MEMORANDUM

TO: Members, Utah State Board of Education

FROM: Brad C. Smith
Chief Executive Officer

DATE: February 6, 2015

ACTION: Release Grades 6-8 Science Standards Draft for 90-Day Public Review

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Background:
The Utah State Office of Education in collaboration with the Utah science education community has created a revised draft of the current Utah Core Science Standards for grades 6-8. The revision is based on addressing concerns about the current presentation of science standards in multiple documents and presenting a single vision for college and career readiness in science. The draft responds to feedback from multiple stakeholder groups including parents, teachers, district administrators, and university personnel.

Key Points:
- The draft shifts to student performance expectations with a Utah clarification statement and SAGE boundary to articulate college and career ready goals for science.
- The draft has supporting documentation that outlines specific ties to Utah standards for Mathematics, English Language Arts, and Social Studies to create cohesion and leverage student learning.

Anticipated Action:
The Standards and Assessment Committee will consider approval of the release of the draft Grades 6-8 Science Standards for a 90-day public review period, and if approved, make recommendation to the full Board for approval.

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Utah State Office of Education

UTSEEd 6th Grade Draft for Public Review

February 6, 2015

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Utah Science and Engineering Education Standards

UT SEEd Standards

Draft for Public Review – February 2015

6th Grade Integrated Science

Overview

This document is available as a draft for public feedback. Please utilize the survey tool available online to provide feedback on this document:

https://www.surveymonkey.com/s/SciencePublicReview

Once the 90-Day Public Review has concluded, the teacher writing teams for science grades 6-8 will reconvene to respond to comments and revise the draft accordingly.

Thank you for taking time to provide your feedback and supporting the process of developing science standards that prepare Utah students to be college and career ready.

Timeline for Science Standard Core Revision

Overview

The attached document is a core revision timeline that was approved by the Utah State Board of Education in May 2014 and articulates the planned timeline for revision and implementation of the science standards as well as other subject areas.

Content Area	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Language Arts - Elementary	New Assessment Fully Implement				Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement
Language Arts - Secondary	New Assessment Fully Implement			Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement	
Math – Elementary	New Assessment Fully Implement	Public review		Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement	
Math – Secondary	New Assessment Fully Implement	Public review			Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement
Science Elementary			Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement		
Science 6,7, 8		Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement			
Science HS			Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement		
Soc. Studies Secondary		Revise Standards Public review	Professional Development Adoption	Implement				
Soc. Studies Elementary			Revise Standards Public review	Professional Development	Implement			

Content Area	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Fine Arts Elem		Revise Standards Public review	Professional Development	Implement				
Fine Arts HS		Revise Standards Public review	Professional Development	Implement				
P. E.		Public review Revise Standards	Professional Development Implement					
Health				Revise Standards	Public review Professional Development	Implement		
Dr. Ed.	Implement					Revise Standards	Public review Professional Development	Implement
Library/Media Secondary & Elementary		Public review Revise Standards Adopt	Professional Development Implement					
Ed. Tech		Public review Revise Standards	Professional Development Implement					
World Languages	Public review Revise Standards	Professional Development Implement						

PROCESS

Public Review – The process begins with the formation of a standards public **review** committee for each content area. These committees review specific content area standards. The committees must be formed at least one year before the anticipated State Board adoption date. The committees will meet at least twice during the one-year period before adoption. Revised standards are available for public comment for at least 90 days. At least three public statewide hearings are held in different regions for the purpose of providing face to face opportunities to provide information and answer questions. All commentary is gathered and studied by the content specific revision committee and the content specific review committee to determine if and how the information should be reflected in the standards.

Revise Standards – A content specific **revision** committee composed of experts in the field (both educators and community) is established to gather data from the field, examine existing standards, look at current research and trends, determine what is needed for students to be successful K-12 and beyond, and draft standards for public input.

Adopt Standards – After the work of the standards public **review** committee and the content specific **revision** committee is complete, and the public comment period has ended, the State Board discusses the recommendations, input and new standards. The State Board then decides either to adopt, amend or reject the new standards.

Professional Development – After final Board adoption of standards, educators are engaged in professional development. Depending on the scope of change in existing standards, the professional development could take months or a couple of years to ensure educators are knowledgeable about the required changes in their instruction. New curriculum and materials may also need to be adjusted or adopted.

Implement and align assessment – If the changes to standards are not substantial, implementation efforts come after professional development. If the changes are substantial, the implementation year would also entail ongoing professional development that is sustained by support at the LEA level. Substantial changes generally result in new adoption of texts and materials, which takes ongoing support. Tested subjects would require revamping and alignment of assessments.

Full Implementation – In tested subjects, full implementation takes place after the new assessment has been adopted and used.

UT SEEd Template Roadmap

Overview

The following document provides an overview of the template of the new Utah Science and Engineering Education (UT SEEd) Standards. It provides links to foundational resources used by the community and teacher writing teams in the development of these documents. This document is to help orient individuals to the new format of science standards presented in the draft.

Utah Science and Engineering Education Standards
UT SEEd Standards
Roadmap to the New Format for UT Science Standards

Root Question:

This question is designed to meet the following needs.

a. Provide a narrative that group the PE's
b. Developed as a research style question that could guide a group of students down this learning path
c. The question was designed from a way that could be investigated from multiple angles and pathways and disciplines.
d. Students should be able to answer this question at the conclusion of instruction.

Performance Expectation:

Prior standards documents listed what students should "know" or "understand." These ideas needed to be translated into performances that could be assessed to determine whether or not students met the standard. Different interpretations sometimes resulted in assessments that were not aligned with curriculum and instruction.

The UT SEEd standards revision groups are developing performance expectations (PE's) that state what students should be able to do in order to demonstrate that they have met the standard, thus providing the same clear and specific targets for teachers to design curriculum, instruction, and assessment. These ALWAYS combine a crosscutting concept, science and engineering practice, and disciplinary core idea(s) into each performance expectation. (*Next Generation Science Standards, 2013*) [1]

Utah Clarification Statement:

This provides details to help further explain the performance expectation. It can provide exemplars and/or connections to specific UT phenomena to help create a context to inform curriculum, instruction, and assessment.

SAGE Boundary: This articulates the limitations of the statewide assessment specific to the PE. The boundary is specific to the SAGE assessment and does not directly limit assessment stemming from classroom instruction.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**This box includes statements derived from the Framework's list of crosscutting concepts, which apply to one or more of the performance expectations above. Most sets of PE's limit the number of crosscutting concepts so as focus on those that are readily apparent when considering the Science Core Ideas. The list is not exhaustive nor is it intended to limit instruction.** *(NRC Framework K-12 Science Education, Page 83)* [2]
Science and Engineering Practices	**This box includes the science and engineering practices used to construct the performance expectations above. These statements are derived from and grouped by the eight categories detailed in the Framework to further explain the science and engineering practices important to emphasize in each grade band. Most sets of performance expectations emphasize only one of the practice categories; however, all practices are emphasized within a grade band. Teachers should be encouraged to utilize several practices in any instruction, and need not be limited to a single practice, which is only intended to guide assessment.** *(NRC Framework K-12 Science Education, Page 41)* [2]
Science Disciplinary Core Ideas	**The science core idea box includes statements that are taken from the Framework about the most essential ideas in the major science disciplines that all students should understand during 13 years of school. These detailed statements was very helpful to support teachers as they analyze and "unpack" the disciplinary core ideas and sub-ideas to reach a level that is helpful in describing what each student should understand about each sub-idea. Each of the bulleted statements relates back to the K-12 Framework for Science Education.** *(NRC Framework K-12 Science Education, Page 103)* [2]

Connection with other Utah Standards		
Connection with UT Math Standards: Here is where there are specific UT math standard connections that are highlighted as a primary connection to the performance expectation.	**Connection with UT Literacy and ELA Standards:** Here is where specific UT Literacy Standards for Science as well as ELA standards are highlighted as a primary connection to the performance expectation.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

[1]Next Generation Science Standards: http://www.nextgenscience.org

[2]NRC Framework K-12 Science Education: http://www.nap.edu/catalog.php?record_id=13165

Utah Science and Engineering Education Standards

UT SEEd Standards

Draft for Public Review – February 2015

6th Grade Integrated Science

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 1: How does energy affect the structure and behavior of matter?

6.1-PS1-1 Performance Expectation: Develop models to describe the atomic composition of simple molecules and extended structures.

