ARIZONA SCIENCE TEST

AzSCI Item Specifications Grade Band HS

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Prepared by the Arizona Department of Education

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Introduction

The Arizona Statewide Achievement Assessment for Science (AzSCI) is Arizona's statewide science achievement test. AzSCI assesses the Arizona Science Standards (AzSS) adopted by the Arizona State Board of Education in 2018. AzSCI is a computer-based assessment that allows for the use of a variety of innovative item types where students can apply critical thinking skills to demonstrate a deeper understanding of the three dimensions of the Arizona Science Standards.

During the item-development process, all AzSCI items are written in accordance with the Item Specifications and are reviewed and approved by a committee of Arizona educators to confirm alignment and appropriateness for inclusion in the test. AzSCI item review committee members are generally representative of Arizona's geographic regions and culturally diverse population. Items are reviewed for the following kinds of bias: gender, racial, ethnic, linguistic, religious, geographic, and socioeconomic. Item reviews also include consideration of issues related to individuals with disabilities. Arizona community members also have an opportunity to review items for issues of potential concern to members of the community at large. Reviewers are asked to consider the variety of cultural, regional, philosophical, political, and religious backgrounds throughout Arizona, and then to determine whether the subject matter will be acceptable to Arizona students, families, and other members of Arizona communities.

The AzSCI Item Specifications provide resource documents that define the content and format of the test and test items for item writers and reviewers. Each Item Specifications document indicates the alignment of items with the Arizona Science Standards. It also serves to provide all stakeholders with information about the scope and function of assessment items. This document can also serve to assist educators in understanding how assessment items are developed in alignment with the standards for science. The AzSCI standard-level item specifications provide information about the development of items aligned to the Arizona Science Standards adopted in 2018. AzSCI is designed to reflect the importance of using evidence and reading complex texts outlined in the Arizona Science Standards. Any item specifications absent for standards listed in this document are excluded from the assessable standards. This document does not endorse the exclusion of the instruction of any grade-level content standards.

AzSCI has a test blueprint that was developed by Arizona and is different from any other state or consortium test blueprint. These item specifications for AzSCI are intended to provide information regarding standards, item formats, and response types. The descriptions of blueprints and cognitive complexity in this document are meant to provide an overview of the test. Item specifications are meant for the purposes of assessment, not instruction. They are not intended to be tools for instruction or the basis for curricula.

Standards Description

Purpose of the Arizona Science Standards

The Arizona Science Standards present a vision of what it means to be scientifically literate as well as college and career ready. These standards outline what all students need to know, understand, and be able to do by the end of high school and reflect the following shifts for science education:

- Organize standards around thirteen core ideas and develop learning progressions to coherently and logically build scientific literacy from kindergarten through high school.
- Connect core ideas, crosscutting concepts, and science and engineering practices to make sense of the natural world and understand how science and engineering are practiced and experienced.
- Focus on fewer, broader standards that allow for greater depth, more connections, deeper understanding, and more applications of content.

Core Ideas

AzSCI examines students' performance of scientific and engineering practices in the context of core ideas and crosscutting concepts. Although described separately, they generally function in concert. The ten core ideas for Knowing Science center on understanding the causes of phenomena in physical, Earth and space, and life science. The three core ideas for Using Science connect scientific principles, theories, and models; engineering and technological applications; and societal implications to the content knowledge in order to support that understanding.

Core Ideas for Knowing Science		Core Ideas for Using Science
Physical Science P1: All matter in the Universe is made of very small particles. P2: Objects can affect other objects at a distance. P3: Changing the movement of an object requires a net force to be acting on it. P4: The total amount of energy in a closed system is always the same but can be transferred from one energy store to another during an event. **Earth and Space Science** E1: The composition of the Earth and its atmosphere and the natural and human processes occurring within them shape the Earth's surface and its climate. E2: The Earth and our solar system are a very small part of one of many galaxies within the Universe. **Life Science** L1: Organisms are organized on a cellular basis and have a finite life span. L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms. L3: Genetic information is passed down from one generation of organisms to another. L4: The unity and diversity of organisms, living and extinct, is the result of evolution. *Adapted from ***Working with Big Ideas in Science Education***[2]		U1: Scientists explain phenomena using evidence obtained from observations and or scientific investigations. Evidence may lead to developing models and or theories to make sense of phenomena. As new evidence is discovered, models and theories can be revised. U2: The knowledge produced by science is used in engineering and technologies to solve problems and/or create products. U3: Applications of science often have both positive and negative ethical, social, economic, and/or political implications.

Scientific and Engineering Practices (SEPs)

The science and engineering practices (SEPs) describe a robust process for how scientists investigate and build models and theories of the natural world or how engineers design and build. These practices reflect science and engineering as they are practiced and experienced.

The SEPs are grouped into eight categories, each describing how students should engage in the practices used by scientists and engineers. Students engage in all eight of the SEPs throughout each grade band. As students progress from the lower to the upper grades, the complexity and sophistication of the SEPs increase in order to reflect the progression in students' abilities to use each practice and in their increased understanding of the core ideas.

SEP	Science and Engineering Practices	SEP Reporting Category
INV	Planning and Carrying Out Investigations	Investigating
Q/P	Asking Questions and Defining Problems	Investigating
MCT	Using Mathematical and Computational Thinking	Investigating
DATA	Analyzing and Interpreting Data	Investigating**
MOD	Developing and Using Models	Sensemaking
E/S	Constructing Explanations and Designing Solutions	Sensemaking
ARG	Engaging in Argument from Evidence	Critiquing
INFO	Obtaining, Evaluating, and Communicating Information	Critiquing

**Assessment purpose only.

Crosscutting Concepts (CCCs)

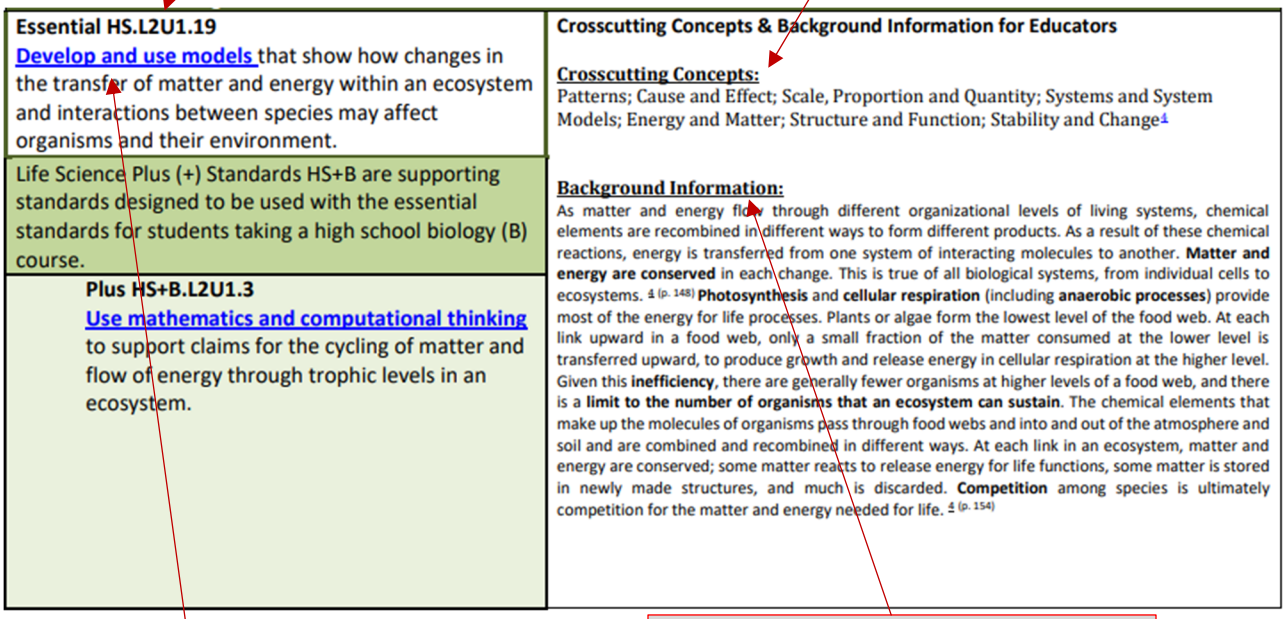
Crosscutting concepts (CCCs) cross boundaries between science disciplines and provide an organizational framework to connect knowledge from various disciplines into a coherent and scientifically based view of the world. They build bridges between science and other disciplines and connect core ideas and practices throughout the fields of science and engineering. Their purpose is to provide a lens to help students deepen their understanding of the core ideas as they make sense of phenomena in the natural and designed worlds. The CCCs are applied across all domains of science and act as a mechanism for linking the different domains. Throughout each grade band, students will engage in all seven CCCs. As with the SEPs, the complexity and sophistication of the CCCs will increase as students increase their understanding of the core ideas while moving from the lower to the upper grades.

