Alabama Comprehensive Assessment Program (ACAP)

Summative

Item Specifications

Science

Grade 8

Alabama Item Specifications

Grade 8 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	Matter and Its Interactions
Standard	8.PS.1: Analyze patterns within the periodic table to construct models (e.g., molecular-level models, including drawings; computer representations) that illustrate the structure, composition, and characteristics of atoms and molecules.
Evidence Statements	The examinee will demonstrate an understanding of constructing models that illustrate the structure, composition, and characteristics of atoms and molecules by analyzing patterns within the periodic table. Possible models may include • molecular-level models, including drawings, and • computer representations. Possible patterns may include • different types of atoms that are attracted and not attracted to each other, • individual atoms that form repeated structures, and molecules of the same type of atom that are not attracted to each other.
Assessment Limits / Content Constraints	• Assessment items should not include demonstrating knowledge of valence electrons. • Assessment items should not include demonstrating knowledge of bonding energy. • Assessment items should not include demonstrating knowledge of the ionic nature of subunits in complex structures.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Based on the patterns in the periodic table, which two atoms would have the most characteristics in common?

Domain	PS-Physical Science
Subdomain	Matter and Its Interactions
Standard	8.PS.2: Plan and carry out investigations to generate evidence supporting the claim that one pure substance can be distinguished from another based on characteristic properties.
Evidence Statements	The examinee will demonstrate an understanding of generating evidence to support the claim that one pure substance can be distinguished from another based on characteristic properties by planning and carrying out investigations. Possible characteristic properties tested or explored during the investigations may include • density, • melting point, • boiling point, • solubility, • reactivity, • flammability, and • odor.
Assessment Limits / Content Constraints	• Assessment items should only use the properties listed in the evidence statements.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which evidence collected during the investigations supports the claim that Powder X and Powder Y are different substances?

Domain	PS-Physical Science
Subdomain	Matter and Its Interactions
Standard	8.PS.3: Construct explanations based on evidence from investigations to differentiate among compounds, mixtures, and solutions.
Evidence Statements	The examinee will demonstrate an understanding of differentiating among compounds, mixtures, and solutions by constructing explanations based on evidence. The examinee will demonstrate an understanding of the fact that a solution is a mixture of two or more compounds or elements. A compound is a chemically unique combination of two or more elements bonded together. An element is a substance that cannot be broken down into a simpler substance. The examinee will collect and analyze information to illustrate how synthetic materials (e.g., medicine, food additives, alternative fuels, plastics) are derived from natural resources and how they impact society.
Assessment Limits / Content Constraints	• Assessment items should be limited to qualitative information regarding how synthetic materials impact society.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Using the evidence provided, which statement best explains why Substance X and Substance Y are considered different compounds?

Domain	PS-Physical Science
Subdomain	Matter and Its Interactions
Standard	8.PS.4: Design and conduct an experiment to determine changes in particle motion, temperature, and state of a pure substance when thermal energy is added to or removed from a system.
Evidence Statements	The examinee will demonstrate an understanding of determining changes in particle motion, temperature, and state of a pure substance when thermal energy is added to or removed from a system by designing and/or conducting an experiment. The examinee will demonstrate this understanding by • designing or conducting an experiment that shows that adding or removing thermal energy increases or decreases the kinetic energy of particles until a change in state occurs.
Assessment Limits / Content Constraints	• Models of particle motion and states of pure substances should only be qualitative. • Particles may include molecules or inert atoms. • Pure substances may include water, carbon dioxide, and helium.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which step should be added to the experiment to determine how the state of the substance shown changes when thermal energy is added? Which part of the experimental design causes the particles in the substance described to experience an increase in kinetic energy?

Domain	PS-Physical Science
Subdomain	Matter and Its Interactions
Standard	8.PS.5: Observe and analyze characteristic properties of substances (e.g., odor, density, solubility, flammability, melting point, boiling point) before and after the substances combine to determine if a chemical reaction has occurred.
Evidence Statements	The examinee will demonstrate an understanding of observing and analyzing characteristic properties of substances before and after the substances combine to determine if a chemical reaction has occurred. The examinee will demonstrate this understanding by • recognizing that each substance has its own characteristic properties and these properties change when the substance reacts chemically with another substance and/or • analyzing data to identify patterns in the characteristics of substances before and after the substances react. Possible characteristic properties may include odor, density, solubility, flammability, melting point, and boiling point.
Assessment Limits / Content Constraints	• The reaction should be simple, such as the burning of sugar or the mixing of zinc with hydrogen chloride.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Use the drop-down menus to complete the statement, identifying whether a chemical reaction occurred and providing supporting evidence for the statement based on the data provided.

Domain	PS-Physical Science
Subdomain	Matter and Its Interactions
Standard	8.PS.6: Create a model, diagram, or digital simulation to describe conservation of mass in a chemical reaction and explain the resulting differences between products and reactants.
Evidence Statements	The examinee will demonstrate an understanding of describing conservation of mass in a chemical reaction and explaining the resulting differences between products and reactants by creating a model, diagram, or digital simulation. The examinee will demonstrate this understanding by using a model to show that during a chemical reaction, the atoms that make up the reactants rearrange and come together in different arrangements to form the products. However, the total mass of the reactants and the total mass of the products are equal (i.e., mass is conserved).
Assessment Limits / Content Constraints	• Assessment items should not require the use of atomic masses. • Assessment items should not require balancing complex equations. • Assessment items should not require demonstration of knowledge of intermolecular forces.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Drag and drop the choices into the boxes provided to show the products of the reaction and the total mass of the products.

Domain	PS-Physical Science
Subdomain	Matter and Its Interactions
Standard	8.PS.7: Design, construct, and test a device (e.g., glow stick, hand warmer, hot or cold pack, thermal wrap) that either releases or absorbs thermal energy by chemical reactions (e.g., dissolving ammonium chloride or calcium chloride in water) and modify the device as needed based on criteria (e.g., amount/concentration, time, temperature).*
Evidence Statements	The examinee will demonstrate an understanding of designing, constructing, and/or testing a device that either releases or absorbs thermal energy by chemical reactions and identifying how to modify the device as needed based on provided criteria. Devices may include • a glow stick, • a hand warmer, • a hot or cold pack, and • a thermal wrap. Chemical reactions may include • dissolving ammonium chloride or calcium chloride in water. Criteria may include • amount/concentration, • time, or • temperature of the substance.
Assessment Limits / Content Constraints	• Examinees should only be required to design/construct/test a device OR to modify a device and not both steps in the same item. • Examinees should be provided with any criteria needed for modifying or testing a device.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which change could be made to the device design shown to increase the rate of the reaction that makes the hot pack feel warm?

