Alabama Comprehensive Assessment Program (ACAP)

Summative

Item Specifications

Science

Grade 4

Alabama Item Specifications

Grade 4 Science

Alabama Comprehensive Assessment Program (ACAP) *Summative*

The *Alabama Comprehensive Assessment Program* (ACAP) *Summative* item specifications are based on the development of summative assessments that measure the Alabama Course of Study Standards. The item specifications define the purpose of the *ACAP Summative* and provide important information regarding the content to be measured. The item specifications also serve as a road map to guide Alabama educators in the development and subsequent review of items that best measure the Course of Study Standards for a given grade and content area. Each content-area and grade-level item specification aligned to the given domain, cluster, and standard includes the following key information:

- Evidence statements
- Content limits/constraints
- Recommended Webb's Depth of Knowledge (DOK) or cognitive levels
- Item types for measuring a given standard
- Information regarding whether context is allowable
- Sample item stem information

The appendix to this document includes sample test items, along with information about the item, including item type, page reference, alignment, point value, depth of knowledge, and answer key. These sample items are provided to be an additional resource for educators to help guide instruction and assessment building in the classroom. Teachers can use the sample items as models when leading classroom discussion as well as creating items for classroom tests or quizzes. In each sample item, the level of rigor needed in the item in order to align with the content standard is evident.

Definitions

Course of Study Standards: The Course of Study Standards are a set of content curriculum statements that define what students should know and be able to do at a given grade level. The goal is to prepare students for future opportunities and options in the workplace and for everyday life. Through the implementation of the Alabama Course of Study: Science, students will be well equipped for the workforce upon graduation or be ready to pursue higher levels of education in Alabama's colleges and universities.

Domain: A domain is a group of related clusters and content standards. Sometimes standards from different domains may be closely related.

Subdomain: A subdomain is a smaller grouping of standards within the domain. For example, within the domain of Earth and Space Science are the subdomains of Earth's Place in the Universe, Earth's Systems, and Earth and Human Activity.

Standard: The standard defines what students should understand (know) and be able to do at the conclusion of a course or grade. The standard text in the item specification is preceded by a standard identifier (e.g., 4.PS.2) to indicate the student grade level as fourth (4), the domain as Physical Science (PS), and the standard number as two (2).

Evidence Statements: Evidence statements are closely aligned to the standard and do not deviate from the requirements of the standard. Standards that are substantial in content do provide for a better opportunity to "unpack the standard," which is the case for many of the Alabama Course of Study Standards. The evidence statements serve that purpose.

Assessment Limits/Content Constraints: Assessment limits and/or content constraints define the range of content knowledge and degree of difficulty that is allowable when items are written to measure a given standard.

Depth of Knowledge (DOK): Depth of knowledge involves the cognitive complexity or the nature of thinking required for a given item. Most recently, Webb's Depth of Knowledge levels are used in the development of items for cognitive demand. Therefore, when developing items for depth of knowledge, the item should be as demanding cognitively as what the actual standard expects. Webb's Depth of Knowledge includes four levels, from the lowest (basic recall) to the highest (extended thinking). The science *ACAP Summative* assessment items are written to one of three cognitive levels of complexity as follows:

- Level 1: Recall
- Level 2: Application of a Skill/Concept
- Level 3: Strategic Thinking

Item Types: The *ACAP Summative* assessments are composed of various item types. These item types are described in the following section.

Sample Stem Information: This statement explains what students are expected to do when they respond to a given item.

Item Types

The *Alabama Comprehensive Assessment Program* (ACAP) *Summative* assessments are composed of various item types. These item types are described below.

Multiple-Choice (MC) Items: MC items have four answer choices, including three distractors and one correct answer. Distractors for science represent common misconceptions, incorrect logic, incorrect understanding of scientific concepts and or principles, etc. A correct response to an MC item is worth one score point in the science *ACAP Summative*.

Multiple-Select (MS) Items: MS items are similar in structure to MC items. However, unlike an MC item, an MS item is composed of more than four options and more than one correct answer. In other words, multiple responses are required for a given item. For science, there are two types of MS configurations. One has five answer options, two of which are correct, and one has six answer options, two or three of which are correct. Directions for the number of options to select are provided with each item. A correct response to an MS item is worth one score point in the science *ACAP Summative*.

Short-Answer (SA) Items: SA items are constructed-response items that require a keyed response from the student. The number of characters is limited to a relatively small number in order to facilitate autoscoring. The types of characters allowed can also be limited to text only, numbers only, or a mix.

Technology-Enhanced (TE) Items: TE items share the same functional structure as traditional paper-and-pencil test items; however, the expansive features and functions of a computer-based medium allow for the incorporation of technical enhancements into traditional elements of a test item, such as the item stem, the stimulus (if any), the response area, or a combination of all three. These items require the use of one or more tools. In the science *ACAP Summative*, these item types are autoscored using scoring guidelines for the correct answer. TE items are worth one or two score points.