CCC	Crosscutting Concept	CCC	Crosscutting Concept
PAT	Patterns	E/M	Energy and Matter
C/E	Cause and Effect	S/F	Structure and Function
SPQ	Scale, Proportion, and Quantity	S/C	Stability and Change
SYS	System and System Models		

Coding and Navigating the Standards

Standard: High School, Core Ideas L2 and U1, standard number 19

CCC: CCCs that may be most appropriate for use with the standard.



Essential HS.L2U1.19
Develop and use models that show how changes in the transfer of matter and energy within an ecosystem and interactions between species may affect organisms and their environment.

Life Science Plus (+) Standards HS+B are supporting standards designed to be used with the essential standards for students taking a high school biology (B) course.

Plus HS+B.L2U1.3
Use mathematics and computational thinking to support claims for the cycling of matter and flow of energy through trophic levels in an ecosystem.

Crosscutting Concepts & Background Information for Educators

Crosscutting Concepts:
Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Structure and Function; Stability and Change[1]

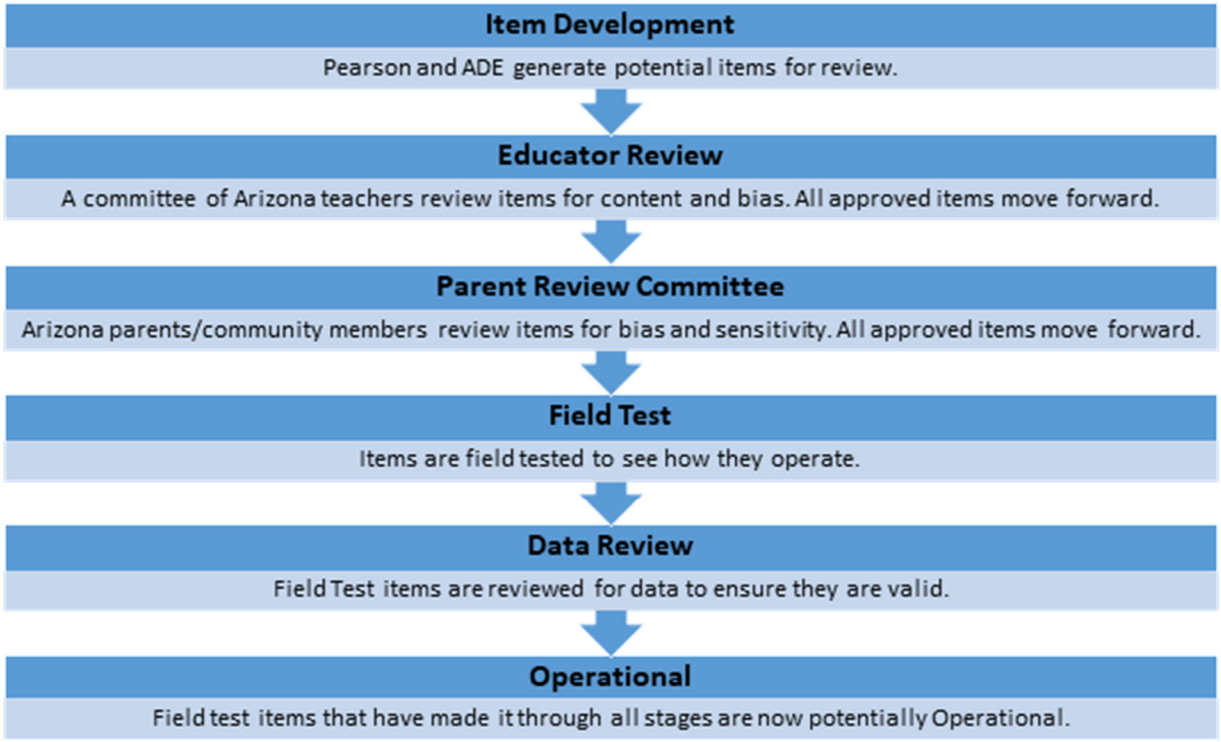
Background Information:
As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. **Matter and energy are conserved** in each change. This is true of all biological systems, from individual cells to ecosystems. [1 (p. 148)] **Photosynthesis** and **cellular respiration** (including **anaerobic processes**) provide most of the energy for life processes. Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this **inefficiency**, there are generally fewer organisms at higher levels of a food web, and there is a **limit to the number of organisms that an ecosystem can sustain**. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil and are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved; some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. **Competition** among species is ultimately competition for the matter and energy needed for life. [1 (p. 154)]

SEP: Developing and Using Models

Background Information: A guidance resource embedded into the standards document. This is the first step to deepen content knowledge and to make apparent the research behind the standard. The learning progression is supporting material and not the

Item Development Process

AzSCI items go through a rigorous review before they are operational. When an item is "operational" it means that it is used to determine a student's score on the assessment. This is a description of the process every item must go through before it is operational on AzSCI.



Sample tests are available online for the science portion of AzSCI. To access the AzSCI Sample Tests, go to: https://home.testnav.com/, select "Arizona," and then select "Mic Check and Sample Tests."

Test Design and Blueprint Tables

AzSCI is a grade-band assessment where each of the Core Ideas is assessed in each grade band: 3–5, 6–8, and high school. The new assessment consists of a combination of independent and cluster items. AzSCI will ask students to do more than answer recall questions about science; they will apply the practices, or behaviors, of scientists and engineers to investigate each real-world phenomenon and design solutions to problems. The 2018 Arizona Science Standards were developed using a three-dimensional approach to K–12 science education that captures students' interests and provides them with the necessary foundational knowledge for basic proficiency and continuing study in science.

AzSCI Blueprint

AzSCI identifies what it means to be proficient in science; it rests on a view of science as both a body of knowledge and an evidence-based, model- and theory-building enterprise that continually extends, refines, and revises knowledge. AzSCI reflects the three dimensions that are combined to form each standard and item. The construction of the AzSCI assessment is guided by the depth and rigor of the Arizona Science Standards. Items are created to address key components of the standards and assess a range of important skills. The AzSCI Blueprint provides an overview of the distribution of items on the AzSCI according to the standards. The standards for SEPs and CCCs are embedded within all AzSCI items. Further, the AzSCI blueprint outlines the Depth of Knowledge (replaced with the Task Analysis Guide in Science [TAGS]), SEP and CCC coverage, and distribution of items.

AzSCI Assessment Grade Band 9–11 Blueprint

Domain	Percent Range
Science and Engineering Practices and Crosscutting Concepts in Physical Sciences	32%–40%
Science and Engineering Practices and Crosscutting Concepts in Life Sciences	34%–42%
Science and Engineering Practices and Crosscutting Concepts in Earth and Space Sciences	22%–30%

Every standard in each grade band will be assessed over a three-year period.

SEP Coverage

Practice	Percent Range
Investigating	16%–26%
Sensemaking	34%–48%
Critiquing	24%–38%

Investigating Practices	Sensemaking Practices	Critiquing Practices
Asking Questions and Defining Problems	Developing and Using Models	Engaging in Argument from Evidence
Planning and Carrying Out Investigations	Constructing Explanations and Designing Solutions	Obtaining, Evaluating, and Communicating Information
Using Mathematical and Computational Thinking		
Analyzing and Interpreting Data***		

***Assessment Reporting Categories for Science Engineering Practices (SEP) may vary.

Cognitive Complexity

Conventional cognitive complexity models, such as Depth of Knowledge (DOK), evaluate based on individual cognitive actions (memorization, application, evaluation, and analysis). This works well with one-dimensional standards. This does not work as well with multidimensional standards, such as the Arizona Science Standards, because each dimension being assessed could have its own cognitive level. To sufficiently evaluate a student's range of proficiency, Arizona needed a scale that goes beyond a singular focus and takes into account three-dimensionality.

The Task Analysis Guide in Science (TAGS) was developed for classroom use to evaluate cognitive demand with integration of practices and content (see Tekkumsu-Kisa, Stein, & Schunn, *A Framework for Analyzing Cognitive Demand and Content-Practices Integration: Task Analysis Guide in Science [TAGS]*, 2015).