Domain	PS-Physical Science
Subdomain	Motion and Stability: Forces and Interactions
Standard	8.PS.8: Use Newton's first law to demonstrate and explain that an object is either at rest or moves at a constant velocity unless acted upon by an external force (e.g., model car on a table remaining at rest until pushed).
Evidence Statements	The examinee will demonstrate an understanding of using Newton's first law to demonstrate and explain that an object is either at rest or moves at a constant velocity unless acted upon by an external force. A possible example of this could be a model car on a table remaining at rest until it is pushed by a student.
Assessment Limits / Content Constraints	• Assessment items should be limited to forces and changes in motion in one dimension in an inertial reference frame. • Assessment items should be limited to a change in one variable at a time. • Assessment items should not require the use of trigonometry.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Use the drop-down menus below to construct an explanation of why a model car does not move across a flat table after being placed there by a student, and identify the scientific law that describes this phenomenon.

Domain	PS-Physical Science
Subdomain	Motion and Stability: Forces and Interactions
Standard	8.PS.9: Use Newton's second law to demonstrate and explain how changes in an object's motion depend on the sum of the external forces on the object and the mass of the object (e.g., billiard balls moving when hit with a cue stick).
Evidence Statements	The examinee will demonstrate an understanding of using Newton's second law to demonstrate and explain how changes in an object's motion depend on the sum of the external forces on the object and the mass of the object. The examinee will demonstrate an understanding of the fact that the greater the mass of an object, the greater the force needed to achieve the same motion. The examinee will demonstrate an understanding of the fact that for any given object, a larger force causes a larger change in motion. A possible example of this could be a billiard ball moving when hit with a cue stick.
Assessment Limits / Content Constraints	• Assessment items should be limited to forces and changes in motion in one dimension in an inertial reference frame. • Assessment items should be limited to a change in one variable at a time. • Assessment items should not require the use of trigonometry.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Based on Newton's second law, which statement best predicts a difference in the distance a billiard ball moves when struck by a cue stick with the two forces listed?

Domain	PS-Physical Science
Subdomain	Motion and Stability: Forces and Interactions
Standard	8.PS.10: Use Newton's third law to design a model to demonstrate and explain the resulting motion of two colliding objects (e.g., two cars bumping into each other, a hammer hitting a nail).*
Evidence Statements	The examinee will demonstrate an understanding of using Newton's third law to design a model to demonstrate and explain the resulting motion of two colliding objects. The examinee will demonstrate an understanding of the fact that for any pair of objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first but in the opposite direction. Possible examples could include • two cars bumping into each other and • a hammer hitting a nail.
Assessment Limits / Content Constraints	• Assessment items should be limited to horizontal or vertical interactions in one dimension
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Given the strength and direction of the force the hammer exerts on the nail, drag and drop an arrow and a label into the model to represent the direction of force of the nail on the hammer and the strength of this force.

Domain	PS-Physical Science
Subdomain	Motion and Stability: Forces and Interactions
Standard	8.PS.11: Plan and carry out investigations to evaluate how various factors (e.g., electric force produced between two charged objects at various positions; magnetic force produced by an electromagnet with varying number of wire turns, varying number or size of dry cells, and varying size of iron core) affect the strength of electric and magnetic forces.
Evidence Statements	The examinee will demonstrate an understanding of evaluating how various factors affect the strength of electric and magnetic forces by planning and carrying out investigations. Factors may include • an electric force produced between two charged objects at various positions and • a magnetic force produced by an electromagnet with varying numbers of wire turns, varying numbers or sizes of dry cells, and varying sizes of iron core. Examples of devices that could be used in the investigations may include • electromagnets, • electric motors, and • generators.
Assessment Limits / Content Constraints	• Assessment items should require limited proportional reasoning and algebraic thinking for any quantitative answers. • Assessment items should use qualitative measures/comparisons of the strength of electric and magnetic forces.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Which change could be made to the electromagnet in the investigations that would make the electromagnet stronger?

Domain	PS-Physical Science
Subdomain	Motion and Stability: Forces and Interactions
Standard	8.PS.12: Construct an argument from evidence explaining that fields exist between objects exerting forces on each other (e.g., interactions of magnets, electrically charged strips of tape, electrically charged pith balls, gravitational pull of the moon creating tides) even when the objects are not in contact.
Evidence Statements	The examinee will demonstrate an understanding of explaining that fields exist between objects exerting forces on each other even when the objects are not in contact. The examinee will construct an argument from evidence. Examples of objects that exert forces on each other may include • magnets, • electrically charged strips of tape, • electrically charged pith balls, and • the moon and gravity.
Assessment Limits / Content Constraints	• Assessment items should be limited to electric, magnetic, and gravitational fields only. • Assessment items should be limited to qualitative evidence for the existence of fields only.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Use the drop-down menus to construct an argument about the forces the magnets exert on each other that is best supported by the evidence in the diagram.

Domain	PS-Physical Science
Subdomain	Energy
Standard	8.PS.13: Create and analyze graphical displays of data to illustrate the relationships of kinetic energy to the mass and speed of an object (e.g., riding a bicycle at different speeds, hitting a table tennis ball versus a golf ball, rolling similar toy cars with different masses down an incline).
Evidence Statements	The examinee will demonstrate an understanding of illustrating the relationships of kinetic energy to the mass and speed of an object by creating and analyzing graphic displays of data. The examinee will demonstrate an understanding of the fact that the kinetic energy of an object doubles as the mass of the object doubles. The examinee will demonstrate this understanding by creating or analyzing graphic displays of data. The examinee will demonstrate an understanding of the fact that the kinetic energy of an object quadruples as the speed of the object doubles. The examinee will demonstrate this understanding by creating or analyzing graphic displays of data. Examples that represent relationships of kinetic energy to the mass and speed of an object may include • riding a bicycle at different speeds, • hitting a table tennis ball versus hitting a golf ball, and • rolling similar toy cars with different masses down an incline.
Assessment Limits / Content Constraints	• Examinees should only be required to address one relationship (e.g., kinetic energy/mass OR kinetic energy/speed) per item.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Drag each speed label next to the kinetic energy in the graph that best represents the speeds of a bicycle at different kinetic energies as it rolls down two different hills. Based on the graph, which relationship between the kinetic energies and the masses of the toy cars is best represented by the data?