Science TE items include, but are not limited to, the following:

- **Drag-and-Drop Input:** These TE items provide a student with draggable entities that can be configured to be used once or multiple times.
- **Drop-Down List Input:** These TE items allow a student to select elements in drop-down lists that can be embedded within text or tables.
- **Hot Spot:** These TE items allow for an image to be highlighted or replaced with another image when selected by the student.
- **Text Highlight:** These TE items allow for designated text to be highlighted in a word, phrase, sentence, or paragraph.
- **Matching Table:** These TE items include a table with multiple rows and columns, and the student makes matches between the given elements in the rows and columns. The table can be customized to allow for only a single selection in a row or column or for multiple selections within each.
- **Bar Graph:** These TE items allow a student to adjust the bars of a graph up or down to identify specific values during the development of these items.

Item Specifications for Science

Item specifications are one of the key requirements for a high-quality, legally defensible, standards-based assessment. Item specifications help define important characteristics of the items (i.e., test questions) developed for each standard. These item specifications provide guidelines to help clarify the focus of what is to be assessed, what items may include, and what items may not include (i.e., assessment limits). Item specifications are used by item writers, item editors, and item reviewers as a common reference throughout the item-development process, from initial writing to final approval. These sample science item specifications are based on the Alabama Course of Study Standards.

Domain	PS-Physical Science
Subdomain	Energy
Standard	4.PS.1: Use evidence to explain the relationship of the speed of an object to the energy of that object.
Evidence Statements	The examinee will demonstrate an understanding of using evidence such as observations and patterns to explain the relationship of the speed of an object to the energy of that object by • describing how the relative speed of an object (fast vs. slow) relates to the relative energy of the object.
Assessment Limits / Content Constraints	• Assessment items should not include quantitative measurements of changes in speed of an object in motion. • Assessment items should not include any quantitative definitions of energy.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Two identical marbles, Marbles X and Y, are traveling down ramps of the same length. Marble X travels faster down its ramp than Marble Y does. Which marble has more energy as it rolls down the ramp, and why?

Domain	PS-Physical Science
Subdomain	Energy
Standard	4.PS.2: Plan and carry out investigations that explain transference of energy from place to place by sound, light, heat, and electric currents.
Evidence Statements	The examinee will demonstrate an understanding of planning and carrying out investigations that explain transference of energy from place to place by sound, light, heat, and electric currents by • providing evidence that heat can be produced in many ways and can move from one object to another by conduction; • demonstrating that different objects can absorb, reflect, and/or conduct energy; or • demonstrating that electric currents require a complete loop through which an electric current can pass.
Assessment Limits / Content Constraints	• Examinees can design an investigation, refine a provided investigation, or explain transfers of energy occurring within a current investigation design. • Examples of ways the heat can be produced include rubbing hands together and burning objects, such as dried leaves. • Assessment items should be limited to only sound, light, heat, and electric currents as transferences of energy. • Assessment items should not include classifying different forms of heat energy (i.e., radiation, convection, conduction) or chemical energy.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which investigation would **best** test an energy exchange related to light and heat?

Domain	PS-Physical Science
Subdomain	Energy
Standard	4.PS.3: Investigate to determine changes in energy resulting from increases or decreases in speed that occur when objects collide.
Evidence Statements	The examinee will demonstrate an understanding of investigating to determine the changes in energy that result from increases or decreases in speed that occur when objects collide by • using evidence from an investigation to identify and/or describe how the speed of two objects in motion changes after a collision or • using evidence from an investigation to describe how changes in the speed of two objects after a collision is related to the energy of each object.
Assessment Limits / Content Constraints	• Assessment items should not include any precise quantitative definition or measurement of energy. • Assessment items should not make a distinction between kinetic and potential energy but rather just describe energy of colliding objects in more general terms (e.g., motion energy). • Assessment items should not make or identify distinctions between elastic and inelastic collisions. • Assessment items should be limited to collisions of two objects.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	How will the motion energy of the two toy cars change after the cars collide?

Domain	PS-Physical Science
Subdomain	Energy
Standard	4.PS.4: Design, construct, and test a device that changes energy from one form to another (e.g., electric circuits converting electrical energy into motion, light, or sound energy; a passive solar heater converting light energy into heat energy).*
Evidence Statements	The examinee demonstrates an understanding of designing, constructing, and testing a device that changes energy from one form to another by • identifying, suggesting modifications to, or examining the results gathered from testing a device that demonstrates an energy change. Energy changes may include, but are not limited to, the following examples: • electric circuits converting electrical energy into motion, light, or sound energy • a passive solar heater converting light energy into heat energy
Assessment Limits / Content Constraints	• Assessment items should only focus on one energy change at a time (e.g., light to heat energy, electrical to motion energy). • All energy conversion devices should be shown in graphic form with labels and/or described in detail. • Assessment items should not use overly complex devices.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which device is best designed to show energy changing from one form to another? Which of the devices shown provides an example of one way that light energy can be converted to heat energy?

