MEMORANDUM

TO:       Members, Utah State Board of Education

FROM:     Brad C. Smith
          Chief Executive Officer

DATE:     January 8, 2015

INFORMATION:  Preview Draft Science Standards

Background:
In the 2014 general legislative session, H.B. 342 Powers and Duties of the State Board of Education was passed. It requires standard review committees for various subject areas, including science. Since then, USOE staff have been working to meet that requirement while working on improving and revising the science standards.

Key Points:
Staff will present information on the draft science standards as preparation for their presentation to the Board in February 2015.

Anticipated Action:
The Board will receive the information.

Contact:  Sydnee Dickson  801-538-7515
          Diana Suddreth  801-538-7739
Science Grades 6-8 Standards Review Report

The Standards Review Committee for Science Grades 6-8 has been completed according to 53A-1-402.8.

The Standards Review Committee recommends the following actions be taken in the revision of the core standards. These recommendations represent the consensus of the committee.

- Thank you to the writers involved and their time and effort in relationship to this process and their work in the classroom.
- The committee supports having a set of standards that have high expectations that engage students in science and engineering practices.
- The committee supports the integration of technological tools and skills to gather and analyze data and communicate information to enhance science learning.
- The committee recommends the inclusion of computer science in the grades 6-8 standards.

The Standards Review Committee requests the Board also considers the following recommendations, but where consensus was not reached.

- The committee recommends the inclusion of computer science in the grades 6-8.
  - There were 6 out of 12 committee members who recommended inclusion of components of computer science specifically in the science standards for grades 6-8.
- There was a discussion around the role of Next Generation Science Standards in regards to the drafting of new science standards for Utah grades 6-8. There were two recommendations that came from the discussion.
  - There were 2 out of 12 committee members that would like to recommend starting over with drafting new standards or revising Utah’s current standards so that they are not necessarily aligned with the Next Generation Science Standards in the revision of grades 6-8 by looking at different templates.
  - There were 10 out of 12 committee members that support the use of Next Generation Science Standards as the foundation in the revision of grades 6-8 as represented in the current drafts of UT SEEd standards.
- There were 9 out of 12 committee members that recommend that writing groups edit the SEEd standards drafts to have stronger alignment to the core idea progressions associated with the current science topics in Grades 6-8 considering what is best for students.
- There were 2 out of 12 committee members that recommend that the SEEd drafts need to be redrafted to demonstrate that all topics (such as life science evolution and global warming issues) are tentative and subject to change. Additionally, there is a recommendation that dissenting scientific data be encouraged in science classrooms and be discussed.
- There were 9 out of 11 committee members that support the evolution position statement that was approved with the Utah State Board of Education in 2005 and is reflected in the current Utah SEEd drafts.
- There were 10 out of 11 committee members that recommend the standards reflect the nature of science.

December 16, 2014
Science Grades 6-8 Standards Review Overview

This document was prepared by Utah State Office of Education facilitator and K-12 Science Specialist Sarah Young to provide an overview of the process and work of this committee.

Process

This committee has been established through legislation HB 342 - 2014, to review the core standards in light of giving students an adequate foundation to successfully pursue college, technical education, a career, or other life pursuits. The charge of the committee is to submit comments and recommendations to the Utah State Board of Education regarding changes to existing core and/or adoption of new core standards. This committee met on two separate occasions.

The first meeting was held on October 14, 2014 with the intended outcome of the first meeting to prepare specific, actionable recommendations for the standards working committees regarding review of both the current Utah Science Standards as well as the internal drafts of the new Utah Science and Education Standards (UT SEEd). Members agreed to work through a Google Drive document to collaborate and share thoughts and feedback during and after the conclusion of the meeting. Additionally, the committee communicated through email. Feedback that was received by Thursday, October 30th was shared with the writing committees as they continued to reflect on community feedback from multiple sources to refine the draft.

The second meeting was held on December 11, 2014 with a focus on the charge of the committee to submit comments and recommendations to the Utah State Board of Education regarding changes to existing core and/or adoption of new core standards. The committee was charged with working to collectively create a document to present to the State Board of Education that reflects the work of the committee. Upon Board consideration and direction, staff will incorporate Board recommendations into drafts of the standards prior to requesting public comment and hearings.