Domain	PS-Physical Science
Subdomain	Energy
Standard	8.PS.14: Use models to construct an explanation of how a system of objects may contain varying types and amounts of potential energy (e.g., observing the movement of a roller coaster cart at various inclines, changing the tension in a rubber band, varying the number of batteries connected in a series, observing a balloon with static electrical charge being brought closer to a classmate's hair).
Evidence Statements	The examinee will demonstrate an understanding of constructing an explanation of how a system of objects may contain varying types and amounts of potential energy by using models. Possible examples of systems of objects may include • observing the movement of a roller-coaster cart at various inclines, • changing the tension in a rubber band, • varying the number of batteries connected in a series, and • observing a balloon with static electric charge being brought closer to a person's hair.
Assessment Limits / Content Constraints	• Assessment items should be limited to electric, magnetic, and gravitational interactions as they relate to potential energy.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Based on the model shown, which statement best explains how the amount of potential energy of the roller-coaster cart changes between Location X and Location Y?

Domain	PS-Physical Science
Subdomain	Energy
Standard	8.PS.15: Analyze and interpret data from experiments to determine how various factors affect energy transfer as measured by temperature (e.g., comparing final water temperatures after different masses of ice melt in the same volume of water with the same initial temperature, observing the temperature change of samples of different materials with the same mass and the same material with different masses when adding a specific amount of energy).
Evidence Statements	The examinee will demonstrate an understanding of determining how various factors affect energy transfer as measured by temperature by analyzing and interpreting data from experiments. The examinee will demonstrate an understanding of the fact that the amount of energy transferred to an object is dependent on the state, type, and amount of matter present. The examinee will demonstrate an understanding of the fact that energy is transferred from warmer regions to cooler regions. Possible examples of experiments include • comparing the final water temperatures after different masses of ice melt in the same container of water with the same initial temperature and • observing the change in temperature of samples of different materials with the same mass and samples of the same material with different masses when adding a specific amount of energy.
Assessment Limits / Content Constraints	• Experimental information should be provided in the item prompt. • Assessment items should not require the calculation of the total amount of thermal energy transferred.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Based on the temperature data provided, which statement best describes the effect of different masses of ice on the transfer of energy to the ice?

Domain	PS-Physical Science
Subdomain	Energy
Standard	8.PS.16: Apply the law of conservation of energy to develop arguments supporting the claim that when the kinetic energy of an object changes, energy is transferred to or from the object (e.g., bowling ball hitting pins, brakes being applied to a car).
Evidence Statements	The examinee will demonstrate an understanding of developing arguments supporting the claim that when the kinetic energy of an object changes, energy is transferred to or from that object. The examinee will demonstrate this understanding by using the law of conservation of energy. The examinee will demonstrate an understanding of the fact that when the motion energy of an object changes, some other change in energy occurs simultaneously. Possible example systems may include • a bowling ball hitting pins and • brakes being applied to a car.
Assessment Limits / Content Constraints	• Assessment items should not require calculations of energy.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Use the drop-down menus below to construct an argument about the energy of a soccer ball after a player kicks the ball.

Domain	PS-Physical Science
Subdomain	Waves and Their Applications in Technologies for Information Transfer
Standard	8.PS.17: Create and manipulate a model of a simple wave to predict and describe the relationships between wave properties (e.g., frequency, amplitude, wavelength) and energy.
Evidence Statements	The examinee will demonstrate an understanding of predicting and describing the relationships between wave properties and energy by creating and manipulating a model of a simple wave. Wave properties may include frequency, amplitude, and wavelength. The examinee will demonstrate an understanding of the fact that the energy of a wave is proportional to the square of the wave's amplitude. The examinee will demonstrate an understanding of the fact that the energy transferred by a wave is proportional to the wave's frequency. The examinee will also analyze and interpret data to illustrate an electromagnetic spectrum.
Assessment Limits / Content Constraints	• Assessment items should be limited to standard repeating waves.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Drag the four models into the boxes provided to arrange waves with different wavelengths in order from having the least amount of energy to having the most amount of energy.

Domain	PS-Physical Science
Subdomain	Waves and Their Applications in Technologies for Information Transfer
Standard	8.PS.18: Use models to demonstrate how light and sound waves differ in how they are absorbed, reflected, and transmitted through different types of media.
Evidence Statements	The examinee will demonstrate an understanding of using models to demonstrate how light and sound waves differ in how they are absorbed, reflected, and transmitted through different types of media. Using models, the examinee will demonstrate an understanding of one or both of the following facts. • Sound waves need a medium through which to be transmitted, whereas light waves do not. • When light shines, it is absorbed, reflected, and transmitted through an object differently depending on the object's material and the frequency/color of the interacting light.
Assessment Limits / Content Constraints	• Assessment items should be limited to qualitative applications of light and mechanical waves.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Drag and drop the arrows into the boxes shown to model how light waves will interact with the two materials shown in the drawings.

