*

Crosscutting Concepts

Patterns
- Empirical evidence is needed to identify patterns. (HS-ESS1-5)

Scale, Proportion, and Quantity
- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-ESS1-1)
- Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (HS-ESS1-4)

Energy and Matter
- Energy cannot be created or destroyed–only moved between one place and another place, between objects and/or fields, or between systems. (HS-ESS1-2)
- In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-ESS1-3)

Stability and Change
- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS1-6)

Connections to Engineering, Technology and Applications of Science

Interdependence of Science, Engineering, and Technology
- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. (HS-ESS1-2),(HS-ESS1-4)

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs. ▪ Communicate scientific ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-ESS1-3) ---------- *Connections to Nature of Science* **Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena** ▪ A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-ESS1-2),(HS-ESS1-6) ▪ Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. (HS-ESS1-6)	*HS-ESS1-5)* **PS1.C: Nuclear Processes** ▪ Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. *(secondary to HS-ESS1-5),(secondary to HS-ESS1-6)* **PS3.D: Energy in Chemical Processes and Everyday Life** ▪ Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. *(secondary to HS-ESS1-1)* **PS4.B Electromagnetic Radiation** ▪ Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. *(secondary to HS-ESS1-2)*	▪ Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (HS-ESS1-2) ▪ Science assumes the universe is a vast single system in which basic laws are consistent. (HS-ESS1-2)

Connections to other DCIs in this grade-band: **HS.PS1.A** (HS-ESS1-2),(HS-ESS1-3); **HS.PS1.C** (HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-3); **HS.PS2.A** (HS-ESS1-6); **HS.PS2.B** (HS-ESS1-4),(HS-ESS1-6); **HS.PS3.A** (HS-ESS1-1),(HS-ESS1-2); **HS.PS3.B** (HS-ESS1-2),(HS-ESS1-5); **HS.PS4.A** (HS-ESS1-2); **HS.ESS2.A** (HS-ESS1-5)

Articulation of DCIs across grade-bands: **MS.PS1.A** (HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-3); **MS.PS2.A** (HS-ESS1-4); **MS.PS2.B** (HS-ESS1-4),(HS-ESS1-6); **MS.PS4.B** (HS-ESS1-1),(HS-ESS1-2); **MS.ESS1.A** (HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-3),(HS-ESS1-4); **MS.ESS1.B** (HS-ESS1-4),(HS-ESS1-6); **MS.ESS1.C** (HS-ESS1-5),(HS-ESS1-6); **MS.ESS2.A** (HS-ESS1-1),(HS-ESS1-5),(HS-ESS1-6); **MS.ESS2.B** (HS-ESS1-5),(HS-ESS1-6); **MS.ESS2.D** (HS-ESS1-1)

Common Core State Standards Connections:

ELA/Literacy –

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-5),(HS-ESS1-6)*
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ESS1-5),(HS-ESS1-6)
WHST.9-12.1	Write arguments focused on *discipline-specific content.* (HS-ESS1-6)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-ESS1-2),*(HS-ESS1-3),(HS-ESS1-5)*
SL.11-12.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. *(HS-ESS1-3)*

Mathematics –

MP.2	Reason abstractly and quantitatively. (HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-3),(HS-ESS1-4),(HS-ESS1-5),(HS-ESS1-6)
MP.4	Model with mathematics. (HS-ESS1-1),(HS-ESS1-4)
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-4),(HS-ESS1-5),(HS-ESS1-6)
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS1-1),*(HS-ESS1-2)*,(HS-ESS1-4),*(HS-ESS1-5),(HS-ESS1-6)*
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-4),(HS-ESS1-5),(HS-ESS1-6)
HSA-SSE.A.1	Interpret expressions that represent a quantity in terms of its context. *(HS-ESS1-1),(HS-ESS1-2),*(HS-ESS1-4)
HSA-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. *(HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-4)*
HSA-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *(HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-4)*
HSF-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *(HS-ESS1-6)*
HSS-ID.B.6	Represent data on two quantitative variables on a scatter plot, and describe how those variables are related. *(HS-ESS1-6)*

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HS-ESS2 Earth's Systems

HS-ESS2 Earth's Systems

Students who demonstrate understanding can:

HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features. [Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion).] [Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.]

HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. [Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.]

HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. [Clarification Statement: Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and identification of the composition of Earth's layers from high-pressure laboratory experiments.]

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.]

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. [Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).]

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. [Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]

HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. [Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples of include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.] [Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.]

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The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).
- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS2-1),(HS-ESS2-3),(HS-ESS2-6)
- Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4)

Planning and Carrying Out Investigations
Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.
- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-ESS2-5)

Analyzing and Interpreting Data
Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-ESS2-2)

Disciplinary Core Ideas

ESS1.B: Earth and the Solar System
- Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. *(secondary to HS-ESS2-4)*

ESS2.A: Earth Materials and Systems
- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1),(HS-ESS2-2)
- Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3)
- The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4)

ESS2.B: Plate Tectonics and Large-Scale System Interactions
- The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. (HS-ESS2-3)

Crosscutting Concepts

Cause and Effect
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4)

Energy and Matter
- The total amount of energy and matter in closed systems is conserved. (HS-ESS2-6)
- Energy drives the cycling of matter within and between systems. (HS-ESS2-3)

Structure and Function
- The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. (HS-ESS2-5)

Stability and Change
- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS2-7)
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS2-1)
- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS2-2)

Connections to Engineering, Technology, and Applications of Science

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HS-ESS2 Earth's Systems

Engaging in Argument from Evidence
Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
- Construct an oral and written argument or counter-arguments based on data and evidence. (HS-ESS2-7)

Connections to Nature of Science

Scientific Knowledge is Based on Empirical Evidence
- Science knowledge is based on empirical evidence. (HS-ESS2-3)
- Science disciplines share common rules of evidence used to evaluate explanations about natural systems. (HS-ESS2-3)
- Science includes the process of coordinating patterns of evidence with current theory. (HS-ESS2-3)
- Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4)

- Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. *(ESS2.B Grade 8 GBE)* (HS-ESS2-1)

ESS2.C: The Roles of Water in Earth's Surface Processes
- The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5)

ESS2.D: Weather and Climate
- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-2),(HS-ESS2-4)
- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6),(HS-ESS2-7)
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6),(HS-ESS2-4)

ESS2.E: Biogeology
- The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7)

PS4.A: Wave Properties
- Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet. *(secondary to HS-ESS2-3)*

Interdependence of Science, Engineering, and Technology
- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. (HS-ESS2-3)

Influence of Engineering, Technology, and Science on Society and the Natural World
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ESS2-2)

Connections to other DCIs in this grade-band: **HS.PS1.A** (HS-ESS2-5),(HS-ESS2-6); **HS.PS1.B** (HS-ESS2-5),(HS-ESS2-6); **HS.PS2.B** (HS-ESS2-1),(HS-ESS2-3); **HS.PS3.A** (HS-ESS2-4); **HS.PS3.B** (HS-ESS2-2),(HS-ESS2-3),(HS-ESS2-4),(HS-ESS2-5); **HS.PS3.D** (HS-ESS2-3),(HS-ESS2-6); **HS.PS4.B** (HS-ESS2-2); **HS.LS1.C** (HS-ESS2-6); **HS.LS2.A** (HS-ESS2-7); **HS.LS2.B** (HS-ESS2-2),(HS-ESS2-6); **HS.LS2.C** (HS-ESS2-2),(HS-ESS2-4),(HS-ESS2-7); **HS.LS4.A** (HS-ESS2-7); **HS.LS4.B** (HS-ESS2-7); **HS.LS4.C** (HS-ESS2-7); **HS.LS4.D** (HS-ESS2-2),(HS-ESS2-7); **HS.ESS1.C** (HS-ESS2-4); **HS.ESS3.C** (HS-ESS2-2),(HS-ESS2-4),(HS-ESS2-5),(HS-ESS2-6); **HS.ESS3.D** (HS-ESS2-2),(HS-ESS2-4),(HS-ESS2-6)

Articulation of DCIs across grade-bands: **MS.PS1.A** (HS-ESS2-3),(HS-ESS2-5),(HS-ESS2-6); **MS.PS1.B** (HS-ESS2-3); **MS.PS2.B** (HS-ESS2-1),(HS-ESS2-3); **MS.PS3.A** (HS-ESS2-3),(HS-ESS2-4); **MS.PS3.B** (HS-ESS2-3),(HS-ESS2-4); **MS.PS3.D** (HS-ESS2-2),(HS-ESS2-4),(HS-ESS2-6); **MS.PS4.B** (HS-ESS2-2),(HS-ESS2-4),(HS-ESS2-5),(HS-ESS2-6); **MS.LS1.C** (HS-ESS2-4); **MS.LS2.A** (HS-ESS2-7); **MS.LS2.B** (HS-ESS2-1),(HS-ESS2-2),(HS-ESS2-4),(HS-ESS2-6); **MS.LS2.C** (HS-ESS2-2),(HS-ESS2-4),(HS-ESS2-7); **MS.LS4.A** (HS-ESS2-7); **MS.LS4.B** (HS-ESS2-7); **MS.LS4.C** (HS-ESS2-2),(HS-ESS2-7); **MS.ESS1.C** (HS-ESS2-1),(HS-ESS2-7); **MS.ESS2.A** (HS-ESS2-1),(HS-ESS2-2),(HS-ESS2-3),(HS-ESS2-4),(HS-ESS2-5),(HS-ESS2-6),(HS-ESS2-7); **MS.ESS2.B** (HS-ESS2-1),(HS-ESS2-2),(HS-ESS2-3),(HS-ESS2-4),(HS-ESS2-6); **MS.ESS2.C** (HS-ESS2-1),(HS-ESS2-2),(HS-ESS2-4),(HS-ESS2-5),(HS-ESS2-6),(HS-ESS2-7); **MS.ESS2.D** (HS-ESS2-1),(HS-ESS2-2),(HS-ESS2-4),(HS-ESS2-5); **MS.ESS3.C** (HS-ESS2-2),(HS-ESS2-4),(HS-ESS2-6),(HS-ESS2-7); **MS.ESS3.D** (HS-ESS2-2),(HS-ESS2-4),(HS-ESS2-6)

Common Core State Standards Connections:

ELA/Literacy –

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-ESS2-2),(HS-ESS2-3)*
RST.11-12.2	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. *(HS-ESS2-2)*
WHST.9-12.1	Write arguments focused on *discipline-specific content.* (HS-ESS2-7)
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-ESS2-5)
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. *(HS-ESS2-1),(HS-ESS2-3),(HS-ESS2-4)*

Mathematics –

MP.2	Reason abstractly and quantitatively. (HS-ESS2-1),(HS-ESS2-2),(HS-ESS2-3),(HS-ESS2-4),(HS-ESS2-6)
MP.4	Model with mathematics. (HS-ESS2-1),(HS-ESS2-3),(HS-ESS2-4),(HS-ESS2-6)
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS2-1),(HS-ESS2-2),(HS-ESS2-3),(HS-ESS2-4),(HS-ESS2-6)
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS2-1),(HS-ESS2-3),(HS-ESS2-4),(HS-ESS2-6)
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS2-1),(HS-ESS2-2),(HS-ESS2-3),(HS-ESS2-4),(HS-ESS2-5),(HS-ESS2-6)

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HS-ESS3 Earth and Human Activity

HS-ESS3 Earth and Human Activity

Students who demonstrate understanding can:

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]

HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* [Clarification Statement: Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen.]

HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. [Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.]

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. [Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5)

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-ESS3-3)
- Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS3-1)
- Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ESS3-4)

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8

Disciplinary Core Ideas

ESS2.D: Weather and Climate

- Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. *(secondary to HS-ESS3-6)*

ESS3.A: Natural Resources

- Resource availability has guided the development of human society. (HS-ESS3-1)
- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)

ESS3.B: Natural Hazards

- Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)

ESS3.C: Human Impacts on Earth Systems

- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)
- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

ESS3.D: Global Climate Change

- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)
- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)

ETS1.B: Developing Possible Solutions

- When evaluating solutions, it is important to take into

Crosscutting Concepts

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1)

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6)

Stability and Change

- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-3),(HS-ESS3-5)
- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS3-4)

Connections to Engineering, Technology and Applications of Science

Influence of Engineering, Technology, and Science on Society and the Natural World

- Modern civilization depends on major technological systems. (HS-ESS3-1),(HS-ESS3-3)
- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-ESS3-2),(HS-ESS3-4)
- New technologies can have deep impacts

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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HS-ESS3 Earth and Human Activity

experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed world(s).
Arguments may also come from current scientific or historical episodes in science.

- Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). (HS-ESS3-2)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Science investigations use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5)
- New technologies advance scientific knowledge. (HS-ESS3-5)

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based on empirical evidence. (HS-ESS3-5)
- Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS3-5)

account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. *(secondary to HS-ESS3-2),(secondary HS-ESS3-4)*

on society and the environment, including some that were not anticipated. (HS-ESS3-3)

- Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ESS3-2)

Connections to Nature of Science

Science is a Human Endeavor

- Science is a result of human endeavors, imagination, and creativity. (HS-ESS3-3)

Science Addresses Questions About the Natural and Material World

- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (HS-ESS3-2)
- Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. (HS-ESS3-2)
- Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. (HS-ESS3-2)

Connections to other DCIs in this grade-band: **HS.PS1.B** (HS-ESS3-3); **HS.PS3.B** (HS-ESS3-2),(HS-ESS3-5); **HS.PS3.D** (HS-ESS3-2),(HS-ESS3-5); **HS.LS1.C** (HS-ESS3-5); **HS.LS2.A** (HS-ESS3-2),(HS-ESS3-3); **HS.LS2.B** (HS-ESS3-2),(HS-ESS3-3),(HS-ESS3-6); **HS.LS2.C** (HS-ESS3-3),(HS-ESS3-4),(HS-ESS3-6); **HS.LS4.D** (HS-ESS3-2),(HS-ESS3-3),(HS-ESS3-4),(HS-ESS3-6); **HS.ESS2.A** (HS-ESS3-2),(HS-ESS3-3),(HS-ESS3-6); **HS.ESS2.D** (HS-ESS3-5); **HS.ESS2.E** (HS-ESS3-3)

Articulation of DCIs across grade-bands: **MS.PS1.B** (HS-ESS3-3); **MS.PS3.B** (HS-ESS3-5); **MS.PS3.D** (HS-ESS3-2),(HS-ESS3-5); **MS.LS2.A** (HS-ESS3-1),(HS-ESS3-2),(HS-ESS3-3); **MS.LS2.B** (HS-ESS3-2),(HS-ESS3-3); **MS.LS2.C** (HS-ESS3-3),(HS-ESS3-4),(HS-ESS3-6); **MS.LS4.C** (HS-ESS3-3); **MS.LS4.D** (HS-ESS3-1),(HS-ESS3-2),(HS-ESS3-3); **MS.ESS2.A** (HS-ESS3-1),(HS-ESS3-3),(HS-ESS3-4),(HS-ESS3-5),(HS-ESS3-6); **MS.ESS2.C** (HS-ESS3-6); **MS.ESS2.D** (HS-ESS3-5); **MS.ESS3.A** (HS-ESS3-1),(HS-ESS3-2),(HS-ESS3-3); **MS.ESS3.B** (HS-ESS3-1),(HS-ESS3-4),(HS-ESS3-5); **MS.ESS3.C** (HS-ESS3-2),(HS-ESS3-3),(HS-ESS3-4),(HS-ESS3-5),(HS-ESS3-6); **MS.ESS3.D** (HS-ESS3-4),(HS-ESS3-5),(HS-ESS3-6)

Common Core State Standards Connections:

ELA/Literacy –

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. *(HS-ESS3-1),*(HS-ESS3-2),(HS-ESS3-4),(HS-ESS3-5)
RST.11-12.2	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. *(HS-ESS3-5)*
RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ESS3-5)
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ESS3-2),(HS-ESS3-4)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-ESS3-1)

Mathematics –

MP.2	Reason abstractly and quantitatively. *(HS-ESS3-1),*(HS-ESS3-2),(HS-ESS3-3),*(HS-ESS3-4),*(HS-ESS3-5),(HS-ESS3-6)
MP.4	Model with mathematics. (HS-ESS3-3),(HS-ESS3-6)
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. *(HS-ESS3-1),*(HS-ESS3-4),(HS-ESS3-5),(HS-ESS3-6)
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. *(HS-ESS3-1),(HS-ESS3-4),(HS-ESS3-5),*(HS-ESS3-6)
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *(HS-ESS3-1),(HS-ESS3-4),*(HS-ESS3-5),(HS-ESS3-6)

DRAFT

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

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HS-ETS1 Engineering Design

HS-ETS1 Engineering Design

Students who demonstrate understanding can:

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems

Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (HS-ETS1-1)

Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.

- Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2)
- Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)
- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)

ETS1.B: Developing Possible Solutions

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)
- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)

ETS1.C: Optimizing the Design Solution

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)

Crosscutting Concepts

Systems and System Models

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales. (HS-ETS1-4)

Connections to Engineering, Technology and Applications of Science

Influence of Science, Engineering, and Technology on Society and the Natural World

- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ETS1-1) (HS-ETS1-3)

Connections to HS-ETS1.A: Defining and Delimiting Engineering Problems include:
Physical Science: HS-PS2-3, HS-PS3-3

Connections to HS-ETS1.B: Designing Solutions to Engineering Problems include:
Earth and Space Science: HS-ESS3-2, HS-ESS3-4, **Life Science:** HS-LS2-7, HS-LS4-6

Connections to HS-ETS1.C: Optimizing the Design Solution include:
Physical Science: HS-PS1-6, HS-PS2-3

Articulation of DCIs across grade-bands: **MS.ETS1.A** (HS-ETS1-1),(HS-ETS1-2),(HS-ETS1-3),(HS-ETS1-4); **MS.ETS1.B** (HS-ETS1-2),(HS-ETS1-3),(HS-ETS1-4); **MS.ETS1.C** (HS-ETS1-2),(HS-ETS1-4)

Common Core State Standards Connections:

ELA/Literacy –

RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ETS1-1), *(HS-ETS1-3)*
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. *(HS-ETS1-1),*(HS-ETS1-3)
RST.11-12.9	Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-1), *(HS-ETS1-3)*

Mathematics –

MP.2	Reason abstractly and quantitatively. (HS-ETS1-1),*(HS-ETS1-3),(HS-ETS1-4)*
MP.4	Model with mathematics. (HS-ETS1-1),(HS-ETS1-2),(HS-ETS1-3),(HS-ETS1-4)

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ACTION SUMMARY SHEET
STATE BOARD OF EDUCATION

DATE: October 8, 2013

ISSUE:

Chapter 10 Rules – Revised Standards for Science, Social Studies, Physical Education, and Career/Vocational Education

BACKGROUND:

Per W.S. 21-9-101, the State Board of Education is responsible for setting educational standards in the nine content areas. The content and performance standards are reviewed every five years. Chapter 10 reflects the revisions to the aforementioned content areas.

SUGGESTED MOTION(s)/RECOMMENDATION(s):

I move to adopt the revised standards for Science, Social Studies, Physical Education, and Career/Vocational Education.

SUPPORTING INFORMATION ATTACHED:

PREPARED BY:

ACTION TAKEN BY STATE BOARD: _____DATE:_____

COMMENTS:

WYOMING

State Board of Education

Hathaway Building, 2nd Floor
2300 Capitol Avenue
Cheyenne, Wyoming 82002-0050
(307) 777-6213 • (307) 777-6234 FAX

RON MICHELI
Chair, Fort Bridger

SCOTTY RATLIFF
Vice Chair, Riverton

PETE GOSAR
Treasurer, Laramie

SUE BELISH
Ranchester

KATHY COON
Lusk

RICHARD CRANDALL
WDE Director

HUGH HAGEMAN
Fort Laramie

CINDY HILL
State Superintendent

KEN RATHBUN
Sundance

GERALD REICHARDT
Wheatland

KATHRYN SESSIONS
Cheyenne

WALT WILCOX
Casper

BELENDA WILLSON
Thermopolis

CHELSIE BAILEY
Executive Assistant

To: *Honorable Matt Mead, Governor*

From: *Ron Micheli, Chair*
Wyoming State Board of Education

Subject: *Amended Rules for Chapter 10*

Priority: *HIGH – Deadline for response is Month DD, 2013*

Summary: The State Board of Education is proposing to amend rules for Chapter 10. The revised rules include the following changes:

- 2013 Wyoming Content and Performance Standards for Social Studies;
- 2013 Wyoming Content and Performance Standards for Science;
- 2013 Wyoming Content and Performance Standards for Physical Education; and,
- 2013 Wyoming Content and Performance Standards for Career & Vocational Education

Specific information on the changes can be found in the Statement of Reasons.

Agency Contact Name: Laurie Hernandez

Agency Contact Phone: 307-777-3469

Agency Contact Email: laurie.hernandez@wyo.gov

Governor's Response Options (to be completed by Governor's Office):

_____ Agency may proceed.

_____ Delay Public Comment and Set Up Meeting with

_____

_____
Signature: Governor's Counsel

If no response has been received by the 10th working day, the Agency will proceed with these rules.

CHAPTER 10
WYOMING CONTENT AND PERFORMANCE STANDARDS
STATEMENT OF REASONS

Pursuant to Wyo. Stat. § 21-2-304(a)(iii), the Wyoming State Board of Education must prescribe uniform student content and performance standards for the common core of knowledge specified by Wyo. Stat. § 21-9-101(b)(i). The common core of knowledge includes reading/language arts, social studies, mathematics, science, fine and performing arts, physical education, health and safety, humanities, career/vocational education, foreign cultures and languages, applied technology, and government and civics.

After careful consideration, and with support from members of the following review committees: Science, Social Studies, Physical Education, and Career & Vocational Education, the Wyoming State Board of Education approved the adoption of the 2013 Revised Wyoming Content and Performance Standards for the above named content areas.

The Board is promulgating revised rules for the Science, Social Studies, Physical Education, and Career & Vocational Education standards. These standards define the knowledge and skills students should know and be able to do throughout their K-12 education so they can graduate from high school able to succeed in college and career.

These rules meet the minimum substantive state statutory requirements and are within the Board and Department's statutory authority. No part of this action should be interpreted as any attempt to dictate curriculum at the national or state level.

Notice of Intent to Adopt Rules

1. General Information

a. Agency/Board Name *See attached list for references*
Wyoming Department of Education

b. Agency/Board Address	c. Agency/Board City	d. Agency/Board Zip Code
Hathaway Bldg., 2nd Floor, 2300 Capitol Avenue	Cheyenne	Wyoming 82002-0050

e. Name of Contact Person	f. Contact Telephone Number
Laurie Hernandez	307-777-3469

g. Contact Email Address
Laurie.Hernandez@wyo.gov

h. Date of Public Notice:	i. Comment Period Ends:
November 26, 2013	January 10, 2014

j. Program(s) *See attached list for references*
General Agency

2. Rule Type and Information

a. Choose all that apply: ☐ New Rules* ☒ Amended Rules ☐ Repealed Rules

** "New" rules means the first set of regular rules to be promulgated by the Agency after the Legislature adopted a new statutory provision or significantly amended an existing statute.*

If "New," provide the Enrolled Act number and year enacted:

b. Provide the Chapter Number, and Short Title of Each Chapter being Created/Amended/Repealed *(if more than 5 chapters are being created/amended/repealed, please use the Additional Rule Information form and attach it to this certification)*

Chapter Number:	Short Title:
Chapter 10	Wyoming Content and Performance Standards

c. ☒ The Statement of Reasons is attached to this certification.

d. ☐ N/A ☐ In consultation with the Attorney General's Office, the Agency's Attorney General representative concurs that strike and underscore is not required as the proposed amendments are pervasive (Section 5 of the Rules on Rules).

e. A copy of the proposed rules* may be obtained:

☒ By contacting the Agency at the physical and/or email address listed in Section 1 above.
☒ At the following URL: http://edu.wyoming.gov/Programs/standards/chapter-10-rules.aspx (Chapter 10)

* If Item "d" above is not checked, the proposed rules shall be in strike and underscore format.

3. Public Comments and Hearing Information

a. A public hearing on the proposed rules has been scheduled. ☒ Yes ☐ No

If "Yes:"	Date:	Time:	City:	Location:
	January 2014	6:00 - 8:00 p.m.	Statewide (3-4 dates)	TBD

b. What is the manner in which interested person may present their views on the rulemaking action?

☒ By submitting written comments to the Agency at the physical and/or email address listed in Section 1 above.

☒ At the following URL: http://edu.wyoming.gov/Programs/standards/chapter-10-rules.aspx (Chapter 10)

A public hearing will be held if requested by 25 persons, a government subdivision, or by an association having not less than 25 members. Requests for a public hearing may be submitted:

☒ To the Agency at the physical and/or email address listed in Section 1 above.

☐ At the following URL: _____

c. Any person may urge the Agency not to adopt the rules and request the Agency to state its reasons for overruling the consideration urged against adoption. Requests for an agency response must be made prior to, or within thirty (30) days, after adoption of the rule, addressed to the Agency and Contact Person listed in Section 1 above.

4. Federal Law Requirements

a. These rules are created/amended/repealed to comply with federal law or regulatory requirements. ☐ Yes ☒ No

If "Yes:" Applicable Federal Law or Regulation Citation:

Indicate one (1):

☐ The proposed rules meet, but do not exceed, minimum federal requirements.

☐ The proposed rules exceed minimum federal requirements.

Any person wishing to object to the accuracy of any information provided by the Agency under this item should submit their objections prior to final adoption to:

☐ To the Agency at the physical and/or email address listed in Section 1 above.

☐ At the following URL: _____

5. State Statutory Requirements

a. Indicate one (1):

☒ The proposed rule change *MEETS* minimum substantive statutory requirements.

☐ The proposed rule change *EXCEEDS* minimum substantive statutory requirements. Please provide a statement explaining the reason the rules exceeds the requirements:

6. Authorization

a. I certify that the foregoing information is correct.

Printed Name of Authorized Individual	Ron Micheli
Title of Authorized Individual	Chairman of the State Board of Education
Date of Authorization	08 October 2013

Distribution List:

- Attorney General and LSO: Hard copy of Notice of Intent; Statement of Reasons; Clean copy of the rules; and Strike-through and underline version of rules (if applicable).
- Secretary of State: Electronic version of Notice of Intent sent to rules@state.wy.us

Wyoming Department of Education

Chapter 10

Wyoming Content and Performance Standards

Section 1. **Authority.**

(a) These rules and regulations are promulgated pursuant to the Wyoming Education Code of 1969 (as amended - 2002)[W.S. 21-2-304 (a) (i) (ii) (iii) and (iv)].

Section 2. **Applicability.**

(a) These rules and regulations pertain to the uniform student content and performance standards for the common core of knowledge and the common core of skills specified under W.S. 21-9-101(b).

Section 3. **Promulgation, Amendment, or Repeal of Rules.**

(a) These rules and any amendments thereof shall become effective as provided by the Wyoming Administrative Procedures Act. (W.S. 16-3-101 through 16-3-115).

Section 4. **Definitions.**

(a) Common Core of Knowledge. Areas of knowledge each student is expected to acquire at levels established by the state board of education. [W.S. 21-9-101 (b)(i)]

(b) Common Core of Skills. Skills each student is expected to demonstrate at levels established by the state board of education. [W.S. 21-9-101 (b)(iii)]. These skills may be integrated into the uniform student content and performance standards for the Common Core of Knowledge.

(c) Content and Performance Standards. Standards which include the K-12 content standards, benchmark standards at grades 4, 8, and 11 for science, social studies, health, physical education, foreign language, fine and performing arts, and career/vocational education, and benchmark standards at grades kindergarten through grade 8 and grade 11 for language arts and mathematics, and the performance standards level descriptors established for the Common Core of Knowledge and Common Core of Skills. [W.S. 21-2-304 (a)(iii)]

Section 5. **Wyoming Statutes.**

(a) All public school districts, and the schools and personnel within those districts, must comply with the applicable statutes of the State of Wyoming.