Utah Clarification Statement: Emphasis is on understanding the difference between atoms and molecules and developing models of simple molecules such as water (H2O), oxygen (O2), nitrogen (N2), and carbon dioxide (CO2), to show and explain the relationship between atoms and molecules. Examples of molecular-level models could include drawings, 3D structures, or computer representations.

SAGE 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, use of the period table. Students in 6th grade focus on models of simple molecules.

Science Foundations Addressed in Performance Expectations	
Cross Cutting Concepts	**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)
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)
Physical Science 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) Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)

Connection with UT Math Standards:	Connection with UT Literacy and ELA Standards:	Connection with UT Social Studies Standards:
6.RP.3 - Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.	**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).	*These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 1: How does energy affect the structure and behavior of matter?

6.1-PS1-4 Performance Expectation: 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.

Utah Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases. State changes of water should be modeled to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Emphasis should be to prepare students to understand the hydrologic cycle.

SAGE Boundary: Assessment includes phase change as it applies to the hydrologic cycle.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
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)
Physical Science Core Ideas	**PS1.A: Structure and Properties of Matter** 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) 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) **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 jointly on the temperature, the total number of atoms in the system, and the state of the material. (secondary to MS-PS1-4)

Connection with other Utah Standards		
Connection with UT Math Standards: **6.NS.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.	**Connection with UT Literacy and ELA Standards:** **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).	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 1: How does energy affect the structure and behavior of matter?

6.1-PS3-1 Performance Expectation: 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.

Utah Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Students should understand that increasing mass and /or speed increases the amount of kinetic energy but not calculate kinetic energy. Graphing could include trend graphs. Examples could include riding a bicycle at different speeds, rolling different masses downhill, and getting hit by a wiffle ball versus a tennis ball.

SAGE Boundary: Assessment aligns to the examples (or comparable) provided in the clarification statement.

Science Foundations Addressed in Performance Expectation	
Cross Cutting 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)
Science and Engineering Practices	**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)
Physical Science 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)

Connection with other Utah Standards		
Connection with UT Math Standards: **6.RP.1 -** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. **6.RP.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. **6.SP.4 -** Display numerical data in plots on a number line, including dot plots, histograms, and box plots. **6.SP.5 -** Summarize numerical data sets in relation to their context.	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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). **RI 6.1** - Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. **RI 6.7** - Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 1: How does energy affect the structure and behavior of matter?

6.1-PS3-3 Performance Expectation: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

Utah Clarification Statement: Emphasis should be on investigating how different materials minimize or maximize thermal energy transfer and applying the evidence from these investigations to determine materials that could be used to insulate or conduct thermal energy.

SAGE Boundary: Sixth grade assessment emphasizes the determination of appropriate materials rather than a final design. It does not include calculating the total amount of thermal energy transferred. Eighth grade students will build on their understanding to design and evaluate design solutions.

6-ETS-1-1 Engineering Performance Expectation: 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.

Utah Clarification Statement: Focus should be on student identification of a problem using scientific principles and understandings of contextual resources and constraints to develop feasible solutions.

6-ETS-1-3 Engineering Performance Expectation: 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.

Utah Clarification Statement: Creation of novel and improved design solutions by selecting the most successful components from existing designs. Students can refine previous/existing solutions as teams or individuals to develop better solutions.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Energy and Matter** The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3)
Science and Engineering Practices	**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) **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)

Physical Science Core Ideas	**PS3.A: Definitions of Energy** 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** Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3) **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** 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) **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)

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **RST.6-8.3 -** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. **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). **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.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 1: How does energy affect the structure and behavior of matter?

6.1-PS3-4 Performance Expectation: 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.

Utah Clarification Statement: Emphasis is on student generated investigations which explore how the change in the temperature of matter depends on the type of matter, the size of the sample, and the environment. 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 or the temperature change of samples of different materials with the same mass as they cool or heat in the environment.

SAGE Boundary: Assessment does not include calculating the total amount of thermal energy transferred, the formula for kinetic energy, or measurement of particle movement.

Science Foundations Addressed in Performance Expectation	
Cross Cutting 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)
Science and Engineering Practices	**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)
Physical Science Core Ideas	**PS3.A: Definitions of Energy** 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** 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)

Connection with other Utah Standards		
Connection with UT Math Standards: **6.SP.5 -** Summarize numerical data sets in relation to their context.	**Connection with UT Literacy and ELA Standards:** *There are no specific core connections articulated for this performance expectation.*	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 2: How do energy and matter move in patterns that affect Earth's weather and climate?

6.2-ESS2-4 Performance Expectation: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

Utah Clarification Statement: Models should emphasize the way energy from the sun changes the state of water as it moves through the multiple pathways of the hydrologic cycle and the role of gravity in moving water.

SAGE Boundary: A quantitative understanding of the latent heat of vaporization (boiling) and latent heat of fusion (freezing) is not assessed.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Energy and Matter** Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)
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 unobservable mechanisms. (MS-ESS2-4)
Earth and Space Science Core Ideas	**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) Global movements of water and its changes in form are propelled by sunlight and gravity. (MS-ESS2-4)

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** *There are no specific core connections articulated for this performance expectation.*	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Root Question 2: How do energy and matter move in patterns that affect Earth's weather and climate?

6.2-ESS2-5 Performance Expectation: Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

Utah 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. Data can be collected by students through field observations, obtained through laboratory experiments (such as with evaporation or condensation), or provided to students (such as weather maps, diagrams, and visualizations).

SAGE Boundary: Assessment focuses on explanation of weather and should not include recall of specific names of cloud types, weather symbols used on weather maps, or the reported diagrams from weather stations.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5)
Science and Engineering Practices	**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)
Earth and Space Science Core Ideas	**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) **ESS2.D: Weather and Climate** Because these patterns are so complex, weather can only be predicted probabilistically. (MS-ESS2-5)

Connection with other Utah Standards		
Connection with UT Math Standards: **6.NS.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.	**Connection with UT Literacy and ELA Standards:** **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.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 2: How do energy and matter move in patterns that affect Earth's weather and climate?

6.2-ESS2-6 Performance Expectation: 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.

Utah Clarification Statement: Models should represent how sunlight, altitude, latitude, and geographic land distribution affect atmospheric and oceanic flow patterns to determine regional climates. Examples of models can be diagrams, maps and globes, or digital representations and could include Utah regional patterns (such as lake-effect and inversion).

SAGE Boundary: Assessment does not include the dynamics of the Coriolis effect.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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)
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-particle-1),(MS-ESS2-6)
Earth and Space Science Core Ideas	**ESS2.C: The Roles of Water in Earth's Surface Processes** Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. (MS-ESS2-6) **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) The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. (MS-ESS2-6)

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **SL 6.5 -** Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 2: How do energy and matter move in patterns that affect Earth's weather and climate?

6.2-ESS3-5 Performance Expectation: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Utah Clarification Statement: Examples of factors include natural processes (such as changes in incoming solar radiation or volcanic activity) and human activities (such as fossil fuel combustion, cement production, and agricultural activity). Evidence can include tables, graphs, and maps representing global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and human activities. Emphasis is on analyzing evidence to understand the role that natural processes play in causing climate change and the human activities that contribute to the current rise in global temperatures.

SAGE Boundary: Assessment aligns to the examples (or comparable) provided in the clarification statement.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Stability and Change** Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)
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)
Earth and Space Science Core Ideas	**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)

Connection with other Utah Standards		
Connection with UT Math Standards: **6.EE.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.	**Connection with UT Literacy and ELA Standards:** **6 SL.1c -** Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 3: How does the availability of energy and matter affect stability and change in ecosystems?

6.3-LS2-1 Performance Expectation: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

Utah Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the population of organisms in ecosystems during periods of abundant and scarce resources.

SAGE Boundary: Assessment will include ecosystems and organisms within Utah environments.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)
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 and interpret data to provide evidence for phenomena. (MS-LS2-1)
Life Science 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)

Connection with other Utah Standards		
Connection with UT Math Standards: **6.SP.4 -** Display numerical data in plots on a number line, including dot plots, histograms, and box plots. **6.SP.5 -** Summarize numerical data sets in relation to their context.	**Connection with UT Literacy and ELA Standards:** **SL 6.2 -** Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 3: How does the availability of energy and matter affect stability and change in ecosystems?

6.3-LS2-2 Performance Expectation: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

Utah Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different types of 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.