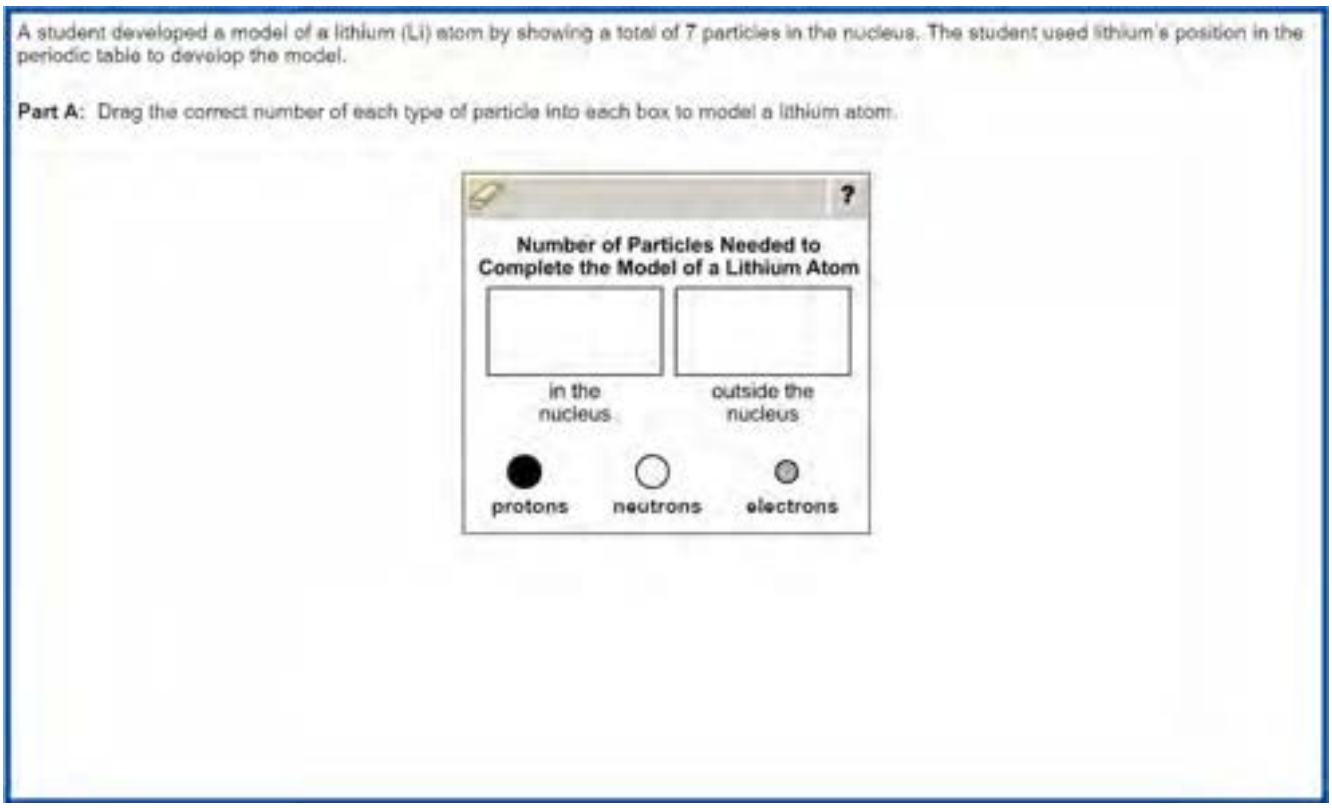
Domain	PS-Physical Science
Subdomain	Waves and Their Applications in Technologies for Information Transfer
Standard	8.PS.19: Integrate qualitative information to explain that common communication devices (e.g., cellular telephones, radios, remote controls, Wi-Fi components, global positioning systems [GPS], wireless technology components) use electromagnetic waves to encode and transmit information.
Evidence Statements	The examinee will demonstrate an understanding of explaining that common communication devices use electromagnetic waves to encode and transmit information. The examinee will demonstrate this understanding by integrating qualitative information. Possible common communication devices may include • cellular telephones, • radios, • remote controls, • Wi-Fi components, • global positioning systems (GPS), and • wireless technology components.
Assessment Limits / Content Constraints	• Assessment items should provide qualitative information the student needs to construct explanations. • Assessment items should not require specific knowledge about the mechanism of any device function. • Assessment items should not require knowledge of binary counting. • Assessment items should only require the integration of two pieces of qualitative information per item.
DOK(s)	2 or 3
Item Type(s)	MC, MS, SA, TE
Sample Stem Information (as applicable)	Based on the two devices shown, which statement best explains how the devices send and receive information?

Appendix A: Sample Items

Sample Items

Appendix A: Sample Items

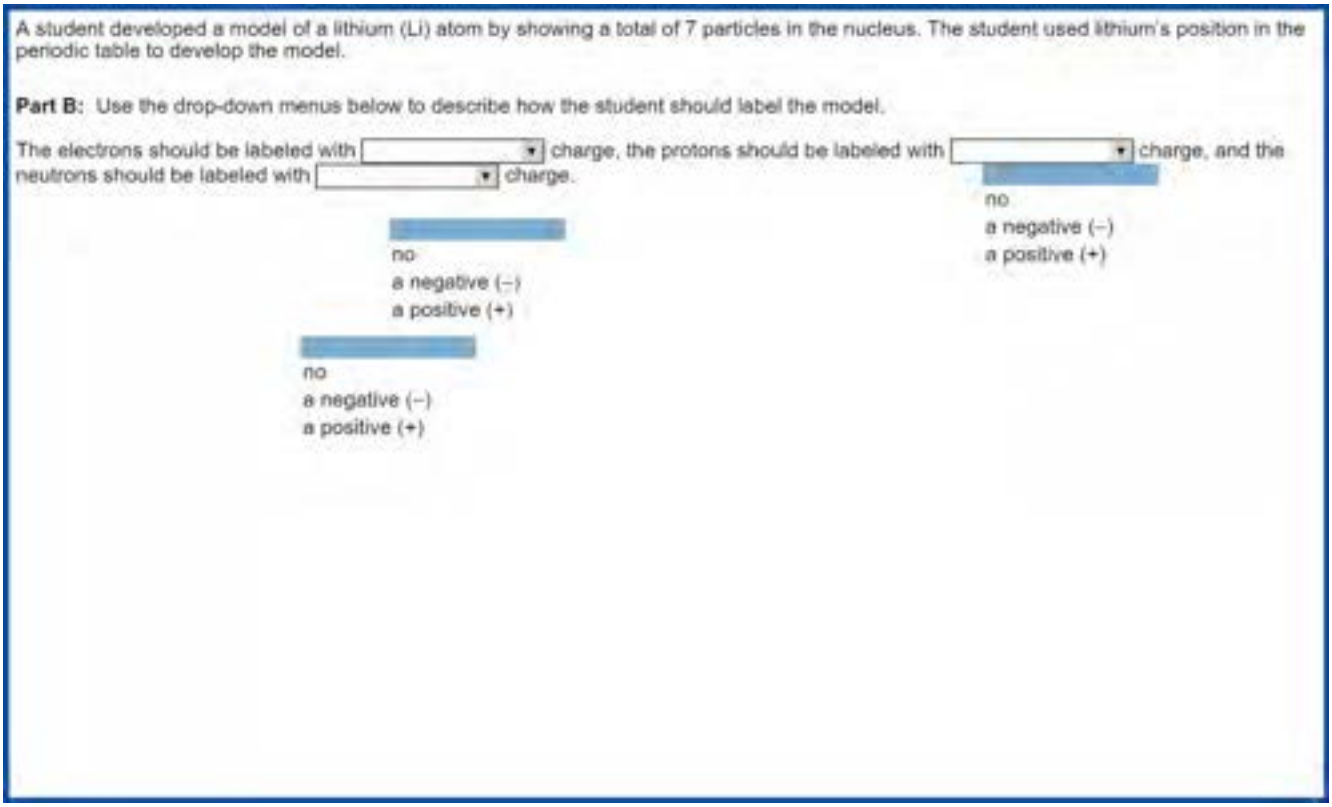
Sample Item 1: Part A



Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	Part A: 3 protons and 4 neutrons in the nucleus, 3 electrons outside the nucleus
Page Reference	7	
Alignment	PS.1	
Point Value	2	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 1: Part B



Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	Part B: a negative (–), a positive (+), no
Page Reference	7	
Alignment	PS.1	
Point Value	2	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 2


A student places an object in a beaker containing pure water. The student observes that the object sinks in water and is therefore denser than water. The student knows that iron is denser than water, so the student claims that the object is made from iron.