Arizona modified these models for the AzSCI assessment in order to more accurately recognize that cognitive demand increases as the number of integrated dimensions increases.

AZ Task Analysis Guide in Science

TAGS	Az TAGS Example	TAGS Coding	
		Students must use 2 Dimensions	Students must use 3 Dimensions
Doing Science Tasks: Students are required to DO science by using practices to DEVELOP an understanding of a scientific or engineering phenomenon. Students must develop a model, explanation or argument from raw data or information. Students must be able to determine which data or information is appropriate and how to use it.	Doing Science items will typically not direct the students to specific information to use. Students must look through all information/tabs to determine what information is relevant. *Use the information to explain the patterns observed.* OR *Which graph best represents the changes in X?*	D2	D3
Guided Science Tasks: Students use higher-level thinking to work through guided or scaffolded tasks. Students are told what information (model, data etc.) to use or are provided with information and then required to develop the actual answer.	Guided items will typically direct the students to the information to use (Tab 2, Graph 1, etc.), but the method for completing the task is left for the student to develop/ determine with minimal, if any, further instruction. *Based on Graph 1, which statement explains when X event will happen?*	G2	G3
Scripted Science Tasks: Students follow a script (defined actions or procedure) to complete a task.	Scripted items will typically direct the student to the information to use (Tab 1, Table 1, etc.) AND provide a set of well-defined actions or procedures to perform in order to complete a given task. Drag and drop (*Drag the arrows to complete the food chain*), hot spots, etc.	S2	S3

Item Sets and Item Types

An item set is a group of items that share the same stimulus centered on a specific science and/or engineering phenomenon. The AzSCI assessment uses two different types of item sets: independent and clusters. Sets of questions assess student application of knowledge across the domains of science for a comprehensive picture of student readiness for their next grade or course in science.

Independent Item Set	Cluster Item Set
Aligns to at least one standard	Aligns to at least one standard
Three or more associated items	Five associated items
Items must function independently and do not need to be related.	All five items will be placed on the same form and should work together to show understanding of the phenomena.
Stimulus has a maximum of two tabs. (Tabs are labeled as Figures/Tables).	Stimulus has a maximum of four tabs. (Tabs are labeled as Figures/Tables).
Answers to items may be found in figures, tables, and the text surrounding the figures and tables.	Answers to items may be found in figures, tables, and the text surrounding the figures and tables.

Standalone Item
Aligns to one standard
Discrete item that may be any item type
Item functions independently and is not related to other items.
Item is displayed on full screen, without a separate stimulus.
Answers to items may be found in figures, tables, and the text surrounding the figures and tables.

Item Types

AzSCI assessments are composed of item formats that include traditional multiple-choice response items (MC) and technology-enhanced response items (TEI).

For paper-based assessments, TEIs will be modified so that they can be key entered and scored electronically.

Item Type	Specifications
Multiple Choice (MC)	Four image, math, or text-based choices with a single correct choice
Multiple Response (MR)	Five to six image, math, or text-based choices with two or three correct choices (No partial credit)
Inline Choice	Multiple drop-down menus are used within a range of text to provide several options consisting of words or phrases.
Bar Graph	Vertical bar graph
Point Graph	Points are plotted on a graph.
Hot Spot	Object Selection, Graphic Change. One or more images or portions of an image are selected.
Match	Responses are dragged into text gaps.
Gap Match	Drag and Drop. Responses are dragged into categories.
Graphic Gap Match	Graphic Gap Match interactions are drag and drop that include responses that are images.
Gap Match - Table	Responses are dragged into a table grid.
Match-Table Grid	Responses are indicated by selecting radio buttons or checkboxes within a table grid.
Two-Part Independent (TPI)	Any combination of item types. Two-part independent (TPI) items will be weighted as two points, one point awarded for each part. TPI items ask the student to demonstrate a deeper understanding of the standard by completing two separate thought processes.
Two-Part Dependent (TPD)	Any combination of item types. Two-part dependent (TPD) items will be weighted as one point (no partial credit). TPD items ask students to demonstrate their understanding of the standard by selecting a claim in Part A and identifying supporting evidence in Part B. Correctly answering Part B is dependent on correctly answering Part A and is part of the same thought process.

Universal Tools

The following tools will be available in the online test administration platform to assist each student while taking the AzSCI.

Text to Speech: Text to speech is available to all students who take the AzSCI assessment in the online platform.

Answer Eliminator: Students can use this tool to cross out answers they believe are incorrect.

Notepad: Allows students to take notes on each item screen.

Ruler: Students measure objects on the screen using either a standard or metric ruler.

Highlighter: Students select words on the screen to highlight.

Zoom: If pictures and words on the screen are too small, students can make them larger using buttons on the keyboard.

Protractor: Students measure angles on the screen using the protractor tool.

Calculator:
Grade 5: A four-function calculator is permitted on AzSCI. The Desmos four-function calculator is embedded in the online AzSCI test.
Grades 8 and 11: A scientific calculator is permitted on AzSCI. The scientific calculator should include these functions: standard four functions (addition, subtraction, multiplication, and division), decimal, change sign (+/-), parentheses, square root, and π. They may NOT include: any problem-solving or programming capabilities, place values, or inequalities. Sample acceptable calculator: TI-30X IIS or similar. The Desmos Scientific calculator is embedded in the online AzSCI test.

Exhibits: Exhibits are information sheets available to help students answer some questions. The AzSCI assessment will provide the AzSCI Periodic Table of the Elements (https://www.azed.gov/sites/default/files/2020/10/AzSCI%20Periodic%20Table%20of%20the%20Elements-horizontal.pdf) on both the Grade 8 and Grade 11 assessments. The Grade 11 assessment will also have the AzSCI Formula Reference Guide (https://www.azed.gov/sites/default/files/2021/09/AZSci%20HS%20Reference%20Guide_w_Disclaimer_9.21.2021.pdf) available to assist students on questions that require the use of a specific formula. This document is NOT intended to dictate information that should be taught as part of Arizona Science Standards or curriculum. This reference sheet is intended to cover a list of all potential HS symbols, equations, terminology, and formulas that students may encounter on the AzSCI assessment.

AZ High School Item/Standard Specifications

HS.P1U1.1

Standard	**Develop and use models** to explain the relationship of the structure of atoms to patterns and properties observed within the Periodic Table and describe how these models are revised with new evidence.
SEPs	**Developing and Using Models**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Models, Figures, Diagrams

Task Demand	Common Item Formats
Use models to identify atomic structures. Use models of atomic structures to identify and predict periodic trends. Utilize the periodic table to identify elements that have similar chemical properties.	• Graphic Gap Match • Hot Spot • Inline Choice • Match -Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify subatomic particles of atoms **SEP** • identify reliable models • identify models that illustrate a relationship between systems	The student is able to • describe the electric charges of the subatomic particles in atoms **SEP** • distinguish models that address the same process or system • develop or modify a model based on evidence
Proficient	**Highly Proficient**
The student is able to • demonstrate the relationship of atomic structures to placement in the periodic table **SEP** • design a test of the model to ascertain reliability and identify limitations • develop and use models to describe merits or limitations of two models of the same process • develop and use models to show relationships between systems or components of a system • develop and use models to generate data that support explanations of phenomena or provide a solution to a problem • develop and use models to describe unobservable mechanisms	The student is able to • evaluate or predict how changes to atomic structures alter properties **SEP** • evaluate or revise a model for a proposed process, tool, or system • develop, revise, and use models to manipulate or test a proposed system • revise and use models to describe unobservable mechanisms • develop, revise, and use models to generate data useful in predicting phenomena

HS.P1U1.2

Standard	**Develop and use models** for the transfer or sharing of electrons to predict the formation of ions, molecules, and compounds in both natural and synthetic processes.
SEPs	**Developing and Using Models**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Models, Figures, Diagrams