SAGE Boundary: Assessment aligns to the examples (or comparable) provided in the clarification statement.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Patterns** Patterns can be used to identify cause and effect relationships. (MS-LS2-2)
Science and Engineering Practices	**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)
Life Science Core Ideas	**LS2.A: Interdependent Relationships in Ecosystems** 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)

Connection with other Utah Standards		
Connection with UT Math Standards: **6.SP.5 -** Summarize numerical data sets in relation to their context.	**Connection with UT Literacy and ELA Standards:** **RI 6.1 -** Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. **SL 6.4 -** Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 3: How does the availability of energy and matter affect stability and change in ecosystems?

6.3-LS2-3 Performance Expectation: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Utah Clarification Statement: Emphasis is on describing the transfer of matter and energy into and out of various ecosystems, and on defining the boundaries of the system. Models could include examples of decomposers, producers, and consumers and their role in food webs of various ecosystems, including Utah ecosystems.

SAGE Boundary: Assessment will focus on examples provided in the clarification statement and include connections of how energy flows within an ecosystem. It will not include the use of chemical reactions to describe the energy transfer.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Energy and Matter** The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)
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)
Life Science Core Ideas	**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)

Connection with other Utah Standards		
Connection with UT Math Standards: **6.EE.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.	**Connection with UT Literacy and ELA Standards:** **SL 6.5 -** Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 3: How does the availability of energy and matter affect stability and change in ecosystems?

6.3-LS2-4 Performance Expectation: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Utah Clarification Statement: Emphasis is on using patterns in data to evaluate empirical evidence, make warranted inferences, and support arguments about how changes to living and nonliving components in an ecosystem affect populations in that ecosystem. Sources of evidence could include: data from student conducted simulation or experiment, analysis of images of ecosystems before and after events, or numerical data on variations in populations over time. Data sets and classroom examples should include information from Utah.

SAGE Boundary: Assessment aligns to the examples (or comparable) provided in the clarification statement.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Stability and Change** Small changes in one part of a system might cause large changes in another part. (MS-LS2-4),(MS-LS2-5)
Science and Engineering Practices	**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)
Life Science Core Ideas	**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)

Connection with other Utah Standards		
Connection with UT Math Standards: **6.RP.3 -** Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.	**Connection with UT Literacy and ELA Standards:** **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. **W 6.1 -** Write arguments to support claims with clear reasons and relevant evidence. **W 6.4 -** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **W 6.7 -** Conduct short research projects to answer a question, drawing on several sources and refocusing the inquiry when appropriate.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Root Question 3: How does the availability of energy and matter affect stability and change in ecosystems?

6.3-LS2-5 Performance Expectation: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Utah Clarification Statement: Focus should be on students evaluating real world design solutions for preserving ecosystems and biodiversity based on how well the solutions meet the criteria and constraints of the ecological problem. Examples might include: evaluating local, state, and national policies affecting ecosystems or evaluating solutions for the preservation of ecosystem services (water purification, nutrient recycling, prevention of soil erosion, etc.). Examples of design solution constraints could include scientific, economic, and social considerations specific to Utah.

SAGE Boundary: Assessment aligns to the examples (or comparable) provided in the clarification statement.

6-ETS-1-2 Engineering Performance Expectation: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Utah Clarification Statement: Evaluation of viable solutions to design problems using a variety of measures, with emphasis on the evidence that supports one solution as the best fit for the agreed upon criteria. Systematic processes could include development of student-generated rubrics, cost analysis, graphical data displays, test results and other data collection tools.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Stability and Change** Small changes in one part of a system might cause large changes in another part. (MS-LS2-4),(MS-LS2-5)
Science and Engineering Practices	**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). Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)
Life Science Core Ideas	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** 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. (MS-ETS1-2), (MS-ETS1-3)

Connection with other Utah Standards

Connection with UT Math Standards:	Connection with UT Literacy and ELA Standards:	Connection with UT Social Studies Standards:
6.RP.3 - Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.	**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. **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. **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.	*These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 4: How can the use of matter and energy affect Earth's systems?

6.4-ESS3-3 Performance Expectation: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Utah Clarification Statement: The design process should include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Designs could include land use, urban development, pollution, water use, agriculture, or recreation within Utah.

SAGE Boundary: Assessment aligns to the examples (or comparable) provided in the clarification statement.

6-ETS-1-1 Engineering Performance Expectation: 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.

Utah Clarification Statement: Focus should be on student identification of a problem using scientific principles and understandings of contextual resources and constraints to develop feasible solutions.

6-ETS-1-4 Engineering Performance Expectation: 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.

Utah Clarification Statement: Students continue systematic refinement process of a proposed design to determine the viability of success. Refinement and data collection could include component testing, monitoring, modeling, surveys, data display, cost analysis, needs assessments, etc.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)
Science and Engineering Practices	**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 principles to design an object, tool, process or system. (MS-ESS3-3) **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)

Earth and Space Science Core Ideas	**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) **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) Models of all kinds are important for testing solutions. (MS-ETS1-4) **ETS1.C: Optimizing the Design Solution** 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)

Connection with other Utah Standards		
Connection with UT Math Standards: **6.RP.1 -** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. **6.EE.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.	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. **SL 6.5** - Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
6th Grade Integrated Science

Root Question 4: How can the use of matter and energy affect Earth's systems?

6.4-ESS3-3 Performance Expectation: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Utah Clarification Statement: Evidence could include age-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Learning could include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The relationship between increases in human population(s) and consumption of natural resources may be described using scientific data, thus informing societal actions. Data sets and classroom examples should include information from Utah.

SAGE Boundary: Assessment aligns to the examples (or comparable) provided in the clarification statement.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)
Science and Engineering Practices	**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)
Earth and Space Science Core Ideas	**ESS3.C: Human Impacts on Earth Systems** 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)

Connection with other Utah Standards		
Connection with UT Math Standards: **6.RP.1 -** Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. **6.RP.3 -** Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. **6.EE.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.	**Connection with UT Literacy and ELA Standards:** **RST.6-8.8 -** Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. **6 W.1** - Write arguments to support claims with clear reasons and relevant evidence. **6 W.4** - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah State Office of Education

UTSEEd 7th Grade Draft for Public Review

February 6, 2015

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Utah Science and Engineering Education Standards

UT SEEd Standards

Draft for Public Review – February 2015

7th Grade Integrated Science

Overview

This document is available as a draft for public feedback. Please utilize the survey tool available online to provide feedback on this document:

https://www.surveymonkey.com/s/SciencePublicReview

Once the 90-Day Public Review has concluded, the teacher writing teams for science grades 6-8 will reconvene to respond to comments and revise the draft accordingly.

Thank you for taking time to provide your feedback and supporting the process of developing science standards that prepare Utah students to be college and career ready.

Timeline for Science Standard Core Revision

Overview

The attached document is a core revision timeline that was approved by the Utah State Board of Education in May 2014 and articulates the planned timeline for revision and implementation of the science standards as well as other subject areas.

Content Area	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Language Arts - Elementary	New Assessment Fully Implement				Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement
Language Arts - Secondary	New Assessment Fully Implement			Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement	
Math – Elementary	New Assessment Fully Implement	Public review		Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement	
Math – Secondary	New Assessment Fully Implement	Public review			Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement
Science Elementary			Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement		
Science 6,7, 8		Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement			
Science HS			Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement		
Soc. Studies Secondary		Revise Standards Public review	Professional Development Adoption	Implement				
Soc. Studies Elementary			Revise Standards Public review	Professional Development	Implement			

Content Area	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Fine Arts Elem		Revise Standards Public review	Professional Development	Implement				
Fine Arts HS		Revise Standards Public review	Professional Development	Implement				
P. E.		Public review Revise Standards	Professional Development Implement					
Health				Revise Standards	Public review Professional Development	Implement		
Dr. Ed.	Implement					Revise Standards	Public review Professional Development	Implement
Library/Media Secondary & Elementary		Public review Revise Standards Adopt	Professional Development Implement					
Ed. Tech		Public review Revise Standards	Professional Development Implement					
World Languages	Public review Revise Standards	Professional Development Implement						

PROCESS

Public Review – The process begins with the formation of a standards public **review** committee for each content area. These committees review specific content area standards. The committees must be formed at least one year before the anticipated State Board adoption date. The committees will meet at least twice during the one-year period before adoption. Revised standards are available for public comment for at least 90 days. At least three public statewide hearings are held in different regions for the purpose of providing face to face opportunities to provide information and answer questions. All commentary is gathered and studied by the content specific revision committee and the content specific review committee to determine if and how the information should be reflected in the standards.