Which statement **best** describes the results of the investigation?

(a) The results of the investigation support the claim because both the object and water have unique densities.

(b) The results of the investigation support the claim because there are no other substances denser than water.

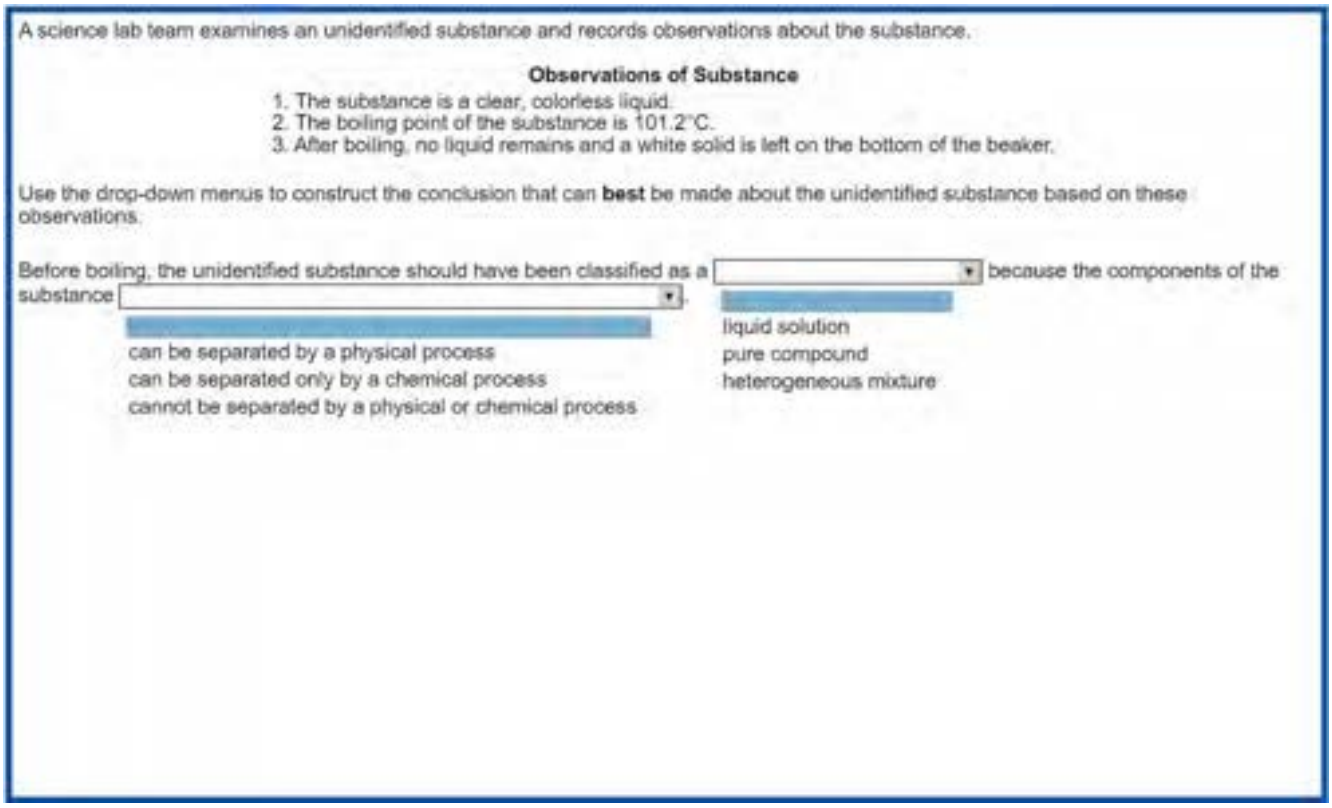
(c) The results of the investigation do not support the claim, because there are other substances denser than water.

(d) The results of the investigation do not support the claim, because both the object and water have unique densities.

Item Information	
Item Type	Multiple Choice
Page Reference	8
Alignment	PS.2
Point Value	1
Depth of Knowledge	3
Answer Key	C