Task Demand	Common Item Formats
Use models to identify or explain the transfer or sharing of electrons between atoms during a chemical reaction. Modify models to show how electrons are shared with or donated to other atoms when molecules are formed. Use models to determine the correct end product in a chemical reaction.	• Gap Match • Graphic Gap Match • Hot Spot • Inline Choice • Multiple Choice • Multiple Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify elements, ions, and molecules **SEP** • identify reliable models • identify models that illustrate a relationship between systems	The student is able to • describe how electrons can be shared or transferred **SEP** • distinguish models that address the same process or system • develop or modify a model based on evidence
Proficient	**Highly Proficient**
The student is able to • demonstrate the role of electrons in the formation of ions, molecules, and compounds **SEP** • design a test of the model to ascertain reliability and identify limitations • develop and use models to describe merits or limitations of two models of the same process • develop and use models to show relationships between systems or components of a system • develop and use models to generate data that support explanations of phenomena or provide a solution to a problem • develop and use models to describe unobservable mechanisms	The student is able to • evaluate conditions regarding electron activity in the formation of molecules **SEP** • evaluate or revise a model for a proposed process, tool, or system • develop, revise, and use models to manipulate or test a proposed system • revise and use models to describe unobservable mechanisms • develop, revise, and use models to generate data useful in predicting phenomena

HS.P1U1.3

Standard	**Ask questions, plan, and carry out investigations** to explore the cause and effect relationship between reaction rate factors.
SEPs	**Asking Questions and Defining Problems** **Planning and Carrying Out Investigations**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Identify or construct testable questions about reaction rates that can be answered through the investigative process. Identify controlled, dependent, and independent variables during investigations that explore reaction rates. Construct an experimental hypothesis that predicts changes to reaction rates based on existing experimental information. Predict or describe how reaction rates change when variables are changed.	• Hot Spot • Inline Choice • Match Table Grid • Multiple Choice • Multiple Select • Point Graph

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify conservation of mass in reactions **SEP** • ask questions that identify observations • ask questions that can be investigated in lab settings • ask questions that identify design problems • identify data that can be used as evidence • identify hypotheses that properly state the independent and dependent variables	The student is able to • identify factors that affect reaction rates **SEP** • ask questions that determine relationships between variables • ask questions that are testable • ask questions that arise from observation of phenomena or unexpected results • ask questions to distinguish variables • identify and carry out investigations that generate data that can be used as evidence to support explanations • identify and carry out investigations that produce data of sufficient quantity and accuracy to form or support explanations • identify and carry out investigations that include safe and ethical procedures • identify appropriate tools to collect, record, analyze, and evaluate data

Proficient	Highly Proficient
The student is able to • understand that reaction rates depend on molecular collisions **SEP** • ask questions that clarify or provide additional information about phenomena, models, or theories • ask questions to determine relationships, including quantitative relationships, between variables • determine whether a question is testable and relevant • test a design by producing relevant data • have directional hypotheses that will determine what happens to the responding variable when another variable is manipulated • provide data of a proposed process to identify failure points or to improve performance • use appropriate tools to collect, record, analyze, and evaluate data	The student is able to • predict the outcomes of reactions based on factors that affect molecular collisions **SEP** • ask questions that evaluate the relevance and feasibility of a proposed investigation • ask questions that revise or clarify a model, an explanation, or an engineering design • ask questions that challenge the premise(s) of an argument, the interpretation of data, or the suitability of a design • ensure proper variables are used, measured, and controlled • improve performance relative to criteria for success or other variables

HS.P1U3.4

Standard	**Obtain, evaluate, and communicate information** about how the use of chemistry related technologies have had positive and negative ethical, social, economic, and/or political implications.
SEPs	**Obtaining, Evaluating, and Communicating Information**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Describe economic, ethical, and political implications of utilizing chemicals that have environmental impacts. Evaluate and determine whether chemical related technologies have positive or negative impacts. Evaluate the impact of political and environmental policies for chemical technologies.	• Gap Match • Graphic Gap Match • Inline Choice • Match • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify ethical, social, economic, or political effects of chemistry-related technologies **SEP** • identify useful scientific information • identify ways to communicate scientific information	The student is able to • describe ethical, social, economic, and/or political implications of chemistry-related technologies **SEP** • obtain, evaluate, and communicate information to determine the central idea or conclusion of presented information • obtain, evaluate, and communicate information to distinguish sources of information that can be used to address a scientific question or problem
Proficient	**Highly Proficient**
The student is able to • differentiate between positive and negative ethical, social, economic, and/or political effects of chemistry-related technologies **SEP** • obtain, evaluate, and communicate information to summarize complex evidence, concepts, or processes • obtain, evaluate, and communicate information to integrate credible sources that address scientific questions or solve problems • obtain, evaluate, and communicate information to present technical information or ideas that address a phenomenon or that address the process of the development and design of a proposed solution	The student is able to • critique or predict the effects of chemistry-related technologies **SEP** • obtain, evaluate, and communicate information to defend or critique the validity or reliability of claims • obtain, evaluate, and communicate information to defend or critique the validity or reliability of sources of information

HS.P2U1.5

Standard	**Construct an explanation** for a field's strength and influence on an object (electric, gravitational, magnetic).
SEPs	**Constructing Explanations and Designing Solutions**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Explain the relationship between field strength and distance. Predict how an object moves when it is positioned near a field-producing object or when positioned between two field-producing objects. Identify forces, their relative magnitudes, and their directions. Explain how charge signs influence the direction of a field and how they can influence the motion of an object. Explain how mass and charge quantity can influence field strength. Explain how magnetic field direction and strength can be changed in electromagnets.	• Gap Match • Graphic Gap Match • Inline Choice • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify fields (electric, gravitational, magnetic) and forces (electric, gravitational, magnetic) **SEP** • identify explanations supported by evidence • identify manipulated and responding variables	The student is able to • distinguish the effects of distance, mass, or charge on the strength of fields (electric, gravitational, magnetic) and/or forces (electric, gravitational, magnetic) **SEP** • distinguish explanations and solutions that are supported by valid and reliable evidence • distinguish explanations and solutions that contain qualitative or quantitative information regarding the relationship between variables
Proficient	**Highly Proficient**
The student is able to • demonstrate factors that influence the strength of fields (electric, gravitational, magnetic) and forces (electric, gravitational, magnetic) **SEP** • make a quantitative and/or a qualitative claim regarding the relationship between manipulated and responding variables • construct explanations and design solutions based on reliable and valid evidence obtained from a variety of sources • apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems taking into account possible unanticipated effects • apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion	The student is able to • predict how field strength (electric, gravitational, magnetic) and the magnitude of force (electric, gravitational, magnetic) are affected by distance, mass, or charge **SEP** • construct and evaluate explanations and solutions that predict outcomes when certain conditions exist • construct and evaluate explanations and solutions that describe methods ensuring validity and reliability of results • construct and evaluate explanations and solutions that prioritize criteria and include tradeoff considerations

HS.P3U1.6

Standard	**Collect, analyze and interpret data** regarding the change in motion of an object or system in one dimension, to construct an explanation using Newton's Laws.
SEPs	**Analyzing and Interpreting Data**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Use motion data to compare the change in motion between objects. Use Newton's laws of motion to predict the change in an object's motion. Use data to determine whether objects are undergoing uniformly accelerated motion or maintaining constant motion. Use data to determine the relative magnitude and direction of forces acting on objects. Describe how changing variables affect an object's motion. Identify the relative magnitudes of forces acting on objects and how changes in magnitude and direction of forces affect an object's motion.	• Gap Match • Graphic Gap Match • Inline Choice • Match • Match Table Grid • Multiple Choice • Multiple Select • Point Graph

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify changes in an object's motion **SEP** • identify tools, technology, and/or models used in analyzing data	The student is able to • distinguish between constant motion and acceleration **SEP** • identify, distinguish, or describe data to compare data sets to determine consistency of observations • identify, distinguish, or describe data to provide an analysis of a proposed process or system
Proficient	**Highly Proficient**
The student is able to • demonstrate the role of force in situations that lead to changes in motion using Newton's Laws **SEP** • analyze and interpret data to make a valid and reliable scientific claim • analyze and interpret data to determine an optimal design solution • analyze and interpret data to establish limitations of data analysis • analyze and interpret data to identify design features or characteristics to optimize a process or system, given success criteria	The student is able to • evaluate situations to predict the cause or result of an object's motion using Newton's Laws **SEP** • analyze, interpret, and evaluate data to generate statistical analysis including correlation coefficient for linear data, slope, and intercept using digital tools • analyze, interpret, and evaluate data to determine measurement error • analyze, interpret, and evaluate data to propose explanations of the impact of new data on a process or system