Revise Standards – A content specific **revision** committee composed of experts in the field (both educators and community) is established to gather data from the field, examine existing standards, look at current research and trends, determine what is needed for students to be successful K-12 and beyond, and draft standards for public input.

Adopt Standards – After the work of the standards public **review** committee and the content specific **revision** committee is complete, and the public comment period has ended, the State Board discusses the recommendations, input and new standards. The State Board then decides either to adopt, amend or reject the new standards.

Professional Development – After final Board adoption of standards, educators are engaged in professional development. Depending on the scope of change in existing standards, the professional development could take months or a couple of years to ensure educators are knowledgeable about the required changes in their instruction. New curriculum and materials may also need to be adjusted or adopted.

Implement and align assessment – If the changes to standards are not substantial, implementation efforts come after professional development. If the changes are substantial, the implementation year would also entail ongoing professional development that is sustained by support at the LEA level. Substantial changes generally result in new adoption of texts and materials, which takes ongoing support. Tested subjects would require revamping and alignment of assessments.

Full Implementation – In tested subjects, full implementation takes place after the new assessment has been adopted and used.

UT SEEd Template Roadmap

Overview

The following document provides an overview of the template of the new Utah Science and Engineering Education (UT SEEd) Standards. It provides links to foundational resources used by the community and teacher writing teams in the development of these documents. This document is to help orient individuals to the new format of science standards presented in the draft.

Utah Science and Engineering Education Standards
UT SEEd Standards
Roadmap to the New Format for UT Science Standards

Root Question:
This question is designed to meet the following needs.
a. Provide a narrative that group the PE's
b. Developed as a research style question that could guide a group of students down this learning path
c. The question was designed from a way that could be investigated from multiple angles and pathways and disciplines.
d. Students should be able to answer this question at the conclusion of instruction.

Performance Expectation:
Prior standards documents listed what students should "know" or "understand." These ideas needed to be translated into performances that could be assessed to determine whether or not students met the standard. Different interpretations sometimes resulted in assessments that were not aligned with curriculum and instruction.
The UT SEEd standards revision groups are developing performance expectations (PE's) that state what students should be able to do in order to demonstrate that they have met the standard, thus providing the same clear and specific targets for teachers to design curriculum, instruction, and assessment. These ALWAYS combine a crosscutting concept, science and engineering practice, and disciplinary core idea(s) into each performance expectation. (*Next Generation Science Standards, 2013*) [1]

Utah Clarification Statement:
This provides details to help further explain the performance expectation. It can provide exemplars and/or connections to specific UT phenomena to help create a context to inform curriculum, instruction, and assessment.

SAGE Boundary: This articulates the limitations of the statewide assessment specific to the PE. The boundary is specific to the SAGE assessment and does not directly limit assessment stemming from classroom instruction.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**This box includes statements derived from the Framework's list of crosscutting concepts, which apply to one or more of the performance expectations above. Most sets of PE's limit the number of crosscutting concepts so as focus on those that are readily apparent when considering the Science Core Ideas. The list is not exhaustive nor is it intended to limit instruction.** *(NRC Framework K-12 Science Education, Page 83)* [2]
Science and Engineering Practices	**This box includes the science and engineering practices used to construct the performance expectations above. These statements are derived from and grouped by the eight categories detailed in the Framework to further explain the science and engineering practices important to emphasize in each grade band. Most sets of performance expectations emphasize only one of the practice categories; however, all practices are emphasized within a grade band. Teachers should be encouraged to utilize several practices in any instruction, and need not be limited to a single practice, which is only intended to guide assessment.** *(NRC Framework K-12 Science Education, Page 41)* [2]
Science Disciplinary Core Ideas	**The science core idea box includes statements that are taken from the Framework about the most essential ideas in the major science disciplines that all students should understand during 13 years of school. These detailed statements was very helpful to support teachers as they analyze and "unpack" the disciplinary core ideas and sub-ideas to reach a level that is helpful in describing what each student should understand about each sub-idea. Each of the bulleted statements relates back to the K-12 Framework for Science Education.** *(NRC Framework K-12 Science Education, Page 103)* [2]

Connection with other Utah Standards		
Connection with UT Math Standards: Here is where there are specific UT math standard connections that are highlighted as a primary connection to the performance expectation.	**Connection with UT Literacy and ELA Standards:** Here is where specific UT Literacy Standards for Science as well as ELA standards are highlighted as a primary connection to the performance expectation.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

[1]Next Generation Science Standards: http://www.nextgenscience.org
[2]NRC Framework K-12 Science Education: http://www.nap.edu/catalog.php?record_id=13165

Utah Science and Engineering Education Standards

UT SEEd Standards

Draft for Public Review – February 2015

7th Grade Integrated Science

Utah Science and Engineering Education Standards
UT SEEd Standards
7th Grade Integrated Science

Root Question 1: How does the structure and behaviors of an organism affect its ability to grow, survive, and reproduce?

7.1 LS1-1 Performance Expectation: Performance Expectation: Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

Utah Clarification Statement: LS1.B: Growth and Development of Organisms. Animals engage in characteristic behaviors that increase the odds of reproduction. Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.

SAGE Boundary: Assessment does not include cell organelles or differences between plant and animal cells.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Scale, Proportion, and Quantity** Phenomena that can be observed at one scale may not be observable at another scale.
Science and Engineering Practices	**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.
Life Science 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).

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** *There are no specific core connections articulated for this performance expectation.*	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
7th Grade Integrated Science

Root Question 1: How does the structure and behaviors of an organism affect its ability to grow, survive, and reproduce?

7.1 LS1-4 Performance Expectation: 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.

Utah 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.

SAGE Boundary: Assessment does not include any human behaviors or human reproduction.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Science and Engineering Practices	**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). 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.
Life Science Core Ideas	**LS1.B: Growth and Development of Organisms** Animals engage in characteristic behaviors that increase the odds of reproduction. Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
7th Grade Integrated Science

Root Question 1: How does the structure and behaviors of an organism affect its ability to grow, survive, and reproduce?

7.1 LS1-5 Performance Expectation: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Utah 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 seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.

SAGE Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Science and Engineering Practices	**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.
Life Science Core Ideas	**LS1.B: Growth and Development of Organisms** Genetic factors as well as local conditions affect the growth of the adult plant.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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. **W 7.9** - Draw evidence from literary or informational texts to support analysis, reflection, and research.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
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Root Question 1: How does the structure and behaviors of an organism affect its ability to grow, survive, and reproduce?

7.1 LS3-1: Performance Expectation: 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.

Utah Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins and that changes in protein can affect the expressed traits of an organism.

SAGE Boundary: Assessment does not include specific changes at the molecular level, details of DNA structure, nucleotides, mechanisms for protein synthesis, or specific types of mutations.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
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.
Life Science Core Ideas	**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. **LS3.B: Variation of Traits** 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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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. **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).	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
7th Grade Integrated Science

Root Question 1: How does the structure and behaviors of an organism affect its ability to grow, survive, and reproduce?

7.1 LS3-2 Performance Expectation: 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.

Utah Clarification Statement: Emphasis is on using models such as Punnett squares (using simple dominant/recessive traits), diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.

SAGE Boundary: Assessment does not include the specific processes of mitosis and meiosis, the law of segregation, the law of independent assortment, and dihybrid crosses. Assessment does not include codominance, incomplete dominance, sex-linked traits, or polygenic inheritance. Assessment also does not include specific structures and functions of reproductive systems.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural systems.
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.
Life Science Core Ideas	**LS1.B: Growth and Development of Organisms** Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary) **LS3.A: Inheritance of Traits** Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. **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.

Connection with other Utah Standards		
Connection with UT Math Standards: **Math Practice #4 Model with mathematics -** Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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. **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).	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
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7th Grade Integrated Science

Root Question 1: How does the structure and behaviors of an organism affect its ability to grow, survive, and reproduce?

7.1 LS4-4 Performance Expectation: 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.

Utah Clarification Statement: Constructed explanations should use simple probability statements and proportional reasoning.