Domain	PS-Physical Science
Subdomain	Energy
Standard	4.PS.5: Compile information to describe how the use of energy derived from natural renewable and nonrenewable resources affects the environment (e.g., constructing dams to harness energy from water, a renewable resource, while causing a loss of animal habitats; burning of fossil fuels, a nonrenewable resource, while causing an increase in air pollution; installing solar panels to harness energy from the Sun, a renewable resource, while requiring specialized materials that necessitate mining).
Evidence Statements	The examinee demonstrates an understanding of compiling information to describe how the use of energy derived from natural renewable and nonrenewable resources affects the environment by • identifying, describing, and/or analyzing relationships in provided background information related to the use of specific resources and their effects on a specific part of the natural environment.
Assessment Limits / Content Constraints	• All information the student needs to compile will be provided in the assessment item and can be in the form of text, graphics, models, or data. • Assessment items should be limited to one environmental effect per resource-use example. • Assessment items should focus on environmental effect of each type of resource use and not on merely categorizing resources as renewable or nonrenewable, or defining these terms. • Possible examples of relationships include, but are not limited to: construction of dams to harness energy from water (renewable resource) while causing a loss of animal habitats; burning of fossil fuels (nonrenewable resource) while causing an increase in air pollution; installing solar panels to harness energy from the Sun (renewable resource) while requiring specialized materials that necessitate mining.
DOK(s)	2
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which effect does the construction of a river dam most likely have on fish populations on one side of the dam that usually migrate to an area upriver on the other side of the dam to lay their eggs?

Domain	PS-Physical Science
Subdomain	Waves and Their Applications in Technologies for Information Transfer
Standard	4.PS.6: Develop a model of waves to describe a pattern in terms of amplitude and wavelength, and including that waves can cause objects to move.
Evidence Statements	The examinee demonstrates an understanding of patterns in the amplitude and wavelength of waves by using or developing a model and an understanding of the concept that waves can cause objects to move by • identifying similarities and differences in patterns of waves shown in a model; • developing a model to show patterns in waves; or • identifying how wave patterns can be used to describe simple relationships related to amplitude, wavelength, and/or the motion of an object moved by a wave.
Assessment Limits / Content Constraints	• Assessment items should not directly assess the terms *amplitude* and *wavelength*. • Assessment items should not include electromagnetic waves, non-periodic waves, quantitative models of amplitude or wavelength, or the concept of wave interference. • Assessment items should only assess patterns in simple periodic waves. • Models may include diagrams, physical models, examples, and analogies.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which prediction describes how the motion of a floating block in the water would most likely change if the amplitude of the waves were to increase? Which change should be made to the string-and-pencil model to increase the wavelength of the wave represented by the model?

Domain	PS-Physical Science
Subdomain	Waves and Their Applications in Technologies for Information Transfer
Standard	4.PS.7: Develop and use models to show multiple solutions in which patterns are used to transfer information (e.g., using a grid of 1s and 0s representing black and white to send information about a picture, using drums to send coded information through sound waves, using Morse code to send a message).*
Evidence Statements	The examinee demonstrates an understanding of developing or using models to show multiple solutions in which patterns are used to transfer information. The examinee • shows an understanding of how information can be transferred using patterns; • proposes or compares two design solutions for a communication problem; or • evaluates and/or compares communication solutions that use patterns to determine their fit for certain provided criteria (e.g., safety, cost, materials available).
Assessment Limits / Content Constraints	• Assessment items should not compare more than two communication design solutions at a time. • Examinees should not be required to identify/categorize communication solutions by name (e.g., binary code, Morse code). • Assessment items should not focus on specific quantitative differences in signal degradation for digital versus analog signals. • Possible examples of solutions include using a grid of 1s and 0s representing black and white to send information using a picture; using drums to send coded information through sound waves; and using Morse code to send a message.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which model best shows a communication solution for sending a picture over a long distance?