HS.P3U2.7

Standard	**Use mathematics and computational thinking** to explain how Newton's laws are used in engineering and technologies to create products to serve human ends.
SEPs	**Using Mathematics and Computational Thinking**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Use math concepts to predict how changing variables in a system will change forces acting on an object. Use math concepts to describe forces that are present when objects are used to change the motion of other objects. Use math concepts to determine how forces will change the motion of an object. Describe how forces and counterforces act on objects within a defined system.	• Gap Match • Graphic Gap Match • Inline Choice • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify products engineered to involve motion **SEP** • identify what type of data (qualitative or quantitative) is best to determine whether a proposed object or tool meets criteria for success • identify units that accompany measurement computations	The student is able to • select math concepts applied to objects in everyday situations **SEP** • use mathematical and computational thinking to verify a solution • use mathematical and computational thinking to distinguish between solutions • use mathematical and computational thinking to apply correct units to solutions
Proficient	**Highly Proficient**
The student is able to • apply math concepts to explain how force is used in useful objects **SEP** • use mathematical and computational thinking to construct a model or simulation of a process, phenomenon, or system • use mathematical and computational thinking to select and apply correct techniques to derive a solution • use mathematical and computational thinking to apply ratios, rates, percentages, and unit conversions in measurements	The student is able to • predict outcome when changes are made to forces acting on everyday objects **SEP** • use mathematical and computational thinking to evaluate a proposed solution • use mathematical and computational thinking to revise a solution to include supplemental data • use mathematical and computational thinking to convert units of complex measurements involving derived units

HS.P4U1.8

Standard	**Engage in argument from evidence** that the net change of energy in a system is always equal to the total energy exchanged between the system and the surroundings.
SEPs	**Engaging in Argument From Evidence**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Use evidence to show that total energy is conserved as it moves through a system and transformed into different forms. Identify evidence that can confirm the conservation of energy within a system. Assess and evaluate statements that describe the movement and/or conservation of energy in a system. Use evidence to explain how energy leaves or is introduced into a system.	• Bar Graph • Gap Match • Graphic Gap Match • Hot Spot • Inline Choice • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify or define energy in different forms **SEP** • identify claims or evidence that support an argument	The student is able to • distinguish different forms of energy **SEP** • engage in arguments from evidence to describe merits of an argument • engage in arguments from evidence to distinguish data that support a claim or argument
Proficient	**Highly Proficient**
The student is able to • apply the conservation of energy principle to account for energy changes **SEP** • evaluate an argument or solutions in light of new evidence or trade-offs • evaluate evidence, claims, or reasons behind currently accepted explanations to determine the merits of an argument • engage in arguments from evidence to defend a claim or argument based on evidence based on scientific knowledge • engage in arguments from evidence to construct a claim, an argument, or counterargument based on data and evidence • engage in arguments from evidence to compare competing design solutions based on scientific principles	The student is able to • evaluate or construct explanations to describe conservation of energy **SEP** • engage in arguments from evidence to evaluate competing arguments or solutions in light of new evidence or trade-offs • engage in arguments from evidence to evaluate evidence, claims, or reasons behind currently accepted explanations to determine the merits of an argument

HS.P4U3.9

Standard	**Engage in argument from evidence** regarding the ethical, social, economic, and/or political benefits and liabilities of energy usage and transfer.
SEPs	**Engaging in Argument From Evidence**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Identify evidence that can be used to support or disprove statements concerning new energy technologies. Identify the benefits and potential costs of recapturing and storing energy using new technologies. Evaluate statements that predict changes in energy usage when new technologies are implemented on a large scale. Differentiate how energy is transferred between technologies that use different energy inputs.	• Gap Match • Graphic Gap Match • Inline Choice • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify benefits of energy usage **SEP** • identify claims or evidence that support an argument	The student is able to • differentiate effects of transfer of different energy resources in society **SEP** • engage in arguments from evidence to describe merits of an argument • engage in arguments from evidence to distinguish data that support a claim or argument
Proficient	**Highly Proficient**
The student is able to • demonstrate effects of energy usage/transfer involving different energy resources on society **SEP** • evaluate an argument or solutions in light of new evidence or trade-offs • evaluate evidence, claims, or reasons behind currently accepted explanations to determine the merits of an argument • engage in arguments from evidence to defend a claim or argument based on evidence based on scientific knowledge • engage in arguments from evidence to construct a claim, an argument, or counterargument based on data and evidence • engage in arguments from evidence to compare competing design solutions based on scientific principles	The student is able to • critique or revise explanations or predict outcome on society of energy usage/transfer involving different energy resources **SEP** • engage in arguments from evidence to evaluate competing arguments or solutions in light of new evidence or trade-offs • engage in arguments from evidence to evaluate evidence, claims, or reasons behind currently accepted explanations to determine the merits of an argument

HS.P4U1.10

Standard	**Construct an explanation** about the relationships among the frequency, wavelength, and speed of waves traveling in various media, and their applications to modern technology.
SEPs	**Constructing Explanations and Designing Solutions**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Details of quantum physics are not formally taught at this grade level.
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Describe how waves interact with different types of surfaces. Describe how the frequencies and wavelengths of waves produced from objects moving toward or away from an observation point change. Understand how light interacts with Earth as it enters the atmosphere. Describe how light can be used to create other forms of useful energy. Identify and describe the function of different wave components from different wave types.	• Gap Match • Graphic Gap Match • Hot Spot • Inline Choice • Multiple Choice • Multiple Select • Point Graph

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify characteristics of waves **SEP** • identify explanations supported by evidence • identify manipulated and responding variables	The student is able to • describe the relationship between frequency, wavelength, and speed of waves **SEP** • distinguish explanations and solutions that are supported by valid and reliable evidence • distinguish explanations and solutions that contain qualitative or quantitative information regarding the relationship between variables
Proficient	**Highly Proficient**
The student is able to • understand the effects different media have on wave characteristics, including in technological applications **SEP** • make a quantitative and/or a qualitative claim regarding the relationship between manipulated and responding variables • construct explanations and design solutions based on reliable and valid evidence obtained from a variety of sources • apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems taking into account possible unanticipated effects • apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion	The student is able to • predict wave behavior in different media, including behavior in technological applications **SEP** • construct and evaluate explanations and solutions that predict outcomes when certain conditions exist • construct and evaluate explanations and solutions that describe methods ensuring validity and reliability of results • construct and evaluate explanations and solutions that prioritize criteria and include tradeoff considerations

HS.E1U1.11

Standard	**Analyze and interpret data** to determine how energy from the Sun affects weather patterns and climate.
SEPs	**Analyzing and Interpreting Data**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	**Common Item Formats**
Identify that sunlight is the source for weather conditions. Correlate changes in the amount of energy produced by the sun to changes in climate. Describe how energy from the sun affects climate.	• Gap Match • Gap Match - Table • Hot Spot • Inline Choice • Match • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify the sun as the source of both weather and climate **SEP** • identify tools, technology, and/or models used in analyzing data	The student is able to • differentiate between weather and climate **SEP** • identify, distinguish, or describe data to compare data sets to determine consistency of observations • identify, distinguish, or describe data to provide an analysis of a proposed process or system
Proficient	**Highly Proficient**
The student is able to • demonstrate how energy from the sun affects weather patterns and climate **SEP** • analyze and interpret data to make a valid and reliable scientific claim • analyze and interpret data to determine an optimal design solution • analyze and interpret data to establish limitations of data analysis • analyze and interpret data to identify design features or characteristics to optimize a process or system, given success criteria	The student is able to • predict how changes in Earth's atmosphere affect weather and climate **SEP** • analyze, interpret, and evaluate data to generate statistical analysis including correlation coefficient for linear data, slope, and intercept using digital tools • analyze, interpret, and evaluate data to determine measurement error • analyze, interpret, and evaluate data to propose explanations of the impact of new data on a process or system

HS.E1U1.12

Standard	**Develop and use models** of the Earth that explains the role of energy and matter in Earth's constantly changing internal and external systems (geosphere, hydrosphere, atmosphere, biosphere).
SEPs	**Developing and Using Models**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Models, Figures, Diagrams