Section 6. **Wyoming State Board of Education Policies and Regulations.**

(a) All public school districts, and the schools and personnel within those districts, must comply with applicable state board policies and regulations. (W.S. 21-2-304)

Section 7. **Uniform Student Content and Performance Standards.**

(a) Uniform student content and performance standards, including standards for graduation, are hereby incorporated by reference pursuant to W.S. 16-3-103(h) and include the following:

(i) Wyoming Language Arts Content and Performance Standards as approved by the Wyoming State Board of Education on June 8, 1998, amended on July 7, 2003, amended on November 19, 2008, and amended on September 23, 2011;

(A) Wyoming Language Arts Content and Performance Standards amended on September 23, 2011 shall be fully implemented on or before the first day of the 2015-2016 school year.

(ii) Wyoming Mathematics Content and Performance Standards as approved by the Wyoming State Board of Education on June 8, 1998, amended on July 7, 2003, amended on November 19, 2008, and amended on September 23, 2011;

(A) Wyoming Mathematics Content and Performance Standards amended on September 23, 2011 shall be fully implemented on or before the first day of the 2015-2016 school year.

(iii) Wyoming Science Content and Performance Standards as approved by the Wyoming State Board of Education on June 9, 1999, amended on July 7, 2003, ~~and~~ amended on November 19, 2008~~;~~, and amended on October 8, 2013;

(A) Wyoming Science Content and Performance Standards amended on October 8, 2013 shall be fully implemented on or before the first day of the 2017-2018 school year.

(iv) Wyoming Social Studies Content and Performance Standards as approved by the Wyoming State Board of Education on June 9, 1999, amended on July 7, 2003, ~~and~~ amended on November 19, 2008~~;~~, and amended on October 8, 2013;

(A) Wyoming Science Content and Performance Standards amended on October 8, 2013 shall be fully implemented on or before the first day of the 2016-2017 school year.

(v) Wyoming Health Content and Performance Standards as approved by the Wyoming State Board of Education on June 6, 2000, amended on July 7, 2003, amended on November 19, 2008, and amended on September 23, 2011;

(A) Wyoming Health Content and Performance Standards amended on September 23, 2011 shall be fully implemented on or before the first day of the 2015-2016 school year.

(vi) Wyoming Physical Education Content and Performance Standards as approved by the Wyoming State Board of Education on June 6, 2000, amended on July 7, 2003, ~~and~~ amended on November 19, 2008~~;~~, and amended on October 8, 2013;

(A) Wyoming Science Content and Performance Standards amended on October 8, 2013 shall be fully implemented on or before the first day of the 2016-2017 school year.

(vii) Wyoming Foreign Language Content and Performance Standards as approved by the Wyoming State Board of Education on June 6, 2000, amended on July 7, 2003, amended on November 19, 2008, and amended on May 8, 2013;

(A) Wyoming Foreign Language Content and Performance Standards amended on November 2, 2012 shall be fully implemented on or before the first day of the 2016-2017 school year.

(viii) Wyoming Career/Vocational Education Content and Performance Standards as approved by the Wyoming State Board of Education on June 6, 2001, amended on July 7, 2003, ~~and~~ amended on November 19, 2008~~;~~, and amended on October 8, 2013;

(A) Wyoming Science Content and Performance Standards amended on October 8, 2013 shall be fully implemented on or before the first day of the 2016-2017 school year.

(ix) Wyoming Fine and Performing Arts Content and Performance Standards as approved by the Wyoming State Board of Education on June 6, 2001, amended on July 7, 2003, ~~and~~ amended on November 19, 2008, and amended on May 8, 2013.

(A) Wyoming Fine and Performing Arts Content and Performance Standards amended on November 2, 2012 shall be fully implemented on or before the first day of the 2016-2017 school year.

(b) The above-referenced content and performance standards are available at the Wyoming Department of Education website at edu.wyoming.gov, or are available at cost from the Wyoming Department of Education, 2300 Capitol Avenue, Hathaway Building, 2nd Floor, Cheyenne, Wyoming, 82002.

(c) The above-referenced content and performance standards dated November 19, 2008, September 23, 2011, ~~and~~ November 2, 2012, and October 8, 2013 are the most current editions.

(d) The above-referenced content and performance standards do not include any amendments to or editions of the standards since the effective date of this rule.

Wyoming Department of Education

Chapter 10

Wyoming Content and Performance Standards

Section 1. **Authority.**

(a) These rules and regulations are promulgated pursuant to the Wyoming Education Code of 1969 (as amended - 2002)[W.S. 21-2-304 (a) (i) (ii) (iii) and (iv)].

Section 2. **Applicability.**

(a) These rules and regulations pertain to the uniform student content and performance standards for the common core of knowledge and the common core of skills specified under W.S. 21-9-101(b).

Section 3. **Promulgation, Amendment, or Repeal of Rules.**

(a) These rules and any amendments thereof shall become effective as provided by the Wyoming Administrative Procedures Act. (W.S. 16-3-101 through 16-3-115).

Section 4. **Definitions.**

(a) Common Core of Knowledge. Areas of knowledge each student is expected to acquire at levels established by the state board of education. [W.S. 21-9-101 (b)(i)]

(b) Common Core of Skills. Skills each student is expected to demonstrate at levels established by the state board of education. [W.S. 21-9-101 (b)(iii)]. These skills may be integrated into the uniform student content and performance standards for the Common Core of Knowledge.

(c) Content and Performance Standards. Standards which include the K-12 content standards, benchmark standards at grades 4, 8, and 11 for science, social studies, health, physical education, foreign language, fine and performing arts, and career/vocational education, and benchmark standards at grades kindergarten through grade 8 and grade 11 for language arts and mathematics, and the performance standards level descriptors established for the Common Core of Knowledge and Common Core of Skills. [W.S. 21-2-304 (a)(iii)]

Section 5. **Wyoming Statutes.**

(a) All public school districts, and the schools and personnel within those districts, must comply with the applicable statutes of the State of Wyoming.

Section 6. **Wyoming State Board of Education Policies and Regulations.**

(a) All public school districts, and the schools and personnel within those districts, must comply with applicable state board policies and regulations. (W.S. 21-2-304)

Section 7. **Uniform Student Content and Performance Standards.**

(a) Uniform student content and performance standards, including standards for graduation, are hereby incorporated by reference pursuant to W.S. 16-3-103(h) and include the following:

(i) Wyoming Language Arts Content and Performance Standards as approved by the Wyoming State Board of Education on June 8, 1998, amended on July 7, 2003, amended on November 19, 2008, and amended on September 23, 2011;

(A) Wyoming Language Arts Content and Performance Standards amended on September 23, 2011 shall be fully implemented on or before the first day of the 2015-2016 school year.

(ii) Wyoming Mathematics Content and Performance Standards as approved by the Wyoming State Board of Education on June 8, 1998, amended on July 7, 2003, amended on November 19, 2008, and amended on September 23, 2011;

(A) Wyoming Mathematics Content and Performance Standards amended on September 23, 2011 shall be fully implemented on or before the first day of the 2015-2016 school year.

(iii) Wyoming Science Content and Performance Standards as approved by the Wyoming State Board of Education on June 9, 1999, amended on July 7, 2003, amended on November 19, 2008, and amended on October 8, 2013;

(A) Wyoming Science Content and Performance Standards amended on October 8, 2013 shall be fully implemented on or before the first day of the 2017-2018 school year.

(iv) Wyoming Social Studies Content and Performance Standards as approved by the Wyoming State Board of Education on June 9, 1999, amended on July 7, 2003, amended on November 19, 2008, and amended on October 8, 2013;

(A) Wyoming Science Content and Performance Standards amended on October 8, 2013 shall be fully implemented on or before the first day of the 2016-2017 school year.

(v) Wyoming Health Content and Performance Standards as approved by the Wyoming State Board of Education on June 6, 2000, amended on July 7, 2003, amended on November 19, 2008, and amended on September 23, 2011;

(A) Wyoming Health Content and Performance Standards amended on September 23, 2011 shall be fully implemented on or before the first day of the 2015-2016 school year.

(vi) Wyoming Physical Education Content and Performance Standards as approved by the Wyoming State Board of Education on June 6, 2000, amended on July 7, 2003, amended on November 19, 2008, and amended on October 8, 2013;

(A) Wyoming Science Content and Performance Standards amended on October 8, 2013 shall be fully implemented on or before the first day of the 2016-2017 school year.

(vii) Wyoming Foreign Language Content and Performance Standards as approved by the Wyoming State Board of Education on June 6, 2000, amended on July 7, 2003, amended on November 19, 2008, and amended on May 8, 2013;

(A) Wyoming Foreign Language Content and Performance Standards amended on November 2, 2012 shall be fully implemented on or before the first day of the 2016-2017 school year.

(viii) Wyoming Career/Vocational Education Content and Performance Standards as approved by the Wyoming State Board of Education on June 6, 2001, amended on July 7, 2003, amended on November 19, 2008, and amended on October 8, 2013;

(A) Wyoming Science Content and Performance Standards amended on October 8, 2013 shall be fully implemented on or before the first day of the 2016-2017 school year.

(ix) Wyoming Fine and Performing Arts Content and Performance Standards as approved by the Wyoming State Board of Education on June 6, 2001, amended on July 7, 2003, ~~and~~ amended on November 19, 2008, and amended on May 8, 2013.

(A) Wyoming Fine and Performing Arts Content and Performance Standards amended on November 2, 2012 shall be fully implemented on or before the first day of the 2016-2017 school year.

(b) The above-referenced content and performance standards are available at the Wyoming Department of Education website at edu.wyoming.gov, or are available at cost from the Wyoming Department of Education, 2300 Capitol Avenue, Hathaway Building, 2nd Floor, Cheyenne, Wyoming, 82002.

(c) The above-referenced content and performance standards dated November 19, 2008, September 23, 2011, November 2, 2012, and October 8, 2013 are the most current editions.

(d) The above-referenced content and performance standards do not include any amendments to or editions of the standards since the effective date of this rule.

ACTION SUMMARY SHEET
STATE BOARD OF EDUCATION

DATE: October 7, 2013

ISSUE: October 15 Phase I Report

BACKGROUND: See board packet

SUGGESTED MOTION/RECOMMENDATION:

To approve the information to be included in the October 15 Phase I accountability report to the legislature.

SUPPORTING INFORMATION ATTACHED:

- See board packet

PREPARED BY: *Bailey Anthony*
Bailey Anthony, Executive Assistant

ACTION TAKEN BY STATE BOARD: _____DATE:_____

COMMENTS:

WYOMING SCHOOL PERFORMANCE RATING MODEL

IMPLEMENTATION HANDBOOK

(September 24, 2013)

The Wyoming Accountability in Education Act (WAEA) established a requirement to develop procedures for assigning all Wyoming public schools to one of four performance level categories: *Exceeding Expectations, Meeting Expectations, Partially Meeting Expectations* and *Not Meeting Expectations.* Each school's performance level determination was based upon the school's performance on various indicators that were prescribed by statute. The methodology for evaluating each schools performance on the indicators was established in accordance with the January, 2012, *Education Accountability Report*[1]. A professional judgment panel (PJP) was prescribed by statute to engage in a standard setting process to establish cut-scores and other parameters for a school performance rating model. The PJP met on September 16, 17, and 18, 2013 and this report reflects the decisions made by that panel.

INDICATORS BY GRADE

Indicators are a function of grade in school.

- Grade Three through Grade Eight School Indicators
  - Achievement
  - Growth
  - Equity measured by growth
- Grade Nine through Twelve Indicators
  - Achievement
  - Readiness
  - Equity measured by change in the achievement gap

The readiness indicator for grade nine through 12 was applied only to those schools from which students could earn a high school diploma. Some junior high schools have a grade nine. The grade nine readiness indicators were not used for school performance ratings at these schools. Some high schools have grades ten through 12. The grade nine readiness indicators were not used for school performance ratings at these schools.

Some schools had grade configurations that included both grades nine through 12 and grades eight and lower (e.g., schools with grades K-12). These schools had two school performance levels computed initially; one for grades eight and below and one for grades nine through 12. The school was assigned to the performance level that is the lower of the two computed performance levels.

INDICATORS AND INDICATOR SCORES

[1] Marion, S. & Domaleski, C. (2012). *The Wyoming Comprehensive Accountability Framework: Phase I.* Produced for the Wyoming Select Committee on Statewide Education Accountability.

ACHIEVEMENT

There was one overall *school achievement score* for each school that included the performance in all tested grades and content areas at each school. The score was the percent of tested students who scored proficient or above on the Wyoming state achievement test. The 2012-13 achievement tests used for state accountability[2] included:

- The Proficiency Assessment for Wyoming Students (PAWS)
  - Reading in grades 3 through 8
  - Math in grades 3 through 8
  - Science in grades 4 and 8
- The ACT
  - Reading test in grade 11
  - Mathematics test in grade 11
  - Science test in grade 11

An illustration of how school achievement scores were computed is presented in Table 1. Assume the hypothetical school represented in Table 1 was an elementary school with grades kindergarten through six with 20 students per grade level. Science would only be tested in grade 4 at this school. Because fewer students were tested in science, exceptionally high or low performance on the science test would have less impact on the school achievement score than would exceptionally high or low performance on either the reading tests or the math tests[3].

Table 1. Illustration of Computation of a School Achievement Score.

Content	Count of Tested Students	Count of Proficient Students	School Achievement Score
Math	80	65	
Reading	80	60	
Writing	40	25	
Science	20	12	
Column Totals	220	162	162/220 = 73.6%

This school achievement score (i.e., the total percent proficient on all achievement tests) was used for assigning schools to one of three categories on the achievement indicator: (a) exceeding targets, (b) meeting targets, or (c) below targets. A professional judgment panel (PJP) of education stakeholders established the school achievement score cut points during a September

[2] In 2014 the student assessment of writing skills (SAWS) and the ACT Writing test will be included in the achievement scores for schools.

[3] Weighting for different tested content areas will be a function of the number of students taking a test in each content area. This weighting reflects the policy maker decisions about which grade-by-content areas to test. For example, when federal and state policy makers required testing in reading and math in seven grades but they required testing in science in just three grades they suggested the weights reflected in this rating model. As a result, more students take reading and math tests than science test and reading and math will carry more weight on the achievement indicator than science.

2013 standard setting session that were used to assign schools to these three categories. Separate cut-points will be established for each of three grade level bands.

- Grade Band One = Grades 3 through 6
- Grade Band Two = Grades 7 and 8
- Grade Band Three = Grade 11

Table 2. 2013 Achievement Cut Points by Grade Band.

	Low Cut	High Cut
Grade Band 1 (3-6)	75	86
Grade Band 2 (7-8)	68	80
Grade Band 3 (11)	70	83

Note. Established by the September 2013 professional judgment panel.

Some schools had students in both grade band one and grade band two. When this happened, cut points were adjusted to accurately reflect the number of students in each of the grade bands at the school using the procedure illustrated in Table 3. The school represented in Table 3 is a hypothetical middle school with grades six, seven, and eight.

Table 3. Illustration of Method of Adjusting a Cut Point when a School Includes Two Grade Bands

	Band 1	Band 2	Steps 1 & 2	Step 3	Step 4
Cut Points	75	68	75 - 68 = 7		
n of Students	100	200	100/(100+200) = .333	7*0.333 = 2.33	68+2.33 = 70.33

Step 1 in Table 3 involves simple subtraction to determine the magnitude of the difference in the cut-points from each grade band. The difference between 75 and 68 is 7. Step 2 in Table 3 involves determining the percentage of total students in grade band 1. Grade band 1 included 33.3% of the total student count at the school. In step 3 the result of step 1 is multiplied by the result of step 2. The result, 2.3 is 33% of the 7 point difference in the cut-points for grade band one versus grade band two. In step 4, the final step, 2.3 is added to the lower of the two cut-points (i.e., the cut-point for grade band two). The adjusted cut-point for this hypothetical school would be 70.3.

GROWTH

Growth refers to a change in the achievement within students as they progress from year to year. In order to compute growth scores, students must have at least two consecutive years of state test scores. Since the Wyoming state test is first administered in grade three, growth was first measured in grade four. Growth was computed separately for reading and for math on the Wyoming state test for students in grades four through eight.

The method used to measure growth will produce student growth percentiles[4] (SGPs) that indicate how an individual student's growth compared with that of all Wyoming public school students[5] from that particular year in the same grade that had similar scores in previous years. SGPs range from 1 to 99 with lower scores indicating lower growth and higher scores indicating higher growth. This measure of growth is independent of the achievement level performance of students[6]. Students with low achievement may have low or high growth. Likewise, students with high achievement may have low or high growth. Regardless of how high a student's test scores in past years were, they still may earn any of the SGPs from 1 to 99.

The median SGP at a school (i.e., the school's MGP) is the SGP that half of the students at the school scored above and half scored below. MGPs have the same meaning for any group. As such, they can be computed separately for each grade and content area at a school. Separate MGPs for each grade and content area at a school were computed and reported to assist schools with their improvement efforts. The most accurate median to represent total growth at a school across all grades and both content areas, however, would be the median of all SGPs (i.e., the MGP) at the school regardless of grade or content area. That *school MGP* was used as the school's growth score.

MGPs at each school will further be placed into one of three categories: (a) exceeding target, (b) meeting target and (c) not meeting target. The PJP established cut points for the MGPs that separated these three categories from one another. The cut point established by the PJP for school MGPs were a low cut of 45 (i.e., between below target and meeting target) and a high cut of 60 (i.e., between meeting target and exceeding target).

EQUITY

An important goal of WAEA is to "minimize achievement gaps" [Wyoming Statute 21-2-204(b)(vi)]. During the 2013 session of the Wyoming legislature more specificity was added to the definition of equity for the purpose of accountability [Wyoming Statute 21-2-204(c)(vii)]. As a result there will be two methods used to measure equity in Wyoming schools. The method used for a particular school will depend upon whether there are measures of student growth available to the school. Measures of student growth were available to schools with students in grades four through eight. Since high schools do not have a measure of growth, an alternative measure of equity was required for high schools.

Consolidated Subgroup. When a school has growth measures, a consolidated subgroup consisting of all students who were below proficient during the previous year on the state test in math and/or reading will be used in the measurement of equity. Because the previous year's test performance defines this group, educators will know who is in this group at the beginning of each new school year. This will permit educators to be strategic about planning to improve

[4] See Betebenner, D. W. (2008). *Norm- and criterion-referenced student growth.* Available at http://www.nciea.org.
[5] Some private school and home school students take the PAWS test. If these students are not enrolled in a public school at the time of the testing, their score will not be included in the norm sample. If they enroll in a public school the following year and take the PAWS test, their previous PAWS test scores will be used to compute growth.
[6] Correlation coefficients for prior achievement with SGPs at the student level in Wyoming were all very near r = 0.00.

outcomes for students in this subgroup. The minimum *n* for the consolidated subgroup was 15 students. Schools with fewer than 15 students below proficient in the prior year will not have an equity indicator.

Equity for Schools with Growth Scores. For schools that have students with growth scores (i.e., SGPs) on the state test, a *growth to standard* approach is used for the measurement of equity. Specifically, adequate growth percentiles (AGPs) were computed for all students. For students in the consolidated subgroup, an AGP represents the minimum SGP that the students needs for the current year in order to be considered to be *on track* to reach proficiency within three years or by the end of grade eight. The equity indicator, therefore, for schools with growth scores was the percent of students in the consolidated subgroup who obtain SGP scores that are at or above their AGP score. The PJP determine the percentages of students meeting this criterion that resulted in schools being considered as exceeding targets, meeting targets or not meeting targets. The low cut score identified by the PJP was 40 high cut score was 55. Schools where less than 40% of students from the consolidated subgroup had SGPs that equaled or exceeded their AGPs were "not meeting" the equity target. Schools where 55% or more of students from the consolidated subgroup had SGPs that equaled or exceeded their AGPs were "exceeding" the equity target. The remainder of the schools that met the minimum *n* for the consolidated subgroup were in the "meeting target" category.

Equity for Schools without Growth Scores in 2013. The policy goal for an equity measure is to encourage a focus on improving the performance of the most high-risk students. The current plans call for a revision of the high school equity indicator for 2014. In 2013, the initial pilot year for school performance ratings, the measurement of equity was constrained by the available data. Specifically, the current year grade 11 students did not participate in census testing on any test in 2012. As such, it was not possible to establish a consolidated subgroup based upon prior year performance.

The equity measure used in 2013 is described here. In order for a high school to meet the minimum *n* requirement, at least 15 students needed a reading or math subject area test score on the ACT in 2013. High school equity was only measured in those schools that met the minimum *n* requirement. The 2013 method for identifying equity that was the final result is reported here.

- Step 1. The percent of test scores at each school on the subject area tests of reading and math that were not proficient were computed for 2013.
- Step 2. The percent of test scores at each school on the reading and math subtests of the PAWS that were not proficient were computed for 2012.
- A *change* score was computed to reflect the change in percent of students not proficient from 2012 to 2013.
- The change scores were used place each high school that met the minimum *n* for the current year into one of three categories. Approximately one third of schools were placed into each category. The categories were:
    - Negative Change. Schools that had an increase in the percent of students not proficient (i.e., schools with change scores lower than -3.12).
    - Positive Change. Schools that had a decrease in the percent of students not proficient (i.e., schools with change scores of +2.76 or higher).

- Minimal Change. Schools that where the percent of students not proficient remained essentially unchanged from 2012 to 2013 (i.e., schools with change scores from -3.12 to < +2.76).

Schools in the *negative change* category were identified as not meeting targets, schools in the *minimal change* category identified as meeting targets, and schools in the *positive change* category were identified as exceeding targets.

Equity for High Schools in 2014. Next year's grade 11 students will have PLAN scores from 2013 that will be used to identify a consolidated subgroup. The distance that this subgroup's performance differed from overall state level performance will be computed for 2013 using the PLAN. The distance that the performance of those same students differed from the overall state level performance will be computed for 2014. A change score will be computed for each school to represent the change relative to the state mean from 2013 to 2014 for this cohort of students. This change score will become the school's equity score and a PJP process will establish cut-scores for these equity scores. The major difference between the 2013 method and the 2014 method is that a cross section of students from each year was included in the analyses for 2013. The students were from different cohorts. Whereas, the cohort of the below proficient students from a prior year will be tracked longitudinally in 2014[7].

READINESS

Readiness was measured at all high schools (i.e., schools from which students may earn a high school diploma). There were two subindicators for readiness in 2013.

- Tested readiness as measured on tests in the ACT suite of tests (i.e., ACT Explore in grade 9, ACT Plan in grade 10 and the ACT in grade 11)
- A graduation index

These subindicator scores were combined into one overall readiness indicator. The weights and index values were first suggested by the advisory committee to Wyoming legislature's select committee on school accountability during July, 2013. They were finalized by the PJP during September 2013. For 2013, tested readiness was weighted as 40% of the total readiness score and the graduation index was weighted as 60% of the total readiness score.

ACT Suite of Readiness Tests. Scores on the ACT Explore in the spring of grade nine, the ACT Plan in the spring of grade ten and the ACT in grade 11 will provide test evidence of readiness. An index was developed for each of the three tests which were used in computing the measure of tested readiness used in 2013. ACT composite test scores are presently used in Wyoming as one source of information that determines a student's level of eligibility for Hathaway Scholarships. The ACT composite score cut points used for Hathaway Scholarship eligibility informed the development of the Wyoming accountability tested readiness index. Specifically the ACT composite cut point for the lowest level of Hathaway Scholarship eligibility became the lowest

[7] Flicek (2013) in an unpublished research paper compared this method with the growth-to-standard method that was used for grades 4 through 8. The Pearson correlation coefficient comparing school scores from both methods was $r = .50$.

cut point for Wyoming accountability. The ACT composite cut point for the highest level of Hathaway Scholarship eligibility became the highest cut point for Wyoming accountability. Finally, an ACT composite cut point for a middle level of Hathaway Scholarship eligibility became the middle cut point for Wyoming accountability. Table 4 presents the Wyoming ACT readiness score ranges and associated index values that resulted from this process.

Table 4. ACT College Readiness Index Score Ranges.

Wyoming ACT Readiness Levels	Composite Score Ranges			Index Points*
	ACT Explore Grade 9	ACT Plan Grade 10	ACT Test Grade 11	
Level 4	21-25	22-32	25-36	100
Level 3	18-20	19-21	21-24	80
Level 2	15-17	16-18	17-20	50
Level 1	1-14	1-15	1-16	20

*Initial index point values were derived from advisory committee to the Wyoming select committee on school accountability standard setting activity.

Next, Table 4.9 in the *Technical Manual Plan* provided observed ACT scores from fall of grade 12 for students who also had Plan scores from spring of grade ten. The frequency distributions from this matrix of scores were used to identify the score point on the Plan that was a mid point in the score range associated with the ACT cut points represented in Table 4 above. The Plan score ranges in Table 4 were constructed using those corresponding Plan composite scores as cut points.

Finally, Table 4.19 of the *Technical Manual Explore* provides observed Plan composite scores from fall of grade 10 for students who also had Explore scores from the spring of grade nine. The frequency distributions from this matrix of scores were used to identify the score point on the Explore that were a mid point in the score range associated with the Plan cut points represented in Table 4 above. The Explore score ranges in Table 4 above were constructed using those corresponding Explore cut points.

A school was assigned 20 points for each student at a school who performed at level 1, 50 points for each student who performs at level 2, 80 points for each student who performs at level 3 and 100 points for each student who performs at level 4. A school received one overall readiness score for student performance on all tests from the ACT suite that were administered at the school. The school's tested readiness score was the mean index score for all students across all tests from this suite that were administered at the school.

Tested readiness for students who take the alternate assessment was based upon the number of subject area tests on which they were proficient or better. Specifically, a school will be assigned 100 index points for each student who earns a proficient or better score on all four subject area tests on the alternate assessment. A school will be assigned 80 index points for all students who earn a proficient or better score on three of the four subject area tests on the alternate assessment. A school will be assigned 50 index points for all students who are proficient on one or two of the

four subject area tests on the alternate assessment. A school will be assigned 20 points for all students who are proficient on none of the four subject area tests on the alternate assessment.

Graduation Index. Table 5 illustrates the graduation index. The index point values in Table 5 were assigned by the PJP. The index points are assigned to the school for each student who meets the student result criteria in Table 5. The school's graduation index score will be the mean of student index points.

Table 5. Graduation Index.

Criteria Numbers	Student Result	Points
5	Diploma Earned in Four Years or Less	100
3	Diploma Earned in More than Four Years	100
2	Continued Enrollment**	50
1	Noncompleters	0

*Continued enrollment after the student's grade nine cohort had been in school for four years.

Specific definitions of the criteria in Table 8 follow.

Diploma Earned in Four Years or Less. This criterion was met when students received their high school diploma four years or less from their first entry into grade nine.

Diploma Earned in More than Four Years. Any student who receives a high school diploma but who first entered grade nine more than four years earlier meets this criterion.

Continued Enrollment. Continued enrollment applies to students who first entered grade nine more than four years ago but remain enrolled in school on October 1st of a following school year. Students who graduate in that year would earn the school index points for diploma earned in more than four years in the following school year. The school will earn 50 points when this student remains enrolled after her four year cohort exited and another 100 points the following year if she graduates that year. When a school is awarded points for a student's continued enrollment one year and that student does not go on to graduate and is not enrolled in school on October 1st of the following year, that student will be included with the noncompleters in that year.

Noncompleters. When computing the school index score, schools will be assigned zero points for noncompleters and they will be included in the computation of the mean student index score for the school. Students will count as noncompleters when they were the grade nine drop-outs three years ago, the grade ten drop-outs two years ago, the grade eleven drop-outs one year ago and the current year grade 12 drop-outs. Continued enrollment students who do not graduate and fail to return a subsequent year will also be considered noncompleters.

Changes planned for 2014. Work is underway to collect information about which students are working on alternate standards at each school in Wyoming. When this data becomes available an additional category is planned for the graduation index. This category would award index points

to a school when students on alternate standards successfully complete their education program. No more than one percent of students statewide may be counted for this purpose.