Domain	PS-Physical Science
Subdomain	Waves and Their Applications in Technologies for Information Transfer
Standard	4.PS.8: Construct a model to explain that an object can be seen when light reflected from its surface enters the eye.
Evidence Statements	The examinee demonstrates an understanding of constructing a model or analyzing a model provided to explain that an object can be seen when light reflected from its surface enters the eye. Constructed models should include components such as the eye, light from a source, objects, and the path that the light follows between the source, object, and the eye. Analysis of the model could include describing the effects of removing or changing the light source of the object seen; closing the eye; or changing the path of the light.
Assessment Limits / Content Constraints	• Examinees should not be required to know how specific colors are reflected or detected by the eye. • Examinees should not be required to know the specific cellular mechanisms associated with vision. • Examinees should not be required to know how specific parts of the eye (e.g., retina) function.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Drag and drop the drawings into the boxes to model the path that light takes to allow the student to see a soccer ball, at rest, in the grass.

Domain	LS-Life Science
Subdomain	From Molecules to Organisms: Structures and Processes
Standard	4.LS.9: Examine evidence to support an argument that the internal and external structures of plants (e.g., thorns, leaves, stems, roots, colored petals, xylem, phloem) and animals (e.g., heart, stomach, lung, brain, skin) function to support survival, growth, behavior, and reproduction.
Evidence Statements	The examinee demonstrates an understanding of examining evidence to support an argument about how the internal and external structures of plants and animals function to support survival, growth, behavior, and reproduction by • describing functions of specific structures based on provided evidence; • using evidence to support a claim about a structure-function relationship; • explaining how particular structures can specifically support survival, growth, behavior, or reproduction based on provided evidence; or • comparing structures across two different organisms to examine possible related/similar functions.
Assessment Limits / Content Constraints	• Assessment items should only assess macroscopic plant and animal structures. • The assessed structures of plants can include thorns, leaves, stems, roots, colored petals, xylem, and phloem. • The assessed structures of animals may include heart, stomach, lung, brain, and skin.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which argument is best supported by the data showing the relationship between the number of thorns on a plant and the number of animals that fed on the plant?

Domain	LS-Life Science
Subdomain	From Molecules to Organisms: Structures and Processes
Standard	4.LS.10: Obtain and communicate information explaining that humans have systems that interact with one another for digestion, respiration, circulation, excretion, movement, control, coordination, and protection from disease.
Evidence Statements	The examinee demonstrates an understanding of how human systems interact with one another for digestion, respiration, circulation, excretion, movement, control, coordination, and protection from disease by using provided information or by communicating information using various methods of direct communication.
Assessment Limits / Content Constraints	• Provided information/methods of communication by examinee can include models, analogies, diagrams, or data. • Examinees should not be required to examine more than two interacting human systems at a time. • Assessment items should be limited to the general functions of the interacting systems and not complex physiological processes of the human body (e.g., exact mechanisms of digestion, sensory processes involved in coordination, immune responses to pathogens).
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Using the model provided, how do the respiratory system and circulatory system work together to help the body when a person is running?

Domain	LS-Life Science
Subdomain	From Molecules to Organisms: Structures and Processes
Standard	4.LS.11: Investigate different ways animals receive information through the senses, process that information, and respond to it in different ways (e.g., skunks lifting tails and spraying an odor when threatened, dogs moving ears when reacting to sound, snakes coiling or striking when sensing vibrations).
Evidence Statements	The examinee demonstrates an understanding of investigating different ways animals receive information through the senses, process that information, and respond to it in different ways by • communicating about how animals sense different types of information in their surroundings, transmit this information, and then process it in the brain; • examining a given model or example that shows how animals shape their behaviors around different pieces of information they process about their surroundings; or • using models or data/observations collected from investigations to test or explain interactions between animals and their environment.
Assessment Limits / Content Constraints	• Assessment items should not require knowledge of how sensory receptors function. • Assessment items should not require knowledge of how the brain stores and recalls information.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which pathway shows how information travels in the wolf's sensory system when it hears and then sees prey nearby?

Domain	ESS-Earth and Space Science
Subdomain	Earth's Systems
Standard	4.ESS.12: Construct explanations by citing evidence found in patterns of rock formations and fossils in rock layers that Earth changes over time through both slow and rapid processes (e.g., rock layers containing shell fossils appearing above rock layers containing plant fossils and no shells indicating a change from land to water over time, a canyon with different rock layers in the walls and a river in the bottom indicating that over time a river cut through the rock).
Evidence Statements	The examinee demonstrates an understanding of how to cite evidence found in patterns of rock formations and fossils in rock layers to construct explanations about how Earth has changed over time through both slow and rapid processes. The examinee • identifies evidence that supports a change in Earth's surface over time, • examines the order of rock layers and predicts certain patterns in the landscape over relative time, • uses reasoning to connect provided evidence with Earth processes and to communicate whether the process was relatively slow or rapid, or • demonstrates an understanding of the order in which rock layers are deposited over time (lower layers are older and upper layers are newer). Possible examples of evidence from observed patterns could include the following: • rock layers containing shell fossils appearing above rock layers containing plant fossils and no shells, indicating a change from land to water over time • a canyon with different rock layers in the walls or with a river in the bottom, indicating that over time a river cut through the rock
Assessment Limits / Content Constraints	• Assessment items should only include relative representations of time. • Assessment items should not include knowledge of the specific mechanisms associated with rock formation. • Assessment items should not require recall of specific rock formations or rock types.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which explanation about the changes in Earth's surface at Location X is best support by the evidence shown in the rock layer model?