Appendix A: Sample Items

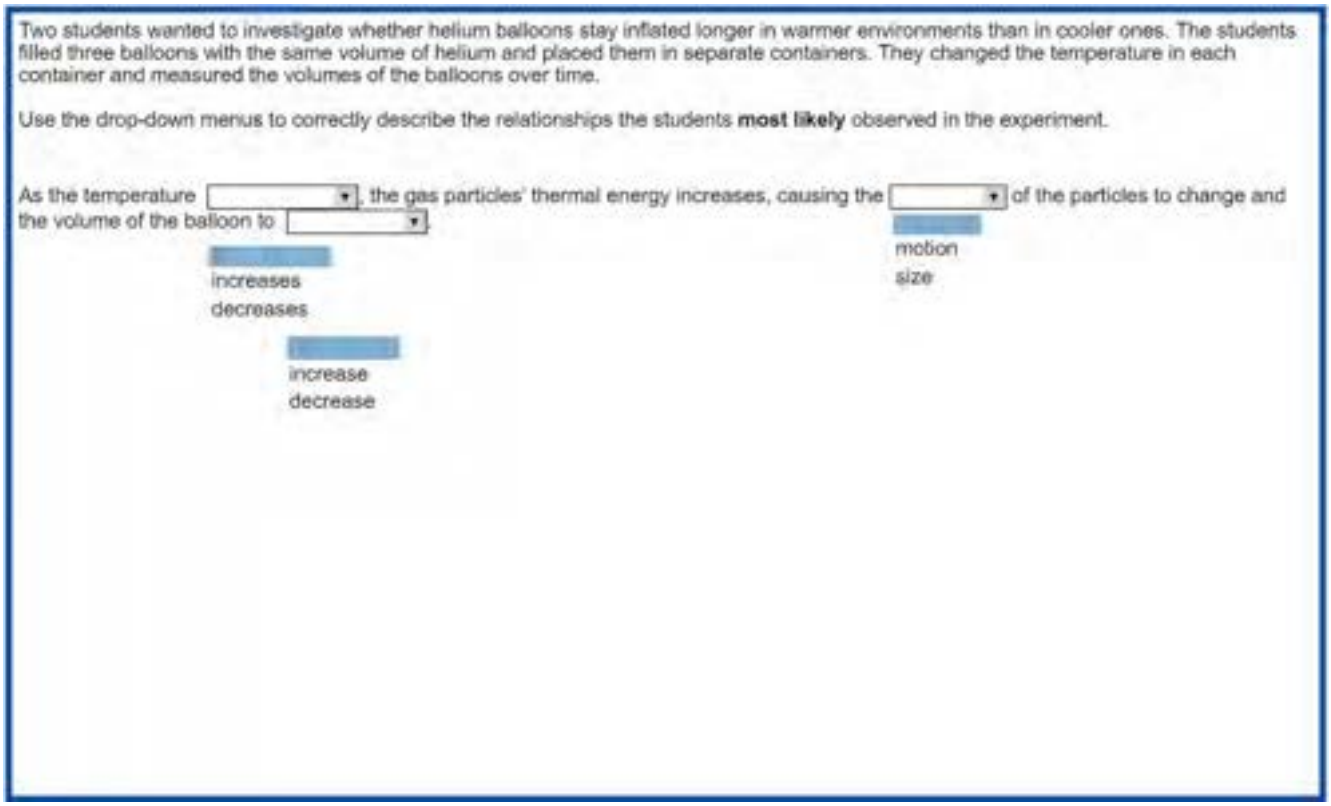
Sample Item 3



Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	liquid solution, can be separated by a physical process
Page Reference	9	
Alignment	PS.3	
Point Value	1	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

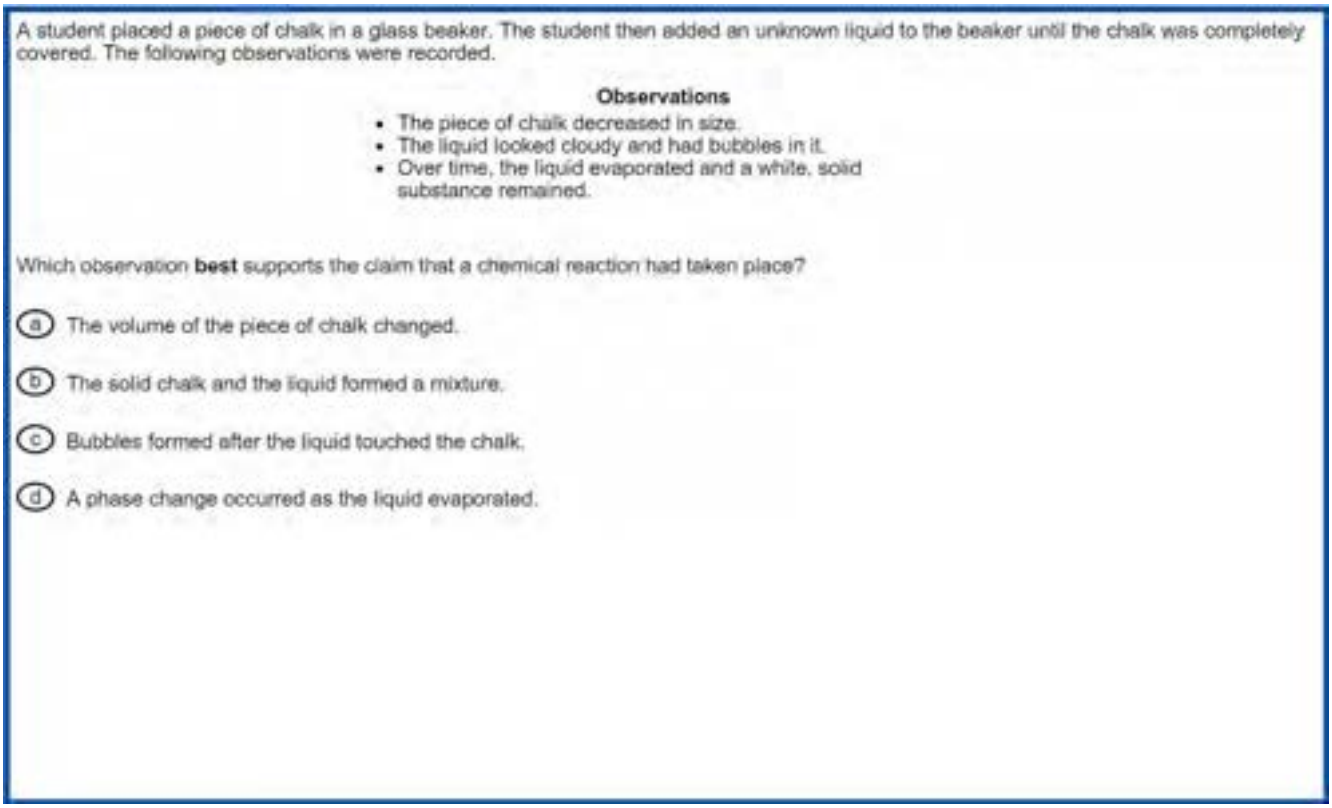
Sample Item 4



Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	increases, motion, increase
Page Reference	10	
Alignment	PS.4	
Point Value	1	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 5



A student placed a piece of chalk in a glass beaker. The student then added an unknown liquid to the beaker until the chalk was completely covered. The following observations were recorded.

Observations

- The piece of chalk decreased in size.
- The liquid looked cloudy and had bubbles in it.
- Over time, the liquid evaporated and a white, solid substance remained.

Which observation **best** supports the claim that a chemical reaction had taken place?

(a) The volume of the piece of chalk changed.

(b) The solid chalk and the liquid formed a mixture.