Alternate Standards Certificate per IEP[8]. Students meeting this criterion will be those students who were on an individual education plan (IEP) that stipulated they were working on alternate standards. These students are not eligible for a diploma since their IEP teams had determined that their disability made working on alternate standards more appropriate than working on regular state standards. These points are awarded to the school only when the student is exiting high school for a final time (e.g., when they age out at age 21) and is determined to have successfully completed their educational program. The school may be awarded points for continued enrollment for these students each year after their four year graduation cohort exits but before these students successfully complete their program.

Two additional subindicators are planned for the readiness indicator for 2014.

- Grade nine credits earned.
- Hathaway scholarship eligibility level

Grade Nine Credits Earned. Grade nine may or may not be part of the grade configuration for all Wyoming schools from which students may receive a diploma. Some high schools serve students in grades ten through 12 while most presently serve students in grades nine through 12. Grade nine credits earned will be an indicator for all schools from which students may receive a diploma, regardless of the grade configuration of the school. The number of credits a student has when entering grade ten is a leading indicator for success in high school regardless of where the student attended school for grade nine. Therefore, high schools have an interest in and can choose to have some role in how well students are performing in grade nine even when grade nine is housed in a feeder school rather than in the high school itself.

Some students earn grade nine credits during a summer session. In order to be able to credit schools for ninth grade credits earned in the summer, the grade nine credits earned indicator will lag one year. In this respect it will be similar to the long standing practice in Wyoming of lagging the reporting of graduation rate for accountability purposes by one year so that students who graduate following the successful completion of required courses during the summer session may be included in a school's graduation rate. When grade nine is housed at the high school, grade nine credits earned will be computed for all students who were enrolled in that school at the end of grade nine. When grade nine is housed in feeder schools, grade nine credits will be computed for all students enrolled at the high school on October 1st of the year after they first attended grade nine[9].

[8] Current information systems do not contain information about students who were alternate standards certificate per IEP students. Collections will be established for the school year that follows the pilot. For the pilot year, identified alternate standards students from the relevant cohorts will be excluded from the computation of the graduation index.

[9] A potential negative unintended consequence could be associated with this particular business rule. Specifically, a district may choose to retain students in grade nine in a junior high if they do not have all credits needed to be considered "on-track" for high school completion. An additional unintended consequence would be a practice of becoming more lenient about awarding credits in grade nine. A choice by the professional judgment panel to place

A school's score for grade nine credits will be the percentage of students that earned one fourth of the credits required to earn a diploma at the high school they are attending by the end of grade nine.

Hathaway Scholarship Level. There are four Hathaway scholarship levels in Wyoming. Eligibility for each level is based upon three criteria: (a) unweighted high school grade point average, (b) a minimum ACT or Work Keys score and (c) completion of the success curriculum at a particular level. The scholarship levels and the eligibility criteria are presented in Table 6.

Table 6. Hathaway Scholarship Eligibility Levels and Criteria.

	Scholarship Level			
Criteria	Provisional	Opportunity	Performance	Honors
High School Minimum GPA	2.5	2.5	3.0	3.5
Minimum ACT*	17**	19	21	25
High School Curriculum	Success***	Success	Success	Success

*ACT can be the student's best ACT score which may not be from the census administration in grade 11.
**Or a WorkKeys score of at least 12.
***Completion of a success curriculum as defined by the Wyoming Department of Education.

Hathaway Scholarship eligibility will be measured using an index for the purpose of computing school performance levels under WAEA. The index is presented in Table 7.

Table 7. Hathaway Scholarship Eligibility Index.

Student Eligibility Level	Points*
Level 5: Honors	100
Level 4: Performance	90
Level 3: Opportunity	80
Level 2: Provisional	70
Level 1: Not Eligible	0

**Initial index point values were derived from advisory committee to the Wyoming select committee on school accountability standard setting activity.

The school's score will be the mean of student points for the graduating class at the school. The possible scores for a school will range from 0 to 100.

The Hathaway eligibility used for accountability will not necessarily match Hathaway eligibility for awards. For awards, a students' best ACT score can be used. The WDE Hathaway data collection may not include a student's best ACT score. In addition, a students' success curriculum performance will be computed electronically based upon transcript information. For

less weight on this readiness indicator compared to the other readiness indicators could mitigate the likelihood of the potentially negative changes in practice.

award eligibility success curriculum performance and other eligibility criteria are judged by a human inspection of the student's transcript.

SCHOOL PERFORMANCE LEVEL ASSIGNMENT

The indicator category scores were combined to arrive at a school performance level designation for each school in Wyoming using decision tables. The performance level associated with each cell in the decision tables were established during the September 2013 standard setting meeting by the PJP. The median of PJP member judgments for each cell on a second round of making judgments were used to identify the performance level associated with each cell. The decision tables are presented below.

Table 8. Decision Table for Assigning School Performance Levels for Schools with Grades Three through Eight that have Three Indicators.

		Achievement Below	Achievement Meeting	Achievement Exceeding
Equity Below	Growth Below	1	2	2
	Growth Meeting	2	3	3
	Growth Exceeding	2	3	3
Equity Meeting	Growth Below	2	3	3
	Growth Meeting	2	3	3
	Growth Exceeding	2	3	4
Equity Exceeding	Growth Below	2	3	3
	Growth Meeting	2	3	4
	Growth Exceeding	3	3	4

Note. "1" = Not Meeting Expectations, "2" = Partially Meeting Expectations, "3" = Meeting Expectations, and "4" = Exceeding Expectations

Table 9. Decision Table for Assigning School Performance Levels for High Schools that have Three Indicators.

		Achievement Below	Achievement Meeting	Achievement Exceeding
Equity Below	Readiness Below	1	2	2
	Readiness Meeting	2	3	3
	Readiness Exceeding	2	3	3
Equity Meeting	Readiness Below	2	3	3
	Readiness Meeting	2	3	3
	Readiness Exceeding	2	3	4
Equity Exceeding	Readiness Below	2	3	3
	Readiness Meeting	2	3	4
	Readiness Exceeding	2	3	4

Note. Note. "1" = Not Meeting Expectations, "2" = Partially Meeting Expectations, "3" = Meeting Expectations, and "4" = Exceeding Expectations

There will be some schools that have only two indicators. For example, many schools will not have a consolidated subgroup that meets the minimum *n* requirement. These schools will not have an equity indicator. When schools have only two indicators the decision tables below will be used for determining the school performance level.

Table 10. Decision Table for Assigning School Performance Levels when a School with Grades Three through Eight has Only Two Indicators.

	Achievement Below	Achievement Meeting	Achievement Exceeding
Growth Below	1	2	2
Growth Meeting	2	3	3
Growth Exceeding	2	3	4

Note. Note. “1” = Not Meeting Expectations, “2” = Partially Meeting Expectations, “3” = Meeting Expectations, and “4” = Exceeding Expectations

Table 11. Decision Table for Assigning School Performance Levels when a High School has Only Two Indicators.

	Achievement Below	Achievement Meeting	Achievement Exceeding
Readiness Below	1	2	2
Readiness Meeting	2	3	3
Readiness Exceeding	2	3	4

Note. Note. “1” = Not Meeting Expectations, “2” = Partially Meeting Expectations, “3” = Meeting Expectations, and “4” = Exceeding Expectations

PARTICIPATION RATE

Rules for minimum participation rate are important to assure that test results used as accountability indicators are representative of the performance of students receiving instruction at a school. Non participation in testing is unlikely to be randomly distributed among students attending a school. Non participation is more likely to be systematic. When a sample of non participants in testing at a school is systematic (e.g., when the students who are non participants are those likely to have low test scores), selection bias occurs and the validity associated with using those scores in school performance computations is called into question (Marion & Domaleski, 2012). The accountability conclusions about school performance will not match actual school performance.

Participation rate is computed for (a) all enrolled students and (b) all enrolled students who were below proficient in the prior year on each assessment that is used in computing Wyoming school performance levels. The students who were below proficient in the prior year serve as a

consolidated subgroup[10]. As a group these are students with high needs and it is important that they not be systematically excluded from testing. All schools are expected to meet the minimum annual participation rate of 95 percent for both student groups. When a school fails to meet the minimum participation rate on all tests involved in computing school performance levels the school will be assigned to the school performance level that is one level below the computed performance level.

Any school that fails to meet an annual percentage rate of at least 90 percent on any test that is used in the assignment of Wyoming school performance levels will be declared "unscoreable". Consequences for schools that are unscoreable will align with those for schools that fall within the school performance level of not meeting expectations and these schools will be reported as not meeting expectations.

Exemptions

In rare instances, districts may petition the Wyoming Department of Education for an exemption from testing for students with the most significant cognitive disability who are assessed on the alternate assessment when they move into the school from another school district after the beginning of the alternate assessment window. Students moving between schools within a district are not eligible for an exemption. Eligibility for an exemption should not be based on the disability category, the amount of time for which the students receives service, the location or delivery of service or the level of functioning of the student.

The Wyoming Department of Education will consider the amount of time left in the testing window to prepare for and administer the assessment. There must be evidence that the amount of time left in the testing window is not adequate to allow for a valid administration. The Wyoming Department of Education may consider evidence about the individual student's response time when demonstrating academic knowledge if such evidence is provided. For approved exemptions the performance of the student is not considered in participation rate computations or in school performance level computations.

FULL ACADEMIC YEAR

Student mobility varies across schools. Students sometimes move into a school just prior to testing. When computing school performance levels, it is reasonable to include only students who were present at the school for a full academic year (Marion & Domaleski, 2012). It is possible to exclude the performance of students who have recently arrived at the school from the school performance level computations.

"Full academic year" will be defined for Wyoming accountability as being enrolled in the same school on October 1 and on the day that is the midpoint of the testing window for each test used

[10] For the purpose of computing participation rate, students who score below proficient on the subject-area tests of the ACT in grade 11 will comprise the consolidated subgroup. For the purpose of computing participation rate on the Explore and Plan, students who perform at the Level 1 of the readiness index will comprise the consolidated subgroup.

in the computation of school performance levels. Students who were not at the school for the full academic year will be excluded from school performance level computations.

MINIMUM *n* FOR ACCOUNTABILITY

For accountability decisions, the minimum number of students (*n*) in the consolidated subgroup is 15. For schools with a consolidated subgroup of less than 15 the performance of the consolidated subgroup over multiple years will be considered. Subgroup performance will be considered over two years. If that results in 15 students in the consolidated subgroup equity would be measured for those combined years. If not subgroup performance will be considered over three years. If there are not 15 students in the subgroup over three years, equity will not be measured at the school.

Wyoming has a sizable number of schools with fewer than 15 tested students in an all students group. For the all students group at a school the minimum *n* size will be six. Schools with fewer than six tested students in any one year will be reviewed based on average performance over the previous two or three years depending upon which leads to at least six tested students being available. Any student tested in reading, math, or reading and math will be counted to determine the schools *n.* No student will be counted more than once.

STUDENTS TESTED ON ALTERNATE ASSESSMENTS

Students on individual education plans who are working on alternate standards will be required to test on an alternate assessment. Students on alternate standards who do not test will be considered as not tested for the participation rate computations. Student performance on alternate assessments will be counted for school performance level determinations.

SCHOOLS WITH ONE OR NO TESTED GRADES

There are schools in Wyoming with grade three as their only tested grade. When a school's only tested grade is grade three have data for an achievement indicator but they do not have data for the growth indicator or the equity indicator. For the purpose of accountability these schools are "paired" with a school that includes grade four and/or above. This ensures school performance levels are based upon more than just one indicator. The grade three achievement scores from these schools are combined with the achievement scores from their paired school when determining school performance levels. In other words, the combined school is treated as a single school for accountability.

In Wyoming there are schools with grade configurations that do not include any tested grade. For example, several LEAs have organized their elementary schools so that students attend grade K-2 in one building and then move to a different building for grades 3-5. In this case, the school performance level for the 3-5 school is used to hold the K-2 school accountable as well. The rationale for this is that the teachers in the two different schools need to be communicating across buildings to plan their curricular and instructional sequences for the successful transition of students between schools. Holding both schools equally accountable for the 3-5 school results should help foster this communication.

Table 12 is a list of Wyoming schools that do not contain any of the currently assessed grades and the school with which they are paired for accountability purposes. This table will be updated each year.

Table 12. Accountability School Pairings for Schools without Tested Grades.

School ID	School Name	Grades Served	Accountability Related School	Grades Served	School ID
0501002	Douglas Primary School	K-2	Douglas Intermediate School	3-5	0501010
0701007	North Elementary &	K-1	Baldwin Creek Elementary	4-5	0701009
0701008	Gannett Peak Elementary	2-3			
0706001	Crowheart Elementary	K-3	Wind River Elementary	K-5	0706002
0725001	Ashgrove Elementary School	K-2	Rendezvous Elementary	3-5	0725007
0725005	Aspen Park Elementary School	K-2			
0725003	Jackson Elementary School	K-2			
0801007	Lincoln Elementary	K-2	Trail Elementary	3-5	0801006
1001006	Meadowlark Elementary	K-3	Clear Creek Elementary	4-5	1001002
1101021	Lebhart Elementary	K-2	Fairview Elementary	3-6	1101013
1101010	Deming Elementary	K-3	Miller Elementary	4-6	1101022
1101040	PODER Elementary	K-3			
1202001	Afton Elementary	K-3	Osmond Elementary	4-6	1202005
1202003	Thayne Elementary	K-3	Etna Elementary	4-6	1202004
1601003	Libbey Elementary	K-2	West Elementary	3-5	1601005
2001010	Jackson Elementary	K-2	Colter Elementary	3-5	2001009
2104001	Mountain View Elementary	K-2	Fort Bridger Elementary	3-5	2104002
2301003	Newcastle Elementary	K-2	Gertrude Burns Intermediate	3-5	2301001

SMALL SCHOOL DEFINITION AND PROCEDURES

Schools that do not have at least six students included on any of the WAEA indicators. Furthermore, some schools have at least six students on just one of the three indicators. Schools in both of these conditions will be considered a small school for the purpose of WAEA accountability. To put it another way, in order for a school to be assigned a school performance level without using small school procedures, the school must meet the minimum *n* of six students on two indicators. For schools that do not meet the minimum *n* of six students on two indicators, two years of evidence will be combined in an effort to obtain the minimum *n* of six students on two indicators. If a minimum *n* of two indicators is reached by combining two years of evidence a school performance level will be assigned to the school based upon those two years of evidence. For schools that do not meet the minimum *n* of six students on two indicators when two years of evidence are combined, a third year of evidence will be added. Schools that then meet the minimum *n* of at least six students on two indicators when the third year of evidence is included will be assigned a school performance level based upon the three years of evidence. Finally, some schools will still not meet the minimum *n* of six students on two indicators when three years of evidence are combined. A small school review process is under development that will be used in assessing these schools.

APPENDIX A

PERFORMANCE LEVEL DESCRIPTIONS (for schools with grades 3 through 8)

EXCEEDING EXPECTATIONS: Schools in this category, which is reserved for schools considered models of performance, have demonstrated high growth overall, have average to high levels of achievement (proficiency rates) overall, and excel in promoting equity based on growth for students with prior below proficient performance.

MEETING EXPECTATIONS: Schools in this category have demonstrated acceptable levels of achievement and growth overall and are showing acceptable progress in promoting equity based on growth for students with prior below proficient performance.

PARTIALLY MEETING EXPECTATIONS: Schools in this category have demonstrated either acceptable levels of growth or acceptable levels of achievement overall. Schools in this category may or may not show acceptable performance in promoting equity based on growth for students with prior below proficient performance.

NOT MEETING EXPECTATIONS: This category is reserved for schools with unacceptable performance on many or most indicators. For schools in this category improvement is a priority. These schools have low levels of achievement overall and demonstrate low to average growth overall and fall short of producing growth for below proficient students that will move them toward proficiency.

PERFORMANCE LEVEL DESCRIPTIONS (for schools that award diplomas)

EXCEEDING EXPECTATIONS: Schools in this category, which is reserved for schools considered models of performance, have demonstrated average to high levels of achievement (proficiency rates) overall, have high performance on graduation rates and other readiness indicators and have narrow and/or improving achievement gaps for students with below proficient performance.

MEETING EXPECTATIONS: Schools in this category have demonstrated either high levels of achievement overall or high performance on graduation rates and other readiness indicators and are showing acceptable performance in promoting equity based on the magnitude and/or improvement of the achievement gap for students with below proficient performance.

PARTIALLY MEETING EXPECTATIONS: Schools in this category have demonstrated either acceptable levels of achievement overall or acceptably performance on graduation rates and other readiness indicators. Schools in this category may or may not demonstrate acceptable performance for promoting equity based on the size of the achievement gap or improvement in the achievement gap for students with below proficient performance.

NOT MEETING EXPECTATIONS: This category is reserved for schools with unacceptable performance on many or most indicators. For schools in this category improvement is a priority. These schools typically have low levels of achievement fall short of expectations on graduation and other readiness indicators and have large achievement gaps that show little improvement.

Summary

Results of Wyoming Professional Judgment Panel Meetings and Recommendations for the State's School Accountability Program

Michael D. Beck
BETA, Inc.

Abstract

The Wyoming Professional Judgment Panel (PJP) met on 16—18 September in Casper to make recommendations concerning the state's school accountability program. The meeting had three primary objectives:

1. To recommend school-based standards for the several Performance Indicators identified by the developers of the School Performance Rating Model (Flicek, 2013);

2. To use these established Performance Indicator standards in a "body of work" approach to set recommended school performance levels for all Wyoming schools;

3. To discuss and agree to wording of the School Performance Rating performance level descriptors that define each of the four possible school accountability ratings.

At the completion of the meetings, the PJP had accomplished each of above objectives. They carried out the process of establishing school performance standards for each of the Performance Indicators for both Grades 3-8 and Grades 9-12, used these results to recommend School Performance Levels (SPLs), and reviewed and commented on the draft Performance Level Descriptors for the school accountability program.

Recommendations of the PJP are summarized in the accompanying attachments. Resulting school accountability ratings for each Wyoming school building were generated by Mike Flicek using the PJP recommendations. A

summary of those school ratings is also attached. A longer technical report detailing the PJP's work and the various stages of their deliberations and judgments is under preparation and will be available in mid-October.

Summary of PJP Meetings

The PJP met in Casper for three days in mid-September for the purpose of establishing the cutscores for the Wyoming School Performance Ratings. ***Appendix A*** lists all PJP committee members who attended the sessions.

The PJP's work was facilitated by a consultant contracted under a Scope of Work for the Standard Setting and Professional Judgment Panel. This consultant was primarily guided in directing this work by the August 30 draft of the Wyoming Accountability in Education Act School Performance Rating Model, (Flicek, 2013) which established the Performance Indicators and accountability determination procedures for the current year of the accountability program. In preparation for the sessions, the consultants, Dr. Flicek, Dr. Fenton Hughes, and representatives of the National Center on Assessment held several extended conference calls to discuss elements of the process. Dr. Flicek was present during the September PJP sessions to assist in describing elements of the model and to generate various "impact data" for PJP consideration. Dr. Fenton Hughes was present to monitor all PJP and consultant work.

An agenda for the PJP sessions is provided in ***Appendix B***. As this exhibit demonstrates, the beginning of the PJP session was devoted to a discussion of the overall model for the process and a discussion of the general process of establishing performance levels. Then, approximately one day of the three-day session was devoted to providing the panelists with multiple opportunities to consider and recommend cutscores for the several Performance Indicators (PIs) – three for Grades 3-8, three for Grades 9-12. The first such judgments were made independently by each judge; the following day, a summary of the initial judgments was presented (anonymously), with extensive opportunity for panelists to discuss their initial judgments and reconsider their recommendations; then a second round of recommendations was conducted, again anonymously; when the second round of judgments was discussed with the complete PJP, they recommend a third round of reconsiderations for one of the PIs. The round-by-round PJP recommended cutscores for each of the PIs are presented in ***Appendix C***.

After all final PJP recommendations were finalized for the PIs, the panel was given the opportunity to make initial recommendation of School Performance Levels for each possible combination of PI outcomes. The recording form used by the panel for making their recommended cutscores is shown in ***Appendix D,*** which summarizes the final recommendations of the judges. The initial PJP recommendations were then discussed at length by the panel and the PJP was

provided with “impact data” (a summary of the number of schools whose results fell into each possible School Performance Level). They then discussed these data as a group and independently made revised recommendations. These revised, final recommendations were used by Mike Flicek and his data analysts to generate the final School Performance Levels for all Wyoming schools (excepting a small number that do not have sufficient numbers of students to provide stable ratings. These data – the number and percent of schools falling within each performance level using the PJP-recommended cutscores - are presented in ***Appendix E***.

Panelists were encouraged to suggest revision or editorial – minor or significant – changes to the draft Performance Level Descriptors provided for each of the school Performance Levels – Exceeding Expectations, Meeting Expectations, Partially Meeting Expectations, and Not Meeting Expectations. These draft PLDs were discussed during the PJP sessions; immediately subsequent to the sessions, all members were sent a draft version of the PLDs and asked to indicate any changes they would make to the PLDs before they became public. These comments are being distilled and the group consensus wording of the PLDs will be contained in the final technical report of the sessions, available in mid-October.

It is the opinion of the PJP consultant who facilitated the sessions that the panel – individually and as a committee – applied themselves seriously, attentively, and professionally to the tasks they were given. They came up with reasoned and reasonable standards for the PIs, then applied these PI standards in a thoughtful and deliberative manner to the School Performance Ratings. The PJP’s recommendations yielded statewide school “impact” – accountability results – that appear both to be reasonable and to reflect the overall judgment of the majority of the PJP membership. The panel’s recommended cutscores, in the consultant’s opinion, should be accepted.

MDB/
10-13

APPENDIX A:

Professional Judgment Panel Members In Attendance at September 16-18 Sessions

State Board of Education
Sue Belish
Walt Wilcox
Kathy Coon

Public School Teachers
Elementary--Alana Engel—Rawlins Elementary School
MS/JH---Paul Crips--Carey Jr. High
HS--Brent Daly---Campbell County HS
Kara Sweet--Newcastle HS
Michael Read--Ft. Washakie HS

Principal
Elementary--Dr. Joseph Ingalls--North Evanston Elem
JH/MS--Ken Griffith--Guernsey-Sunrise
HS--Darrin Peppard--Rock Springs HS

School District Superintendent
Small District--Dr. Summer Stephens--Weston # 7 Upton
Medium District -- Terry Snyder -- Fremont #25
Large District--Donna Little-Kaumo--Sweetwater #2 Green River

Business & Community at-Large
Robert Blaylock—Gillette *(Day 1 only)*
Michelle M. Kiggins--Riverton
Jill Bramlet—Wheatland
Leona Wunnenburg - Jackson

Parent
Greg Legerski -- Pinedale
David Nicholas -- Worland

School District Central Office
John Metcalfe--Lander Fremont #1
Mark Taylor--Afton--Lincoln #2
Jody Rakness--Worland--Washakie #1

Wyoming School District Board of Trustees
Linda S. Jennings—Campbell #1
Nita Werner--Converse #1
Wyoming Post Secondary Institutions
Karen Werth—Central Wyoming College

Kay Persichitte--University of Wyoming
Lona Tracy--Adjunct Prof for EWC
Support Services
Kim Jones
Doug Rose

APPENDIX B:

AGENDA

Wyoming Professional Judgment Panel Meetings

Casper, WY - 16 – 18 September 2013

Monday (8:30 – approx. 4:00)

A.M.

- Introductions / Orientation / Goals / Responsibilities
- What is "standard setting"? How this relates to PJP
- Overview of the 4 Performance Indicators (PIs):

  Achievement, Equity, Readiness, and *Growth*
  - How each PI is operationally defined
  - How these lead to a School Accountability System
- Giving meaning to three sets of Terminology

  for *PAWS*, for the *PI*s, for the *Accountability System*

P.M.

- Discussion of Business Rules & various details in the Model *(Mike Flicek)*
- Methodology used to set school performance standards for each of the PIs for Gr. 3-8 and Gr. 9-12
- Selected statewide summary data for each PI
- ***JUDGES*:** Initial recommended standards for Grades 3 – 8 Schools
- ***JUDGES:*** Initial recommended standards for High Schools

TUESDAY (8:30 – 4:00)

A.M.

- Review of Day 1activities
- Summary of Initial Recommendations for standards on each PI; state impact data
- ***JUDGES:*** Discussion of Initial Recommendations among PJP
- ***JUDGES:*** *Final* recommendations for each PI for Gr. 3-8 & HS

P.M.

- Transforming PI standards into a School Accountability system

- Components of the system – different for Gr. 3-8 schools & high schools
- Melding PI standards into Accountability – "matrix"
- ***JUDGES:*** Making the Accountability Descriptors more concrete – discussion and clarification of draft Performance Level Descriptors (PLDs) for the School Performance Rating system
- *Thought Experiment:* How is Wyoming as a state performing on the same Performance Indicators being applied to Wyoming school buildings?
- Making School Performance Level judgments – methodology & mechanics
- ***JUDGES:*** Initial Accountability Ratings for Schools

WEDNESDAY 3 *(8:30 – approx. 3:30)*

A.M.

- Review of the final judgments of the panel on each PI; statewide implications for schools.

P.M.