Effective facilitation of group dynamics includes setting norms of conduct. A committee member contacted Board members with concerns about having to follow pre-established norms of conduct. Facilitation of the second meeting included getting group input and consensus on group norms. The committee agreed on the following norms of behavior for the second meeting:

- Using name tags to identify a comment and taking turns in speaking
- Voting to be able to consider airtime needs by the committee at the conclusion of the first hour of the meeting
- Using the “fist to five system” to vote for support for initiatives. Fist – not support to five – I do support.
- Be fully present
- Listen with the intent to learn
- Monitor your own airtime
- Engage in respectful and open dialogue
- Ask questions for clarification and understanding
Stay focused on purpose

Norm that was not agreed upon with full consensus:
  • Honor privacy of conversations within group

Science Standards Review Committee Members

House of Representatives Nominees

John Emett
johnemett@gmail.com

Sheila Johnston
Sheila.Johnston@wasatch.edu

Jenny Olsen - Requested to be dismissed from the committee due to stronger interest in mathematics on Thursday, November 6, 2014
jolsen717@yahoo.com

Jacob Siebach – Requested removal from the committee due to relocation on Friday, December 5, 2014
jacob@jacobsiebach.com

LeAnn Wood
lwood7@gmail.com

Senate Nominees

Toby Dillon
jeditoby@msn.com

Laura Albrecht
Albrechtfamily2000@gmail.com

Vincent Newmeyer
VNewmeyer@SofToolsConsulting.com

Alisa Ellis
Alisa.ellis@gmail.com

Sheri Mattle
Sheri.mattle@gmail.com
State Board of Education Nominees

Maria Farrington – Not present for the second meeting on Thursday, December 9th, 2014 and therefore was not able to vote on recommendations.
mfarrington@discoverygateway.org

Dr. David Feldon - Not present for the second meeting on Thursday, December 9th, 2014 and therefore was not able vote on recommendations.
dffeldon@gmail.com

Brett Moulding
brett.moulding@nebo.edu

Jeff Nelson – Was unable to attend the second meeting on December 9, 2014 due a conflict with an existing work engagement and therefore was not able to vote on recommendations.
JNelson@nelsonlabs.com

Dr. John Taylor - Was released from the committee on Tuesday, November 18, 2014 at the request of the State Board of Education due to conflict as current science writing committee member.
taylorjr@suu.edu

Dr. Rich Tolman
tolmanri@uvu.edu

Stephanie Wood - Was released from the committee on Tuesday, November 18, 2014 at the request of the State Board of Education due to conflict as current science writing committee member.
swood@graniteschools.org
gsdscience@gmail.com

Dr. Louisa Stark - Was added to the committee to replace Dr. John Taylor on Tuesday, December 2, 2014
louisa.stark@utah.edu

Ken O'Brien - Was added to the committee to replace Stephanie Wood on Tuesday, December 9, 2014
Ken.Obrien@slcschools.org
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.

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.

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.

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)

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.

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)

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.

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 were 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)

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# 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.

### 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.

### Cross Cutting Concepts

<table>
<thead>
<tr>
<th>Scale, Proportion, and Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>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)</td>
</tr>
</tbody>
</table>

### 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).

### Science and Engineering Practices

<table>
<thead>
<tr>
<th>Developing and Using Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>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)</td>
</tr>
</tbody>
</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.

<table>
<thead>
<tr>
<th>Physical Science Core Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>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)</td>
</tr>
<tr>
<td>Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1)</td>
</tr>
</tbody>
</table>

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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.

| Connection with UT Math Standards: 6.NS.5 | Cross Cutting Concepts: Cause and Effect  
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. | 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) |
| Understanding 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.

**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)
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.

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.

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)
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<th>Connection with UT Literacy and ELA Standards:</th>
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<td><strong>RST.6-8.1</strong> - Cite specific textual evidence to support analysis of science and technical texts.</td>
</tr>
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<td><strong>RST.6-8.7</strong> - 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).</td>
</tr>
<tr>
<td><strong>RI 6.1</strong> - Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.</td>
</tr>
<tr>
<td><strong>RI 6.7</strong> - 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.</td>
</tr>
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</table>

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<tr>
<th>Science and Engineering Practices</th>
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<tbody>
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<td><strong>Analyzing and Interpreting Data</strong></td>
</tr>
<tr>
<td>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)</td>
</tr>
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<tr>
<td>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)</td>
</tr>
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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.