SAGE Boundary: Assessment does not include Hardy Weinberg calculations.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Science and Engineering Practices	**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 describe phenomena.
Life Science Core Ideas	**LS4.B: Natural Selection** Natural selection leads to the predominance of certain traits in a population, and the suppression of others.

Connection with other Utah Standards		
Connection with UT Math Standards: **7.RP.2 -** Recognize and represent proportional relationships between quantities.	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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. **W 7.2** - Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
7th Grade Integrated Science

Root Question 1: How does the structure and behaviors of an organism affect its ability to grow, survive, and reproduce?

7.1 LS4-5 Performance Expectation: Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Utah 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, agriculture, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.

SAGE Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Science and Engineering Practices	**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.
Life Science Core Ideas	**LS4.B: Natural Selection** 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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
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Root Question 2: What patterns can be observed as evidence to support changes in species over time?

7.2 LS4-1 Performance Expectation: 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.

Utah 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. Refer to examples of the fossil record and rock layers in Utah.

SAGE Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Patterns** Graphs, charts, and images can be used to identify patterns in data.
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 and interpret data to determine similarities and differences in findings.
Life Science 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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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). **W 7.7** - Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation. **W 7.9** - Draw evidence from literary or informational texts to support analysis, reflection, and research.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
7th Grade Integrated Science

Root Question 2: What patterns can be observed as evidence to support changes in species over time?

7.2 LS4-2 Performance Expectation: Apply scientific ideas to construct an explanation for the anatomical similarities and difference among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

Utah 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. Include examples of organisms found in Utah as fossils and their modern day counterpart.

SAGE Boundary: Assessment does not include genetic comparisons of species.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Patterns** Patterns can be used to identify cause and effect relationships.
Science and Engineering Practices	**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.
Life Science Core Ideas	**LS4.A: Evidence of Common Ancestry and Diversity** 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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **W 7.7** - Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation. **W 7.9** - Draw evidence from literary or informational texts to support analysis, reflection, and research.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
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Root Question 2: What patterns can be observed as evidence to support changes in species over time?

7.2 LS4-3 Performance Expectation: 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.

Utah Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures. Include examples of organisms native to Utah.

SAGE Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Patterns** Graphs, charts, and images can be used to identify patterns in data.
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.
Life Science Core Ideas	**LS4.A: Evidence of Common Ancestry and Diversity** Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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). **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.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 2: What patterns can be observed as evidence to support changes in species over time?

7.2 LS4-6 Performance Expectation: Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

Utah Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.

SAGE Boundary: Assessment does not include Hardy Weinberg calculations.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability
Science and Engineering Practices	**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.
Life Science Core Ideas	**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.

Connection with other Utah Standards		
Connection with UT Math Standards: **7.RP.2 -** Recognize and represent proportional relationships between quantities. **Math Practice #2 - Reason abstractly and quantitatively.** Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.	**Connection with UT Literacy and ELA Standards:** *There are no specific core connections articulated for this performance expectation.*	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Root Question 3: How does the cycling of matter and energy affect Earth's evolution over time?

7.3 ESS1-4 Performance Expectation: 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.

Utah 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.

SAGE Boundary: Assessment does not include recalling the specific names and dates of the divisions of the geologic time scale.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
Science and Engineering Practices	**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.
Earth and Space Sciences Core Ideas	**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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RI 7.1 -** Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. **W 7.1 -** Write arguments to support claims with clear reasons and relevant evidence.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Root Question 3: How does the cycling of matter and energy affect Earth's evolution over time?

7.3 ESS2-1 Performance Expectation: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

Utah Clarification Statement: Emphasis is on the processes of the rock cycle including melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials. Emphasize evidence from Utah's varied geological features.

SAGE Boundary: Assessment does not include the testing, identification, or naming of minerals.

8-ETS-1-4 Engineering Performance Expectation: 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.

Utah Clarification Statement: Students continue systematic refinement process of a proposed design to determine the viability of success. Refinement and data collection could include component testing, monitoring, modeling, surveys, data display, cost analysis, needs assessments, etc.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
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.
Earth and Space Sciences Core Ideas	**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. **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. Models of all kinds are important for testing solutions. **ETS1.C: Optimizing the Design Solution** 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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **SL 7.5 -** Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 3: How does the cycling of matter and energy affect Earth's evolution over time?

7.3 ESS2-2 Performance Expectation: Performance Expectation: Construct an explanation based on evidence for how processes have changed Earth's surface at varying time and spatial scales.

Utah 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 geologic processes (such as weathering, deposition, folding, etc.) usually occur gradually but are punctuated by catastrophic events (such as earthquakes, volcanic eruptions, landslides, meteorite impacts, etc.). Examples of geologic processes include surface weathering and deposition by the movements of water, ice, and wind. Focus includes geologic processes that shape Utah geographic features.

SAGE Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
Science and Engineering Practices	**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.
Earth and Space Sciences Core Ideas	**ESS2.A: Earth's Materials and Systems** 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. **ESS2.C: The Roles of Water in Earth's Surface Processes** Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.

Connection with other Utah Standards		
Connection with UT Math Standards: Math Practice #4 Model with mathematics - Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.	**Connection with UT Literacy and ELA Standards:** **SL 7.5** - Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. **RI 7.1** - Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. **W 7.2** - Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 3: How does the cycling of matter and energy affect Earth's evolution over time?

7.3 ESS2-3 Performance Expectation: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of plate motions.

Utah Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), the location of earthquakes and volcanoes, the locations of ocean structures (such as ridges, fracture zones, and trenches), and the relative age of the seafloor.

SAGE Boundary: Paleomagnetic anomalies are not assessed.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Patterns** Patterns in rates of change and other numerical relationships can provide information about natural systems.
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 and interpret data to provide evidence for phenomena.
Earth and Space Sciences 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.(secondary) **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.

Connection with other Utah Standards		
Connection with UT Math Standards: **7.SP.3 -** Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability.	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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). **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.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Root Question 4: How does the force of gravity influence the structure, organization, and motion of objects in space?

7.4 ESS1-1 Performance Expectation: 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.

Utah Clarification Statement: Examples of models can be physical, graphical, or conceptual. Emphasis is on predictable patterns in planetary systems.

SAGE Boundary: Limited to relative sizes, times, and distances. Understanding of tidal forces is not assessed.

8-ETS-1-2 Engineering Performance Expectation: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Utah Clarification Statement: Evaluation of viable solutions to design problems using a variety of measures, with emphasis on the evidence that supports one solution as the best fit for the agreed upon criteria. Systematic processes could include development of student-generated rubrics, cost analysis, graphical data displays, test results and other data collection tools.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Patterns** Patterns can be used to identify cause-and-effect relationships.
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.
Earth and Space Sciences 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. **ESS1.B: Earth and the Solar System** 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. **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.

Connection with other Utah Standards		
Connection with UT Math Standards: **7.RP.2 -** Recognize and represent proportional relationships between quantities. **Math Practice #4 Model with mathematics -** Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.	**Connection with UT Literacy and ELA Standards:** **SL 7.5 -** Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
7th Grade Integrated Science

Root Question 4: How does the force of gravity influence the structure, organization, and motion of objects in space?

7.4 ESS1-2 Performance Expectation: Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

Utah 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).

SAGE Boundary: Assessment does not include Kepler's Laws of orbital motion or the apparent retrograde motion of the planets as viewed from Earth.

8-ETS-1-1 Engineering Performance Expectation: 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.

Utah Clarification Statement: Focus should be on student identification of a problem using scientific principles and understandings of contextual resources and constraints to develop feasible solutions.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Systems and System Models** Models can be used to represent systems and their interactions.
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.
Earth and Space Sciences Core Ideas	**ESS1.A: The Universe and Its Stars** Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. **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. The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.

Connection with other Utah Standards		
Connection with UT Math Standards: **7.RP.2 -** Recognize and represent proportional relationships between quantities. **7.EE.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. **Math Practice #4 Model with mathematics -** Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.	**Connection with UT Literacy and ELA Standards:** **SL 7.5 -** Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
7th Grade Integrated Science

Root Question 4: How does the force of gravity influence the structure, organization, and motion of objects in space?

7.4 ESS1-3 Performance Expectation: Analyze and interpret data to determine scale properties of objects in the solar system.

Utah 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.

SAGE Boundary: Assessment does not include recalling facts about properties of the compositions of planets or other solar system bodies.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
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 and interpret data to determine similarities and differences in findings.
Earth and Space Sciences Core Ideas	**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.