Domain	ESS-Earth and Space Science
Subdomain	Earth's Systems
Standard	4.ESS.13: Plan and carry out investigations to examine properties of soils and soil types (e.g., color, texture, capacity to retain water, ability to support growth of plants).
Evidence Statements	The examinee demonstrates an understanding of how to examine properties of soil and soil types by planning and/or carrying out an investigation by • providing the steps of an investigation that could be used to examine specific soil properties, • analyzing and/or completing the steps of an investigation that could be used to examine specific soil properties, • making conclusions about soil properties based on provided results from an investigation, • comparing the results from different soil investigations to identify how soils in different regions/climates/systems are similar or different, or • identifying and describing relationships between different soil types and their ability to successfully support plant growth. Possible soil properties to examine include color, texture, capacity to retain water, and ability to support growth of plants
Assessment Limits / Content Constraints	• Examinees should not be required to recall technical names of soil types. • Assessment items should include only grade-appropriate soil investigations and only qualitative data collection.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which investigation would best test which type of soil would most likely support the growth of corn plants? Drag and drop the investigation steps in order into the numbered list provided to show the best test for determining soil texture.

Domain	ESS-Earth and Space Science
Subdomain	Earth's Systems
Standard	4.ESS.14: Explore information to support the claim that landforms are the result of a combination of constructive forces, including crustal deformation, volcanic eruptions, and sediment deposition as well as a result of destructive forces, including weather and erosion.
Evidence Statements	The examinee demonstrates an understanding of how to use information to support a claim about the forces involved in forming various landforms. The examinee demonstrates an understanding of the difference between constructive and destructive processes, namely that constructive forces build up landforms and destructive forces break down landforms. The examinee will be able to recognize or supply examples of landforms resulting from both constructive and destructive forces.
Assessment Limits / Content Constraints	• Examinees should not be required to describe, identify, or define terms such as moraine, delta, butte, sea arch, or barrier island.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which evidence from the diagram best supports the claim that volcanic eruptions are constructive forces?

Domain	ESS-Earth and Space Science
Subdomain	Earth's Systems
Standard	4.ESS.15: Analyze and interpret data (e.g., angle of slope in downhill movement of water, volume of water flow, cycles of freezing and thawing of water, cycles of heating and cooling of water, speed of wind, relative rate of soil deposition, amount of vegetation) to determine effects of weathering and rate of erosion by water, ice, wind, and vegetation using one single form of weathering or erosion at a time.
Evidence Statements	The examinee demonstrates an understanding of the effects of weathering and erosion by water, ice, wind, and vegetation by analyzing and/or interpreting data. Types of data analyzed may include, but are not limited to, the following examples: • angle of slope in downhill movement of water • volume of water flow • cycles of freezing and thawing of water • cycles of heating and cooling of water • speed of wind • relative rate of soil deposition • amount of vegetation
Assessment Limits / Content Constraints	• Assessment items should be limited to one single form of weather or erosion at a time. • Changes to Earth's surface caused by weathering and erosion should be limited to observable examples. • Data should be provided in the context of the item. • Data can be in the form of a diagram, chart, data table, graph, or text information.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Based on the graph, use the drop-down menus below to complete a conclusion that can best be made about the effect of volume of water flow on the rate of erosion along the riverbank. Which effect did adding plants to the field by a lake most likely have on the rate of erosion of the field?

Domain	ESS-Earth and Space Science
Subdomain	Earth's Systems
Standard	4.ESS.16: Describe patterns of Earth's features on land and in the ocean using data from maps (e.g., topographic maps of Earth's land and ocean floor; maps of locations of mountains, continental boundaries, volcanoes, and earthquakes).
Evidence Statements	The examinee will demonstrate an understanding of how to describe patterns of Earth's features on land and in the ocean using data retrieved from provided maps. Data from maps can include the following: • topographic maps of Earth's land and ocean floor • maps of locations of mountains, continental boundaries, volcanoes, and earthquakes The examinee will demonstrate an understanding that Earth's features occur in patterns that are a reflection of how they were formed. For example: • Most mountain ranges occur on the edges of, or inside, continents. • A group of active volcanoes is located in the Pacific Ocean. • All continents are surrounded by water.
Assessment Limits / Content Constraints	• Maps should be provided in the context of the item. • Patterns should only be those readily observable in a provided map.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Based on the map, which pattern in the locations of mountains on Earth can be observed? Using the map, which pattern best describes the locations of volcanoes on Earth?