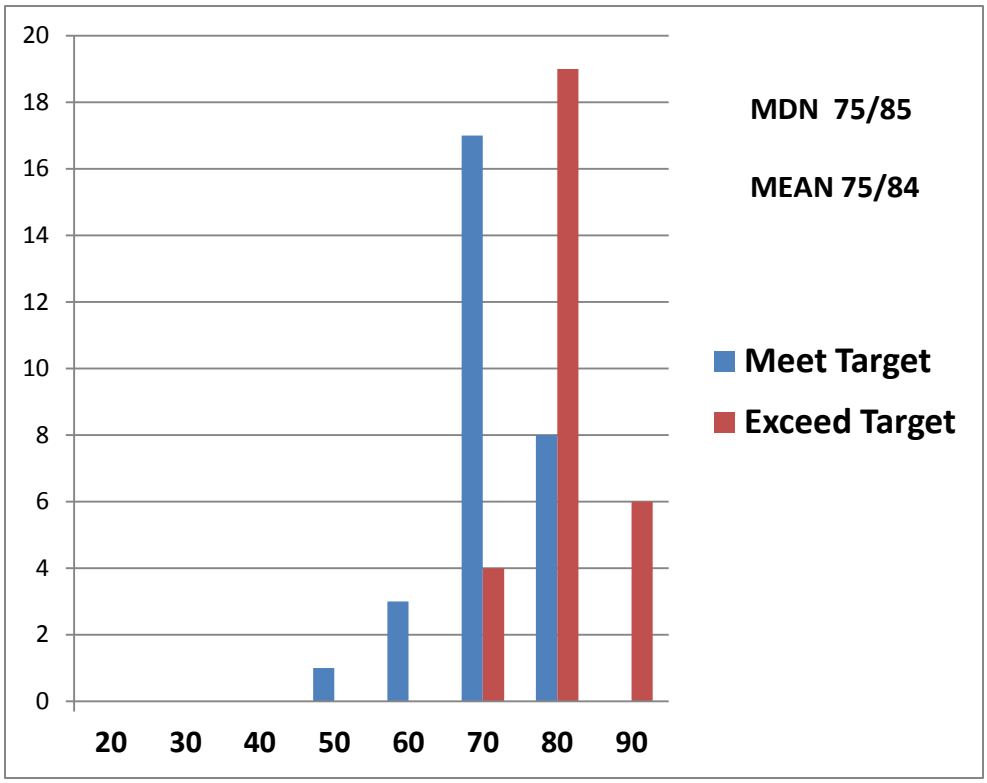
- Suggestions from the PJP on Accountability-related topics/issues
- Next steps in the process (Paige Fenton Hughes, Mike Flicek)
- Summary / Discussion of Initial Accountability Ratings
- *Final* School Performance Level recommendations
- Adjournment (panelists leave as final recommendations are complete)

APPENDIX C:

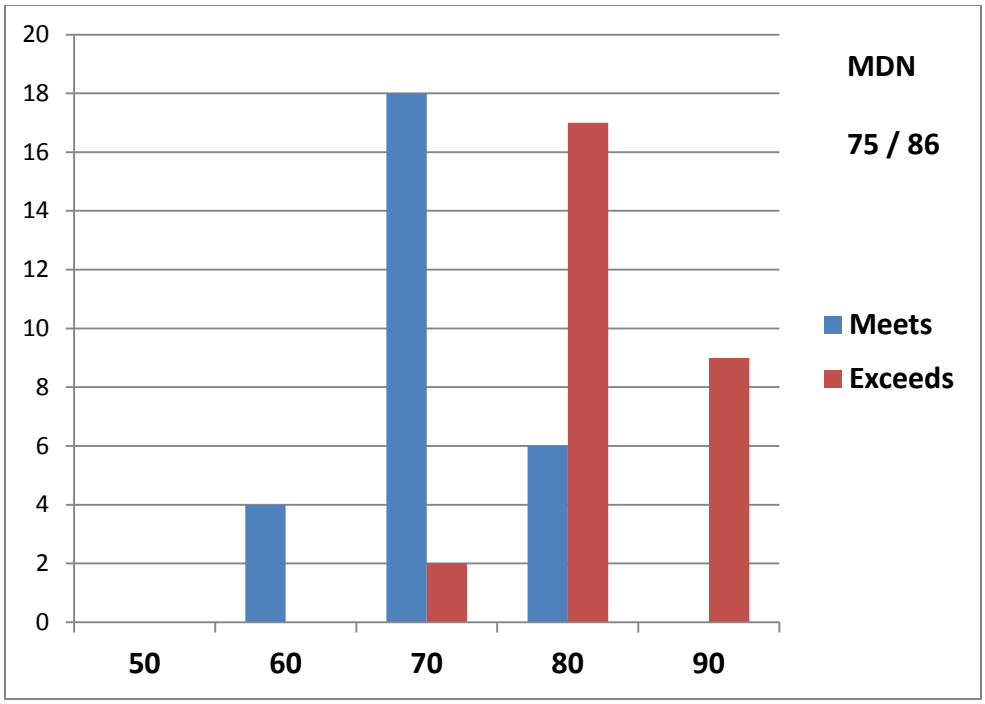
PJP Recommendations for Each Performance Indicator – by Round of Judgments, for *Meets Target* & *Exceeds Target* Minimum Cutscores

Gr. 3-6 Achievement – Rounds 1 & 2 (Final)

Round 1

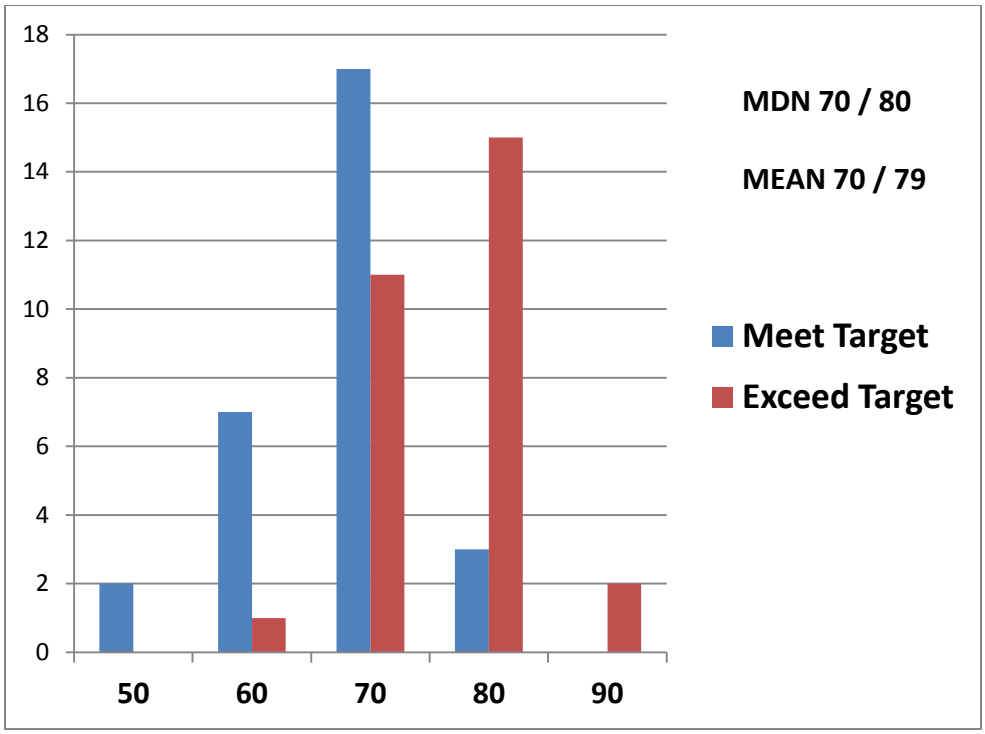


Round 2

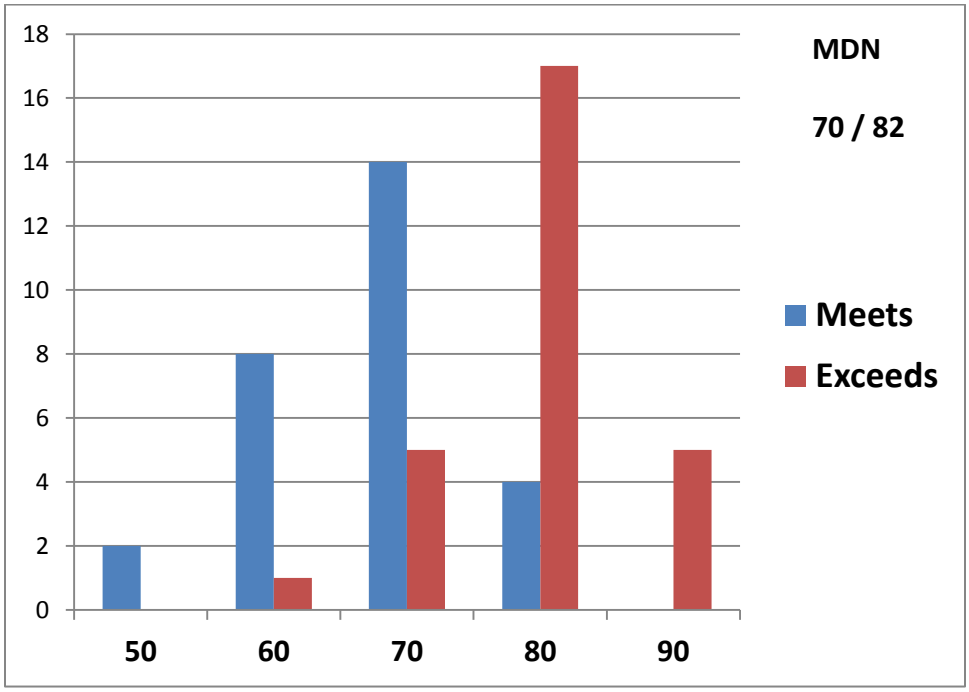


Gr. 7-8 ACHIEVEMENT - Rounds 1, 2, & 3 (FINAL)

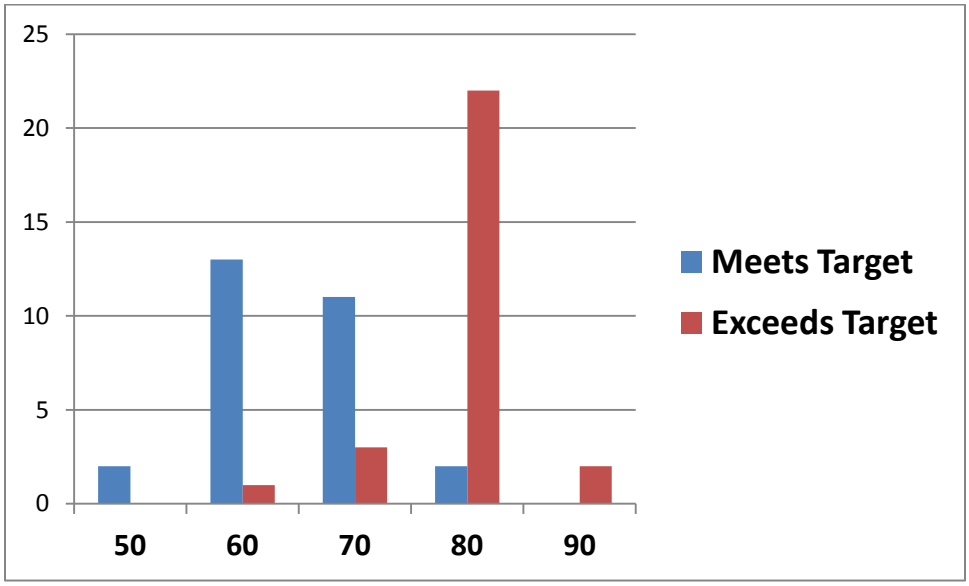
Round 1


18
16
14
12
10
8
6
4
2
0
50
60
70
80
90
MDN 70 / 80
MEAN 70 / 79
Meet Target
Exceed Target

Round 2

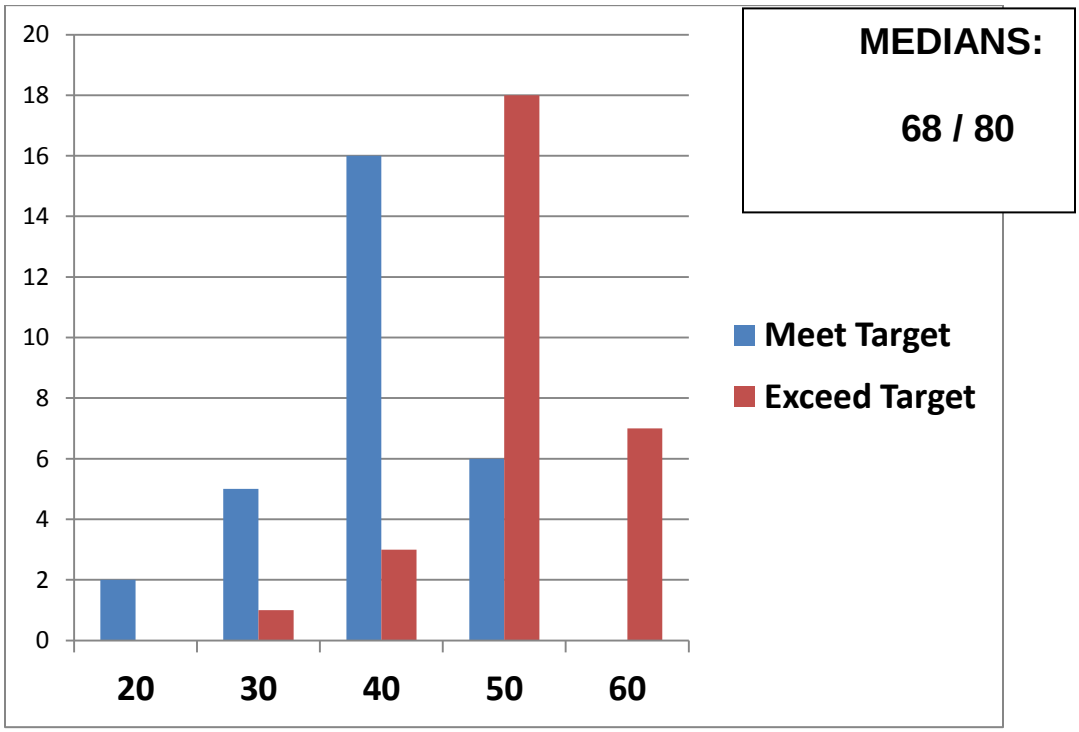

18
16
14
12
10
8
6
4
2
0
50
60
70
80
90
MDN
70 / 82
Meets
Exceeds

Round 3 (FINAL)

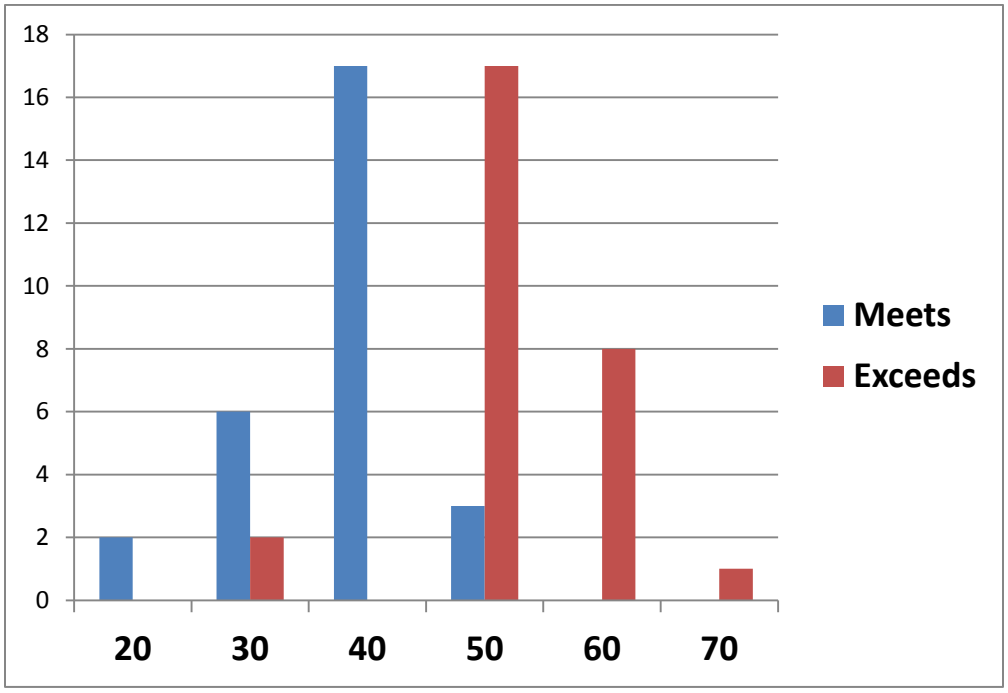


EQUITY (Gr. 3-8) – Rounds 1 & 2 (FINAL)

Round 1

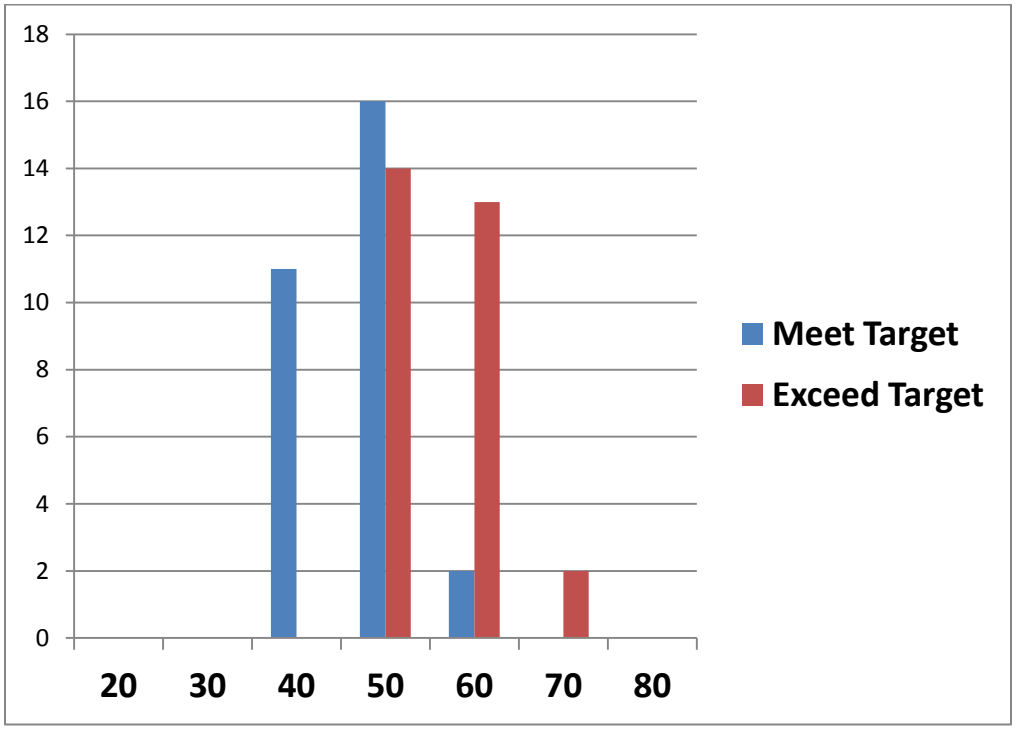


Round 2 (FINAL)

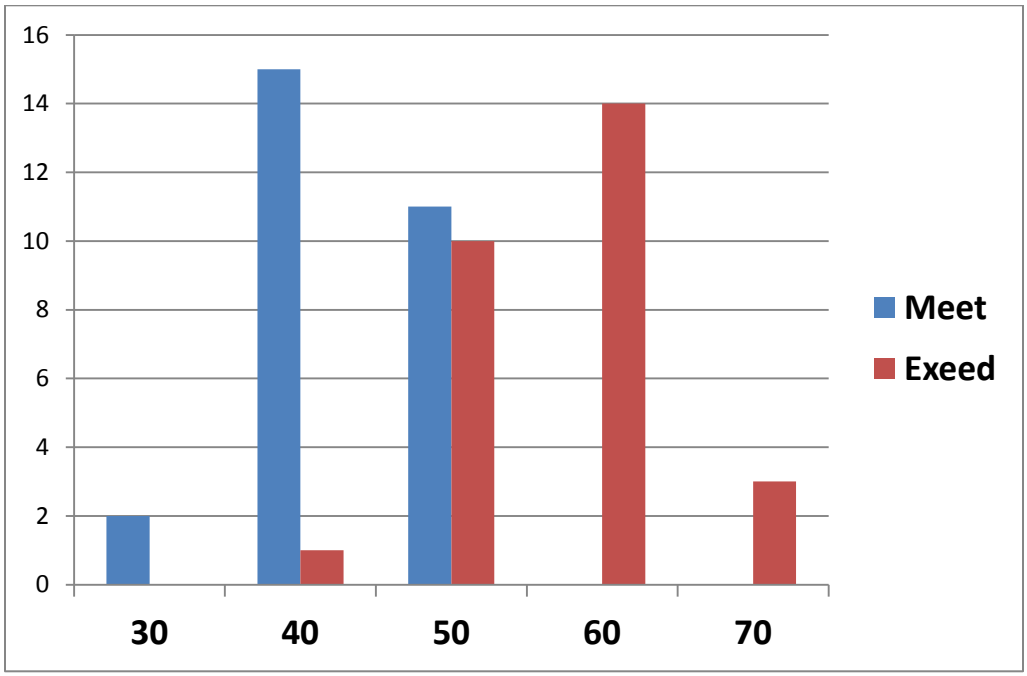


Gr. 3-8 GROWTH – Rounds 1 & 2 (Final)

Round 1

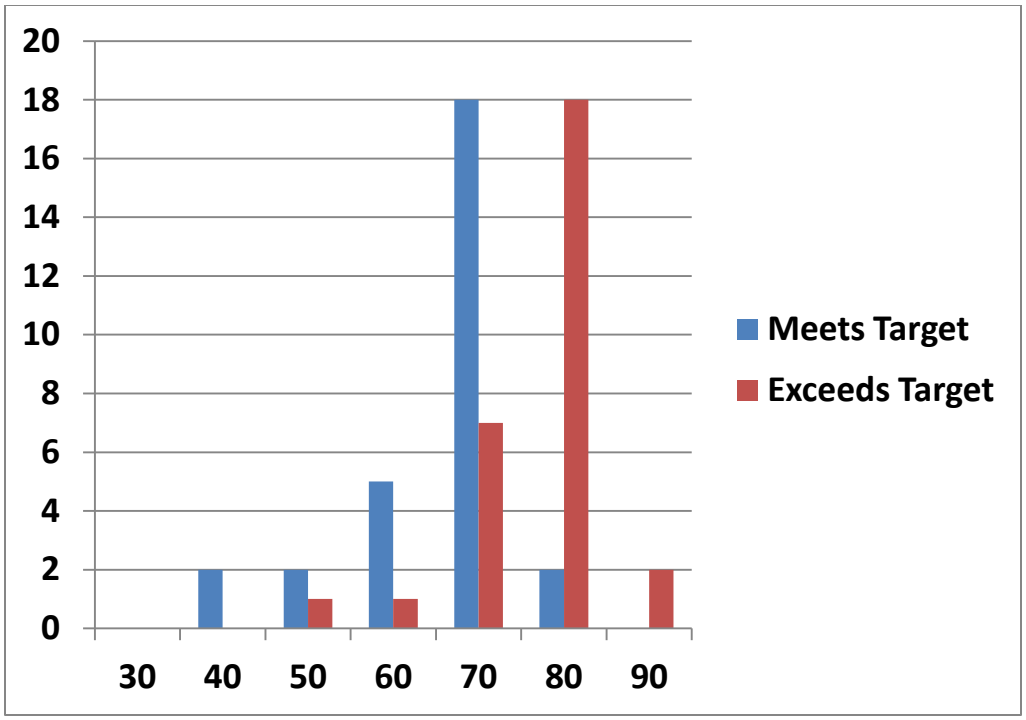


Round 2 (FINAL)

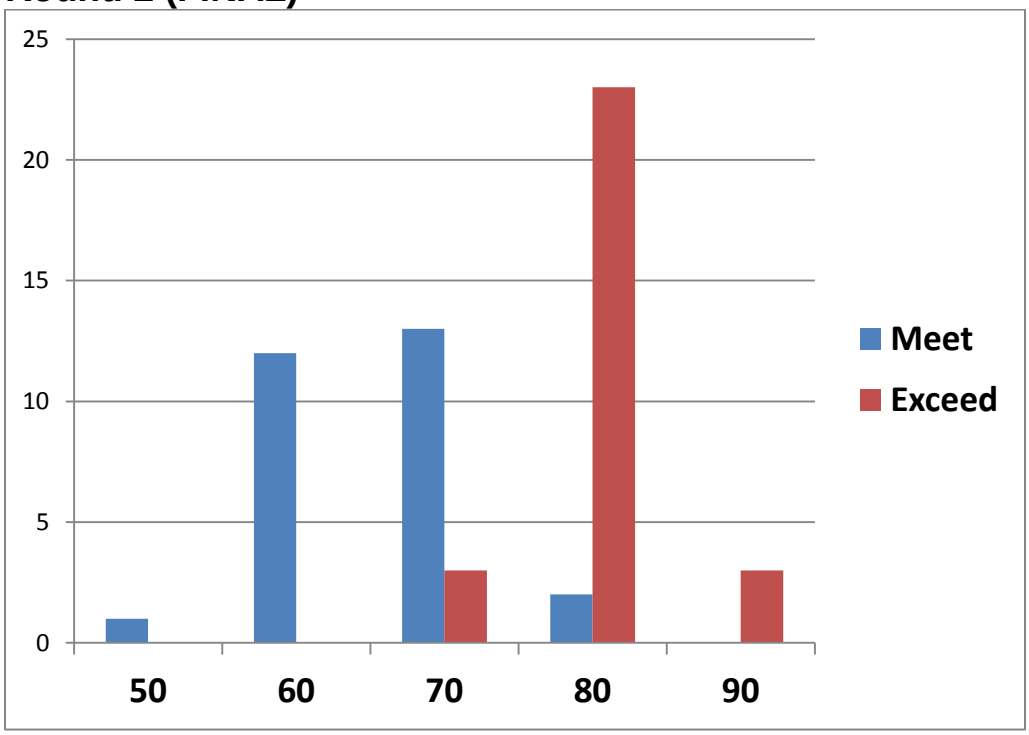


Gr. 9-12 ACHIEVEMENT – Rounds 1 & 2 (Final)

Round 1



Round 2 (FINAL)



Gr. 9-12 EQUITY – Rounds 1 & 2

Round 1- No. judges with each recommendation

% Improvement		% NOT Proficient	
	Highest 1/3	***Middle 1/3***	***Lowest 1/3***
Lowest 1/3	**NOT MEET**	**NOT MEET**	**MEET** – 26 Not Meet - 3
Middle 1/3	N**OT MEET** – 23 Meet - 6	**MEET** – 28 Not Meet - 1	**EXCEED** – 26 Meet - 3
Highest 1/3	**MEET** – 28 Exceed - 1	**EXCEED** – 27 Meet - 2	**EXCEED** - 29

Round 2 – Final PJP Recommendation (median and consensus)

% Improvement		% NOT Proficient	
	Highest 1/3	***Middle 1/3***	***Lowest 1/3***
Lowest 1/3	**NOT MEET**	**NOT MEET**	**NOT MEET**
Middle 1/3	**MEET**	**MEET**	**MEET**
Highest 1/3	**Exceed**	**EXCEED**	**EXCEED**

Gr. 9-12 READINESS – ACT Suite – Rounds 1 & 2

Round 1 – No. judges with each recommended # Index Points

Composite Level	Preliminary Index Pts.	Initial PJP Recommended Index Points 100	90	80	70	60	50	40	30	20	10	0
Level 4 (highest)	100	24	1									
Level 3	80		1	17	7							
Level 2	40			1	1	2	8	13				
Level 1 (lowest)	0								1	5	0	19

Round 2 – FINAL recommendations – median and consensus in *red*

Composite Level	Preliminary Index Pts.	FINAL PJP Recommended Index Points 100	90	80	70	60	50	40	30	20	10	0
Level 4 (highest)	100	26										
Level 3	80	2	0	23	1							
Level 2	40			1	1	3	3	17	1			
Level 1 (lowest)	0							3	1	10	1	6

Gr. 9-12 READINESS – HS Graduation – Rounds 1 & 2

Round 1 – No. judges with each recommended # Index Points

Graduation Result	Preliminary Index Points	Initial PJP Recommendations 100	90	80	70	60	50	40	30	20	10	0
Diploma in 4 years or <	100	28	1									
Diploma in > 4 years	75	4	2	9	13	1						

Continued Enrollment	**50**					**5**	**3**	**15**	**6**			
Noncompleter	**0**									**1**	**0**	**28**

Round 2 - FINAL recommendations – median and consensus in *red*

Graduation Result	Preliminary Index Points	FINAL PJP Recommendations 100	90	80	70	60	50	40	30	20	10	0
Diploma in 4 years or <	**100**	**28**										
Diploma in > 4 years	**75**	**15**	**4**	**5**	**4**							
Continued Enrollment	**50**			**1**	**4**	**2**	**17**	**4**				
Noncompleter	**0**											**28**

APPENDIX D:

Wyoming Professional Judgment Panel
Judges' Recommended School Performance Levels

FINAL **RECOMMENDATIONS** (28 Judges, Gray is the median judgment)

For Schools serving ***Grades 3 – 8***:

Performance Indicator **FINAL PANEL Recommendations**

Achievement	***Equity***	***Growth***	**Exceeding** Expectation	**Meeting** Expectation	**Partially Meeting** Expectation	**Not Meeting** Expectation					
Exceed	Exceed	Exceed	28								
Exceed	Exceed	Meet	22	6							
Exceed	Exceed	Below	1	22	5						
Exceed	Meet	Exceed	19	9							
Exceed	Meet	Meet	1	27							
Exceed	Meet	Below		19	9						
Exceed	Below	Exceed	2	20	6						
Exceed	Below	Meet		19	9						
Exceed	Below	Below		2	25	1					
Meet	Exceed	Exceed	10	18							
Meet	Exceed	Meet		28							
Meet	Exceed	Below		18	10						
Meet	Meet	Exceed	1	27							
Meet	Meet	Meet		28							
Meet	Meet	Below		17	11						
Meet	Below	Exceed		21	7						
Meet	Below	Meet		18	10						
Meet	Below	Below			25	3					
Below	Exceed	Exceed	1	14	13						
Below	Exceed	Meet		10	18						
Below	Exceed	Below			24	4					
Below	Meet	Exceed		9	19						
Below	Meet	Meet		7	20	1					
Below	Meet	Below			22	6					
Below	Below	Exceed			25	3					
Below	Below	Meet			23	5					
Below	Below	Below				28					

Continue –

FINAL RECOMMENDATIONS

For Schools serving ***Grades 9 – 12***:

_____

_____

Performance Indicator **FINAL PANEL Recommendations**

Achievement	***Equity***	***Readi - ness***	**Exceeding** Expectation	**Meeting** Expectation	**Partially Meeting** Expectation	**Not Meeting** Expectation					
Exceed	Exceed	Exceed	28								
Exceed	Exceed	Meet	21	7							
Exceed	Exceed	Below	1	20	7						
Exceed	Meet	Exceed	21	7							
Exceed	Meet	Meet		27	1						
Exceed	Meet	Below		17	11						
Exceed	Below	Exceed	4	16	8						
Exceed	Below	Meet		19	9						
Exceed	Below	Below		3	23	2					
Meet	Exceed	Exceed	8	20							
Meet	Exceed	Meet		28							
Meet	Exceed	Below		19	9						
Meet	Meet	Exceed		28							
Meet	Meet	Meet		27	1						
Meet	Meet	Below		15	13						
Meet	Below	Exceed		20	8						
Meet	Below	Meet		16	12						
Meet	Below	Below			25	3					
Below	Exceed	Exceed	2	9	17						
Below	Exceed	Meet		8	20						
Below	Exceed	Below		1	25	2					
Below	Meet	Exceed		8	20						
Below	Meet	Meet		6	21	1					
Below	Meet	Below		1	24	3					
Below	Below	Exceed		1	25	2					
Below	Below	Meet		1	22	5					
Below	Below	Below				28					

CONTINUE -

For Gr. 3 – 8 Schools with only Two Performance Indicators:

-

_____

_____

Performance Indicator **FINAL PANEL Recommendations**

Achieve ment	***Growth***	**Exceeding** Expectation	**Meeting** Expectation	**Partially Meeting** Expectation	**Not Meeting** Expectation					
Exceed	Exceed	28								
Exceed	Meet	8	20							
Exceed	Below		13	15						
Meet	**Exceed**	2	26							
Meet	**Meet**		15	13						
Meet	**Below**		2	26						
Below	Exceed		3	25						
Below	Meet			27	1					
Below	Below				28					

For High Schools with only Two Performance Indicators:

_____

_____

Performance Indicator **FINAL PANEL Recommendations**

Achieve ment	***Readi - ness***	**Exceeding** Expectation	**Meeting** Expectation	**Partially Meeting** Expectation	**Not Meeting** Expectation					
Exceed	Exceed	28								
Exceed	Meet	10	18							
Exceed	Below		13	15						
Meet	**Exceed**	3	25							
Meet	**Meet**		28							
Meet	**Below**		1	27						
Below	Exceed		2	26						
Below	Meet			27	1					
Below	Below				28					

APPENDIX E:

IMPACT OF FINAL PJP RECOMMENDATIONS BY SCHOOL ORGANIZATION – Number and Percent of Schools with Each Possible Accountability Categorization

Number & Percent of Schools by Grade Organization

Classification	# of Gr. 3-6	% of Gr.3-6	# of Gr. 7-8	% of Gr. 7-8	# of Gr.3-8*	% of Gr.3-8	# of Gr.9-12	% of Gr.9-12	**TOTAL****	**% of TOTAL**
NOT MEETING	**20**	**11%**	**8**	**30%**	**9**	**14%**	**16**	**19%**	**53**	**15.5%**
PARTIALLY MEETING	**42**	**24%**	**7**	**26%**	**17**	**27%**	**19**	**22%**	**89**	**25.9%**
MEETING	**85**	**49%**	**11**	**41%**	**28**	**44%**	**37**	**44%**	**172**	**50.1%**
EXCEEDING	**14**	**8%**	**1**	**4%**	**6**	**10%**	**6**	**7%**	**29**	**8.5%**
Not Classified	14	8%	0	0%	3	5%	6	7%		
Subtotal	*175*		*27*		*63*		*84*		*343*	

* Represents schools with a mixture of grades in the Gr. 3-6 and 7-8 bands.