Connection with other Utah Standards		
Connection with UT Math Standards: **7.RP.2 -** Recognize and represent proportional relationships between quantities. **7.G.1** - Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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).	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Root Question 5: How do forces interact with matter?

7.5 PS2-1 Performance Expectation: Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.

Utah 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. Emphasize that the paired forces are equal (Newton's 3rd Law), but the changes in motion are dependent on an object's mass (Newton's 2nd Law).

SAGE Boundary: Assessment is limited to vertical or horizontal interactions in one dimension. Calculations of accelerations are not assessed.

8-ETS-1-4 Engineering Performance Expectation: 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.

Utah Clarification Statement: A physical model can be used to simulate a real life scenario and provide meaningful data (e.g., collisions between carts on a track and their subsequent motion data can model the collision between a meteor and a space vehicle). Students continue systematic refinement process of a proposed design to determine the viability of success. Refinement and data collection could include component testing, monitoring, modeling, surveys, data display, cost analysis, needs assessments, etc.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
Science and Engineering Practices	**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.
Physical Science 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). **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. Models of all kinds are important for testing solutions. **ETS1.C: Optimizing the Design Solution** 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.

Connection with other Utah Standards		
Connection with UT Math Standards: **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. **7.EE.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.	**Connection with UT Literacy and ELA Standards:** *There are no specific core connections articulated for this performance expectation.*	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
7th Grade Integrated Science

Root Question 5: How do forces interact with matter?

7.5 PS2-2 Performance Expectation: 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.

Utah 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.

SAGE 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.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
Science and Engineering Practices	**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.
Physical Science Core Ideas	**PS2.A: Forces and Motion** 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. 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.

Connection with other Utah Standards		
Connection with UT Math Standards: **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. **7.EE.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.	**Connection with UT Literacy and ELA Standards:** *There are no specific core connections articulated for this performance expectation.*	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
7th Grade Integrated Science

Root Question 5: How do forces interact with matter?

7.5 PS2-3 Performance Expectation: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

Utah 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.

SAGE Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.

8-ETS-1-3 Engineering Performance Expectation: 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.

Utah Clarification Statement: Creation of novel and improved design solutions by selecting the most successful components from existing designs. Students can refine previous/existing solutions as teams or individuals to develop better solutions.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems.
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.
Physical Science Core Ideas	**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. **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. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. **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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **SL 7.1c -** Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed**.**	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
7th Grade Integrated Science

Root Question 5: How do forces interact with matter?

7.5 PS2-4 Performance Expectation: Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

Utah 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.

SAGE Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
Science and Engineering Practices	**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.
Physical Science Core Ideas	**PS2.B: Types of Interactions** 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.

Connection with other Utah Standards		
Connection with UT Math Standards: **Math Practice #3 - Construct viable arguments and critique the reasoning of others.** Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.	**Connection with UT Literacy and ELA Standards:** **RI 7.1 -** Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. **W 7.1** - Write arguments to support claims with clear reasons and relevant evidence.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Root Question 5: How do forces interact with matter?

7.5 PS2-5 Performance Expectation: 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.

Utah Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, or electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.

SAGE Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.

8-ETS-1-1 Engineering Performance Expectation: 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.

Utah Clarification Statement: Focus should be on student identification of a problem using scientific principles and understandings of contextual resources and constraints to develop feasible solutions. The design problem can be the setup of an experiment to test for relative strengths of fields; students should evaluate the scale, sensitivity, and limits of the data collected in their investigation.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems.
Science and Engineering Practices	**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. 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.
Physical Science Core Ideas	**PS2.B: Types of Interactions** 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). **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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **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).	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah State Office of Education

UTSEEd 8th Grade Draft for Public Review

February 6, 2015

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Utah Science and Engineering Education Standards

UT SEEd Standards

Draft for Public Review – February 2015

8th Grade Integrated Science

Overview

This document is available as a draft for public feedback. Please utilize the survey tool available online to provide feedback on this document:

https://www.surveymonkey.com/s/SciencePublicReview

Once the 90-Day Public Review has concluded, the teacher writing teams for science grades 6-8 will reconvene to respond to comments and revise the draft accordingly.

Thank you for taking time to provide your feedback and supporting the process of developing science standards that prepare Utah students to be college and career ready.

Timeline for Science Standard Core Revision

Overview

The attached document is a core revision timeline that was approved by the Utah State Board of Education in May 2014 and articulates the planned timeline for revision and implementation of the science standards as well as other subject areas.

Content Area	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Language Arts - Elementary	New Assessment Fully Implement				Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement
Language Arts - Secondary	New Assessment Fully Implement			Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement	
Math – Elementary	New Assessment Fully Implement	Public review		Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement	
Math – Secondary	New Assessment Fully Implement	Public review			Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement
Science Elementary			Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement		
Science 6,7, 8		Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement			
Science HS			Public review Revise Standards	Adoption Professional Development	Begin to implement and align assessment	New Assessment Fully Implement		
Soc. Studies Secondary		Revise Standards Public review	Professional Development Adoption	Implement				
Soc. Studies Elementary			Revise Standards Public review	Professional Development	Implement			

Content Area	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Fine Arts Elem		Revise Standards Public review	Professional Development	Implement				
Fine Arts HS		Revise Standards Public review	Professional Development	Implement				
P. E.		Public review Revise Standards	Professional Development Implement					
Health				Revise Standards	Public review Professional Development	Implement		
Dr. Ed.	Implement					Revise Standards	Public review Professional Development	Implement
Library/Media Secondary & Elementary		Public review Revise Standards Adopt	Professional Development Implement					
Ed. Tech		Public review Revise Standards	Professional Development Implement					
World Languages	Public review Revise Standards	Professional Development Implement						

PROCESS

Public Review – The process begins with the formation of a standards public **review** committee for each content area. These committees review specific content area standards. The committees must be formed at least one year before the anticipated State Board adoption date. The committees will meet at least twice during the one-year period before adoption. Revised standards are available for public comment for at least 90 days. At least three public statewide hearings are held in different regions for the purpose of providing face to face opportunities to provide information and answer questions. All commentary is gathered and studied by the content specific revision committee and the content specific review committee to determine if and how the information should be reflected in the standards.

Revise Standards – A content specific **revision** committee composed of experts in the field (both educators and community) is established to gather data from the field, examine existing standards, look at current research and trends, determine what is needed for students to be successful K-12 and beyond, and draft standards for public input.

Adopt Standards – After the work of the standards public **review** committee and the content specific **revision** committee is complete, and the public comment period has ended, the State Board discusses the recommendations, input and new standards. The State Board then decides either to adopt, amend or reject the new standards.

Professional Development – After final Board adoption of standards, educators are engaged in professional development. Depending on the scope of change in existing standards, the professional development could take months or a couple of years to ensure educators are knowledgeable about the required changes in their instruction. New curriculum and materials may also need to be adjusted or adopted.

Implement and align assessment – If the changes to standards are not substantial, implementation efforts come after professional development. If the changes are substantial, the implementation year would also entail ongoing professional development that is sustained by support at the LEA level. Substantial changes generally result in new adoption of texts and materials, which takes ongoing support. Tested subjects would require revamping and alignment of assessments.

Full Implementation – In tested subjects, full implementation takes place after the new assessment has been adopted and used.

UT SEEd Template Roadmap

Overview

The following document provides an overview of the template of the new Utah Science and Engineering Education (UT SEEd) Standards. It provides links to foundational resources used by the community and teacher writing teams in the development of these documents. This document is to help orient individuals to the new format of science standards presented in the draft.

Utah Science and Engineering Education Standards
UT SEEd Standards
Roadmap to the New Format for UT Science Standards

Root Question:
This question is designed to meet the following needs.
a. Provide a narrative that group the PE's
b. Developed as a research style question that could guide a group of students down this learning path
c. The question was designed from a way that could be investigated from multiple angles and pathways and disciplines.
d. Students should be able to answer this question at the conclusion of instruction.

Performance Expectation:
Prior standards documents listed what students should "know" or "understand." These ideas needed to be translated into performances that could be assessed to determine whether or not students met the standard. Different interpretations sometimes resulted in assessments that were not aligned with curriculum and instruction.
The UT SEEd standards revision groups are developing performance expectations (PE's) that state what students should be able to do in order to demonstrate that they have met the standard, thus providing the same clear and specific targets for teachers to design curriculum, instruction, and assessment. These ALWAYS combine a crosscutting concept, science and engineering practice, and disciplinary core idea(s) into each performance expectation. (*Next Generation Science Standards, 2013*) [1]

Utah Clarification Statement:
This provides details to help further explain the performance expectation. It can provide exemplars and/or connections to specific UT phenomena to help create a context to inform curriculum, instruction, and assessment.