Domain	ESS-Earth and Space Science
Subdomain	Earth's Systems
Standard	4.ESS.17: Formulate and evaluate solutions to limit the effects of natural Earth processes on humans (e.g., designing earthquake, tornado, or hurricane-resistant buildings; improving monitoring of volcanic activity).*
Evidence Statements	The examinee demonstrates an understanding of how to formulate and evaluate solutions that limit the effects of natural Earth processes on humans. Some examples of solutions include the following: • designing earthquake, tornado, or hurricane-resistant buildings • improving monitoring of volcanic activity The examinee demonstrates an understanding of how certain solutions meet specific criteria/constraints, which could include time, materials, and costs. • The examinee demonstrates an understanding of how specific design solutions change the effect of Earth processes on humans.
Assessment Limits / Content Constraints	• Examinees should only be required to evaluate and/or compare a maximum of two solutions at one time. • The context of the solution(s) should be provided in the item. • Natural Earth processes should be limited to volcanic eruptions, floods, tornadoes, earthquakes, and tsunamis.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Based on the data in the table, which solution could best be used to help warn people about possible future volcanic activity at the lowest cost?

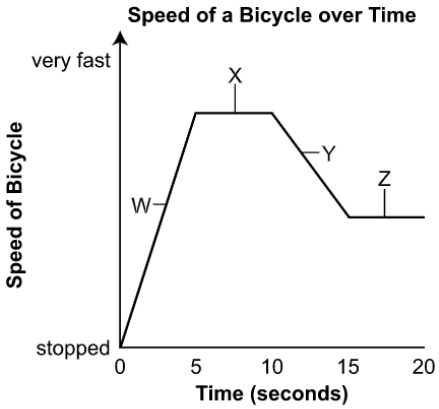
Appendix A: Sample Items

Sample Items

Appendix A: Sample Items

Sample Item 1

The graph shows the speed of a bicycle over time.



Based on the graph, use the drop-down menus to make a claim about the energy of the bicycle.

The energy of the bicycle was greatest at time [ ] because the speed of the bicycle was [ ].

W
X
Y
Z

increasing
the fastest
not changing

Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	X, the fastest
Page Reference	7	
Alignment	PS.1	
Point Value	1	
Depth of Knowledge	3	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 2

Students conduct an investigation to learn about the transfer of energy from one material to another. The drawing shows their investigation setup.

Investigation Setup

empty cup with rock | cup with room temperature water | thermometer

Part A: On a hot day, the students place the cup with the rock in a sunny location for one hour. They then pour the room temperature water into the cup with the rock.

Use the drop-down menus to explain how the students can **best** observe the transfer of energy from the rock to the water.

[▾] the temperature of the water [▾] the water is poured into the cup with the rock.

Feel	after
Guess	before
Measure	before and after

Part B: Select the **two** energy transfers that must occur for this investigation to work.

- Heat moves from the Sun to the rock.
- Heat moves from the cup to the rock.
- Heat moves from the Sun to the water.
- Heat moves from the rock to the water.

Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	Part A: Measure, before and after Part B: Heat moves from the Sun to the rock. Heat moves from the rock to the water.
Page Reference	8	
Alignment	PS.2	
Point Value	2	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 3

A student wants to investigate the energies of two identical marbles before and after they collide. The student plans to roll the marbles toward each other across a flat surface. Changes to which two characteristics of the marbles would **best** show that the energy of each marble changed during and after the collision?

(a) mass and shape

(b) shape and speed

(c) location and mass

(d) speed and location

Item Information	
Item Type	Multiple Choice
Page Reference	9
Alignment	PS.3
Point Value	1
Depth of Knowledge	2
Answer Key	D

Appendix A: Sample Items

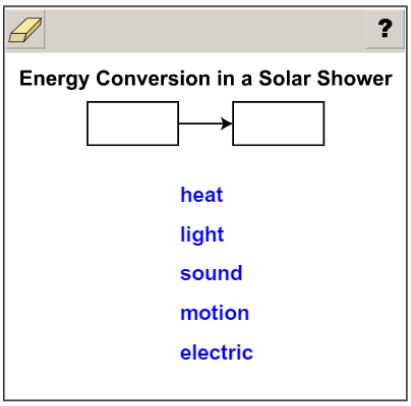
Sample Item 4: Part A

A solar shower is a device that people use to take showers outside. The device includes a bag and a hose with a spout. Two solar showers are filled with water and placed outside in direct sunlight. A student records the time needed for the temperature of the water in the two solar showers to increase.