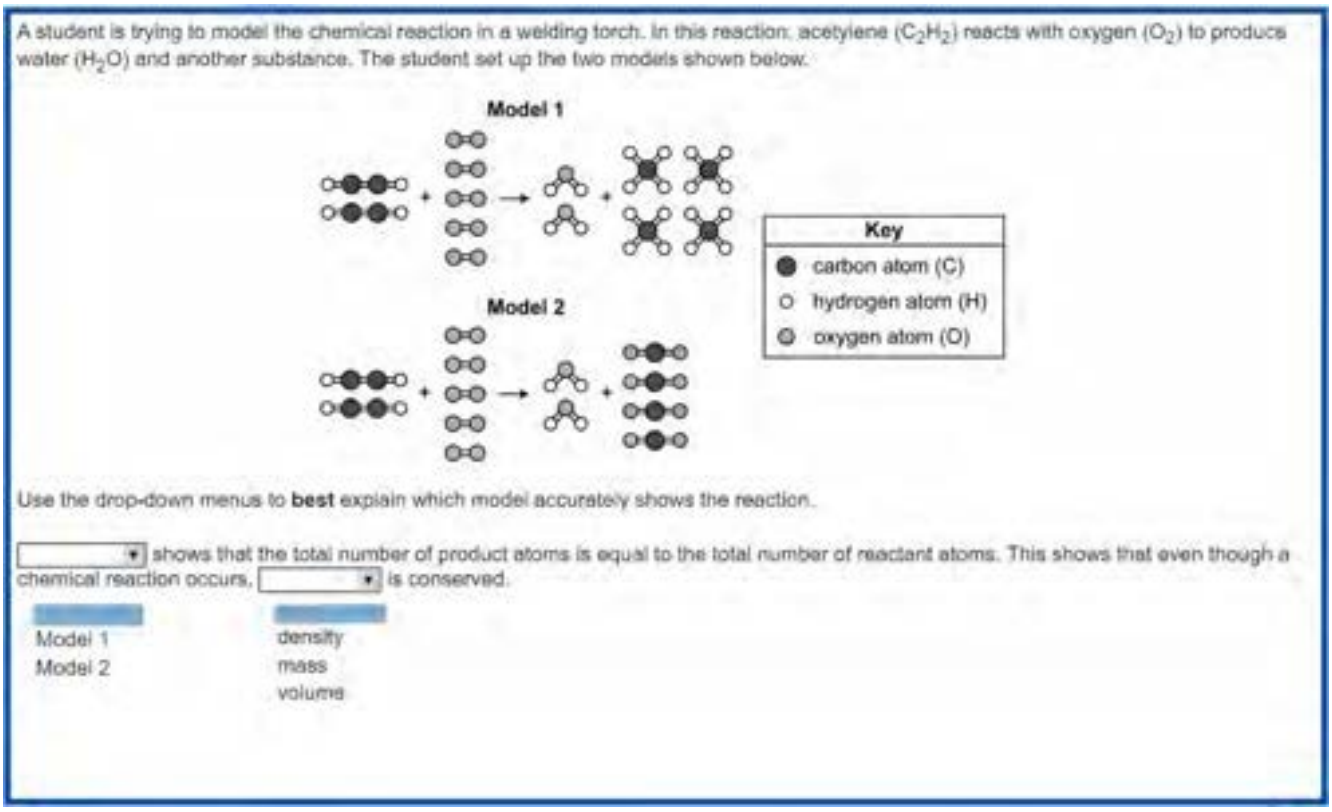
(c) Bubbles formed after the liquid touched the chalk.

(d) A phase change occurred as the liquid evaporated.

Item Information	
Item Type	Multiple Choice
Page Reference	11
Alignment	PS.5
Point Value	1
Depth of Knowledge	2
Answer Key	C

Appendix A: Sample Items

Sample Item 6



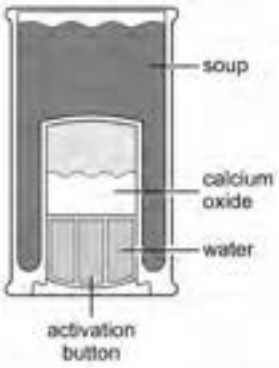
Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	
Page Reference	12	Model 2, mass
Alignment	PS.6	
Point Value	1	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 7

Some companies that make and sell soup are packaging the soup in self-heating cans. The cans allow people to enjoy hot soup without using a stove or microwave. The diagram shows the parts of a self-heating can of soup.

Self-Heating Can



When a person pushes the button on the bottom of the can, it causes the thin layer between the calcium oxide and the water to break. Thermal energy is released when calcium oxide and water combine. During the development of the self-heating cans, researchers initially noticed that the cans were not generating enough thermal energy to warm the soup.

Use the drop-down menus to describe the likely results after the researchers tested two possible solutions.

Solution	Likely Result
Shake the can after pushing the button.	Shaking the can will likely [▾] the rate of the chemical reaction but not change the amount of thermal energy transferred to the soup.
Increase the amount of calcium oxide.	Increasing calcium oxide will likely [▾] the amount of thermal energy transferred to the soup given that water does not limit the reaction.

increase
decrease

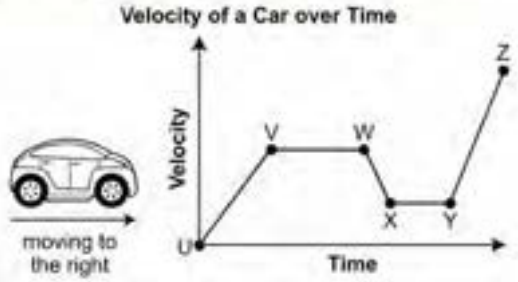
increase
decrease
not change

Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	
Page Reference	13	increase, increase
Alignment	PS.7	
Point Value	1	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 8

A student performed an investigation on the velocity of a toy car over time. The student recorded the car's velocity in the graph below.



Select the **two** statements that **best** describe the movement of the toy car.

(a) The car was at rest between points V and W.

(b) The car was at rest until a force acted on it at point U.

(c) The car was constantly accelerating between points U and X.

(d) The forces acting on the car were balanced between points V and W.

(e) The forces acting on the car were unbalanced between points W and X and between points X and Y.

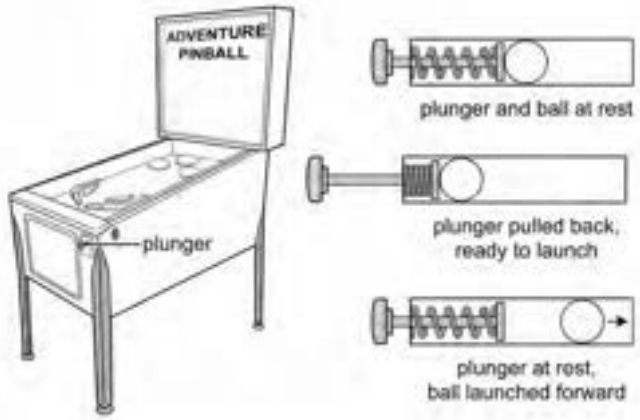
Item Information		Answer Key(s) Description
Item Type	Multiple Select	
Page Reference	14	B, D
Alignment	PS.8	
Point Value	1	
Depth of Knowledge	3	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 9

An engineer visited a classroom to demonstrate how a pinball machine works. The part of the machine that launches a ball is called the plunger. The engineer used a steel ball and a brass ball to model how the mass of a ball affects the ball's speed, even when the diameter of each ball is the same. The students observed that when the plunger was released against each ball, the brass ball was slower and did not travel as far compared to the steel ball.