SAGE Boundary: This articulates the limitations of the statewide assessment specific to the PE. The boundary is specific to the SAGE assessment and does not directly limit assessment stemming from classroom instruction.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**This box includes statements derived from the Framework's list of crosscutting concepts, which apply to one or more of the performance expectations above. Most sets of PE's limit the number of crosscutting concepts so as focus on those that are readily apparent when considering the Science Core Ideas. The list is not exhaustive nor is it intended to limit instruction.** *(NRC Framework K-12 Science Education, Page 83)* [2]
Science and Engineering Practices	**This box includes the science and engineering practices used to construct the performance expectations above. These statements are derived from and grouped by the eight categories detailed in the Framework to further explain the science and engineering practices important to emphasize in each grade band. Most sets of performance expectations emphasize only one of the practice categories; however, all practices are emphasized within a grade band. Teachers should be encouraged to utilize several practices in any instruction, and need not be limited to a single practice, which is only intended to guide assessment.** *(NRC Framework K-12 Science Education, Page 41)* [2]
Science Disciplinary Core Ideas	**The science core idea box includes statements that are taken from the Framework about the most essential ideas in the major science disciplines that all students should understand during 13 years of school. These detailed statements was very helpful to support teachers as they analyze and "unpack" the disciplinary core ideas and sub-ideas to reach a level that is helpful in describing what each student should understand about each sub-idea. Each of the bulleted statements relates back to the K-12 Framework for Science Education.** *(NRC Framework K-12 Science Education, Page 103)* [2]

Connection with other Utah Standards		
Connection with UT Math Standards: Here is where there are specific UT math standard connections that are highlighted as a primary connection to the performance expectation.	**Connection with UT Literacy and ELA Standards:** Here is where specific UT Literacy Standards for Science as well as ELA standards are highlighted as a primary connection to the performance expectation.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

[1]Next Generation Science Standards: http://www.nextgenscience.org
[2]NRC Framework K-12 Science Education: http://www.nap.edu/catalog.php?record_id=13165

Utah Science and Engineering Education Standards

UT SEEd Standards

Draft for Public Review – February 2015

8th Grade Integrated Science

Utah Science and Engineering Education Standards
UT SEEd Standards
8th Grade Integrated Science

Root Question 1: How do matter and energy interact to form the physical world?

8.1 PS1-1 Performance Expectation: Develop models to describe the atomic composition of simple molecules and extended structures.

Utah Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples could include carbon, carbon dioxide, diamonds, hydrogen, water, or sodium chloride. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.

SAGE Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule. Assessment does not use of the periodic table.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
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.
Physical Science 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) Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)

Connection with other Utah Standards		
Connection with UT Math Standards: **8.EE.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.	**Connection with UT Literacy and ELA Standards:** **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).	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
8th Grade Integrated Science

Root Question 1: How do matter and energy interact to form the physical world?

8.1 PS1-2 Performance Expectation: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

Utah Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.

SAGE Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Patterns** Macroscopic patterns are related to the nature of microscopic and atomic-level structure.
Science and Engineering Practices	**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.
Physical Science Core Ideas	**PS1.A: Structure and Properties of Matter** Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. **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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** *There are no specific core connections articulated for this performance expectation.*	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
8th Grade Integrated Science

Root Question 1: How do matter and energy interact to form the physical world?

8.1 PS1-3 Performance Expectation: Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

Utah 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.

SAGE Boundary: Assessment is limited to qualitative information.

8-ETS-1-1 Engineering Performance Expectation: 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.

Utah Clarification Statement: Focus should be on student identification of a problem using scientific principles and understandings of contextual resources and constraints to develop feasible solutions.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
Science and Engineering Practices	**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 now supported by evidence.
Physical Science Core Ideas	**PS1.A: Structure and Properties of Matter** Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. **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. **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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **W 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.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
8th Grade Integrated Science

Root Question 1: How do matter and energy interact to form the physical world?

8.1 PS1-4 Performance Expectation: 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.

Utah 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 drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.

SAGE Boundary: Assessment does not include plasma.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems.
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.
Physical Science Core Ideas	**PS1.A: Structure and Properties of Matter** Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. 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. The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. **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) 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 jointly on the temperature, the total number of atoms in the system, and the state of the material. (secondary)

Connection with other Utah Standards		
Connection with UT Math Standards: **Math Practice #4 Model with mathematics -** Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.	**Connection with UT Literacy and ELA Standards:** **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).	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
8th Grade Integrated Science

Root Question 1: How do matter and energy interact to form the physical world?

8.1 PS1-5 Performance Expectation: 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.

Utah Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.

SAGE Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Energy and Matter** Matter is conserved because atoms are conserved in physical and chemical processes.
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.
Physical Science Core Ideas	**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. The total number of each type of atom is conserved, and thus the mass does not change.

Connection with other Utah Standards		
Connection with UT Math Standards: **Math Practice #4 Model with mathematics -** Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.	**Connection with UT Literacy and ELA Standards:** **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).	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
8th Grade Integrated Science

Root Question 1: How do matter and energy interact to form the physical world?

8.1 PS1-6 Performance Expectation: Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

Utah 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.

SAGE Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.

8-ETS-1-1 Engineering Performance Expectation: 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.

Utah Clarification Statement: Focus should be on student identification of a problem using scientific principles and understandings of contextual resources and constraints to develop feasible solutions.

8-ETS-1-3 Engineering Performance Expectation: 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.

Utah Clarification Statement: Creation of novel and improved design solutions by selecting the most successful components from existing designs. Students can refine previous/existing solutions as teams or individuals to develop better solutions.

8-ETS-1-4 Engineering Performance Expectation: 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.

Utah Clarification Statement: Students continue systematic refinement process of a proposed design to determine the viability of success. Refinement and data collection could include component testing, monitoring, modeling, surveys, data display, cost analysis, needs assessments, etc.

SAGE Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Energy and Matter** The transfer of energy can be tracked as energy flows through a designed or natural system.
Science and Engineering Practices	**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.

Physical Science Core Ideas	**PS1.B: Chemical Reactions** Some chemical reactions release energy, others store energy. **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) **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) 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)

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.3 -** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
8th Grade Integrated Science

Root Question 2: How is energy stored and transferred in physical systems?

8.2 PS3-1 Performance Expectation: 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.

Utah 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 down a hill, and getting hit by a whiffle ball verses a tennis ball.

SAGE Boundary: Assessment does not include recall of Newton's 2nd Law.

Science Foundations Addressed in Performance Expectation	
Cross Cutting 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.
Science and Engineering Practices	**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.
Physical Science 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.

Connection with other Utah Standards		
Connection with UT Math Standards: **8.EE.1 -** Know and apply the properties of integer exponents to generate equivalent numerical expressions. **8.EE.2 -** Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. **8.F.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.	**Connection with UT Literacy and ELA Standards:** **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).	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Root Question 2: How is energy stored and transferred in physical systems?

8.2 PS3-2 Performance Expectation: Develop a model to describe that when the arrangement of objects at a distance changes, different amounts of potential energy are stored in the system.

Utah 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 classmates hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.

SAGE Boundary: Assessment is limited to two objects and electric magnetic and gravitational interactions.

8-ETS-1-1 Engineering Performance Expectation: 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.

Utah Clarification Statement: Focus should be on student identification of a problem using scientific principles and understandings of contextual resources and constraints to develop feasible solutions.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
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.
Physical Science Core Ideas	**PS3.A: Definitions of Energy** A system of objects may also contain stored (potential) energy, depending on their relative positions. **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. **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.

Connection with other Utah Standards		
Connection with UT Math Standards: **Math Practice #4 Model with mathematics -** Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.	**Connection with UT Literacy and ELA Standards:** *There are no specific core connections articulated for this performance expectation.*	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
8th Grade Integrated Science

Root Question 2: How is energy stored and transferred in physical systems?

8.2 PS3-5 Performance Expectation: 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.

Utah 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.

SAGE Boundary: Assessment does not include calculations of energy.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Energy and Matter** Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).
Science and Engineering Practices	**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.
Physical Science Core Ideas	**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.