Features of Two Solar Showers

Feature	Solar Shower 1	Solar Shower 2
How it looks		
Amount of water it holds	5 gallons	5 gallons
Color	clear	black

Part A: Drag a form of energy into each box to show the energy change that happens in a solar shower.



Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	Part A: light → heat
Page Reference	10	
Alignment	PS.4	
Point Value	2	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 4: Part B

A solar shower is a device that people use to take showers outside. The device includes a bag and a hose with a spout. Two solar showers are filled with water and placed outside in direct sunlight. A student records the time needed for the temperature of the water in the two solar showers to increase.

Features of Two Solar Showers

Feature	Solar Shower 1	Solar Shower 2
How it looks		
Amount of water it holds	5 gallons	5 gallons
Color	clear	black

Part B: Select the **two** tools the student should use to measure the speed of the energy change in this experimental design.

Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	Part B: stopwatch, thermometer
Page Reference	10	
Alignment	PS.4	
Point Value	2	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 5

Students have been asked to use Morse code to send a short message to one another. Each pair of students will stand facing away from each other at a distance of 20 feet. Which method would work **best** for each pair of students to send a message using Morse code?

(a) using a flashlight

(b) blinking their eyes

(c) using sign language

(d) playing a musical instrument

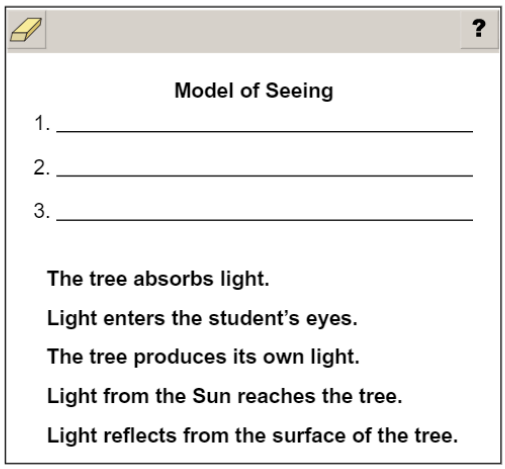
Item Information	
Item Type	Multiple Choice
Page Reference	13
Alignment	PS.7
Point Value	1
Depth of Knowledge	2
Answer Key	D

Appendix A: Sample Items

Sample Item 6

A student looks at a tree. The student wants to model the path of light and how the tree can be seen.

Drag **three** statements into the list to model how the student sees the tree.



Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	1. Light from the Sun reaches the tree. 2. Light reflects from the surface of the tree. 3. Light enters the student's eyes.
Page Reference	14	
Alignment	PS.8	
Point Value	1	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 7

During the fall season, the belly of a male brook trout becomes bright orange. The orange belly provides some camouflage for the fish and helps attract females. Scientists have observed that males with pale-orange bellies do not attract as many females as males with bright-orange bellies.

How does the orange-belly trait **most likely** help brook trout?

(a) The orange-belly trait helps the fish grow in size.

(b) The orange-belly trait helps the fish produce offspring.

(c) The orange-belly trait helps the fish control their behavior.

(d) The orange-belly trait helps the fish survive temperature changes.

Item Information	
Item Type	Multiple Choice
Page Reference	15
Alignment	LS.9
Point Value	1
Depth of Knowledge	2
Answer Key	B

Appendix A: Sample Items

Sample Item 8

The list describes actions that occur in the body when a person eats food.

Body Actions That Occur When a Person Eats Food

- Chewing begins to break down food in the mouth.
- Food moves into the stomach and then into the small intestine.
- Important nutrients leave the small intestine and enter the bloodstream.
- The remaining materials move into the large intestine.

Which pair of body systems interact **most** in the processes described in the list?

(a) muscular and circulatory

(b) circulatory and digestive

(c) digestive and respiratory

(d) respiratory and muscular

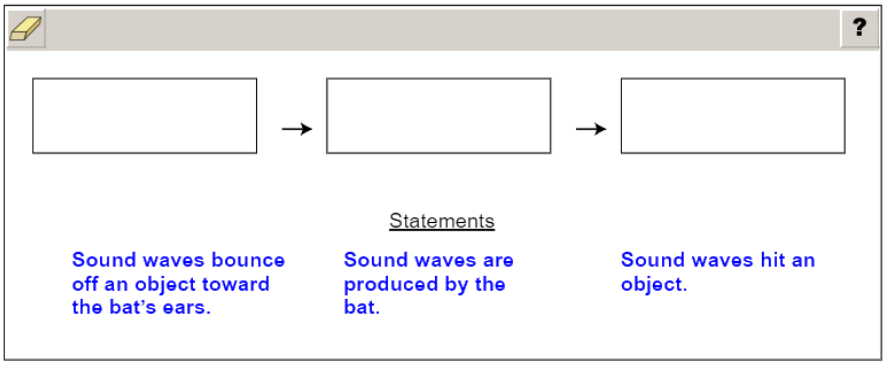
Item Information	
Item Type	Multiple Choice
Page Reference	16
Alignment	LS.10
Point Value	1
Depth of Knowledge	2
Answer Key	B

Appendix A: Sample Items

Sample Item 9

A bat is observed in the night sky searching for food. The bat uses sound waves to help it find and catch flying insects.