Connection with UT Math Standards:
Beyond the mathematical foundation for science, no specific core connections are noted.

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)
**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.

**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)

**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.

**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)
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.

<table>
<thead>
<tr>
<th>Connection with UT Math Standards:</th>
<th>Connection with UT Literacy and ELA Standards:</th>
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<tbody>
<tr>
<td><strong>6.SP.5</strong> - Summarize numerical data sets in relation to their context.</td>
<td>There are no specific core connections articulated for this performance expectation.</td>
</tr>
</tbody>
</table>

### Cross Cutting Concepts

<table>
<thead>
<tr>
<th>Scale, Proportion, and Quantity</th>
<th>Planning and Carrying Out Investigations</th>
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<tr>
<td>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)</td>
<td>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)</td>
</tr>
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### Science and Engineering Practices
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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<td>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)</td>
</tr>
<tr>
<td></td>
<td>PS3.B: Conservation of Energy and Energy Transfer</td>
</tr>
<tr>
<td></td>
<td>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)</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Connection with UT Math Standards: Beyond the mathematical foundation for science, no specific core connections are noted.</th>
<th>Cross Cutting Concepts</th>
<th>Energy and Matter Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. (MS-ESS2-4)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Connection with UT Literacy and ELA Standards: There are no specific core connections articulated for this performance expectation.</th>
<th>Science and Engineering Practices</th>
<th>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)</th>
</tr>
</thead>
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<table>
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<tr>
<th>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.</th>
<th>Earth and Space Science Core Ideas</th>
<th>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)</th>
</tr>
</thead>
</table>
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.

| 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. | _Cross Cutting Concepts_ | Cause and Effect | Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS2-5) |
### 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.

### 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)

### 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.

### 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)
Utah Science and Engineering Education Standards
UT SEEEd 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.

Connection with UT Math Standards:
Beyond the mathematical foundation for science, no specific core connections are noted.

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)

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.

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)

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.

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)
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.

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.

Cross Cutting Concepts

Stability and Change
Stability might be disturbed either by sudden events or gradual changes that accumulate over time. (MS-ESS3-5)
### 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.

#### 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)

### 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.

#### 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)
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.

| Cross Cutting Concepts | Cause and Effect
---|---
| **6.SP.4** - Display numerical data in plots on a number line, including dot plots, histograms, and box plots. | 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
---|---
| **6.SP.5** - Summarize numerical data sets in relation to their context. | 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
---|---
| These connections are still being considered while social studies works on standard review and revision. These will be included in a later draft. | 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)
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.

<table>
<thead>
<tr>
<th>Cross Cutting Concepts</th>
<th>Patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.SP.5 - Summarize numerical data sets in relation to their context.</td>
<td>Patterns can be used to identify cause and effect relationships. (MS-LS2-2)</td>
</tr>
</tbody>
</table>

**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.

**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)

**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.

**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)
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.

**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)
Utah Science and Engineering Education Standards
UT SEEd Standards
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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.

| 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. | 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) |
**Connection with UT Literacy and ELA Standards:**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RI 6.8</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>W 6.1</strong></td>
<td>Write arguments to support claims with clear reasons and relevant evidence.</td>
</tr>
<tr>
<td><strong>W 6.4</strong></td>
<td>Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</td>
</tr>
<tr>
<td><strong>W 6.7</strong></td>
<td>Conduct short research projects to answer a question, drawing on several sources and refocusing the inquiry when appropriate.</td>
</tr>
</tbody>
</table>

**Science and Engineering Practices**

<table>
<thead>
<tr>
<th>Practice</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engaging in Argument from Evidence</strong></td>
<td>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)</td>
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</tbody>
</table>

**Connection with UT Social Studies Standards:**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Life Science Core Ideas</strong></td>
<td>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)</td>
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</tbody>
</table>

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[http://creativecommons.org/licenses/by-nc-sa/4.0/](http://creativecommons.org/licenses/by-nc-sa/4.0/)
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.

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.