Task Demand	Common Item Formats
Determine what kinds of changes occur to Earth's systems when energy is added or removed. Model the movement of energy and matter through Earth's systems. Use models to show how energy inputs can influence Earth's systems. Explain how energy, when added to one of Earth's systems, can affect other systems. Predict how changes in energy inputs can affect Earth's systems.	• Bar Graph • Graphic Gap Match • Hot Spot • Inline Choice • Match • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify changes in matter that occur in Earth's internal and external systems **SEP** • identify reliable models • identify models that illustrate a relationship between systems	The student is able to • describe the role of energy in changes that can occur in Earth's external and internal systems **SEP** • distinguish models that address the same process or system • develop or modify a model based on evidence
Proficient	**Highly Proficient**
The student is able to • demonstrate the role of energy and matter in changes in Earth's internal and external systems **SEP** • design a test of the model to ascertain reliability and identify limitations • develop and use models to describe merits or limitations of two models of the same process • develop and use models to show relationships between systems or components of a system • develop and use models to generate data that support explanations of phenomena or provide a solution to a problem • develop and use models to describe unobservable mechanisms	The student is able to • evaluate or revise explanations of factors that cause changes in Earth's internal and external systems **SEP** • evaluate or revise a model for a proposed process, tool, or system • develop, revise, and use models to manipulate or test a proposed system • revise and use models to describe unobservable mechanisms • develop, revise, and use models to generate data useful in predicting phenomena

HS.E1U1.13

Standard	**Evaluate explanations** and theories about the role of energy and matter in geologic changes over time.
SEPs	**Constructing Explanations and Designing Solutions**
CCCs	Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Describe how energy drives tectonic plate movement, crust formation, and recycling of Earth's crust. Explain how the cycling of energy and matter causes the formation of and change in geological features over time. Describe how surface conditions can cause geological changes over time.	• Hot Spot • Inline Choice • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify theories about the role of energy and matter in geologic changes over time **SEP** • identify explanations supported by evidence • identify manipulated and responding variables	The student is able to • compare theories about the role of energy and matter in geologic changes over time **SEP** • distinguish explanations and solutions that are supported by valid and reliable evidence • distinguish explanations and solutions that contain qualitative or quantitative information regarding the relationship between variables
Proficient	**Highly Proficient**
The student is able to • evaluate theories about the role of energy and matter in geologic changes over time **SEP** • make a quantitative and/or a qualitative claim regarding the relationship between manipulated and responding variables • construct explanations and design solutions based on reliable and valid evidence obtained from a variety of sources • apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems taking into account possible unanticipated effects • apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion	The student is able to • evaluate changes in Earth's surface based on theories about the role of energy and matter in geologic changes over time **SEP** • construct and evaluate explanations and solutions that predict outcomes when certain conditions exist • construct and evaluate explanations and solutions that describe methods ensuring validity and reliability of results • construct and evaluate explanations and solutions that prioritize criteria and include tradeoff considerations

HS.E1U3.14

Standard	**Engage in argument from evidence** about the availability of natural resources, occurrence of natural hazards, changes in climate, and human activity and how they influence each other.
SEPs	**Engaging in Argument From Evidence**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Identify evidence that can support claims about the effect of human activity on climate. Evaluate arguments that describe how changes in the use of natural resources can affect climate. Evaluate methods for conserving natural resources in order to sustain human populations and the environment. Demonstrate how human practices can have a positive or negative impact on climate, resource availability, or the frequency of natural hazards. Differentiate between different extraction methods of natural resources, and construct arguments based on their pros and cons.	• Inline Choice • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify impact of human activity on natural resources **SEP** • identify claims or evidence that support an argument	The student is able to • describe effects of human activity on climate, natural resources, and/or natural hazards **SEP** • engage in arguments from evidence to describe merits of an argument • engage in arguments from evidence to distinguish data that support a claim or argument
Proficient	**Highly Proficient**
The student is able to • describe the interrelatedness of human activity, natural resources, natural hazards, and climate **SEP** • evaluate an argument or solutions in light of new evidence or trade-offs • evaluate evidence, claims, or reasons behind currently accepted explanations to determine the merits of an argument • engage in arguments from evidence to defend a claim or argument based on evidence based on scientific knowledge • engage in arguments from evidence to construct a claim, an argument, or counterargument based on data and evidence • engage in arguments from evidence to compare competing design solutions based on scientific principles	The student is able to • evaluate or predict outcomes of human activity on natural resources, hazards, or climate **SEP** • engage in arguments from evidence to evaluate competing arguments or solutions in light of new evidence or trade-offs • engage in arguments from evidence to evaluate evidence, claims, or reasons behind currently accepted explanations to determine the merits of an argument

HS.E2U1.15

Standard	**Construct an explanation based on evidence** to illustrate the role of nuclear fusion in the life cycle of a star.
SEPs	**Constructing Explanations and Designing Solutions** **Engaging in Argument From Evidence**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Identify hydrogen nuclei as the initial fuel input for fusion in a star. Understand that heavier elements are formed during the initial and following fusion reactions during a star's life up to iron. Evaluate changes in light emitted from stars during different stages of the star life cycle due to changes in the type of fusion that is occurring. Understand that the rate of fusion can influence light that is emitted from stars. Understand that the life cycles of regular-mass and supermassive stars are different.	• Gap Match • Hot Spot • Inline Choice • Match • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify fuel source for stars **SEP** • identify explanations supported by evidence • identify manipulated and responding variables • identify claims or evidence that support an argument	The student is able to • describe the life cycle of a star **SEP** • distinguish explanations and solutions that are supported by valid and reliable evidence • distinguish explanations and solutions that contain qualitative or quantitative information regarding the relationship between variables • engage in arguments from evidence to describe merits of an argument • engage in arguments from evidence to distinguish data that support a claim or argument

Proficient	Highly Proficient
The student is able to • demonstrate the role of nuclear fusion in a star's life cycle **SEP** • make a quantitative and/or a qualitative claim regarding the relationship between manipulated and responding variables • construct explanations and design solutions based on reliable and valid evidence obtained from a variety of sources • apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems taking into account possible unanticipated effects • apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion • evaluate an argument or solutions in light of new evidence or trade-offs • evaluate evidence, claims, or reasons behind currently accepted explanations to determine the merits of an argument • engage in arguments from evidence to defend a claim or argument based on evidence based on scientific knowledge • engage in arguments from evidence to construct a claim, an argument, or counterargument based on data and evidence • engage in arguments from evidence to compare competing design solutions based on scientific principles	The student is able to • predict energy and/or starlight changes based on nuclear changes **SEP** • construct and evaluate explanations and solutions that predict outcomes when certain conditions exist • construct and evaluate explanations and solutions that describe methods ensuring validity and reliability of results • construct and evaluate explanations and solutions that prioritize criteria and include tradeoff considerations • engage in arguments from evidence to evaluate competing arguments or solutions in light of new evidence or trade-offs • engage in arguments from evidence to evaluate evidence, claims, or reasons behind currently accepted explanations to determine the merits of an argument

HS.E2U1.16

Standard	**Construct an explanation** of how gravitational forces impact the evolution of planetary motion, structure, surfaces, atmospheres, moons, and rings.
SEPs	**Constructing Explanations and Designing Solutions**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Describe or predict the relative magnitude of the gravitational force acting on an orbiting object based on radial distance and masses of the interacting objects. Understand that satellite objects orbiting at lower altitudes must move at a greater orbital velocity to maintain orbit to offset a greater gravitational pull compared to slower-moving satellite objects at higher altitudes. Explain how gravitational action pairs can form larger spatial objects such as planets and moons. Describe how gravitational forces can pull objects apart and/or capture moving objects in space to form planetary rings. Explain how the gravitational force acting on an object can be non-constant for satellite objects that have an elliptical orbit.	• Hot Spot • Inline Choice • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify gravity as the relevant force in planetary motion **SEP** • identify explanations supported by evidence • identify manipulated and responding variables	The student is able to • describe planetary orbital paths in terms of gravitational force **SEP** • distinguish explanations and solutions that are supported by valid and reliable evidence • distinguish explanations and solutions that contain qualitative or quantitative information regarding the relationship between variables
Proficient	**Highly Proficient**
The student is able to • demonstrate how gravitational forces impact the evolution of planetary motion, structure, atmospheres, moons, and rings **SEP** • make a quantitative and/or a qualitative claim regarding the relationship between manipulated and responding variables • construct explanations and design solutions based on reliable and valid evidence obtained from a variety of sources • apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems taking into account possible unanticipated effects • apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion	The student is able to • predict effects of other bodies' gravitational force on planetary motion and features **SEP** • construct and evaluate explanations and solutions that predict outcomes when certain conditions exist • construct and evaluate explanations and solutions that describe methods ensuring validity and reliability of results • construct and evaluate explanations and solutions that prioritize criteria and include tradeoff considerations