Connection with other Utah Standards		
Connection with UT Math Standards: **8.F.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.	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **W 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.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 3: How is energy carried in waves?

8.3 PS4-1 Performance Expectation: 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.

Utah Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.

SAGE Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Patterns** Graphs and charts can be used to identify patterns in data.
Science and Engineering Practices	**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.
Physical Science Core Ideas	**PS4.A: Wave Properties** A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **SL 8.5 -** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
UT SEEd Standards
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Root Question 3: How is energy carried in waves?

8.3 PS4-2 Performance Expectation: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Utah Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.

SAGE Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.

8-ETS-1-2 Engineering Performance Expectation: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Utah Clarification Statement: Evaluation of viable solutions to design problems using a variety of measures, with emphasis on the evidence that supports one solution as the best fit for the agreed upon criteria. Systematic processes could include development of student-generated rubrics, cost analysis, graphical data displays, test results and other data collection tools.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
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.
Physical Science Core Ideas	**PS4.A: Wave Properties** A sound wave needs a medium through which it is transmitted. **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. 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. A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. However, because light can travel through space, it cannot be a matter wave, like sound or water waves. **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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Utah Science and Engineering Education Standards
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Root Question 3: How is energy carried in waves?

8.3 PS4-3 Performance Expectation: 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.

Utah Clarification Statement: Emphasis is on 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.

SAGE Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Structure and Function** Structures can be designed to serve particular functions.
Science and Engineering Practices	**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.
Physical Science Core Ideas	**PS4.C: Information Technologies and Instrumentation** Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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. **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. **W 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.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Root Question 4: How do humans respond to and interact with Earth?

8.4 ESS3.1 Performance Expectation: 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.

Utah 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). Utah's unique geologic history led to the irregular distribution of various natural resources. Examples include mining of copper, uranium, gold, silver, mineral resources, oil shale, natural gas wells, and other resources.

SAGE Boundary: Assessments do not include specific quantities of resources produced.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems.
Science and Engineering Practices	**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.
Earth and Space Sciences 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.

Connection with other Utah Standards		
Connection with UT Math Standards: **Math Practice #3 - Construct viable arguments and critique the reasoning of others.** Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1** - Cite specific textual evidence to support analysis of science and technical texts. **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.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 4: How do humans respond to and interact with Earth?

8.4 ESS 3-2 Performance Expectation: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

Utah 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, avalanches and tsunamis), or severe weather events (such as hurricanes, tornadoes, blizzards 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 structures to withstand local catastrophic events).

SAGE Boundary: Assessment does not include the specific procedural methods used to gather the predictive data.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Patterns** Graphs, charts, and images can be used to identify patterns in data.
Science and Engineering Practices	**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.
Earth and Space Sciences Core Ideas	**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.

Connection with other Utah Standards		
Connection with UT Math Standards: **Math Practice #2 - Reason abstractly and quantitatively.** Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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).	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

Root Question 4: How do humans respond to and interact with Earth?

8.4 ESS3-3 Performance Expectation: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Utah Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and design and evaluating solutions that could reduce the 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).

SAGE Boundary: Assessments do not include the specifics of environmental testing procedures (e.g. water quality indicators like phosphorus, pH, oxygen or nitrate tests).

8-ETS-1-1 Engineering Performance Expectation: 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.

Utah Clarification Statement: Focus should be on student identification of a problem using scientific principles and understandings of contextual resources and constraints to develop feasible solutions.

8-ETS-1-4 Engineering Performance Expectation: 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.

Utah Clarification Statement: Students continue systematic refinement process of a proposed design to determine the viability of success. Refinement and data collection could include component testing, monitoring, modeling, surveys, data display, cost analysis, needs assessments, etc.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.
Science and Engineering Practices	**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 principles to design an object, tool, process or system.
Earth and Space Sciences Core Ideas	**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. 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. **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. **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. Models of all kinds are important for testing solutions. **ETS1.C: Optimizing the Design Solution** 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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** *There are no specific core connections articulated for this performance expectation.*	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 4: How do humans respond to and interact with Earth?

8.4 ESS3-4 Performance Expectation: Construct an argument supported by evidence for how changes in human population and per-capita consumption of natural resources impact Earth's systems.

Utah 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). Example of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. Utah examples could include the availability of water, effect of grazing on erosion and loss of farmland in Utah communities as populations continue to grow. The consequences of changes in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.

SAGE Boundary: Assessments do not include recall of specific data regarding global population sizes, energy consumption or resource use.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural or designed systems.
Science and Engineering Practices	**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.
Earth and Space Sciences Core Ideas	**ESS3.C: Human Impacts on Earth Systems** 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.

Connection with other Utah Standards		
Connection with UT Math Standards: **Math Practice #2 - Reason abstractly and quantitatively.** Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **W 8.1** - Write arguments to support claims with clear reasons and relevant evidence.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 5: How are living things organized?

8.5 LS1-1 Performance Expectation: Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.

Utah Clarification Statement: Emphasis is on developing evidence that living things are made of cells; distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.

SAGE Boundary: Assessment does not include specific tissues, organs, or systems or organisms.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Scale, Proportion, and Quantity** Phenomena that can be observed at one scale may not be observable at another scale.
Science and Engineering Practices	**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.
Life Science 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).

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** *There are no specific core connections articulated for this performance expectation.*	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 5: How are living things organized?

8.5 LS1-2 Performance Expectation: Develop and use a model to describe the function of a cell as a whole and the way parts of cells contribute to the function.

Utah 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.

SAGE Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the structure of the cell wall and cell membrane may not include molecular structure. 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.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**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.
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.
Life Science Core Ideas	**LS1.A: Structure and Function** Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** *There are no specific core connections articulated for this performance expectation.*	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 5: How are living things organized?

8.5 LS1-3 Performance Expectation: Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

Utah 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.

SAGE Boundary: Assessment is to show understanding that systems work together and does not include the mechanism of one body system independent of other systems. Assessment is limited to vertebrates. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Systems and System Models** Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems.
Science and Engineering Practices	**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). Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.
Life Science Core Ideas	**LS1.A: Structure and Function** 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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **RI 8.2** - Determine a central idea of a text and analyze its development over the course of the text, including its relationship to supporting ideas; provide an objective summary of the text. **W 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.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 6: How is life maintained?

8.6 LS1-4 Performance Expectation: 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.

Utah 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.

SAGE Boundary: Assessment is limited to examples listed in the clarification statement. Assessment does not include primates, including humans.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
Science and Engineering Practices	**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). 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.
Life Science Core Ideas	**LS1.B: Growth and Development of Organisms** Animals engage in characteristic behaviors that increase the odds of reproduction. Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **W 8.1** - Write arguments to support claims with clear reasons and relevant evidence.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 6: How is life maintained?

8.6 LS1-6 Performance Expectation: 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.

Utah Clarification Statement: Emphasis is on tracing movement of matter and low of energy.

SAGE Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Energy and Matter** Within a natural system, the transfer of energy drives the motion and/or cycling of matter.
Science and Engineering Practices	**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.
Life Science Core Ideas	**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. **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)

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **RST.6-8.1 -** Cite specific textual evidence to support analysis of science and technical texts. **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.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 6: How is life maintained?

8.6 LS1-7 Performance Expectation: 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.

Utah Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.

SAGE Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Energy and Matter** Matter is conserved because atoms are conserved in physical and chemical processes.
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 unobservable mechanisms.
Life Science Core Ideas	**LS1.C: Organization for Matter and Energy Flow in Organisms** 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. **PS3.D: Energy in Chemical Processes and Everyday Life** 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)

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** *There are no specific core connections articulated for this performance expectation.*	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*

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Root Question 6: How is life maintained?

8.6 LS1-8 Performance Expectation: Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Utah Clarification Statement: Please refer to the practices, disciplinary core ideas, and cross cutting concepts in the performance expectation to support students.

SAGE Boundary: Assessment does not include mechanisms for the transmission, synthesis, or interpretation of the stimuli.

Science Foundations Addressed in Performance Expectation	
Cross Cutting Concepts	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural systems.
Science and Engineering Practices	**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.
Life Science Core Ideas	**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.

Connection with other Utah Standards		
Connection with UT Math Standards: *Beyond the mathematical foundation for science, no specific core connections are noted.*	**Connection with UT Literacy and ELA Standards:** **W 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.	**Connection with UT Social Studies Standards:** *These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft.*