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)
<table>
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<td>Engaging in Argument from Evidence</td>
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<td>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)</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Life Science Core Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS2.C: Ecosystem Dynamics, Functioning, and Resilience</td>
</tr>
<tr>
<td>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)</td>
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<table>
<thead>
<tr>
<th>LS4.D: Biodiversity and Humans</th>
</tr>
</thead>
<tbody>
<tr>
<td>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)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ETS1.B: Developing Possible Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>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)</td>
</tr>
</tbody>
</table>
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.

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.

<table>
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<th>Cross Cutting Concepts</th>
<th>Cause and Effect</th>
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<tbody>
<tr>
<td></td>
<td>Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)</td>
</tr>
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</table>

DRAFT
### 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.

### Science and Engineering Practices

<table>
<thead>
<tr>
<th>Constructing Explanations and Designing Solutions</th>
</tr>
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<tbody>
<tr>
<td>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.</td>
</tr>
<tr>
<td>Apply scientific principles to design an object, tool, process or system. (MS-ESS3-3)</td>
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<table>
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<tr>
<th>Asking Questions and Defining Problems</th>
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</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
<tr>
<td>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)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Developing and Using Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
<tr>
<td>Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)</td>
</tr>
</tbody>
</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.

<table>
<thead>
<tr>
<th>ESS3.C: Human Impacts on Earth Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>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)</td>
</tr>
<tr>
<td>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)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ETS1.A: Defining and Delimiting Engineering Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>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)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ETS1.B: Developing Possible Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)</td>
</tr>
<tr>
<td>Models of all kinds are important for testing solutions. (MS-ETS1-4)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ETS1.C: Optimizing the Design Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>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)</td>
</tr>
</tbody>
</table>
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.
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.

Cross Cutting Concepts

Cause and Effect
Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)

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.

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)

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.

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)
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.

Connection with UT Math Standards:
Beyond the mathematical foundation for science, no specific core connections are noted.

Cross Cutting Concepts
Scale, Proportion, and Quantity
Phenomena that can be observed at one scale may not be observable at another scale.

Connection with UT Literacy and ELA Standards:
There are no specific core connections articulated for this performance expectation.

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.

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.

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).
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.

Connection with UT Math Standards:
Beyond the mathematical foundation for science, no specific core connections are noted.

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.

Connection with UT Literacy and ELA Standards:

RST.6-8.1 - Cite specific textual evidence to support analysis of science and technical texts.

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.

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.

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.
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.

Connection with UT Math Standards:
Beyond the mathematical foundation for science, no specific core connections are noted.

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.

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.

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.

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.

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.
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.

Connection with UT Math Standards: Beyond the mathematical foundation for science, no specific core connections are noted.

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.
### 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).

### 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.

### 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.*

### 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.
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._

| 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. |

| Cross Cutting Concepts |
| Cause and Effect Cause and effect relationships may be used to predict phenomena in natural systems. |
### 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).

### 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.

### 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.

### 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.
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._

<table>
<thead>
<tr>
<th>Connection with UT Math Standards: 7.RP.2 - Recognize and represent proportional relationships between quantities.</th>
<th><strong>Cross Cutting Concepts</strong></th>
<th>Cause and Effect Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.</th>
</tr>
</thead>
</table>

| 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. | **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. |

| 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. | **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. |

_DRAFT_
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.

Connection with UT Math Standards:
Beyond the mathematical foundation for science, no specific core connections are noted.

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.

Connection with UT Literacy and ELA Standards:
RST.6-8.1 - Cite specific textual evidence to support analysis of science and technical texts.

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.

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.

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.
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._

<table>
<thead>
<tr>
<th>Connection with UT Math Standards: Beyond the mathematical foundation for science, no specific core connections are noted.</th>
<th>Cross Cutting Concepts</th>
<th>Patterns: Graphs, charts, and images can be used to identify patterns in data.</th>
</tr>
</thead>
</table>

| Connection with UT Literacy and ELA Standards: | Science and Engineering Practices | Analyzing and Interpreting Data |
| RST.6-8.1 - Cite specific textual evidence to support analysis of science and technical texts. | 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. |
| 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). | Analyze and interpret data to determine similarities and differences in findings. |
| 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. | |

<table>
<thead>
<tr>
<th>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.</th>
<th>Life Science Core Ideas</th>
<th>LS4.A: Evidence of Common Ancestry and Diversity</th>
</tr>
</thead>
</table>

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.
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.*

<table>
<thead>
<tr>
<th>Connection with UT Math Standards: Beyond the mathematical foundation for science, no specific core connections are noted.</th>
<th>Cross Cutting Concepts</th>
<th>Patterns can be used to identify cause and effect relationships.</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>Science and Engineering Practices</td>
<td>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.</td>
</tr>
<tr>
<td>Life Science Core Ideas</td>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>

Draft 09/08/2014 - UT State Office of Education Internal Draft - 7th Grade
http://creativecommons.org/licenses/by-nc-sa/4.0/
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.