** Total number of schools across all grade organizations; % excludes “not classified” schools.

ASSESSMENT OPTIONS: 2015 AND BEYOND

Assessment Attribute	Build	Buy	
	Educational Testing Service (ETS; current Vendor)	Smarter Balanced (SBAC)	Off the Shelf (e.g. ACT-Aspire, College Board)
Cost[1]	$76/student: 1 component	$27.30/student: 3 components	Likely less than ETS but more than SBAC
Return of Results	3 months	2 weeks	Unknown
Involve WY Teachers	Yes	Yes	No
Alignment	2012 WY Content Standards	2012 WY Content Standards	2012 WY Content Standards
Time in Testing[2]	8:40 - 10:10	7:00 - 8:30	Determined by vendor
Customize Content[3]	Yes	No	No
Comparison to Other States	No	Yes	Limited
Administration Mode	Paper/Pencil	Online[4]	Likely online
Computer Adaptive[5]	No	Yes	Possible
Integrated Interim Assessments	No	Yes	Unlikely
Integrated Formative Assessment Tools	No	Yes	Unlikely
Types of Questions	Multiple choice and writing task	Multiple choice, short answer, perf tasks	Likely multiple choice & short answer
Accessibility[6] **-- Other Languages**	Spanish audio only; no text	Spanish, Sign Language, plus at least 2 more	Possible in Spanish
Testing Window	March/April	Last 12 weeks of year[7]	Determined by WY
Procurement Process	Contract amendment	Request for Proposals (RFP) & contract	Request for Proposals (RFP) & contract
Key Decision Date	March 2014	January 2014	January 2014

[1] SBAC pricing estimates include the costs for 3 components: summative, interim and formative tools. ETS pricing covers only the once per year summative test.
The SBAC summative assessment is taken once per year and is used for school and district accountability.
SBAC interim assessments are taken 2 times per year to identify students' relative strengths/needs and project performance on the annual summative test.
SBAC formative tools can be used daily to help teachers plan and adjust instruction to meet students' needs.

[2] Current state test is untimed; times provided are estimates and vary by grade. SBAC will also be untimed.

[3] Custom tests make comparisons to other states impossible and are significantly more expensive.

[4] Paper/pencil option will be provided for a few transition years; pricing is based on online administration only.

[5] Computer adaptive assessments adjust the difficulty level for each student, depending on his/her responses.

[6] Only Spanish audio is available; no written translation is provided.

[7] Test will be administered in the last 12 weeks for grades 3-8 and in the last 7 weeks for high school; specific windows can be determined by each participating state.

WYOMING DEPARTMENT OF EDUCATION

DISTRICT ASSESSMENT SYSTEM ANNUAL REPORT

DRAFT

GUIDEBOOK

August 2013

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Introduction

This guide summarizes the requirements that apply to preparing and submitting the district assessment system annual report for review by the State Board of Education through the Wyoming Department of Education.

Authority

W.S. 21-2-304 (a) (iv) "….Beginning school year 2014-2015, and each school year thereafter, each district's assessment system shall include a measure or multiple measures for purposes of determining completion of high school graduation requirements. The state board shall by rule and regulation establish guidelines for district development of this measure or measures, and shall through the department of education, provide support to districts in developing each district's measure or measures. The state board shall through the department, annually review and approve each district's assessment system designed to determine the various levels of student performance and the attainment of high school graduation requirements."

W.S. 21-3-110 (a) "….Beginning school year 2014-2015 and each school year thereafter, a component of the district assessment system shall include a measure or multiple measures used to determine satisfactory completion of high school graduation requirements and developed in accordance with guidelines established by the state board. The district shall on or before August 1, 2015 and each August 1 thereafter, report to the state board in accordance with W.S. 21-2-304 (a) (iv) on its assessment system established under this paragraph."

Rules Chapter 6, Section 8 (pending revisions)

Rules Chapter 31, Section 9 (e) **"**The district shall report to the state board in accordance with W.S. 21-2-304 (a) (iv) on its assessment system on or before August 1, 2015, and each August 1 thereafter."

Definitions

1. **DAS:** District Assessment System. A well-articulated set of assessments designed to determine the various levels of student performance K-12 and the attainment of high school graduation requirements.
2. **SAS:** Statewide Assessment System. Wyoming's assessment system that measures students' progress toward the Wyoming Content Standards. The SAS is part of the district assessment system.
3. **WDE:** Wyoming Department of Education. W.S. 21-2-104. A separate and distinct state department… to assist (the director) in the proper and efficient discharge of duties.

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Purpose

Wyoming State Statutes require that each district report on its district assessment system (DAS) to the Wyoming Department of Education (WDE) on or before August 1, 2015 and each August 1 thereafter (W.S. 21-2-304 (a) (iv)). The purpose of the K-12 DAS is to assess progress toward proficiency of the Wyoming Content and Performance Standards in all nine content areas.

The system should be designed and implemented so that inferences pertaining to equality of educational opportunity can be supported by the assessment system. A measure or multiple measures shall be used to determine the various levels of student performance and attainment of high school graduation as described in the uniform student content and performance standards.

Instructions

The DAS annual report will include a district assessment plan matrix, and documentation on the processes in place to ensure that assessments meet the design criteria of alignment, consistency, fairness, and standard-setting. The following sections provide more information on the assessment plan matrix, the definitions for the criteria, and the documentation required for the report.

District Assessment Plan Matrix

Each district shall submit a district assessment plan matrix that includes the measure or multiple measures used by each district to assess progress toward proficiency at grade level and in all nine content areas. The Statewide Assessment System is incorporated into the DAS. A chart including currently administered statewide assessments has been provided for information.

Alignment

Alignment Definition: *The District Assessment System (DAS) is aligned with Wyoming Content and Performance Standards, both in terms of content and cognitive complexity. The district must document the process used to demonstrate alignment.*

The combination of assessments that comprise the system shall be aligned with Wyoming Content and Performance Standards so that the full set of standards in the common core of knowledge and skills, both in terms of content and cognitive complexity are assessed. (Rules, Chapter 6, Section 8)

Through the review process, evaluators will be looking for documentation of the methods or processes used to ensure alignment. Your description of the process should address:

- Adequate sampling of the standards, K -12;
- Assessment items and tasks aligned to the standards and adequate sampling of the standards represented in the assessments; and

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- Assessments reflect the cognitive depth and complexity of the standards.

Artifacts submitted to support implementation of the process may include:

- Sample assessment blueprints;
- Sample assessment matrices;
- Sample curriculum maps;
- Procedures for assuring alignment among the course curriculum, standards, assessments, and grading practices; or
- Evidence of procedures to ensure alignment of assessment items/tasks to the cognition levels called for in the standards.

Consistency

Consistency Definition: *The DAS is applied consistently across the district to yield reliable results regarding student performance. The district must document the process used to demonstrate consistency.*

The assessment system should be designed and implemented in such a way so that inferences drawn from the results of the assessment are consistent and not dependent on error due to raters or the quality of the assessments. While the focus is on the system, in order to meet this requirement, individual assessments within the system will need to be designed to yield consistent results in terms of error due to raters, tasks, administration conditions, and occasions. (Rules, Chapter 6, Section 8)

Through the review process, evaluators will be looking for documentation of the methods or processes used to ensure consistency. Your description of the process should address:

- Factors that impact consistency.
- Sustaining a systemic and systematic process for consistency.

Artifacts submitted to support implementation of the process may include procedures minimizing the differences in:

- Rater agreement;
- Tasks;
- Administrative guidelines;
- Assessment retakes;
- Assessment conditions; or
- Scoring guidelines.

Artifacts submitted to support implementation of the process may also include:

- The methods used to maintain a sustainable systemic and systematic process to address consistency.

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Fairness

Fairness Definition: *The DAS is designed and implemented to minimize bias against any group of students. Multiple assessment opportunities and formats should be used to maximize fairness. The district must document the process used to determine fairness.*

The assessment system should be designed so that it is not biased against any group of students. As such, appropriate accommodations should be used so students with disabilities and English language learners have fair access to the assessment system. Multiple assessment formats should be employed in the assessment system. (Rules, Chapter 6, Section 8)

Through the review process, evaluators will be looking for documentation of the methods or processes used to ensure fairness. Your description of the process should address:

- Methods to minimize bias against any group of students; and
- Multiple assessment opportunities and formats over time, K-12.

Artifacts submitted to support implementation of the process may include procedures addressing:

- Item and task bias against any subgroups of students;
- Appropriate accommodations;
- Multiple opportunities over time, K-12, using different formats and strategies, to demonstrate knowledge and skills;
- Disaggregation of assessment results by subgroups and use of information to make decisions; or
- Participation rates monitored by subgroup.

Standard-Setting

Standard-Setting Definition: *The DAS has a defensible method to define levels of proficiency, (e.g., cut-scores) for each content area. The district must document the process used for standard-setting.*

Cut scores that delineate the various performance levels on each assessment shall be tied to district performance descriptors and based on research or best practices. Descriptions of what constitutes proficient performance shall be clearly articulated and shall be correlated with the performance descriptors found in the Wyoming Content and Performance Standards. (Rules, Chapter 6, Section 8)

Through the review process, evaluators will be looking for documentation of the methods or processes used to ensure standard-setting. Your description of the process should address:

- A defensible method to define levels of proficiency at the content area level.

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- A defensible method for determining student proficiency toward the standards.

Artifacts submitted to support implementation of the process may include:

- The rationale and the standard-setting method used for determining proficiency at the content level; or
- The method used to determine cut scores for each proficiency level; or
- The method used to determine student proficiency in a standard.

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Submitting the Report

The district shall on or before August 1, 2015 and each August 1 thereafter, report to the state board in accordance with W.S. 21-2-304 (a) (iv) on its assessment system. A timeline for submission and guidance for each section of the report follow.

Timeline

WHO?	WHAT?	WHEN?
1. WDE	Call for review of District Assessment System (DAS). Send DAS guidebook and rubric to districts.	December every year
2. **Pilot districts***	Submit documentation of process and supporting artifacts for **ELA, Math,** and **Health**.	by February 1, **2014**
3. WDE and review team	Review DAS submissions from districts.	February 1 – March 31 every year
4. WDE	Notify districts of review completion and results by letter.	by April 1 every year
5. Districts	Review decisions and request corrections, rescore, or appeal if necessary (in writing).	by May 1 every year
6. WDE and review team	Review districts' requests for corrections, rescore, or appeal	May 1 – May 31 every year
7. WDE	Report to State Board of Education (SBE)	on or before August 1 every year
8. WDE and DAS steering committee	Develop review training based on lessons learned and best practices from review of pilot districts	Summer/Fall 2014
9. WDE and DAS steering committee	Share any changes to DAS review process with SBE for approval	Fall/Winter 2014
10. WDE	Communicate DAS review process and requirements with all school districts	by December 2014
11. WDE	Call for review of District Assessment System (DAS). Send DAS guidebook and rubric to all districts.	December every year
12. Districts	Submit documentation of process and supporting artifacts for standards based on schedule below.	by February 1 every year
Repeat steps 3 through 7 above.		

***Pilot districts represented by DAS steering committee.**

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YEAR	CONTENT AREA **At least one artifact per content area per grade band (K-8 and 9-12) must be submitted with the DAS process narrative to demonstrate evidence that all four criteria are met.**
2015	• Language Arts • Math • Health
2016	• Foreign Language • Fine & Performing Arts • PLUS any changes to the DAS process since previous year
2017	• Science • Social Studies • PE • Career/Tech Ed • PLUS any changes to the DAS process since previous year
2018 and beyond	• Changes to DAS process only**

**Per state statute, Wyoming Content and Performance Standards are reviewed every five years. Additionally, district accreditation occurs every five years and the DAS is reviewed at that time.

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Sections of the Report

Statewide Assessment System Information

The SAS is incorporated as part of the overall DAS. The matrix provided below is for information purposes and does not need to be included as part of the district assessment plan matrix.

The Wyoming Statewide Assessment System Is Comprised Of:

Grade	PAWS	PAWS-ALT	SAWS	SAWS-ALT	ACCESS for ELLS	ACCESS-ALT for ELLS	EXPLORE	PLAN	ACT Plus Writing	WorkKeys	COMPASS
K					X						
1					X	X					
2					X	X					
3	X	X	X	X	X	X					
4	X	X	X	X	X	X					
5	X	X	X	X	X	X					
6	X	X	X	X	X	X					
7	X	X	X	X	X	X					
8	X	X	X	X	X	X					
9					X	X	X				
10					X	X		X			
11		X		X	X	X			X	TBD	
12					X	X				TBD	X

http://edu.wyoming.gov/Programs/Statewide_Assessment_System.aspx

District Assessment Plan Matrix

Each district shall submit a district assessment plan matrix that includes locally-developed assessments and required MAP testing (do not include statewide assessments). This table should include the measure or multiple measures used by districts to assess progress toward proficiency at grade level and in all nine content areas. The following table format should be used by districts to summarize this information.

Assessment Name/Description	Type (check one)	Grade Level (s)	Date (s)	Purpose	Results Used To
	_____Diagnostic _____Formative _____Interim (Benchmark) _____Summative _____Other	_____ K _____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 _____ 8 _____ 9 _____10 _____11 _____12			
	_____Diagnostic _____Formative _____Interim (Benchmark) _____Summative _____Other	_____ K _____ 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 _____ 8 _____ 9 _____10 _____11 _____12			

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Alignment Process Documentation and Artifacts Submitted

The District Assessment System (DAS) is aligned with Wyoming Content and Performance Standards, both in terms of content and cognitive complexity. The district must document the process used to demonstrate alignment.

How does the district….

1. Adequately address the standards, K-12;

2. Ensure two-way alignment;

    a. All assessment items and tasks align to the standards;

    b. Adequate sampling of the standards is represented in the assessments.

3. Ensure that assessments reflect the cognitive depth and complexity of the standards.

Artifacts attached to support addressing the standards, K-12, ensuring two-way alignment, and cognitive depth and complexity of the standards may include:

- Sample assessment blueprints;
- Sample assessment matrices;
- Sample curriculum maps;
- Procedures for assuring alignment among the course curriculum, standards, assessments, and/or grading/scoring practices; or
- Evidence of procedures to ensure alignment of assessment items/tasks to the cognitive levels called for in the standards.

Consistency Process Documentation and Artifacts Submitted

The DAS is applied consistently across the district to yield reliable results regarding student performance. The district must document the process used to demonstrate consistency.

How does the district…..

1. Address factors that impact consistency?
2. Sustain a systemic and systematic process for consistency?

Artifacts attached to address factors that impact consistency may include procedures minimizing the differences in:

- Rater agreement;
- Tasks;
- Administrative guidelines;
- Assessment retakes;
- Assessment conditions; or
- Scoring guidelines.

Artifacts attached to address a sustainable systemic and systematic process may include:

- The methods used to maintain a sustainable systemic and systematic process to address consistency.

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Fairness Process Documentation and Artifacts Submitted

The DAS is designed and implemented to minimize bias against any group of students. Multiple assessment opportunities and formats should be used to maximize fairness. The district must document the process used to determine fairness.

How does the district….

1. Ensure methods to minimize bias against any group of students?
2. Ensure multiple assessment opportunities and formats over time, K-12?

Artifacts attached to ensure methods to minimize bias against any group of students and multiple assessment opportunities and formats over time, K-12 may include procedures addressing:

- Item and task bias against any subgroups of students;
- Appropriate accommodations, or
- Multiple opportunities over time, K-12, using different formats and strategies, to demonstrate knowledge and skills, or
- Disaggregation of assessment results by subgroups and use of information to make decisions, or
- Participation rates monitored by subgroup.

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Standard-Setting Process Documentation and Artifacts Submitted

The DAS has a defensible method to define levels of proficiency, (e.g., cut-scores) for each content area. The district must document the process used for standard-setting.

How does the district……

1. Ensure a defensible method to define levels of proficiency at the content-area level?
2. Ensure a defensible method for determining student proficiency toward the standards?

Artifacts attached to ensure a defensible method to define levels of proficiency at the content-area level may include:

- The rationale and the standard-setting method used for determining proficiency at the content level; or
- The method used to determine cut scores for each proficiency level; or
- The method used to determine student proficiency in a standard

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Review Process

A review team consisting of WDE staff will review the DAS reports. Reports will be evaluated using the DAS Review Rubric found on the following pages, according to the timeline included in this document.

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DAS Review Rubric

Alignment Definition: The District Assessment System (DAS) is aligned with Wyoming Content and Performance Standards, both in terms of content and cognitive complexity. The district must document the process used to demonstrate alignment. ***Ensuring the alignment criterion is met:** The combination of assessments that comprise the system shall be aligned with Wyoming Content and Performance Standards so that the full set of standards in the common core of knowledge and skills, both in terms of content and cognitive complexity are assessed. (Rules: Chapter 6 Section 8 (f)(iii)(A))			
☐ Meets criterion (bullets checked are met) ☐ Does not meet criterion	Artifacts may include:	Artifacts submitted by district:	Comments

○ The DAS adequately addresses the standards, K-12; and,
○ the process ensures two-way alignment
  ○ all assessment items and tasks align to the standards;
  ○ adequate sampling of the standards is represented in the assessments; and,
○ The process ensures that assessments reflect the cognitive depth and complexity of the standards.
	○ sample assessment blueprints
	○ sample assessment matrices
	○ sample curriculum maps
	○ procedures for assuring alignment among the course curriculum, standards, assessments, and/or grading/scoring practices
	○ evidence of procedures to ensure alignment of assessment items/tasks to the cognitive levels called for in the standards
		1.
		2.
		3.
		4. etc.	

*Subject to review and revision of Chapter 6 Rules.

Consistency Definition: The DAS is applied consistently across the district to yield reliable results regarding student performance. The district must document the process used to demonstrate consistency. ***Ensuring the consistency criterion is met:** The assessment system should be designed and implemented in such a way so that inferences drawn from the results of the assessments are consistent and not dependent on error due to raters or the quality of the assessments. While the focus is on the system, in order to meet this requirement, individual assessments within the system will need to be designed to yield consistent results, in terms of error due to raters, tasks, administration conditions, and occasions. (Rules: Chapter 6 Section 8 (f)(iii)(B))			
☐ Meets criterion (bullets checked are met) Does not meet criterion	Artifacts may include:	Artifacts submitted by district:	Comments
○ The process addresses factors that impact consistency. ○ The process demonstrates a sustainable systemic and systematic method to address consistency.	Procedures minimizing the differences in: ○ rater agreement ○ tasks ○ administrative guidelines ○ assessment retakes ○ assessment conditions ○ scoring guidelines Procedures demonstrating: ○ the method used to maintain a sustainable systemic and systematic process to address consistency	1. 2. 3. 4. etc.	

* Subject to review and revision of Chapter 6 Rules.

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Fairness Definition: The DAS is designed and implemented to minimize bias against any group of students. Multiple assessment opportunities and formats should be used to maximize fairness. The district must document the process used to determine fairness. ***Ensuring the fairness criterion is met:** The assessment system should be designed so that it is not biased against any group of students. As such, appropriate accommodations should be used so students with disabilities and Limited English Proficient students have fair access to the assessment system. As stated in Section 8(e)(i), (ii) and (iii) herein, multiple assessment formats should be employed in the assessment system which will contribute to improving the fairness of the system. (Rules: Chapter 6 Section 8 (f)(iii)(C))			
☐ Meets criterion (bullets checked are met) Does not meet criterion	Artifacts may include:	Artifacts submitted by district:	Comments
○ The process ensures methods to minimize bias against any group of students. ○ The process ensures multiple assessment opportunities and formats over time, K-12.	Procedures addressing: ○ item and task bias against any subgroups of students. ○ appropriate accommodations ○ multiple opportunities over time, K-12, using different formats and strategies, to demonstrate knowledge and skills ○ disaggregation of assessment results by subgroups and use of information to make decisions ○ participation rates monitored by subgroup	1. 2. 3. 4. etc.	

* Subject to review and revision of Chapter 6 Rules.

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Standard-Setting Definition: The DAS has a defensible method to define levels of proficiency, (e.g., cut-scores) for each content area. The district must document the process used for standard-setting. ***Ensuring defensible standard-setting methods within the DAS:** The cut scores that delineate the various performance levels on each assessment shall be tied to these district performance descriptors and shall be based on research or best practices. Descriptions of what constitutes proficient performance shall be clearly articulated and shall be correlated with the performance descriptors found in the Wyoming Content and Performance Standards. (Rules: Chapter 6 Section 8 (f)(iii)(E))			
☐ Meets criterion (bullets checked are met) ☐ Does not meet criterion	Artifacts may include:	Artifacts submitted by district:	Comments
○ The process ensures a defensible method to define levels of proficiency at the content area level. ○ The process demonstrates ways in which districts determine a student is proficient in a standard.	○ the rationale and the standard-setting method used for determining proficiency at the content level ○ the method used to determine cut scores for each proficiency level ○ the method used to determine student proficiency toward a standard	1. 2. 3. 4. etc.	

* Subject to review and revision of Chapter 6 Rules.

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Glossary

Accreditation: The evaluation process by which a district receives accredited status from the Wyoming Department of Education and the Wyoming State Board of Education.

Accommodation: Accommodations are practices and procedures in the areas of presentation, response, setting, and timing/scheduling that provide equitable access during instruction and assessments for students with disabilities.

Administration Guidelines: Information provided on how an assessment is to be administered.

Alignment: The District Assessment System (DAS) is aligned with Wyoming Content and Performance Standards, both in terms of content and cognitive complexity.

Alternate Assessment: An alternate assessment is a different or altered assessment. An alternate assessment should not change, lower, or reduce learning expectations by requiring a student to learn less material, or by making the assessment easier.

Assessment: Assessment is a process designed to measure students' progress toward meeting the content standards at specific benchmarks. There are many types of assessments such as state, district and classroom assessments and each type of assessment serves different purposes.

Assessment Conditions: Circumstances under which assessment is administered such as timing, assessment structure, environment, information visible, and available to students.

Assessment Retakes: Opportunity for students to take an assessment again in a different form.

Assessment System: An assessment system is a well-articulated set of assessments, each of which contributes toward supporting inferences related to the identified purposes of the system. The most important characteristic distinguishing an assessment system from a simple collection of tests is that a system is designed to provide a cohesive array of information on student performance.

Bloom's Taxonomy: Bloom's Taxonomy is a multi-tiered model of classifying thinking according to six cognitive levels of complexity.

Chapter 6: This Chapter of the Wyoming Education Rules and Regulation requires districts to have a comprehensive K-12 delivery and assessment system for the Wyoming State Content and Performance Standards and the Common Core of Skills.

Chapter 31: This Chapter of the Wyoming Education Rules and Regulation requires districts to have a District Assessment System.

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Cognitive Demand: Cognitive demand is the complexity or "rigor" specified in the performance standards, standards and benchmarks. In Wyoming, most districts use Bloom's Taxonomy or Webb's Depth of Knowledge to analyze performance standards, standards, benchmarks and assessments in terms of cognitive demand.

Compensatory Approach: In a compensatory model of a district assessment system students do not have to demonstrate proficiency on every standard to be considered proficient in the content area. Low performance on one or more standards within a content area may be compensated by high performance in others.

Conjunctive Approach: In a conjunctive model of a district assessment system, students have to demonstrate proficiency on every standard to be considered proficient in the content area.

Consistency: The DAS is applied consistently across the district to yield reliable results regarding student performance.

Content Standards: Content standards define what students should know and be able to do as a result of instruction in the common core of knowledge and skill areas. In Wyoming these are the Wyoming Content and Performance Standards.

Course-Based Approach: A course-based approach for an assessment system identifies courses (or at least certain key courses) that are clearly tied to standards; the grades in those courses are based on achievement of the standards.

DAS Review Rubric: Document used by WDE review team to evaluate annual district assessment system reports submitted by districts.

Depth of Knowledge: Depth of Knowledge is a classification of standards and assessment items created by Norman Webb from the Wisconsin Center for Education Research. The depth of knowledge is the degree of cognitive depth or complexity that knowledge standards or assessments require. Assessments should be as demanding cognitively as the expectations/standards that are set for students.

Design Principles: The primary design principles of an assessment system are: alignment, consistency, fairness, and standard-setting.

District Assessment System: A comprehensive set of assessments K-12 in all nine content areas.

District Assessments: District assessments are those that are common throughout the district within specific grades or courses and should be administered and scored using uniform procedures.