Part A: Drag the statements into the boxes in the correct order to describe the process a bat uses to find its prey.



Part B: Use the drop-down menus to **best** complete the statement.

The messages processed by the bat's [▾] and the bat's sense of [▾] help the bat catch its prey.

eyes	sight
brain	smell
taste buds	hearing

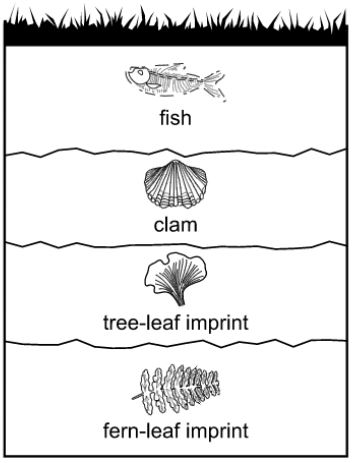
Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	Part A: middle statement → right statement → left statement Part B: brain, hearing
Page Reference	17	
Alignment	LS.11	
Point Value	2	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 10

The diagram shows fossils that have been found in different rock layers under a school playground.

Fossils Found in Rock Layers



Use the drop-down menus to **best** complete the statement.

The fossils in the diagram give evidence that the area under the school playground was likely first a [ ] and later a [ ].

sea
forest
desert

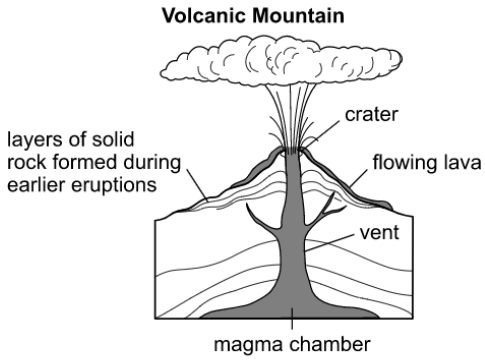
sea
forest
desert

Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	forest, sea
Page Reference	18	
Alignment	ESS.12	
Point Value	1	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 11

The diagram below shows parts of a volcanic mountain.



Which claim is **best** supported by the information in the diagram?

(a) Volcanoes are formed by destructive forces that build landforms.

(b) Volcanoes are formed by constructive forces that build landforms.

(c) Volcanoes are formed by destructive forces that break down landforms.

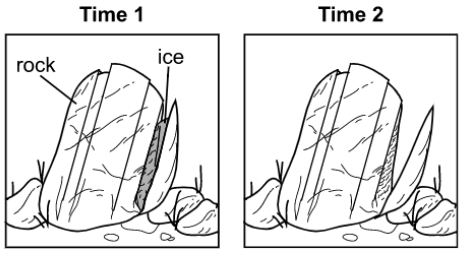
(d) Volcanoes are formed by constructive forces that break down landforms.

Item Information	
Item Type	Multiple Choice
Page Reference	20
Alignment	ESS.14
Point Value	1
Depth of Knowledge	2
Answer Key	B

Appendix A: Sample Items

Sample Item 12

The drawings below show the same rock at two different times.



Which set of information **best** identifies and describes the process shown in the drawings?

(a) **Process**: erosion
Description: Water froze in a crack in the rock and caused the rock to break apart.

(b) **Process**: weathering
Description: Water froze in a crack in the rock and caused the rock to break apart.

(c) **Process**: erosion
Description: Water moved through a crack in the rock and carried small pieces of rock to a new area.

(d) **Process**: weathering
Description: Water moved through a crack in the rock and carried small pieces of rock to a new area.

Item Information	
Item Type	Multiple Choice
Page Reference	21
Alignment	ESS.15
Point Value	1
Depth of Knowledge	2
Answer Key	B

Appendix A: Sample Items

Sample Item 13

Some people live in high-risk areas for earthquakes. Complete the checklist to identify safe and unsafe practices in earthquake zones. Select one box in each row.

	Safe	Unsafe
Place furniture away from large windows.	☐	☐
Place all heavy objects on the top shelves.	☐	☐
Secure bookcases and other tall furniture to the wall.	☐	☐
Prepare an emergency kit with items like flashlights and water.	☐	☐

Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	Top Down: Safe, Unsafe, Safe, Safe
Page Reference	23	
Alignment	ESS.17	
Point Value	1	
Depth of Knowledge	2	
Answer Key	(see description)	