HS.E2U1.17

Standard	**Construct an explanation** of the origin, expansion, and scale of the universe based on astronomical evidence.
SEPs	**Constructing Explanations and Designing Solutions**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Use evidence to explain why most galaxies are moving away from the Milky Way at an increasing rate of motion. Understand that starlight can be used to measure the distance of a star from Earth and explain how Doppler shifts can be used to determine the direction of motion of galaxies. Analyze the universal expansion models and use CMB data to determine probable areas of star formation during the distant past. Understand that galactic distances are measured in light-years.	• Hot Spot • Inline Choice • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify the scale used for galactic distances • describe the origin of the universe **SEP** • identify explanations supported by evidence • identify manipulated and responding variables	The student is able to • describe methods for measuring the expansion of the universe **SEP** • distinguish explanations and solutions that are supported by valid and reliable evidence • distinguish explanations and solutions that contain qualitative or quantitative information regarding the relationship between variables
Proficient	**Highly Proficient**
The student is able to • demonstrate the origin, expansion, and scale of the universe based on astronomical evidence **SEP** • make a quantitative and/or a qualitative claim regarding the relationship between manipulated and responding variables • construct explanations and design solutions based on reliable and valid evidence obtained from a variety of sources • apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems taking into account possible unanticipated effects • apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion	The student is able to • evaluate evidence for origin, expansion, and/or scale of the universe **SEP** • construct and evaluate explanations and solutions that predict outcomes when certain conditions exist • construct and evaluate explanations and solutions that describe methods ensuring validity and reliability of results • construct and evaluate explanations and solutions that prioritize criteria and include tradeoff considerations

HS.L2U3.18

Standard	**Obtain, evaluate, and communicate** about the positive and negative ethical, social, economic, and political implications of human activity on the biodiversity of an ecosystem.
SEPs	**Obtaining, Evaluating, and Communicating Information**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Determine if ecosystem stability is affected by human activity. Differentiate between natural and human-caused activities that affect biodiversity in ecosystems. Show how changes in human activity have affected ecosystem biodiversity. Use information to predict how current human activities and changes in human activities will affect ecosystem biodiversity in the short term and in the long term.	• Gap Match Table • Hot Spot • Inline Choice • Match • Match Table Grid • Multiple Choice • Multiple Select • Point Graph

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify stable ecosystems **SEP** • identify useful scientific information • identify ways to communicate scientific information	The student is able to • describe human activities that can impact an ecosystem **SEP** • obtain, evaluate, and communicate information to determine the central idea or conclusion of presented information • obtain, evaluate, and communicate information to distinguish sources of information that can be used to address a scientific question or problem
Proficient	**Highly Proficient**
The student is able to • demonstrate how humans affect the biodiversity of an ecosystem **SEP** • obtain, evaluate, and communicate information to summarize complex evidence, concepts, or processes • obtain, evaluate, and communicate information to integrate credible sources that address scientific questions or solve problems • obtain, evaluate, and communicate information to present technical information or ideas that address a phenomenon or that address the process of the development and design of a proposed solution	The student is able to • predict or evaluate results of human activity on the biodiversity of an ecosystem **SEP** • obtain, evaluate, and communicate information to defend or critique the validity or reliability of claims • obtain, evaluate, and communicate information to defend or critique the validity or reliability of sources of information

HS.L2U1.19

Standard	**Develop and use models** that show how changes in the transfer of matter and energy within an ecosystem and interactions between species may affect organisms and their environment.
SEPs	**Developing and Using Models**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Models, Figures, Diagrams

Task Demand	Common Item Formats
Identify the sun as the primary energy input in an ecosystem. Identify how organisms from each trophic level obtain matter and energy. Track the movement of matter and energy through an ecosystem. Predict how changes in an ecosystem can change the availability as well as the movement of matter and energy in a system.	• Bar Graph • Gap Match • Graphic Gap Match • Hot Spot • Inline Choice • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify sources of energy for ecosystems **SEP** • identify reliable models • identify models that illustrate a relationship between systems	The student is able to • distinguish energy sources available to different species in an ecosystem **SEP** • distinguish models that address the same process or system • develop or modify a model based on evidence
Proficient	**Highly Proficient**
The student is able to • understand how energy transfer involving different species occurs in an ecosystem **SEP** • design a test of the model to ascertain reliability and identify limitations • develop and use models to describe merits or limitations of two models of the same process • develop and use models to show relationships between systems or components of a system • develop and use models to generate data that support explanations of phenomena or provide a solution to a problem • develop and use models to describe unobservable mechanisms	The student is able to • predict effects of changes in available energy to different species in an ecosystem **SEP** • evaluate or revise a model for a proposed process, tool, or system • develop, revise, and use models to manipulate or test a proposed system • revise and use models to describe unobservable mechanisms • develop, revise, and use models to generate data useful in predicting phenomena

HS.L1U1.20

Standard	**Ask questions** and/or make predictions based on observations and evidence to demonstrate how cellular organization, structure, and function allow organisms to maintain homeostasis.
SEPs	**Asking Questions and Defining Problems**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Identify cell structures and understand their function. Understand processes and transport systems that maintain homeostasis. Predict how external factors can influence homeostasis. Ask questions about how homeostasis can be maintained or disrupted. Understand how daily activities or changes in routine can affect homeostasis in the body.	• Gap Match • Gap Match Table • Hot Spot • Inline Choice • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify major cell structures **SEP** • ask questions that identify observations • ask questions that can be investigated in lab settings • ask questions that identify design problems	The student is able to • distinguish cell organelles and their functions **SEP** • ask questions that determine relationships between variables • ask questions that are testable • ask questions that arise from observation of phenomena or unexpected results • ask questions to distinguish variables
Proficient	**Highly Proficient**
The student is able to • demonstrate cellular organization and processes to maintain homeostasis **SEP** • ask questions that clarify or provide additional information about phenomena, models, or theories • ask questions to determine relationships, including quantitative relationships, between variables • determine if a question is testable and relevant	The student is able to • predict how changes in external factors affect cellular activities **SEP** • ask questions that evaluate the relevance and feasibility of a proposed investigation • ask questions that revise or clarify a model, an explanation, or an engineering design • ask questions that challenge the premise(s) of an argument, the interpretation of data, or the suitability of a design

HS.L2U1.21

Standard	**Obtain, evaluate, and communicate data** showing the relationship of photosynthesis and cellular respiration; flow of energy and cycling of matter.
SEPs	**Obtaining, Evaluating, and Communicating Information**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Differentiate between the inputs and outputs of photosynthesis and respiration. Describe the energy and matter transformations that occur during photosynthesis and cellular respiration. Understand how matter enters and leaves cells before and after photosynthesis and cellular respiration reactions. Determine how changes in external inputs can influence the rate at which photosynthesis and cellular respiration occur.	• Gap Match • Graphic Gap Match • Inline Choice • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • differentiate photosynthesis from cellular respiration **SEP** • identify useful scientific information • identify ways to communicate scientific information	The student is able to • identify inputs and outputs of photosynthesis and cellular respiration **SEP** • obtain, evaluate, and communicate information to determine the central idea or conclusion of presented information • obtain, evaluate, and communicate information to distinguish sources of information that can be used to address a scientific question or problem
Proficient	**Highly Proficient**
The student is able to • show the flow of energy and matter between photosynthesis and cellular respiration **SEP** • obtain, evaluate, and communicate information to summarize complex evidence, concepts, or processes • obtain, evaluate, and communicate information to integrate credible sources that address scientific questions or solve problems • obtain, evaluate, and communicate information to present technical information or ideas that address a phenomenon or that address the process of the development and design of a proposed solution	The student is able to • evaluate/contrast the conditions, inputs, and outputs for photosynthesis and cellular respiration **SEP** • obtain, evaluate, and communicate information to defend or critique the validity or reliability of claims • obtain, evaluate, and communicate information to defend or critique the validity or reliability of sources of information

HS.L1U1 .22

Standard	**Construct an explanation** for how cellular division (mitosis) is the process by which organisms grow and maintain complex, interconnected systems.
SEPs	**Constructing Explanations and Designing Solutions**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Explain the process of mitosis. Describe how diseases and cell damage can impede cellular functions. Explain how mitosis promotes growth and maintains systems.	• Graphic Gap Match • Inline Choice • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify cell division as a cell activity **SEP** • identify explanations supported by evidence • identify manipulated and responding variables	The student is able to • describe outcome of cell division **SEP** • distinguish explanations and solutions that are supported by valid and reliable evidence • distinguish explanations and solutions that contain qualitative or quantitative information regarding the relationship between variables
Proficient	**Highly Proficient**
The student is able to • demonstrate that mitosis is a cellular process for growth and maintaining interconnected systems **SEP** • make a quantitative and/or a qualitative claim regarding the relationship between manipulated and responding variables • construct explanations and design solutions based on reliable and valid evidence obtained from a variety of sources • apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems taking into account possible unanticipated effects • apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion	The student is able to • demonstrate how disruptions in the cell-division process interfere with growth and maintaining interconnected systems **SEP** • construct and evaluate explanations and solutions that predict outcomes when certain conditions exist • construct and evaluate explanations and solutions that describe methods ensuring validity and reliability of results • construct and evaluate explanations and solutions that prioritize criteria and include tradeoff considerations