District-Based Approach: A district-based approach to an assessment system relies on stand-alone assessments at key checkpoints in a student's school career. These assessments can be at the end of specific courses or grades.

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Evaluation Criteria: The evaluation criteria refer to the required components of an assessment system found in the DAS Review Rubric.

Evaluation Process: The evaluation process is a review of a district's assessment system report by a WDE team evaluation utilizing the DAS Review Rubric.

Fairness: The DAS is designed and implemented to minimize bias against any group of students. Multiple assessment opportunities and formats should be used to maximize fairness.

Graduation Requirements: Graduation requirements are state statutes, rules, and regulations specifying what are required for a student to earn a high school diploma.

High School Diploma Endorsements: A high school diploma shall provide for one of the following endorsements, which shall be stated on the transcript of each student: advanced, comprehensive or general. An advanced endorsement requires a student to demonstrate advanced performance in five of nine content areas and proficient performance in the remaining areas. A comprehensive endorsement requires a student to demonstrate proficient performance in all nine content areas. A general endorsement requires a student to demonstrate proficiency in five of the nine content areas.

Inter-Rater Reliability: This is also called inter-rater agreement or concordance. It is the degree of agreement among raters. There are a number of statistics to determine inter-rater reliability.

Multiple Measures: Multiple Measures refers to multiple formats and opportunities for a student to demonstrate proficiency. The district assessment system must provide students with multiple opportunities, using multiple formats to demonstrate their knowledge and skills related to the Wyoming Content and Performance Standards. In other words, the system should allow students the opportunity to show what they know, but the system should be designed in such a way so that students who have not mastered the standards should not be able to pretend to know.

Mixed Model Approach: A mixed-model approach to designing a DAS allows districts to rely on the best features of the different approaches for different content areas. A district does not have to choose a single approach for every content area.

NCLB: NCLB is the No Child Left Behind Act, a federal law passed in 2002 reauthorizing the Elementary and Secondary Education Act.

Performance Standards: Performance standards describe the characteristics of students at various levels of performance. They describe "how good is good enough?" These should clearly differentiate what students "look like" at various stages of learning the content, and the performance standards should be clearly measurable.

Primary Design Principles: The primary design principles guide the development of districts' assessment systems in order to make sure the system fulfills the stated purposes. The primary design principles for a system are: alignment, consistency, fairness, and standard-setting.

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Rater Agreement: The degree to which different judges would evaluate the same assessment.

Results: The term refers to the information or data the assessment(s) are providing the district.

Sampling: Sampling is the process where a district gets a representative sample of student knowledge by collecting data at critical points and intervals throughout the K-12 continuum.

Standards-Based Education: Education reform in the United States since the late 1980's has largely been driven by the setting of academic standards of what students should know and be able to do. A standards-based system measures each student against the concrete standards instead of measuring how well the student performs compared to others. Curriculum, assessments and professional development are aligned to the standards.

Standard-Setting: The DAS has a defensible method to define levels of proficiency, (e.g., cut-scores) for each content area.

Tasks: Performance items.

Test Blueprint: A test blueprint is a process or tool used to analyze the coverage of standards and the cognitive demand of the tasks represented in an assessment.

Validity: Validity is often defined as the degree to which a test measures what it is intended to measure. But is not the test that is valid or not, it is the inferences—in the context of a particular use—that are valid or not.

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WYOMING

State Board of Education

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Executive Assistant

MEMORANDUM

TO: State Board of Education

FROM: Paige Fenton Hughes, Coordinator

DATE: September 30, 2013

SUBJECT: Outreach activities update

During the last legislative session, the State Board was charged with holding a number of outreach meetings across the state to inform education stakeholders, including parents and community members, about the provisions of Phase I of the Wyoming Accountability in Education Act that will be presented to the legislature in the October 15, 2013 report. Toward that end, we scheduled and held a number of meetings in sites across the state. We will actually be holding another set of follow-up meetings in the same sites over the next couple of days, so I will provide additional information to you at our meeting about the October 1 and 2 meetings as well as the September 30 Blackboard session.

The WDE and SBE partnered to offer seven education summits in five sites across the state and using the Blackboard on-line presentation system. The topics of the presentation were the elements of the Phase I accountability work that will be presented in the October 15, 2013 report to the legislature from WDE and SBE. Please see the attached slides for your reference. The presentation itself is available on the WDE website at: https://sas.elluminate.com/site/external/installinfo/playback?sid=vclass&psid=2013-08-30.0857.D.0A4F0CB5F2A0EEC04BFB7388B23CD3.vcr.

The summits began on Monday, August 26 with a Blackboard session at 1 PM and a 6 PM presentation in Cheyenne at the Hathaway Building. On August 27, a noon meeting was held in Gillette and a 6 PM meeting was held in Casper. Worland and Rock Springs were the sites for the August 28 meetings at noon and 6 PM respectively. Finally, a Blackboard session wrapped up the week on Friday, August 30 at 1 PM.

Here is a summary of the number of attendees and the organizations represented. Additionally, there were a number of interested citizens attend in Cheyenne and Casper.

Cheyenne - 8/26 - 22 attendees.
Districts/Organizations: Laramie #1, WSBA, WASA, WDE, Platte #1, WEA, WTE, OSPI

Gillette - 8/27 - 20 attendees.
Districts/Organizations: Campbell #1, Weston #1, The News-Record, Parent

Info Center

Casper - 8/27 - 15 attendees.
Districts/Organizations: Natrona #1, Parent Info Center, House of Representatives, Casper Star-Tribune, Wyoming Freedom in Education, State Board

Worland - 8/28 - 28 attendees.
Districts/Organizations: WEA, Washakie #1, Washakie #2, Senate, Big Horn #4, Park #1, Park #16, House of Representatives, Hot Springs #1, Wyoming Boys' School

Rock Springs - 8/28 - 34 attendees.
Districts/Organizations: Sweetwater #1, Lincoln #2, Sweetwater #2, Uinta #6, Sublette #9, WEA

Blackboard – 8/30 – 18 sites signed in; however, some sites had a number of attendees.

Districts/Organizations: Crook #1, Independent Record, Fremont #1, St. Stephen's, University of Wyoming, Uinta #1, Sublette #1, Fremont #25, WAPCS, Teton #1, Big Horn #4, Johnson #1, Weston #1, WEA, Sheridan #2

Some comments or concerns that we heard more than one time over the course of the meetings are the following:

The inconsistency of assessments over time makes it difficult for districts to put too much stock in longitudinal data. It is very difficult to focus the instructional work on moving targets. Could schools have a grace period regarding accountability until the targets have been stabilized?

Concerns expressed for schools that have larger populations of ELL, low socio-economic status students, higher rates of mobility. Will the indicators ensure those schools are equitably measured? Is it a fair comparison?

Regarding the elements of the model, are we ignoring the upper end of our students with a focus on equity? Is there even a concern about moving kids from proficient to advanced? Several folks advocated for our goals language to be college <u>and</u> career ready.

On the other hand, are we focused too much on college? Many of these commenters advocated for the language college <u>or</u> career ready to be our goal. Many Wyoming careers might not require college.

Some people shared that the system seems too complicated. Will it be effective in informing teacher practice? Will school board members and the public understand it?

There were several written comments and some verbal commentary about the capacity of the WDE to provide support to schools and districts that may be partially meeting or not meeting accountability expectations. The need for support with high quality assessment was specifically mentioned. It was also suggested that every district deserves access to high quality coaching.

Finally, we heard at every site that the PAWS/statewide testing window is too early. In order to measure the full realm of learning, the testing window

needs to be later in the school year.

After the sessions concluded, it's clear there are still quite a few unanswered questions. But one overarching message of the sessions was that the accountability work is being developed, it's ongoing work, and we are committed to getting it right. Also, the session content stressed that the purpose of accountability is not "punishment" for schools, but instead is a way to focus efforts on common targets and direct support to schools in need so we can improve learning opportunities and outcomes for all Wyoming students.

The Professional Judgment Panel (PJP) was held September 16, 17 and 18 in Casper, and we presented the results of the PJP at the Wyoming School Improvement Conference on September 24 during a general session. Because of the short time period for the presentation, we didn't have an opportunity to field many questions. Special thanks to Dr. Annette Bohling and Karan Wright for giving us that forum to share PJP results.

Another set of outreach sessions is coming up this week. Mike Flicek and I will travel to Rock Springs (noon) and Worland (6 PM) on October 1 and Casper (noon) and Gillette (6 PM) on October 2. Our purpose will be to explain the outcomes of the PJP. There will also be a Blackboard session at 1:30 on September 30. An update on this second set of outreach meetings, including comments from participants, will be included in my oral report to the Board on October 8, 2013 as well as in the October 15, 2013 report to the legislature.

The WDE and SBE so much appreciate the support of the school districts that hosted us and would like to express our appreciation to all the people who attended the sessions. I personally would like to thank Julie Magee, Deb Lindsey and Mike Flicek for all the time and effort put into preparing for and presenting a great deal of information in a short time to diverse audiences. Additionally, Tom Lacock has been tremendously helpful in getting out press releases and moderating the Blackboard sessions.

Wyoming Education Accountability Summits

August 2013

The State Board of Education and the Wyoming Department of Education…

- working together to accomplish the goals of the Wyoming Accountability in Education Act.

Outreach Activities

Wyoming WDE and SBE

Outreach Meetings/Activities

- …the state board through the department of education shall provide outreach activities and communications to school districts and to local communities coinciding with the development of components of the report required by subsection (b) of this section, and with the development of recommendations contained within this report. Comments generated from district and local community outreach activities shall be considered by the board and the department in executing requirements imposed under this section, and shall be included within the report submitted to the select committee pursuant to subsection (b) of this section.

Targets for Today's Meeting

- Share the updates on Phase I activities and provide information about each facet
- Gather comments from attendees to inform the rest of the work and to include in the October report to the legislature

WAEA Goals

- Become a national leader in education
- Ensure all students are college or career ready
- Recognize student growth and increase rate of growth for each student
- Recognize student achievement and minimize achievement gaps
- Improve teacher and leader quality
- Maximize efficiency
- Increase credibility and support for WY schools

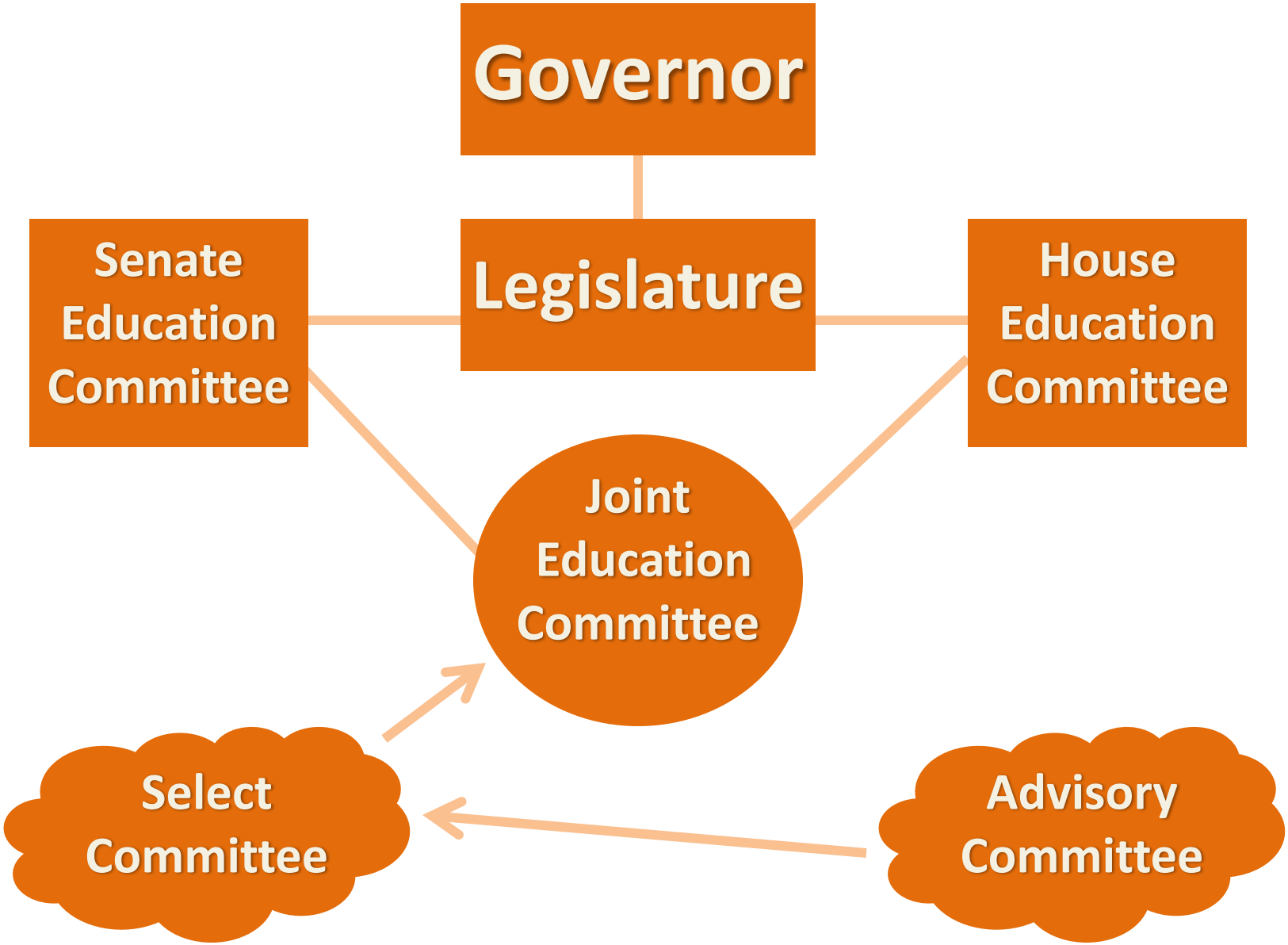
Two Phases of WAEA

Phase I

- School accountability model
- Assessment system
- System of support
- Determination of high school graduation proficiency
- Outreach and reporting

Phase II

- Teacher/leader evaluation and accountability


Governor
Legislature
Senate Education Committee
House Education Committee
Joint Education Committee
Select Committee
Advisory Committee

Timeline

- School accountability model piloted fall 2013
- School accountability model reflecting school performance during 2013-2014 school year will be operational in fall of 2014
- System of support will be implemented in fall of 2014
- Phase II teacher/leader evaluations fully implemented in 2016-2017

Wyoming Accountability Model

Wyoming WDE and SBE

Wyoming School Performance Rating Model

Dr. Michael Flicek
Education Consultant

WAEA School Performance Levels

- Exceeding Expectations
- Meeting Expectations
- Partially Meeting Expectations
- Not Meeting Expectations

Indicators used to Identify School Performance Level

- Schools with grades 3 through 8
  - Achievement
  - Growth
  - Equity
- Schools with grades 9 through 12
  - Achievement
  - Readiness
  - Equity

Achievement – Grades 3-8

- PAWS reading – Grades 3-8
- PAWS math – Grades 3-8
- PAWS science – Grades 4 & 8
- SAWS – Grades 3, 5 &7

Achievement – Grade 11

- ACT Subject-Area Tests
  - Reading
  - Mathematics
  - Science
  - Writing (to begin after spring 2014 testing)

Illustration of Computation of a School Achievement Score

Content	Count of Tested Students	Count of Proficient Students	School Achievement Score
Math	80	65	
Reading	80	60	
Writing	40	25	
Science	20	12	
Column Totals	220	162	162/220 = 73.6%

Grade Bands for Achievement

- Grade 3 through 6
- Grades 7 and 8
- Grade 11

Student Growth – Grades 4-8

- Growth in reading and in math
- Each student will have a student growth percentile (SGP)
  - Same grade in school
  - Similar test scores in previous years
  - Scores from 1 to 99

School Growth – Grades 4-8

- For accountability
  - School median SGP; the SGP that ½ of students at the school scored above and ½ of students at the school scored below
- For school improvement
  - Median SGP reported for each grade-by-content area at the school
  - For example, you will have a report that shows the median SGP in math for Grade 4 students at your school

Equity – Consolidated Subgroup

- Current subgroups performance will continue to be reported
- For Wyoming accountability, however, a consolidated subgroup will be used
- The consolidated subgroup will be all students who scored below proficient on the previous year's achievement test
- Minimum *n* size for subgroup accountability = 15

Equity – Grades 4-8

- Adequate Growth Percentile (AGP)
  - The SGP on this year's test, the student needs to be on track for being proficient within 3 years or by the end of grade 8
  - These are computed for all students in grades 4 through 8 with more than one previous PAWS test
- School's Equity Score
  - The percent of students at the school who are considered on track to become proficient within 3 years (i.e., for whom their SGP equaled or exceeded their AGP)

Equity – Grade 11

- Policy objective: To encourage a focus on improving performance of the most high-risk students
- This will be applied to schools which had at least 15 students assessed on the ACT that were at the school for a full academic year
- It is anticipated that this indicator will be refined going forward as more years of current high school assessment data become available

High School Equity – Rejected Method

- Method 1 Attempted
  - The percent of ACT reading and math subject area test scores that were not proficient
  - When a school had a decrease of not proficient test scores of at least 5% the percentage of the decrease is subtracted from the school's current year not proficient percentage
- Further analysis has shown this method is too highly correlated with the *achievement indicator*
- Therefore, method 2, which is not as highly correlated with achievement, will be used

High School Equity – Accepted Method

- Step 1. Compute the <u>percent of *not proficient*</u> test scores in reading and math in 2013 for all schools that meet the minimum *n*
  - The schools will be placed into one of three (approximately equal) categories
    - Category 1: Minus (i.e., High Not Proficient)
    - Category 2: Neutral (i.e. Middle Not Proficient)
    - Category 3: Plus (i.e., Low Not Proficient)

HS Equity –Method 2

- Set 2. Compute the <u>percent *improvement* (i.e., reduction)</u> in not proficient test scores in reading and math from 2012 to 2013 for all schools that meet the minimum *n*
  - The schools will be placed into one of three (approximately equal) categories for percent improvement
    - Category 1: Low Improvement (i.e., Reduction in Not Proficient)
    - Category 2: Middle Improvement (i.e., Reduction in Not Proficient)
    - Category 3: High Improvement (i.e., Reduction in Not Proficient)

H.S. Equity – Method 2

- Step 3. Use the Percent Not Proficient-by-Improvement matrix to find the "meeting target"

Improvement (Reduction in Percent NP)	Percent Not Proficient (NP)		
	Minus (High NP)	Neutral (Middle NP)	Plus (Low NP)
Low	***Not Meeting***	***Not Meeting***	***Meeting***
Middle	***Not Meeting***	***Meeting***	***Exceeding***
High	***Meeting***	***Exceeding***	***Exceeding***

Readiness – Grades 9-12

- Leading indicators
  - Performance on ACT Suite (Explore, Plan & ACT)
  - Grade 9 credits earned
- Lagging indicators
  - Graduation index
  - Hathaway eligibility

ACT Suite – Avg. Student Index Score

	Composite Score Ranges			
Wyoming ACT Readiness Levels	ACT Explore Grade 9	ACT Plan Grade 10	ACT Test Grade 11	Index Points
Level 1	1-14	1-15	1-16	0
Level 2	15-17	16-18	17-20	40
Level 3	18-20	19-21	21-24	80
Level 4	21-25	22-32	25-36	100

Aligned with Hathaway Scholarship eligibility cut-points.
Each student receives an index score.
The average of the index scores for all students will be the school score.

Grade 9 Credits Earned

- The percent of students who completed grade 9 with one fourth of the credits required to receive a diploma

Graduation Index Illustration

Criteria Numbers	Student Result	Points*
1	Diploma Earned in Four Years	100
2	Alternate Standards Completion**	100
3	Diploma Earned in More than Four Years	75
4	Continued Enrollment***	50
5	Noncompleter	0

Illustration only – stakeholders will determine the point values for each category.
Each student receives an index score.
The average of the index scores for all students will be the school score.

Hathaway Scholarship Eligibility Index

Student Eligibility Level	Points
Not Eligible	0
Provisional	70
Opportunity	80
Performance	90
Honors	100

- The school's score will be the mean of the student points for the graduating class at the school.
- Each student receives an index score.
- The average of the index scores for all students will be the school score.

Combining Readiness Subindicators

Leading Indicators		Lagging Indicators	
Tested Readiness	Grade 9 Credits	Graduation Index	Hathaway Eligiblity
20%	10%	25%	45%
30%		70%	

<u>Weights shown are for illustration only.</u> The professional judgment panel will establish the weights.

Illustration of Computation of Total School Readiness Score.

Subindicator	Hypothetical Score for a School	Example Subindicator Weight	(School Score * Weight)
ACT Suite Index	55	.20	11
Grade 9 % On Track	72	.10	7.2
Graduation Rate Index	67	.25	16.75
Hathaway Eligibility Index	58	.45	26.1
School Readiness Score (Sum of Subindicator Weighted Scores) =			61.05

Professional Judgment Panel (PJP)

- A representative group of 27 to 30 people
  - Representing groups prescribed by statute
  - Selected by the State Board of Education

PJP Major Tasks

- Determine the cut points for school scores on ***each indicator*** that determine if schools are:
  - Exceeding Targets
  - Meeting Targets
  - Below Targets

For schools with Grade 3 through 8, the PJP will determine which school performance level is appropriate for each pattern of school performance on the indicators in this decision table.

		Achievement Below	Achievement Meeting	Achievement Exceeding
Equity Below	Growth Below	Not Meeting Expectations		
	Growth Meeting			
	Growth Exceeding			
Equity Meeting	Growth Below			
	Growth Meeting		Meeting Expectations	
	Growth Exceeding			
Equity Exceeding	Growth Below			
	Growth Meeting			
	Growth Exceeding			Exceeding Expectations

Performance Level Descriptions (For Schools with Grades 3-8)

- **EXCEEDING EXPECTATIONS**: Schools in this category, which is reserved for schools considered models of performance, have demonstrated high growth overall, have average to high levels of achievement (proficiency rates) overall, and excel in promoting equity based on growth for students with prior below proficient performance.
- **MEETING EXPECTATIONS**: Schools in this category have demonstrated acceptable levels of achievement and growth overall and are showing acceptable progress in promoting equity based on growth for students with prior below proficient performance.
- **PARTIALLY MEETING EXPECTATIONS**: Schools in this category have demonstrated either acceptable levels of growth or acceptable levels of achievement overall. Schools in this category may or may not show acceptable performance in promoting equity based on growth for students with prior below proficient performance.
- **NOT MEETING EXPECTATIONS**: This category is reserved for schools with unacceptable performance on many or most indicators. For schools in this category improvement is a priority. These schools have low levels of achievement overall and demonstrate low to average growth overall and fall short of producing growth for below proficient students that will move them toward proficiency.

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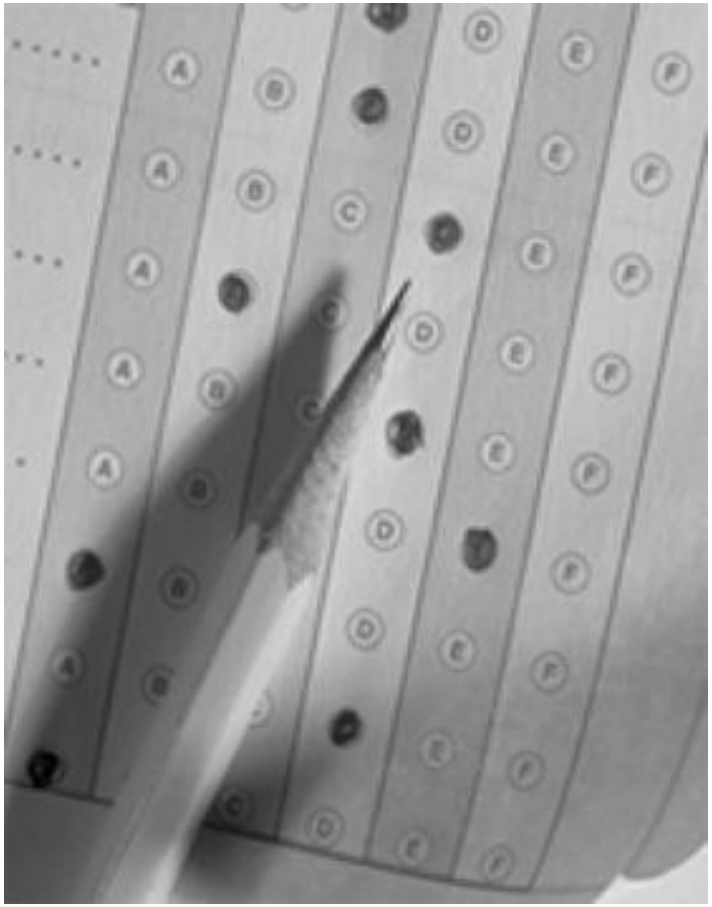
For schools from which students may graduate, the PJP will determine which school performance level is appropriate for each pattern of school performance on the indicators in this decision table.

		Achievement Below	Achievement Meeting	Achievement Exceeding
	Readiness Below	Not Meeting Expectations		
Equity Below	Readiness Meeting			
	Readiness Exceeding			
	Readiness Below			
Equity Meeting	Readiness Meeting		Meeting Expectations	
	Readiness Exceeding			
	Readiness Below			
Equity Exceeding	Readiness Meeting			
	Readiness Exceeding			Exceeding Expectations

Illustration of Decision Table for Assigning School Performance Levels when a School has Only Two Indicators

	Achievement Below	Achievement Meeting	Achievement Exceeding
Growth (or Readiness) Below	Not Meeting Expectations		
Growth (or Readiness) Meeting		Meeting Expectations	
Growth (or Readiness) Exceeding			Exceeding Expectations

District Assessment System



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District Assessment System

- Criteria
  - Alignment
  - Consistency
  - Fairness
  - Standard-setting

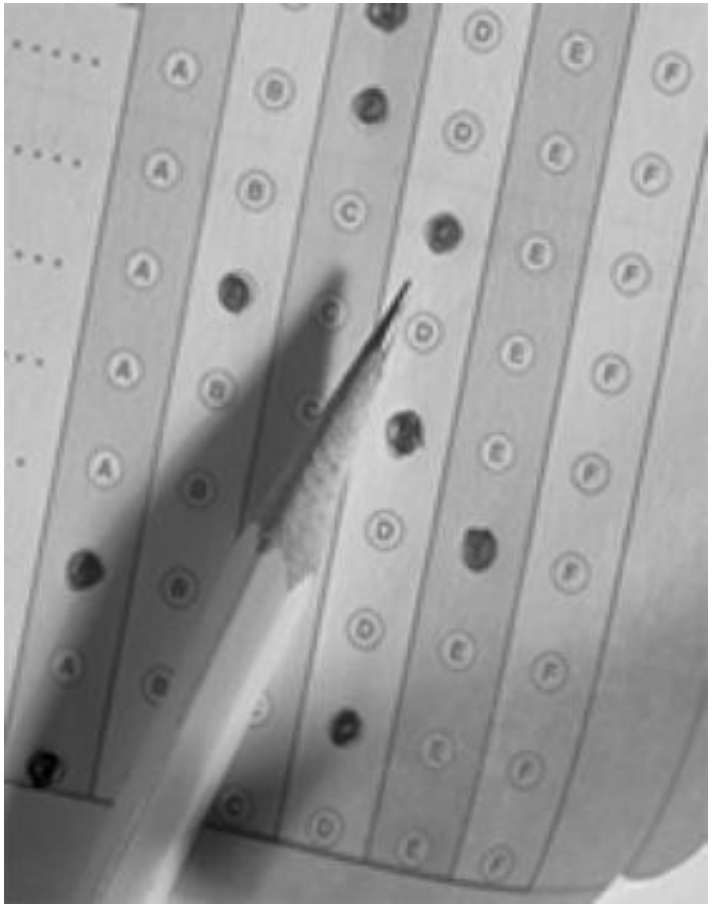
District Assessment System

- Review Process
  - Narrative
  - Artifacts
  - Rubric/Guiding Document

District Assessment System

- Timeline
  - 2013-2014
  - 2014-2015
  - 2015-2016
  - 2016-2017
  - Beyond

State Assessment



Wyoming WDE and SBE

Wyoming State Assessment: Options for the Future

August and September 2013

EA116

"Notwithstanding [existing statute], the state board and the department of education shall investigate options available to the state for future assessment system development. The state board, through the department, shall periodically report to the select committee on statewide education accountability regarding the status of assessment development, investigation of options available to the state and the impact of existing law governing statewide assessments on future assessment development. The select committee shall report to the 2014 legislature on any necessary legislation supporting future assessment development."