### 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.

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**Connection with UT Math Standards:**  
_Beyond the mathematical foundation for science, no specific core connections are noted._

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**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.

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**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: 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.

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.

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

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.

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.

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.
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.

| Connection with UT Math Standards: Beyond the mathematical foundation for science, no specific core connections are noted. | 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. |
|---|---|---|

| 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. | 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. |
|---|---|---|

| 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. | 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. |
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.

Connection with UT Math Standards: Beyond the mathematical foundation for science, no specific core connections are noted.

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.

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.

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.

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.

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.
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.

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.

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.
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.

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.

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.

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.
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._

| 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. | Cross Cutting Concepts | Patterns | Patterns in rates of change and other numerical relationships can provide information about natural systems. |

| 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. | 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. |

| 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. | 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. |
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.
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.

Cross Cutting Concepts
Patterns
Patterns can be used to identify cause-and-effect relationships.

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.

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.

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.

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.
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.
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.

Cross Cutting Concepts

Systems and System Models
Models can be used to represent systems and their interactions.

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.

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.

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.

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.
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.

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<tr>
<td>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.</td>
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**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.

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**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.

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**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.
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.
### 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.

### 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.

### Connection with UT Literacy and ELA Standards:

There are no specific core connections articulated for this performance expectation.

### 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.

### 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.

### 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.
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.

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.

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.
| Connection with UT Literacy and ELA Standards: |
| There are no specific core connections articulated for this performance expectation. |

**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.

| 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. |

**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.
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.

Connection with UT Math Standards:
Beyond the mathematical foundation for science, no specific core connections are noted.

Cross Cutting Concepts
Cause and Effect
Cause and effect relationships may be used to predict phenomena in natural or designed systems.
### 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.

#### 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.

### 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.

#### 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.
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.

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.

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.
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.

Connection with UT Math Standards:
Beyond the mathematical foundation for science, no specific core connections are noted.

Cross Cutting Concepts
Cause and Effect
Cause and effect relationships may be used to predict phenomena in natural or designed systems.

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).

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.

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.

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.
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.

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.

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.

Connection with UT Literacy and ELA Standards:
RST.6-8.7 - Integrate quantitative or technical information expressed in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

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.

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.

Physical Science Core Ideas

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)
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.

| Connection with UT Math Standards: Beyond the mathematical foundation for science, no specific core connections are noted. | Cross Cutting Concepts | Patterns | Macroscopic patterns are related to the nature of microscopic and atomic-level structure. |
|---|---|---|

| Connection with UT Literacy and ELA Standards: There are no specific core connections articulated for this performance expectation. | 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. |
|---|---|---|

| 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. | 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. |
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.

Connection with UT Math Standards:
Beyond the mathematical foundation for science, no specific core connections are noted.

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.

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.

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.

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.

Physical Science Core Ideas
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.
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.

**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.

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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).

### 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.

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**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)
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.

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.

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.
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.

<table>
<thead>
<tr>
<th>Connection with UT Math Standards: Beyond the mathematical foundation for science, no specific core connections are noted.</th>
<th>Cross Cutting Concepts</th>
<th>Energy and Matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructing Explanations and Designing Solutions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**

| 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. |
| 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) |

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Utah Science and Engineering Education Standards
UT SEEEd 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 versus a tennis ball.

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

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.

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.

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).

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.

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.

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.
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.

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.

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.

Connection with UT Literacy and ELA Standards:
There are no specific core connections articulated for this performance expectation.

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.

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.

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.
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.

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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.

Cross Cutting Concepts

Energy and Matter
Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).

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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.

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.

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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.

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.

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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.