HS.L3U1.24

Standard	**Construct an explanation** of how the process of sexual reproduction contributes to genetic variation.
SEPs	**Constructing Explanations and Designing Solutions**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Understand that an offspring receives half of its genes from each parent. Describe the formation of sex cells during/from meiosis Explain how genetic variation occurs and how to optimize genetic variation throughout a population.	• Gap Match Table • Inline Choice • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify DNA's role in sexual reproduction **SEP** • identify explanations supported by evidence • identify manipulated and responding variables	The student is able to • describe how sex cells form **SEP** • distinguish explanations and solutions that are supported by valid and reliable evidence • distinguish explanations and solutions that contain qualitative or quantitative information regarding the relationship between variables
Proficient	**Highly Proficient**
The student is able to • demonstrate how genetic variation is achieved by sexual reproduction **SEP** • make a quantitative and/or a qualitative claim regarding the relationship between manipulated and responding variables • construct explanations and design solutions based on reliable and valid evidence obtained from a variety of sources • apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems taking into account possible unanticipated effects • apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion	The student is able to • predict the outcome of situations involving sexual reproduction **SEP** • construct and evaluate explanations and solutions that predict outcomes when certain conditions exist • construct and evaluate explanations and solutions that describe methods ensuring validity and reliability of results • construct and evaluate explanations and solutions that prioritize criteria and include tradeoff considerations

HS.L3U1.25

Standard	**Obtain, evaluate, and communicate information** about the causes and implications of DNA mutation.
SEPs	**Obtaining, Evaluating, and Communicating Information**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Understand that changes in a nucleotide sequence can result in mutations. Differentiate between the types of DNA mutations. Communicate how gene mutations can cause changes in the expression of traits. Communicate positive and negative outcomes caused by DNA mutations.	• Gap Match Table • Graphic Gap Match • Inline Choice • Match • Match Table Grid • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify a DNA mutation **SEP** • identify useful scientific information • identify ways to communicate scientific information	The student is able to • describe causes of DNA mutations **SEP** • obtain, evaluate, and communicate information to determine the central idea or conclusion of presented information • obtain, evaluate, and communicate information to distinguish sources of information that can be used to address a scientific question or problem
Proficient	**Highly Proficient**
The student is able to • demonstrate causes and implications of DNA mutations **SEP** • obtain, evaluate, and communicate information to summarize complex evidence, concepts, or processes • obtain, evaluate, and communicate information to integrate credible sources that address scientific questions or solve problems • obtain, evaluate, and communicate information to present technical information or ideas that address a phenomenon or that address the process of the development and design of a proposed solution	The student is able to • predict the effect of DNA mutations on the expression of traits **SEP** • obtain, evaluate, and communicate information to defend or critique the validity or reliability of claims • obtain, evaluate, and communicate information to defend or critique the validity or reliability of sources of information

HS.L3U3.26

Standard	**Engage in argument from evidence** regarding the ethical, social, economic, and/or political implications of a current genetic technology.
SEPs	**Engaging in Argument From Evidence**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Describe how technology is used to create mutations that result in the expression of desired traits. Evaluate arguments addressing the benefits and drawbacks of using gene-modifying technologies in agricultural practices. Evaluate the benefits, drawbacks, and limitations of using gene mapping to identify native and non-native species in an ecosystem. Describe the benefits, limitations, and drawbacks of introducing a genetically modified organism into an ecosystem.	• Gap Match • Inline Choice • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify genetic technology **SEP** • identify claims or evidence that support an argument	The student is able to • describe effects of gene technology **SEP** • engage in arguments from evidence to describe merits of an argument • engage in arguments from evidence to distinguish data that support a claim or argument
Proficient	**Highly Proficient**
The student is able to • describe ethical, social, economic, and/or political implications of the application of gene technology **SEP** • evaluate an argument or solutions in light of new evidence or trade-offs • evaluate evidence, claims, or reasons behind currently accepted explanations to determine the merits of an argument • engage in arguments from evidence to defend a claim or argument based on evidence based on scientific knowledge • engage in arguments from evidence to construct a claim, an argument, or counterargument based on data and evidence • engage in arguments from evidence to compare competing design solutions based on scientific principles	The student is able to • evaluate the implications of employing gene technology **SEP** • engage in arguments from evidence to evaluate competing arguments or solutions in light of new evidence or trade-offs • engage in arguments from evidence to evaluate evidence, claims, or reasons behind currently accepted explanations to determine the merits of an argument

HS.L4U1.27

Standard	**Obtain, evaluate, and communicate** evidence that describes how changes in frequency of inherited traits in a population can lead to biological diversity.
SEPs	**Obtaining, Evaluating, and Communicating Information**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Identify expressed traits and understand that they can change over time. Describe how changes in the environment can contribute to the expression of certain traits in a population. Based on presented information, identify factors that can cause variations in gene expression in a population. Describe how gradual changes in traits can lead to increased biodiversity over time.	• Hot Spot • Gap Match • Graphic Gap Match • Inline Choice • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify genetic traits **SEP** • identify useful scientific information • identify ways to communicate scientific information	The student is able to • describe trait variation frequencies in a population **SEP** • obtain, evaluate, and communicate information to determine the central idea or conclusion of presented information • obtain, evaluate, and communicate information to distinguish sources of information that can be used to address a scientific question or problem
Proficient	**Highly Proficient**
The student is able to • demonstrate how biodiversity is affected by the frequency of inherited traits in a population **SEP** • obtain, evaluate, and communicate information to summarize complex evidence, concepts, or processes • obtain, evaluate, and communicate information to integrate credible sources that address scientific questions or solve problems • obtain, evaluate, and communicate information to present technical information or ideas that address a phenomenon or that address the process of the development and design of a proposed solution	The student is able to • predict how variation of traits in a population can lead to biological diversity over multiple generations **SEP** • obtain, evaluate, and communicate information to defend or critique the validity or reliability of claims • obtain, evaluate, and communicate information to defend or critique the validity or reliability of sources of information

HS.L4U1.28

Standard	**Gather, evaluate, and communicate** multiple lines of empirical evidence to explain the mechanisms of biological evolution.
SEPs	**Obtaining, Evaluating, and Communicating Information**
CCCs	Patterns; Cause and Effect; Scale, Proportion and Quantity; Systems and System Models; Energy and Matter; Stability and Change; Structure and Function
Assessment Boundaries	Not applicable
Stimulus Materials	Figures, Diagrams, Graphs, Tables

Task Demand	Common Item Formats
Identify evidence that shows how different species evolved from a common ancestor. Use information to communicate how a species can evolve over time. Use information to describe the processes involved in the evolution of a species. Identify evidence of evolution within presented information.	• Hot Spot • Gap Match • Graphic Gap Match • Inline Choice • Multiple Choice • Multiple Select

Performance Level Descriptors

Minimally Proficient	Partially Proficient
The student strives to • identify evidence of evolution **SEP** • identify useful scientific information • identify ways to communicate scientific information	The student is able to • describe the process of natural selection **SEP** • obtain, evaluate, and communicate information to determine the central idea or conclusion of presented information • obtain, evaluate, and communicate information to distinguish sources of information that can be used to address a scientific question or problem
Proficient	**Highly Proficient**
The student is able to • demonstrate multiple mechanisms of evolution **SEP** • obtain, evaluate, and communicate information to summarize complex evidence, concepts, or processes • obtain, evaluate, and communicate information to integrate credible sources that address scientific questions or solve problems • obtain, evaluate, and communicate information to present technical information or ideas that address a phenomenon or that address the process of the development and design of a proposed solution	The student is able to • evaluate evidence that explains the mechanisms of evolution **SEP** • obtain, evaluate, and communicate information to defend or critique the validity or reliability of claims • obtain, evaluate, and communicate information to defend or critique the validity or reliability of sources of information

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