2015 & Beyond
State Assessment Options

- Build
  - Extend ETS contract for custom state test
- Buy
  - Adopt tests from Smarter Balanced Assessment Consortium (SBAC)
  - Issue RFP for off-the-shelf test

Next Generation Assessments

The U.S. Department of Education funded two consortia of states to develop new general education assessments aligned to college- and career-ready standards

- Rigorous assessment of progress toward “college and career readiness”
- Common cut scores across all Consortium states
- Provide both achievement and growth information
- Valid, reliable, and fair for all students, except those with “significant cognitive disabilities”
- Administer online
- Use multiple measures
- Operational in 2014-15 school year

26 States, nearly 40% of US Students

State-Led Governance

States Join SBAC as Governing or Advisory States

- Governors
- Education Chief
- State Legislatures
- State Boards of Education

State Reps Serve on Executive Committee

- 2 Elected Co-Chairs
- 4 Reps elected by Governing States
- Lead Procurement State (WA)
- Higher Ed Reps

Smarter Balanced Staff

WestEd, Project Mgmt Partner

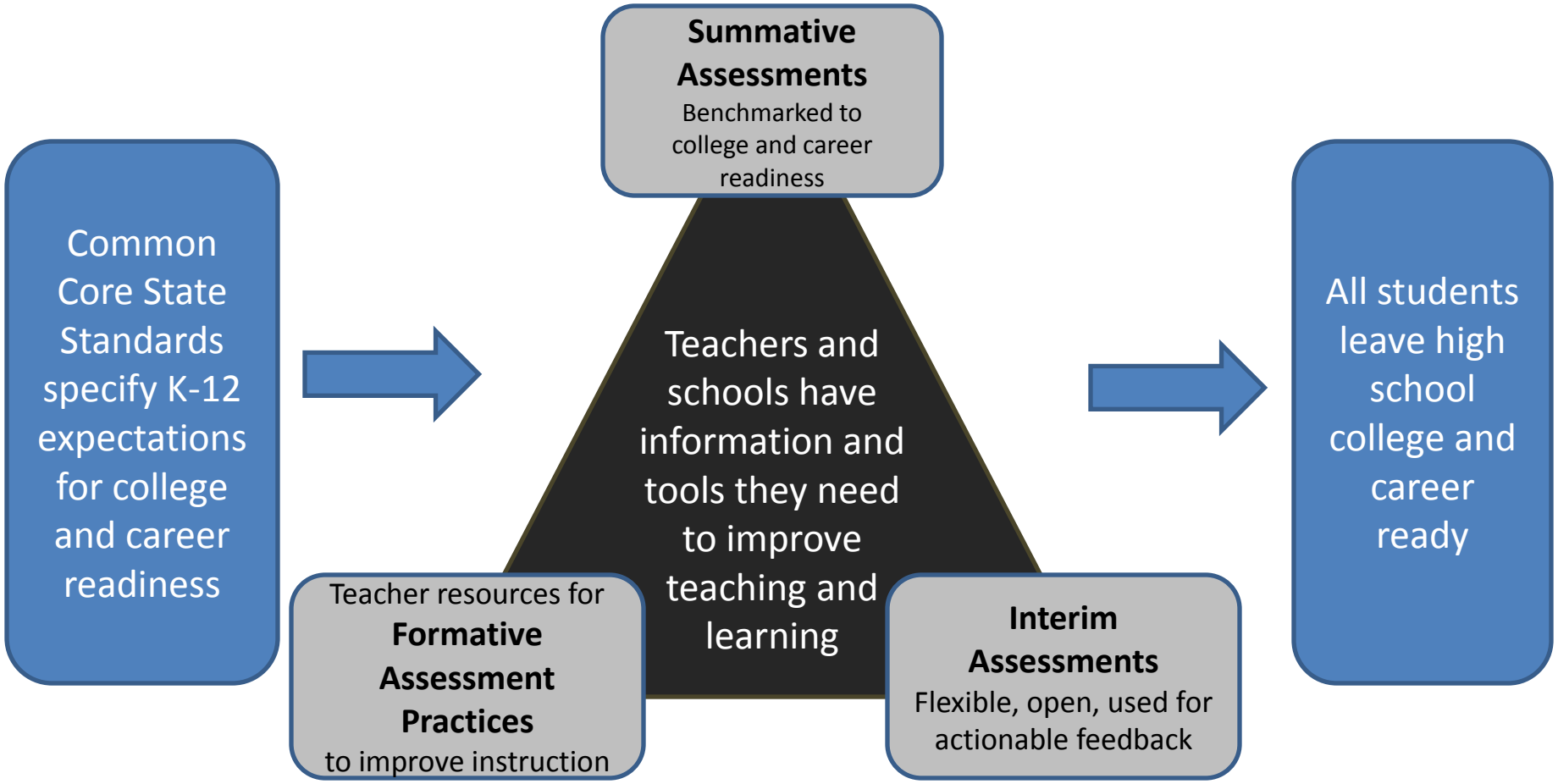
Work Groups and Advisory Committees

Wyoming WDE and SBE

Governing / Advisory

- States join the Consortium at no cost until assessments are delivered in 2015
- Governing states influence direction of Consortium; they vote on matters of importance (e.g. blueprints), take leadership roles in SBAC, and are invited to participate in various activities (teacher PD, state-level item-writing, scientific pilot)
- Change from Advisory to Governing gives Wyoming a voice in the Consortium work

Balanced Assessment System



Smarter Balanced Assessment Consortium

Assessment Components

Summative Assessment (Computer Adaptive)

- Assesses the full range of Common Core in English language arts and mathematics for students in grades 3–8 and 11 (interim assessments can be used in grades 9 and 10)
- Measures current student achievement and growth across time, showing progress toward college and career readiness
- Can be given once or twice a year (mandatory testing window within the last 12 weeks of the instructional year)
- Includes a variety of question types: selected response, short constructed response, extended constructed response, technology enhanced, and performance tasks

Assessment Components

Interim Assessment (Computer Adaptive)

- Optional comprehensive and content-cluster assessment to help **identify specific needs of each student**
- Can be administered **throughout the year**
- Provides **clear examples** of expected performance on Common Core standards
- Includes a **variety of question types:** selected response, short constructed response, extended constructed response, technology enhanced, and performance tasks
- Aligned to and reported on **the same scale as the summative assessments**
- **Fully accessible** for instruction and professional development – **Could replace MAP and save districts approximately $10/student**

Assessment Components

Formative Assessment Practices

- Research-based, **on-demand tools and resources for teachers**
- Aligned to **Common Core**, focused on increasing student learning and enabling differentiation of instruction
- **Professional development** materials include model units of instruction and publicly released assessment items, formative strategies

SBAC Sample Items

- Grade 4 Literacy: Reading http://sampleitems.smarterbalanced.org/itempreview/sbac/ELA.htm
- Grade 4 Math: Problem-Solving http://sampleitems.smarterbalanced.org/itempreview/sbac/index.htm
- SBAC Practice Test Portal http://sbac.portal.airast.org/practice-test/

SBAC Costs

- Summative only cost is approximately 1/3 of current cost of PAWS ($23 vs $76)
- Entire package of integrated assessments and resources is less than ½ the current cost of PAWS ($28 vs $76)
- Entire package could also relieve districts of cost of on-line, adaptive assessments (approx $10 per pupil)
- Grade 11 cost is approximately ½ that of ACT Plus Writing ($23 vs $47.50)

Benefits of SBAC

- *Balanced:* summative, interim, and formative tools/resources – digital library
- *Aligned*: deeper coverage of standards with multiple item types, including CAT multiple choice, constructed response, and extended response/ performance tasks
- *Cost effective:* at under $30/student, it's less than ½ the current cost

Benefits of SBAC

- Returns results to schools two weeks after testing window
- Permits state to state comparisons
- Facilitates cross-state collaboration (partnership w/other states)
- Eases peer review of assessment system
- Improves test security with online administration

Benefits of SBAC

- Measures growth over time with interim and summative integrated scale
- Provides resources for school staff to improve teaching and learning and foster school improvement
- Ensures local control of instructional programs and curriculum while establishing common performance outcomes
- Supports WAEA by providing measures of achievement, growth, and college and career readiness

2015 Statutory Impact

- Separate reading and writing assessments
- Writing assessment in grades 3, 5 and 7 only
- Multiple choice items only in reading and math
- High school assessment system

Other Assessments

- Ongoing need for annual science assessments in grades 4, 8, and 11
- Ongoing need for annual alternate assessments for students with significant cognitive disabilities (1%)
- Ongoing need for annual assessments of English proficiency for English learners

System of Support

Wyoming Statewide System of Support

The Progressive, Multi-Tiered System of Support, Interventions, and Consequences

Regulatory Guidance Provided

- Wyoming Legislature
- Wyoming Department of Education
- United States Department of Education
- AdvancED® Accreditation

Partners in Development

- Wyoming Department of Education
- Mid-Continent Research and Education Laboratory (McRel)
- Academic Development Institute (ADI)
- Marzano Research Laboratory (MRL)
- Center for Education Leadership (CEL)

Proposed System of Support

- **Comprehensive Plan for All Schools**
  - Meets requirements for:
    - WAEA, ESEA and AdvancED® Improvement Plans
    - WAEA Communication Plan
    - WAEA Resourcing Plan
    - ESEA Title 1Plan
    - Federal Turnaround Principles
    - Federal 1003g School Improvement Grant (SIG)
    - Assessment of Effective Practices and Needs
    - State and Federal Statutory Assurances
    - Aligned to AdvancED® School Accreditation Indicators

Support and Capacity Building

- Exceeding expectations schools
- Meeting expectations schools
- Partially meeting expectations schools
- Not meeting expectations schools
  - 21-2-204(f)

Benefit to Schools

- Minimized Duplication of Plan Requirements
- Simple Forms and Processes
- Support from WDE Staff and Coaches
- Statewide Collaboration around Specific Topics in Leadership and Instruction

Increased Student Performance

Measure or Multiple Measures

Wyoming WDE and SBE

Statutory Language

…each district's assessment system shall include a measure or multiple measures for purposes of determining completion of high school graduation requirements. The state board shall by rule and regulation establish guidelines for district development of this measure or measures, and shall through the department of education, provide support to districts in developing each district's measure or measures.

So…how shall we replace BOE?

- That's the task of the Thought Leader Group
  - Determine completion of high school graduation requirements
  - Reduce the burden on districts
  - "Define" a Wyoming high school graduate

Draft MM Plan Presented to the SBE

- Use existing state assessments when possible
- Develop assessments in other content areas at the state level to be used in districts
- Provide comparability data among districts

PHASE II

Wyoming WDE and SBE

Advisory Committee Work (Interim 2013)

- The work of the Select Committee during the 2013 interim will focus largely on Phase I (School Accountability), with some attention to Phase II

- The Advisory Committee, on the other hand, will focus on Phase II in order to ensure that the timelines put forth in HB0072/2013 Chapter 167 can be met…

October 2013 Deliverables

- State Model Leader Evaluation System
- State Model Teacher Evaluation System

- Each Model System will describe:
  - Required components /indicators and processes
  - Recommended components /indicators and processes
  - Recommended methods for combining indicators and making evaluation decisions
  - Implementation guidelines, including necessary training and professional development
  - Serve as a foundation for State Board rules

Design, Piloting, and implementation

2013 Interim:	Designing State Model Systems
2013-2014:	Required training and professional learning
	Voluntary pilot for select districts
2014-2015:	Phased-in implementation pilot
2015-2016:	Full pilot, perhaps with phased-in implementation
2016-2017	Full implementation

Wyoming WDE and SBE

Please send comments to:

- paige.fentonhughes@gmail.com

Wyoming Accountability in Education Act: Results of the Professional Judgment Panel

September 2013

What is the purpose of Wyoming education accountability?

Outreach Activities

Wyoming WDE and SBE

Wyoming Accountability Model

Wyoming WDE and SBE

Wyoming School Performance Rating Model

Dr. Michael Flicek

Education Consultant

September 24, 2013

WAEA School Performance Levels

- Exceeding Expectations
- Meeting Expectations
- Partially Meeting Expectations
- Not Meeting Expectations

Indicators used to Identify School Performance Level

- Schools with grades 3 through 8
  - Achievement
  - Growth
  - Equity
- Schools with grades 9 through 12
  - Achievement
  - Readiness
  - Equity

Achievement – Grades 3-8

- Assessments used in 2013
  - PAWS reading – Grades 3-8
  - PAWS math – Grades 3-8
  - PAWS science – Grades 4 & 8
- Assessment to be added in **2014**
  - SAWS – Grades 3, 5 &7

Achievement – Grade 11

- Assessment used in 2013
  - ACT Subject-Area Tests
    - Reading
    - Mathematics
    - Science
  - Assessment to be added in **2014**
    - Writing (to begin after spring 2014 testing)

Illustration of Computation of a School Achievement Score

Content	Count of Tested Scores	Count of Proficient Scores	School Achievement Score
Math	80	65	
Reading	80	60	
Writing	40	25	
Science	20	12	
Column Totals	220	162	162/220 = 73.6%

Grade Bands for Achievement with PJP Established Cut Scores

- Grade 3 through 6
  - **Low cut = 75**
  - **High cut = 86**
- Grades 7 and 8
  - **Low cut = 68**
  - **High cut = 80**
- Grade 11
  - **Low cut = 70**
  - **High cut = 83**

Student Growth – Grades 4-8

- Growth in reading and in math
- Each student will have a student growth percentile (SGP)
  - Same grade in school
  - Similar test scores in previous years
  - Scores from 1 to 99

School Growth – Grades 4-8

- For accountability
  - School median SGP (MGP)
    - The SGP that ½ of students at the school scored above and ½ of students at the school scored below
  - PJP Established Cut Scores were:
    - **Low cut = 45**
    - **High cut = 60**

Equity – Consolidated Subgroup

- Current subgroups performance will continue to be reported
- For Wyoming accountability, however, a consolidated subgroup will be used
- The consolidated subgroup will be all students who scored below proficient on the previous year's achievement test
- Minimum *n* size for subgroup accountability = 15

Equity – Grades 4-8

- Adequate Growth Percentile (AGP)
  - The SGP on this year's test, the student needs to be on track for being proficient within 3 years or by the end of grade 8
  - These are computed for all students in grades 4 through 8 with more than one previous PAWS test
- School's Equity Score
  - The percent of students at the school who are considered on track to become proficient within 3 years (i.e., for whom their SGP equaled or exceeded their AGP)
- Equity cut scores were:
  - **Low cut = 40**
  - **High cut = 55**

Equity – Grade 11

- Policy objective: To encourage a focus on improving performance of the most high-risk students
- This will be applied to schools which had at least 15 students assessed on the ACT that were at the school for a full academic year

High School Equity 2013

- The percent of not proficient test scores in reading and math on the 2012 PAWS was computed
- The percent of not proficient test score in reading and math on the 2013 ACT subject area test was computed
- The change in the percent of not proficient test scores from 2012 to 2013 was computed

High School Equity 2013

- The schools were placed into one of three (approximately equal) categories for percent improvement
  - Decrease in % Not Proficient (Exceeding)

    (decrease of -3.12% or more)
  - Minimal Change in % Not Proficient (Meeting)

    (-3.12 to +2.76)
  - Increase in % Not Proficient (Below)

    (increase of 2.76 or more)

High School Equity in **2014**

- A consolidated subgroup will be established based upon Plan scores from 2013 for the 2013-14 grade 11 students
- The change in performance of these students from the 2013 PLAN to the 2014 ACT for this cohort will become the metric
- This metric has been shown to perform in a manner similar to the 3-8 equity indicator

Readiness – Grades 9-12

- In 2013
  - Performance on ACT Suite (Explore, Plan & ACT)
  - Graduation index
- Indicators to be added in **2014**
  - Grade 9 credits earned
  - Hathaway eligibility

ACT Suite – Average Index Score for all Tested Students

	Composite Score Ranges			
Wyoming ACT Readiness Levels	ACT Explore Grade 9	ACT Plan Grade 10	ACT Test Grade 11	Index Points
Level 1	**1-14**	**1-15**	**1-16**	**20**
Level 2	**15-17**	**16-18**	**17-20**	**50**
Level 3	**18-20**	**19-21**	**21-24**	**80**
Level 4	**21-25**	**22-32**	**25-36**	**100**

- Aligned with Hathaway Scholarship eligibility cut-points
- Each student receives an index score
- The average of the index scores for all students will be the school score

Wyoming WDE and SBE

Graduation Index 2013

Criteria Numbers	Student Result	Points*
1	Diploma Earned in Four Years	100
2	Diploma Earned in More than Four Years	100
3	Continued Enrollment***	50
4	Noncompleter	0

- The index points were established by the PJP

Graduation Index 2014

Criteria Numbers	Student Result	Points*
1	Diploma Earned in Four Years	100
2	Alternate Standards Completion	100
3	Diploma Earned in More than Four Years	100
4	Continued Enrollment	50
5	Noncompleter	0

- The index points were established by the PJP.

Grade 9 Credits Earned - **2014**

- The percent of students who completed grade 9 with one fourth of the credits required to receive a diploma

Hathaway Scholarship Eligibility Index - 2014

Student Eligibility Level	Points
Not Eligible	0
Provisional	70
Opportunity	80
Performance	90
Honors	100

- The school's score will be the mean of the student points for the graduating class at the school
- The school receives an index score for each graduate
- The average of the index scores for all students will be the school score

Computation of Total School Readiness Score for 2013

Subindicator	Hypothetical Score for a School	Example Subindicator Weight	(School Score * Weight)
ACT Suite Index	55	.40	22
Graduation Rate Index	67	.60	40.2
School Readiness Score (Sum of Subindicator Weighted Scores) =			62.2

Total Readiness Cut Scores

- **Low Cut = 68**
- **High Cut = 80**

Illustration of Computation of Total School Readiness Score for 2014

Subindicator	Hypothetical Score for a School	Example Subindicator Weight	(School Score * Weight)
ACT Suite Index	55	.20	11
Grade 9 % On Track	72	.10	7.2
Graduation Rate Index	67	.25	16.75
Hathaway Eligibility Index	58	.45	26.1
School Readiness Score (Sum of Subindicator Weighted Scores) =			61.05

Professional Judgment Panel (PJP)

- A representative group of 27 to 30 people
  - Representing groups prescribed by statute
  - Selected by the State Board of Education

PJP Major Tasks

- Determined the cut points for school scores on ***each indicator*** that determine if schools are:
  - Exceeding Targets
  - Meeting Targets
  - Below Targets

Decision Table for Schools with Three Indicators for Grades 3-8

		Achievement Below	Achievement Meeting	Achievement Exceeding
Equity Below	Growth Below	NOT	PARTIALLY	PARTIALLY
	Growth Meeting	PARTIALLY	MEETING	MEETING
	Growth Exceeding	PARTIALLY	MEETING	MEETING
Equity Meeting	Growth Below	PARTIALLY	MEETING	MEETING
	Growth Meeting	PARTIALLY	MEETING	MEETING
	Growth Exceeding	PARTIALLY	MEETING	EXCEEDING
Equity Exceeding	Growth Below	PARTIALLY	MEETING	MEETING
	Growth Meeting	PARTIALLY	MEETING	EXCEEDING
	Growth Exceeding	MEETING	MEETING	EXCEEDING

Performance Level Descriptions (For Schools with Grades 3-8)

- **EXCEEDING EXPECTATIONS**: Schools in this category, which is reserved for schools considered models of performance, have demonstrated high growth overall, have average to high levels of achievement (proficiency rates) overall, and excel in promoting equity based on growth for students with prior below proficient performance.
- **MEETING EXPECTATIONS**: Schools in this category have demonstrated acceptable levels of achievement and growth overall and are showing acceptable progress in promoting equity based on growth for students with prior below proficient performance.
- **PARTIALLY MEETING EXPECTATIONS**: Schools in this category have demonstrated either acceptable levels of growth or acceptable levels of achievement overall. Schools in this category may or may not show acceptable performance in promoting equity based on growth for students with prior below proficient performance.
- **NOT MEETING EXPECTATIONS**: This category is reserved for schools with unacceptable performance on many or most indicators. For schools in this category improvement is a priority. These schools have low levels of achievement overall and demonstrate low to average growth overall and fall short of producing growth for below proficient students that will move them toward proficiency.

Wyoming WDE and SBE

Number of Wyoming Schools with Grades 3-8 with Each Pattern (2013)

		Achievement Below	Achievement Meeting	Achievement Exceeding
Equity Below	Growth Below	24	9	0
	Growth Meeting	16	15	0
	Growth Exceeding	0	1	1
Equity Meeting	Growth Below	5	4	0
	Growth Meeting	14	33	3
	Growth Exceeding	2	6	0
Equity Exceeding	Growth Below	0	1	0
	Growth Meeting	0	8	3
	Growth Exceeding	2	3	4

Decision Table for Schools with Two Indicators for Grades 3-8

	Achievement Below	Achievement Meeting	Achievement Exceeding
Growth Below	NOT	PARTIALLY	PARTIALLY
Growth Meeting	PARTIALLY	MEETING	MEETING
Growth Exceeding	PARTIALLY	MEETING	EXCEEDING

Number of Wyoming Schools with Grades 3-8 With Each Pattern (2013)

	Achievement Below	Achievement Meeting	Achievement Exceeding
Growth Below	13	10	1
Growth Meeting	8	22	15
Growth Exceeding	1	10	14

Overall Impact for Grade 3-8 Schools

	3 indicators	2 indicators	1 indicator	0 indicators	all schools	% of all
Not Meeting	24	13	0	0	37	13.07%
Partially Meeting	46	20	0	4	70	24.73%
Meeting	77	47	0	11	135	47.70%
Exceeding	7	14	0	2	23	8.13%
Not Classified	0	0	1	17	18	6.36%
	154	94	1	34	283	

Decision Table for Schools with Three Indicators for High Schools

		Achievement Below	Achievement Meeting	Achievement Exceeding
	Readiness Below	NOT	PARTIALLY	PARTIALLY
Equity Below	Readiness Meeting	PARTIALLY	MEETING	MEETING
	Readiness Exceeding	PARTIALLY	MEETING	MEETING
	Readiness Below	PARTIALLY	MEETING	MEETING
Equity Meeting	Readiness Meeting	PARTIALLY	MEETING	MEETING
	Readiness Exceeding	PARTIALLY	MEETING	EXCEEDING
	Readiness Below	PARTIALLY	MEETING	MEETING
Equity Exceeding	Readiness Meeting	PARTIALLY	MEETING	EXCEEDING
	Readiness Exceeding	PARTIALLY	MEETING	EXCEEDING

Performance Level Descriptions (For High Schools)

- **EXCEEDING EXPECTATIONS**: Schools in this category, which is reserved for schools considered models of performance, have demonstrated average to high levels of achievement (proficiency rates) overall, have high performance on graduation rates and other readiness indicators and have narrow and/or improving achievement gaps for students with below proficient performance.
- **MEETING EXPECTATIONS**: Schools in this category have demonstrated either high levels of achievement overall or high performance on graduation rates and other readiness indicators and are showing acceptable performance in promoting equity based on the magnitude and/or improvement of the achievement gap for students with below proficient performance.
- **PARTIALLY MEETING EXPECTATIONS**: Schools in this category have demonstrated either acceptable levels of achievement overall or acceptably performance on graduation rates and other readiness indicators. Schools in this category may or may not demonstrate acceptable performance for promoting equity based on the size of the achievement gap or improvement in the achievement gap for students with below proficient performance.
- **NOT MEETING EXPECTATIONS**: This category is reserved for schools with unacceptable performance on many or most indicators. For schools in this category improvement is a priority. These schools typically have low levels of achievement fall short of expectations on graduation and other readiness indicators and have large achievement gaps that show little improvement.

Number of Wyoming High Schools with Each Pattern (2013)

		Achievement Below	Achievement Meeting	Achievement Exceeding
	Readiness Below	3	1	0
Equity Below	Readiness Meeting	2	5	1
	Readiness Exceeding	1	2	3
	Readiness Below	3	1	0
Equity Meeting	Readiness Meeting	3	8	0
	Readiness Exceeding	0	1	1
	Readiness Below	3	1	0
Equity Exceeding	Readiness Meeting	1	9	2
	Readiness Exceeding	0	0	2

Decision Table for High Schools with Two Indicators

	Achievement Below	Achievement Meeting	Achievement Exceeding
Readiness Below	NOT	PARTIALLY	PARTIALLY
Readiness Meeting	PARTIALLY	MEETING	MEETING
Readiness Exceeding	PARTIALLY	MEETING	EXCEEDING

Number of Wyoming High Schools with Each Pattern (2013)

	Achievement Below	Achievement Meeting	Achievement Exceeding
Readiness Below	13	0	1
Readiness Meeting	4	4	0
Readiness Exceeding	0	2	1

Overall Impact for High Schools

	3 indicators	2 indicators	1 indicator	0 indicators	all schools	% of all
Not Meeting	3	13	0	0	16	19.05%
Partially Meeting	14	5	0	0	19	22.62%
Meeting	31	6	0	0	37	44.05%
Exceeding	5	1	0	0	6	7.14%
Not Classified	0	0	4	2	6	7.14%
	53	25	4	2	84	

Participation Rate Impact

- Schools with grades 3-8
  - All schools had participation rates of 98% or higher in 2013
  - One small school was docked a performance level for having less than 95% participation when a prior year was included in an attempt to meet the minimum *n* requirement
    - This school went from “meeting” to “partially meeting”

High School Participation Rate

- 11 of 84 high schools had participation rates on the ACT suite of between 90% and <95%
  - 3 of these were already “not meeting expectations”
  - 4 dropped from “meeting” to “partially meeting”
  - 4 dropped from “partially meeting” to “not meeting”

Participation Rate “Not Met”

- 12 high schools had less than 90% participation rate on the ACT suite of tests
  - 7 of these were already “not meeting”
  - 3 dropped from “partially meeting” to “not meeting”
  - 2 dropped from “meeting” to “not meeting”

The Result

- Grades 3-8 did well on participation rate
- 13 of 84 high schools (16%) had lower performance levels because of poor participation rate on the ACT suite of tests
- An additional 10 of 84 high schools (12%) had less than 95% participation rate on the ACT Suite but were already “not meeting”
- 28% of high schools had participation Rate Problems.

Final High School Impact

	3 indicators	2 indicators	1 indicator	0 indicators	all schools	% of all
Not Meeting	8	17	0	0	25	29.76%
Partially Meeting	13	3	0	0	16	19.05%
Meeting	27	4	0	0	31	36.90%
Exceeding	5	1	0	0	6	7.14%
Not Classified	0	0	4	2	6	7.14%
	53	25	4	2	84	

Final Wyoming Result

	3 indicators	2 indicators	1 indicator	0 indicators	all schools	% of all
Not Meeting	32	28	0	0	60	17.09%
Partially Meeting	58	22	0	4	84	23.93%
Meeting	98	47	0	11	156	44.44%
Exceeding	12	13	0	2	27	7.69%
Not Classified	0	0	5	19	24	6.84%
	200	110	5	36	351	

Contact Information

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WAEA School Performance Levels

- Exceeding Expectations
- Meeting Expectations
- Partially Meeting Expectations
- Not Meeting Expectations

Indicators used to Identify School Performance Level

- Schools with grades 3 through 8
  - Achievement
  - Growth
  - Equity
- Schools with grades 9 through 12
  - Achievement
  - Readiness
  - Equity

System of Support

Wyoming Statewide System of Support

The Progressive, Multi-Tiered System of Support, Interventions, and Consequences

Support and Capacity Building

- Exceeding expectations schools
- Meeting expectations schools
- Partially meeting expectations schools
- Not meeting expectations schools
  - 21-2-204(f)

Upcoming Outreach Sessions

- September 30, Blackboard, 1:30 PM
- October 1, Rock Springs at noon and Worland at 6 PM
- October 2, Casper at noon and Gillette at 6 PM

Wyoming WDE and SBE

WAEA Outreach Sessions – Cheyenne – 8.26.16

22 Attendees

Comments:

English usage on the ACT should be included in the composite to make the test valid. It should also be included so that high school students will take this portion of the test seriously. I wonder if some of the cut scores are too high. For example, student needs an 18 on reading/English (I think) but are we requiring a higher cut score for all students when we use Hathaway scores? (18 is the cut score to be admitted to ENG 1010 in community colleges).