<table>
<thead>
<tr>
<th>Connection with UT Math Standards: Beyond the mathematical foundation for science, no specific core connections are noted.</th>
<th>Cross Cutting Concepts</th>
<th>Patterns</th>
<th>Graphs and charts can be used to identify patterns in data.</th>
</tr>
</thead>
</table>

| 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. | 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. |

| 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. | Physical Science Core Ideas | PS4.A: Wave Properties | A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. |
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._

<table>
<thead>
<tr>
<th>Connection with UT Math Standards: Beyond the mathematical foundation for science, no specific core connections are noted.</th>
<th><strong>Cross Cutting Concepts</strong> 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.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Connection with UT Literacy and ELA Standards:</strong> 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.</td>
<td><strong>Science and Engineering Practices</strong> 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.</td>
</tr>
<tr>
<td><strong>Physical Science Core Ideas</strong> 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.</td>
<td></td>
</tr>
</tbody>
</table>
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.*

<table>
<thead>
<tr>
<th>Cross Cutting Concepts</th>
<th>Structure and Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beyond the mathematical foundation for science, no specific core connections are noted.</td>
<td>Structures can be designed to serve particular functions.</td>
</tr>
</tbody>
</table>

**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.

**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.

**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.

**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.
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.

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.

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.
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, tornados, 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.

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.

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.
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.

Connection with UT Math Standards: Beyond the mathematical foundation for science, no specific core connections are noted.

Cross Cutting Concepts: Cause and Effect

Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.
**Connection with UT Literacy and ELA Standards:**
There are no specific core connections articulated for this performance expectation.

**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.

**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.

**Earth and Space Sciences Core Ideas**

<table>
<thead>
<tr>
<th>ESS3.C: Human Impacts on Earth Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>ETS1.A: Defining and Delimiting Engineering Problems</th>
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<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>ETS1.B: Developing Possible Solutions</th>
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<tbody>
<tr>
<td>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.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>ETS1.C: Optimizing the Design Solution</th>
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<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Connection with UT Math Standards: Math Practice #2 - Reason abstractly and quantitatively.</th>
<th>Cross Cutting Concepts</th>
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</thead>
<tbody>
<tr>
<td>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.</td>
<td>Cause and Effect</td>
</tr>
<tr>
<td></td>
<td>Cause and effect relationships may be used to predict phenomena in natural or designed systems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connection with UT Literacy and ELA Standards: RST.6-8.1 - Cite specific textual evidence to support analysis of science and technical texts.</th>
<th>Engaging in Argument from Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>W 8.1 - Write arguments to support claims with clear reasons and relevant evidence.</td>
<td>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.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>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.</th>
<th>Earth and Space Sciences Core Ideas</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>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.</td>
</tr>
</tbody>
</table>
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.

_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).
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.
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.

Connection with UT Math Standards:
Beyond the mathematical foundation for science, no specific core connections are noted.

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.

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.

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.

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.

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.
## 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.

### Connection with UT Math Standards:
*Beyond the mathematical foundation for science, no specific core connections are noted.*

### 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.*

### 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.*

### 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.*

### 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.*

### 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.*
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 flow of energy.

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

Connection with UT Math Standards:
Beyond the mathematical foundation for science, no specific core connections are noted.

Cross Cutting Concepts:
Energy and Matter: Within a natural system, the transfer of energy drives the motion and/or cycling of matter.

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.

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.

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.

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)
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.

<table>
<thead>
<tr>
<th>Connection with UT Math Standards: Beyond the mathematical foundation for science, no specific core connections are noted.</th>
<th>Cross Cutting Concepts</th>
<th>Energy and Matter: Matter is conserved because atoms are conserved in physical and chemical processes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connection with UT Literacy and ELA Standards: There are no specific core connections articulated for this performance expectation.</td>
<td>Science and Engineering Practices</td>
<td>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.</td>
</tr>
<tr>
<td>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.</td>
<td>Life Science Core Ideas</td>
<td>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.</td>
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<td></td>
<td></td>
<td>PS3.D: Energy in Chemical Processes and Everyday Life: Cellular respiration in plants and animals involves 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)</td>
</tr>
</tbody>
</table>

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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.

Connection with UT Math Standards:
Beyond the mathematical foundation for science, no specific core connections are noted.

Cross Cutting Concepts

Cause and Effect
Cause and effect relationships may be used to predict phenomena in natural systems.

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.

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.

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.

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.