I am pleased that Director Crandall sees the need to have test data available to schools so teachers can actually help students who are not achieving. Teachers will welcome the data to improve their lessons! They, maybe student achievement will improve.

Equity ratings are challenging to WY educators, especially where mobility is high and PAWS is ever-changing (for 3-8). Have Dr. Mike Flicek as a spokesman, explaining the ratings is important for Wyoming's process. He has the respect and recognition of expertise across the state.

Assessment portion of presentation (Deb Lindsey) did not make connection to accountability – was only a "sales pitch" on SBAC. Needs to explain how the WDE assessments will impact WAEA ratings.

The stat system of support is key liaison system from WDE, legislature and SBE to districts. Re-building this group is major and important – soon. I am hopeful about Wyoming raising the bar on accountability. Thanks to legislature for making SF104 effective so this can now happen.

Nicely done! Very informative. Easy to follow. The breadth of topics was on target. The depth was at an appropriate level for the audience. *Please upload the PowerPoint to the WDE website. It was a pleasure to see each of you once again!

The inclusion of the measures of Hathaway curriculum is probably unconstitutional, a quick search of the 2012, 2013 laws and the white paper do not reference the curriculum as part of the measures.

It appears that small high schools 15-20 students will be subjected to high year to year variability and sanctions based on performance of 1 student. For instance, 1 missing

student will automatically drop the schools performance based on a more than 5% failure to participate.

Students took writing in 2013. The scores should be reported. This might be more difficult for SAWS but it is inexcusable for ACT.

Julie M. should have completed the draft prior to the summits.

How in the world will the WDE ramp up enough to provide the support and capacity that will be needed? Who and when will the criteria be developed to identify the category of students who take the alternative test?

If English scores are not "counted," yet writing scores are, then English scores actually do count because the writing score correlates with the English score. Writing is a score of 1-12, all other ACT sub tests are 1-36 – we must correlate the writing with English or it doesn't work. Google "Educators Guide to ACT Writing" p.54 – Instead of removing the English score at the secondary level to force it to match the 4-8 test, add English to 4-8 if it is so important for them to be parallel.

Teachers must know if ACT is going away.

If ACT goes away, how many doors are we closing for kids? They count on it financially & it is of great importance in their futures.

With the Equity Piece – are we still ignoring the upper end students??

We are always talking about improving high risk students – what about the kids that start out on the upper end and get lost when we spend so much time remediating?

Are we making teachers to "teach to the test" so pupils do well but do not prepare them for higher-ed and subsequently life? I do not see how we are concentrating on making kids ready to do anything but take a test.

Why was this meeting held on the same night as "Back to School" night in the LCSD#1?

Does WDE currently have the capacity to help schools and districts improve student performance?

All high performing individuals and organizations have "coaches" – "champions have coaches" perhaps each district should have access to coaching?

How will schools be rated to fall into one of the performance levels? I think it is (the accountability process) far too complicated to ever filter down to the classroom teacher and be helpful to teachers.

WAEA Outreach Sessions – Gillette – 8.27.16

20 Attendees

Comments:

A greater clarity explaining the impact of "mobility rates," on the scores/ratings of a building, may be vital!

Will the determination of cut scores be based on "political" (re-election thoughts/popular opinion) or on a "mathematical" (Angoff Method) priority? What training of PJP members will take place prior to the setting of cut scores?

The awarding of points for ACT scores shows 0 pts for a 16 and 40 pts for a 17. Why not consider an awarding of points for each score? IE., 36=108 pts, 27=81 pts, 13=39 pts (Each point value of ACT = 3 points).

Thank you for coming to Gillette! Very informative! ☺

Consider changing "full academic year" start date to Sept. 1 from Oct. 1.

PJP members need to be "experts" in the system before making judgments.

Thank you for looking at impact data during the PJP process.

Thank you for brining this presentation to our region.

If teachers are going to be held accountable, then all teachers should be. Regardless if it is a large school or a small school and whether we are measuring math or P.E. It isn't fair for only part of teachers to be put on the firing range.

We shouldn't be measuring student growth in March. Should be at the end of the year.

When are the students' going to be held accountable? And parents?

Schools who have a high concentrated population of lower socio-economic ELL, SPED etc. will be penalized on the median scores and/or growth at a high penalty than those schools with a low concentration of lower socio-economic, ELL, SPED etc. in their student population.

Concerns for, or with the impact of median growth on:
1. ELs
2. SPED
3. Poverty
4. Mobility

Flip the language – Career & College Readiness. Especially in our state that has had historically high paying careers with minimal or no college, more emphasis needs to be on the career competencies that dovetail into college preparedness.

Please consider alternate year assessments, or every few years. For example:
Reading: 3rd, 6th 9th
Math: 4th, 7th, 10th
Science: 5th, 8th, 11th
Writing: 3rd, 5th, 7th

4th grade with NAEP, Reading, Math, Science is too much in a K-6, Title I, SPED, EL school, it is very problematic providing all accommodations for all grades. In turn, student educational needs

Move assessment to the end of year mid April-mid May

You guys did a great job! Both sessions were very informative. I still need to go to another to "hear" it all.

Suggestions:

1. *Acronyms slip in, explain or don't use*
2. *Julie talks way too fast, even so, she made excellent additions from Gillette to Casper (I understand she is last and tries to fit it in)*

WAEA Outreach Sessions – Casper – 8.27.16

15 Attendees

Comments:

Very happy with graduation index score especially for the students with disabilities on ALT Assessment, who is complete it, will be counted as 100 points! (instead of not counted at all).

I am concerned about the "gray" area kids – now low cognitively enough to be on ALT Assessments, but who still will not do well on regular assessments and how they will still be counted against schools for low or minimal progress. They are often now "tracked" to a non-graduating spec ed class and/or blamed for being the reason (perceived) a school got a low score (now AYP).

I would hope the PJP and advisory group and others involved with developing this model/new system will keep in mind all kids – especially since alternate standards have not been developed yet.

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*Is it a coincidence that the contractor who was hired to give a negative report about the State Superintendent and department has now been hired to design an accountability system? $$$**

*Shouldn't a sub-group be defined by handicapping conditions (physical, mental, educational)? Have to study to determine integrity**

This "progress" report should be presented in touting to be studied before public meetings.

Thanks to State Dept of Ed for holding public sessions! Glad to see contracts for student assessments. SBAC sounds good…. Positive: keep available!

I want a full copy of all the presentation and please include an explanation of all acronyms. How are "sub groups" determined and by whom? Who developed the accountability model? How? What sources? Who sits on the Professional Judgment Panel?

This is an excellent overview of the accountability components…

Suggestion – many of the ?'s from the audience could wait until sections of the presentation are done. Perhaps facilitate it to "hold" questions until a section ends with understanding that the presentation could answer the question if can wait.

Presenters did an excellent job of working to clarify and answer questions.

Goals should reflect college AND career ready rather than college or career ready.

We will need help with ACT definition and Wyoming definition of "ready" vs. "proficient."

Hathaway Index is improved. It needs to be even narrower among various levels. Hathaway/non Hathaway is more important than levels. Otherwise this index suggests all kids should be targeted for University.

This is a school bound accountability system when in fact, we are district accredited.

How broadly will the pilot school ratings in the fall of 2013 be available? School only? District? Board of Trustees?

WAEA Outreach Sessions – Worland – 8.28.16

28 Attendees

Comments:

All forms of accountability seem to be aimed at moving non-proficient students to proficient. Are there concerns about moving students from proficient to advanced?

The system has a lot of thought, one concern is the length of time to receive results, ratings, etc… to actively make changes.

I have concerns about student accountability. We parallel the legislation in our beliefs. What accountability measures are to be developed for students?

Inconsistency with assessment leave little room to prepare to be successful.

The district assessment system sounds identical to BOE. Formative common assessments should be developed by the grade level teams after they have build shared knowledge around standards, and these should be flexible enough to provide data to inform practice. Outside developed assessments will be for compliance – not best practice. Legislature cannot carry what happens in classrooms. The teacher has to be a student of what their kids need to know.

The standards and the state assessment are the guarantee that students receive the opportunities to learn required material.

ACT is an indicator of achievement and growth at the HS. ACT is based on national standards and in the process of alignment with common core.

The parent support for ACT is solid. University admittance is connected to ACT scores. Hathaway is connected to ACT performance.

Continue to support Smarter Balance instead of ACT for measurement. But use ACT as it was intended for college readiness as another indicator.

Good job!

How will the equity component work for grade II if a student is working toward alternate/extended academic content standards? Will there be an "ACT-Alt" assessment for these students?

Please remove references to "1%" when discussing kids who have significant cognitive disabilities. The 1% simply refers to the percentage of proficient scores that can be used for AYP calculation.

Committee should consider allowing a "grace period" on statewide assessment components of the model if/when the assessment changes.

Same type of question/concern for readiness components in grades 9-12. What are the alternate assessments for the ACT Suite?

Committee should consider exemptions students with disabilities from causing penalties to a school's graduation index if the student is continuously enrolled and earns a regular diploma in 5 or 6 years. For these students, the actual result is more important than how quickly the result is achieved.

Is the expectation that each district will build its own district assessment for every grade level and content area? If so, who does the development work? What about piloting, item development, technical adequacy, etc…?

WAEA Outreach Sessions – Rock Springs – 8.28.16

34 Attendees

Comments:

I really appreciated the info about dist. Assessment. I will be anxious to see how it correlates with Chap. 6.

Having accountability is great. Having mandates is communism. Being able to look over the fence and seeing what the neighbor is doing right is enough motivation to change course and improve. We all want the best for our "kiddos." We don't want the rival or the kids across the state to have more advantages than our children. But let us decide the direction for our communities. There has to be measures. Let accountability be measured locally. Provide the data so we can measure the accountability locally. Thanks. Can be mind taxing for a hick from the sticks.

Assessment support would be welcomed – how can I connect with other districts to begin the assessment process aligned to CCSS.

So was it Aug. 2015 that we submit our district assessment plan in reading, math & writing to the state? ELA, Math, health.

It seems with the norm references that you are ensuring that schools will fail. How is this equitable?

Any system must acknowledge the challenges of ELL and low SES with a growth model. Only focusing on a target/cut score negates the hard work of these students/teachers/schools who have much to overcome.

You forget that students, teachers and administrators are PEOPLE, not numbers!

What about schools that have large ELL & low SES populations? Comparing them to schools that do not have these difficulties is comparing apples and grapes!

Students who exceed proficiency or growth need to contribute more than 100 points in the Accountability System on meeting the 4 criteria of body of evidence. Just a thought.

Students with IEPs taking ACT – not measured to standards.

Schools who have more "high risk" students, IEP students, ELL students and compiling median score.

Students in alternative place such as jail.

WAEA Goals – change the word or college AND career ready.

A thought regarding the "exceeds" schools being required to share best practices, could this occur at the school improvement conferences which occur twice each year? Maybe in break-out sessions, or perhaps panel discussions.

It would be awesome if we could go with the SBAC assessments in 2014-2015. It would save time and money. It would also enable us to compare WY to other states. We will never have the ability to compare ourselves to others until we have a common assessment. In addition, the resources and supports that would be available to teachers and districts through SBAC would be invaluable.

Court ordered placed students

1. Sent to institutions that does <u>not offer Hathaway Curriculum</u> (including WBS/WGS)
2. Maybe <u>court ordered</u> or <u>counseled</u> by institution to <u>take GED</u>
3. <u>Can not ear credits in required course work to stay on track for cohort graduation</u>
4. Sweetwater county, unfortunately, has a history of having more court ordered out of district institutional placements (DFS/Community Juvenile Service Board Data) that exceeds the combined total of Casper and Cheyenne districts. We are at the mercy of the court system and are held accountable for students who have significant time outside our influence.
5. Detention centers and secure institutions limit internet (on-line) access for juveniles for security measures and there may be a need for this small, but unique population to have continuous access to paper pencil test as the control is held by the correctional system, not the WDE.

Why is there not an exemption process for these types of students?

I was wondering why PAWS happens in March. Our school does not end until June. That leaves 2 FULL months of education and teaching that is NOT considered. I raised my family in Utah and grew up there myself. My children were tested in May or late April and school finishes late May. Therefore teachers have a full school year to earn growth, equity and achievement. It seems much more fair to both students and teachers and should be considered. As a teacher I have felt frustrated and I have felt cheated by losing those 2 months. (April/May) that may have been used to fully prepare students to show proficiency in PAWS – it makes more sense to test students at the year's end rather than ¾ of the way through a year.

I felt compelled to provide this committee my thoughts on the Accountability report provided to the committee and the public at the May 9th and 10th meetings. I remain unconvinced that the statewide accountability plan put forth represents a positive step for education in Wyoming. The more I talk to educators in the state and in my district the more wary I get of a rigid, overly complicated state wide accountability system. I would like to point out a few concerns of mine, concerns based upon what I hear from those I trust the most in the education field.

I do not believe ranking schools in categories from exceeding expectations to not meeting expectations is going to provide any benefit to children's education. The only reason to do this is if there is some desire to punish or humiliate schools for not meeting some arbitrary benchmarks. The legislation speaks to development of consequences for schools in meeting benchmarks, but there has never been an honest straightforward discussion about what this might entail. Is the state going to take over districts, take over planning, and take over curriculum development? Perhaps the state will fire superintendents, principals, and teachers? The possibilities are endless, and fear of the unknown is unnecessary. This should have been one of the first items discussed and decided upon, if for no other reason than being honest with educators in the state of Wyoming. An accountability system designed to simply provide supports to educators and districts, to better fine tune where the stream of resources should go, would look much different than one designed to punish schools. In my opinion, an accountability system designed to assess where the strengths and weaknesses of school districts lie, and then provide supports to those weaknesses is the system we need in Wyoming.

In order to provide the accountability system I have suggested we would get rid of the school ratings or rankings, and simply focus on rating programs within the schools. Is the second grade math program in a particular elementary school exceeding, meeting, or below expectation, based upon a rating system developed by the Professional Judgment Panel. Once this is known, then the state can work with the

district to focus resources on those programs needing help, and at the same time we will be able to capture the expertise of the districts whom are excelling.

Districts with programs below expectations would submit an Improvement Plan to the Wyoming Department of Education outlining how the deficient program will be improved, with timelines. At the same time these districts would submit an Accountability Plan to the Department outlining how they will hold administrators and teachers accountable for the necessary improvements. Local districts have the expertise and the knowledge to hold their employees accountable, and the state should allow them the opportunity to fix their problems.

As to the indicators, I believe achievement and growth are the only indicators necessary to support improvement in the schools. Equity is simply a function of growth, and over complicates the accountability system. Even Equity could be a tool for some districts to look at, but it should not be tied to some school ranking system. A school could have great growth, but because they were starting from a low point might not be able to meet the improvement schedule outlined in this plan. The Professional Judgment Panel is required to make too many subjective decisions in establishing thresholds under this plan.

Readiness is an important factor for students, probably the most important factor in their ability to lead productive lives, but trying to score that indicator is nearly impossible. Readiness has different meanings to different people. Are we creating students Ready for community college, ready for a university, ready for a job, or simply ready for life? How do we track readiness? There are proven tools for tracking readiness for a college or university, such as the ACT, SAT, and GPA. However tracking readiness for a job is another matter. Districts should strive to ensure college bound students are capable of success at an institution of higher learning. It is important to track the college bound students to see if they were successful in college (graduated), or did their college experience, regardless of completion, give them a leg up in the work force. The state should track students, maybe not all, after they leave the K12 system to see how successful they are in life, do they have a job above the minimum wage, were they productive members of society, or did society end up taking care of them. These are all indicators of whether a school provided the necessary readiness for life. This could be valuable information to a school and district, but should not be part of top down, heavy handed accountability system. However, we should track college ready, for those students going down that path, and provide supports to those districts whose students struggle in the college environment.

I leave this subject with some thoughts from an educator in my district.

“What is the driving force behind education renewal efforts?

What **should** be the driving force behind education renewal efforts?

The answer to the first question reminds me of the snake oil salesman who convinces his buyers they have a problem, and then the salesman has a remedy - for a price. Education is the fat enchilada for testing companies and educational services. Testing companies can create a problem which may or may not exist and service providers can provide the solution - for a price.

We have a career crisis looming in Wyoming and the nation with the exodus of the baby boomers from our workforce. Georgetown University did a study making projections that between 2008 and 2018 Wyoming would have 108,000 job vacancies both from new jobs and job openings due to retirement. 65,000 of those jobs will be for those with post-secondary credentials, 34,000 for high school graduates and 8,000 for high school dropouts. Among the 50 states, Wyoming ranks 43rd in terms of the proportion of its 2018 jobs that will require a Bachelor's degree, and is 44th in jobs for high school dropouts. This means there will be a large demand for people with certifications and skill sets not requiring a Bachelor's degree but requiring more than a HS diploma.

Who is going to address this problem? If it doesn't get addressed, what is the economic impact for Wyoming and its citizens? It was reported to me by Ted Schroeder the trona mines in Sweetwater County are currently looking for more than 500 people to fill positions which require some post-secondary training and the same with another company (Polaris - I think) looking for 900 diesel technicians.

Our focus should be on providing an environment and curriculum where our students leave our high schools confident, responsible, skilled, and prepared to be successful in post-secondary and real world environments. How will accountability legislation nurture this setting? In a recent Gallup poll, it was reported only two out of ten high school students in our country were engaged in their learning. I believe there are two main causes for the other 8 students' disengagement. The first cause is from disconnecting students from their future by chasing down test scores in lieu of chasing down their dreams. The second main cause is too many institutions have failed to bridge students' education to real world settings and problems. We should be spending our resources and energy on connecting students and their learning to our communities, state, nation, and world in real time and hyper reality. Instead we are letting the fear of test scores drive our actions.

Our conservative legislature who complains about the Federal Government eroding the states' local control is at the height of hypocrisy with their efforts in the name of education reform. Recent legislation and events at the WDE have been more of a distraction and obstacle to local districts' efforts to provide a Free and APPROPRIATE Public Education (FAPE). The shifting of the focus to test scores in lieu of preparing each individual student for successful post-high school experiences will only delay education renewal efforts and hinder our children in being prepared for real world

demands. Test scores are only a by-product of our work and provide valuable information for growing our students. However, they should not be the primary focus of our work."

ACTION SUMMARY SHEET
STATE BOARD OF EDUCATION

DATE: October 8, 2013

ISSUE: Response to Select Committee Motion

BACKGROUND: See board packet

SUGGESTED MOTION/RECOMMENDATION:

To forward a memo for discussion to the select committee for consideration.

SUPPORTING INFORMATION ATTACHED:

- See board packet

PREPARED BY: *Bailey Anthony*
Bailey Anthony, Executive Assistant

ACTION TAKEN BY STATE BOARD: _____DATE:_____

COMMENTS:

WYOMING

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MEMORANDUM

TO: State Board of Education Members

FROM: Paige Fenton Hughes, Coordinator

DATE: September 30, 2013

SUBJECT: Select Committee Motion

As you all know, Chad Buckendahl and a team of education Thought Leaders from around Wyoming have been studying options for a system to replace the former BOE system. You will hear a report from Chad about this work which we have been calling "multiple measures," short for "multiple measures to determine requirements for high school graduation." At the same time, the Wyoming Department of Education (WDE), has been designing a document to provide guidelines to districts about how to develop a district assessment system (DAS) that can annually be reviewed by the Board to ensure minimum requirements are met. Julie Magee presented a draft of this document to you earlier in the year.

When we presented the draft of the multiple measures work at the Select Committee meeting in Newcastle in September, it became apparent that everyone was sharing a concern about the amount of burden on both the districts and the WDE to manage this multiple measures work and the district assessment systems as proposed. As a result of a robust discussion about these concerns, and the fact that districts need to focus on the goals and measures of the Wyoming Accountability in Education Act (WAEA), the committee passed the following motion:

The Select Committee finds that the Wyoming Accountability in Education Act (21-2-204 and 21-2- 304(a)(vi), (b)(xv) and (xvi)), the statewide assessment system (W.S. 21-2-304(a)(v)) and district accreditation requirements (W.S. 21-2-202(c) and 21-2-304(a)(ii) and (b)(ii)), coupled with a set of minimum credit and course requirements for high school graduation will satisfy state interests in ensuring the content and performance standards are taught and an equal opportunity for an appropriate education is provided by all school districts across Wyoming.

The Committee therefore directs the State Board to define and establish baseline statewide course requirements for high school graduation and return to the Committee with recommendations for statutory revisions that may be necessary to establish the minimum credit and course requirements as necessary.

In response to this motion, I have met with Shelly Andrews, who has been spearheading the work with the UW MOU about assessment, and Julie

Magee at the WDE. I have also shared information with Michael O'Donnell and Amy Pauli in the attorney general's office, and I have had a phone conference with Director Crandall, Dave Nelson, and Mary Kay Hill. The intent of the motion is to try to determine a way to use the existing processes and work that districts are already doing to satisfy the requirements for the legislature to ensure students have an equal opportunity to get a quality education across our state and to ensure the Wyoming Content and Performance Standards are being taught in all districts.

What you see below is a draft of a response to the motion. The bold statements are excerpts from the document Amy Pauli gave us last spring to remind us of the language that would guide our multiple measures work. **Define and specify what constitutes a proper education for all students including standards and a method for measuring those standards…the state must adopt a uniform system…indentify the 'proper' educational package each Wyoming student is entitled to have…**

Common inputs include:

- Local boards must ensure an educational program that is in accordance with uniform standards as defined in W.S. 21-9-101 is delivered
- Requirements for teachers to be fully certified, highly qualified, and evaluated according to law
- Minimum contact time requirements must be met
- A full array of Hathaway courses must be offered
- Needs of at-risk, special needs, and gifted and talented students must be met
- Minimum graduation course requirements must be met
- Districts must have a professional development plan that focuses on standards and standards-based assessments
- Districts must participate in state education accountability and continuous systems improvement efforts

- Recommendation: Add two assurances to the WDE assurances requirements
    - Every school district shall have a comprehensive district assessment system that utilizes multiple measures of student performance to ensure students are mastering the Wyoming Content and Performance Standards and the common core of knowledge and skills as defined in W.S. 29-1-101.
    - Every school district shall have a comprehensive curriculum plan that ensures the Wyoming Content and Performance Standards and the common core of knowledge and skills as defined in W.S. 29-1-101 are taught to all students.

Common outputs include:

- MAP
- ACT suite
- PAWS
- SAWS

- Recommendation: Add language in rules and regulations
    - Assessments at appropriate grade levels and or content areas to measure the proficiency of students on the Wyoming Content and Performance Standards in all nine content areas as well as the common core of knowledge and skills as defined in W.S. 29-1-101.

Measures Include:

The state legislature [must provide] an education system of character which provides Wyoming students with a uniform opportunity to become equipped for their future roles as citizens, participants in the political system, and competitors both economically and intellectually.

Wyoming Accountability Model: measures college and career readiness through four subindicators

The Wyoming Constitution requires the legislature to define and specify what constitutes a proper education for all Wyoming students, including standards and *a method of measuring those standards.*

Wyoming Accountability Model—allows comparability among districts on three content areas, measured annually; measures growth and equity to ensure all students have an opportunity to learn

Comparable assessment data-on PAWS, SAWS, MAP and ACT suite

AdvancED Accreditation

Standard Indicator 5.1-- The system establishes and maintains a clearly defined and comprehensive student assessment system. (Subindicators include: maintaining and consistently using a comprehensive assessment system that produces data from multiple assessment measures; including locally developed and standardized assessments about student learning as well as school performance; ensuring consistent measurement across all classrooms, courses, and educational programs; using assessments that are proven reliable and bias free; and regularly and systematically evaluating the assessment system for reliability and effectiveness in improving instruction, student learning and the conditions that support learning.)

Standard Indicator 3.1-- The system's curriculum provides equitable and challenging learning experiences that ensure all students have sufficient opportunities to develop learning, thinking and life skills that lead to success at the next level. (Subindicators include: Curriculum and learning experiences in each course/class throughout the system provide all students with challenging and equitable opportunities to develop learning skills, thinking skills and life skills that align with the system's and school's

purpose; evidence clearly indicates curriculum and learning experiences prepare students for success at the next level; and like courses/classes have the same high learning expectations across the system.

Standard Indicator 3.2--Curriculum, instruction, and assessment throughout the system are monitored and adjusted systematically in response to data from multiple assessments of student learning and an examination of professional practice. (Subindicators include: Using data from multiple assessments of student learning and an examination of professional practice [which should include SLOs], system and school personnel systematically monitor and adjust curriculum, instruction and assessment to ensure vertical and horizontal alignment and alignment with goals for achievement and instruction and statements of purpose; there is a systematic, collaborative process in place to ensure alignment each time curriculum, instruction and/or assessments are reviewed or revised at the system or school level; and the continuous improvement process has clear guidelines to ensure that vertical and horizontal alignment as well as alignment with the system's purpose are maintained and enhanced in curriculum, instruction and assessment.)

These indicators are reviewed every five years by an external review team from AdvancED. Additionally, the WDE does an audit of all assurances (to include a district assessment system and a curriculum plan) that coincides with district accreditation.

Recommendation: Schools not meeting expectations under the provisions of WAEA would automatically, through processes and procedures developed by the WDE through the multi-tiered system of supports, have the school's assessment system, curriculum plan, and professional development plan reviewed in the year the school did not meet expectations under WAEA.

Additional Considerations:

At this time, the State Board of Education would not recommend making any changes to the statewide course requirements, as outlined in W.S. 21-2-304, for high school graduation (4 years of English, 3 years of math, 3 years of science, and three years of social studies).

The District Assessment System document developed by WDE with input from a steering committee of curriculum directors will be modified and used as a guide for districts in developing comprehensive assessment systems.
The assessment literacy work planned through the provisions of the assessment MOU with the University of Wyoming will support districts in meeting the requirements of Wyoming statute, rules and regulations, and the standards of AdvancED with regard to continuous systems improvement related to assessment. This professional development will help build capacity in districts to build and sustain assessment systems that use multiple measures to determine student proficiency on the Wyoming Content and Performance Standards in all content areas.

Additional Consideration:

This plan allows for districts to determine specific proficiencies to determine if students meet the 5 of 9 criteria through course completion. Moreover, course completion in additional content areas would also determine the endorsement level students receive on their transcript. One

way to address course completion fidelity would be to have an SSoS review of the district assessment system (when schools fail to meet expectations) also trigger a correlational study between GPA and ACT scores.

Statutory Revisions:

The *annual* review of district assessment systems by the State Board should be replaced by a review every *five* (5) years.

Beginning school year 2014-2015, and each year thereafter, each district's assessment system shall include multiple measures of student performance related to the Wyoming Content and Performance Standards for each of the nine (9) content areas. The state board and department of education shall provide guidance to and support to districts in developing district assessment systems.

This draft does not make a recommendation to eliminate the transcript endorsements; however, I talked about the plan briefly at the state curriculum directors' meeting, and they are universally (all 44 people who were in attendance) opposed to keeping those endorsements. Tracking the endorsements requires a tremendous amount of work by district personnel, and the endorsements are not used by community colleges or the university for any purpose.

Please consider these recommendations with the goal of streamlining the work of districts as an overarching factor while at the same time making certain we are meeting the requirements of the legislature to ensure an appropriate education for all students in our state. I will be asking for your input, so I can revise this draft to be presented at the October 22-23 Select Committee meeting.