Pinball Demonstration



Which statement **best** explains the students' observation?

(a) The brass ball had less mass than the steel ball, and the plunger was pulled back the same amount for each ball.

(b) The brass ball had more mass than the steel ball, and the plunger was pulled back the same amount for each ball.

(c) The brass ball had less mass than the steel ball, and the plunger was pulled back farther for the brass ball than for the steel ball.

(d) The brass ball had more mass than the steel ball, and the plunger was pulled back farther for the brass ball than for the steel ball.

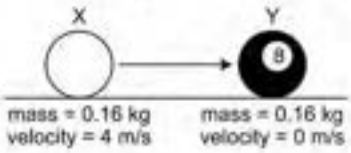
Item Information	
Item Type	Multiple Choice
Page Reference	15
Alignment	PS.9
Point Value	1
Depth of Knowledge	2
Answer Key	B

Appendix A: Sample Items

Sample Item 10

A student designed the model shown below to investigate the resulting motion of two colliding billiard balls.

Colliding Billiard Balls



Predict the **most likely** result of billiard ball X colliding with billiard ball Y.

(a) Billiard ball Y will remain in the same location because each ball has the same mass.

(b) Billiard ball Y will remain in the same location because the balls have different masses.

(c) Billiard ball Y will move to the left because billiard ball X will transfer energy to billiard ball Y.

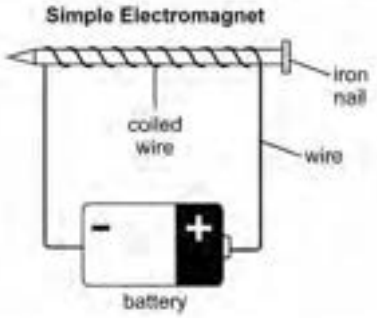
(d) Billiard ball Y will move to the right because billiard ball X will transfer energy to billiard ball Y.

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

Appendix A: Sample Items

Sample Item 11

Two student groups constructed electromagnets similar to the one shown in the following model.



Group 1 was able to pick up more iron filings with its electromagnet than Group 2. Which design change between the groups' electromagnets would **most likely** explain the difference in the results?

(a) Group 2 used a larger battery.

(b) Group 2 used a smaller iron nail.

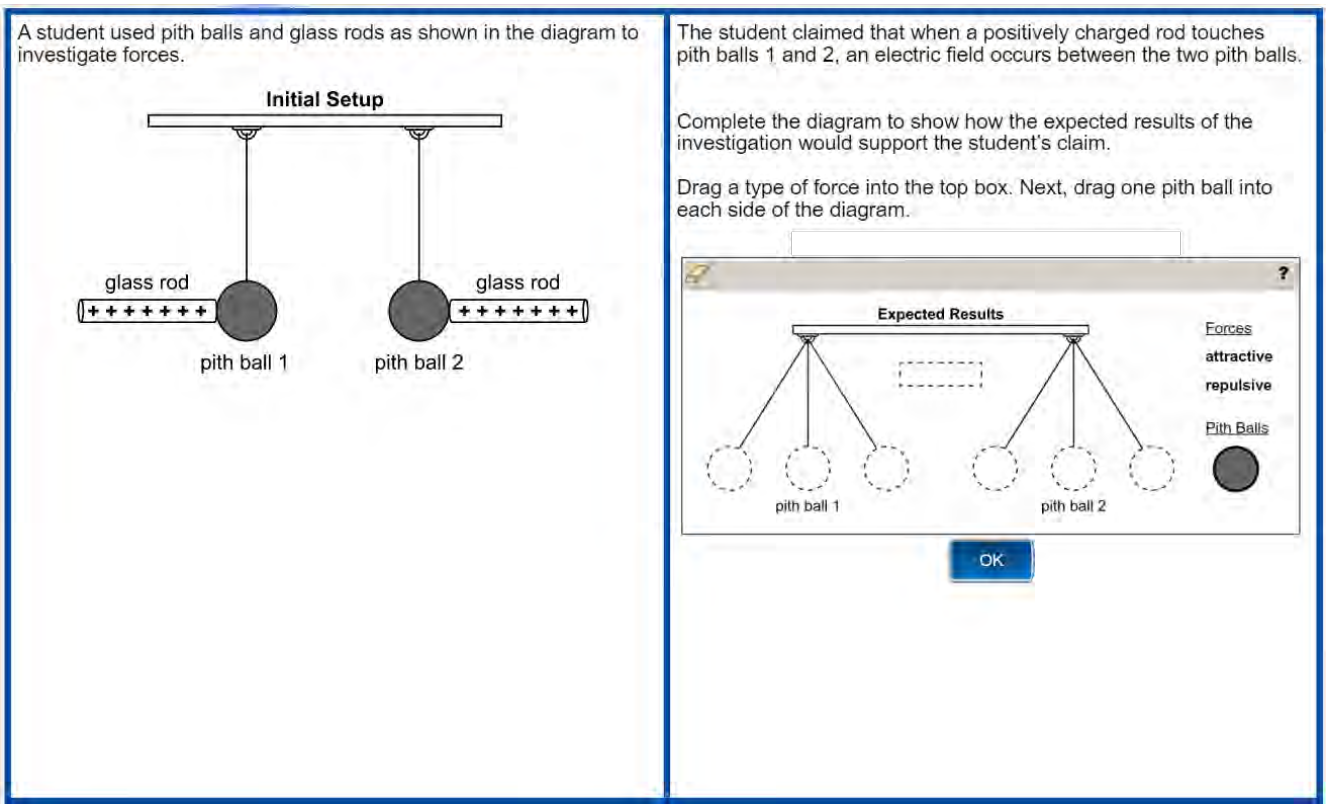
(c) Group 2 reversed the battery direction.

(d) Group 2 had more coiled wire around its iron nail.

Item Information	
Item Type	Multiple Choice
Page Reference	17
Alignment	PS.11
Point Value	1
Depth of Knowledge	2
Answer Key	B

Appendix A: Sample Items

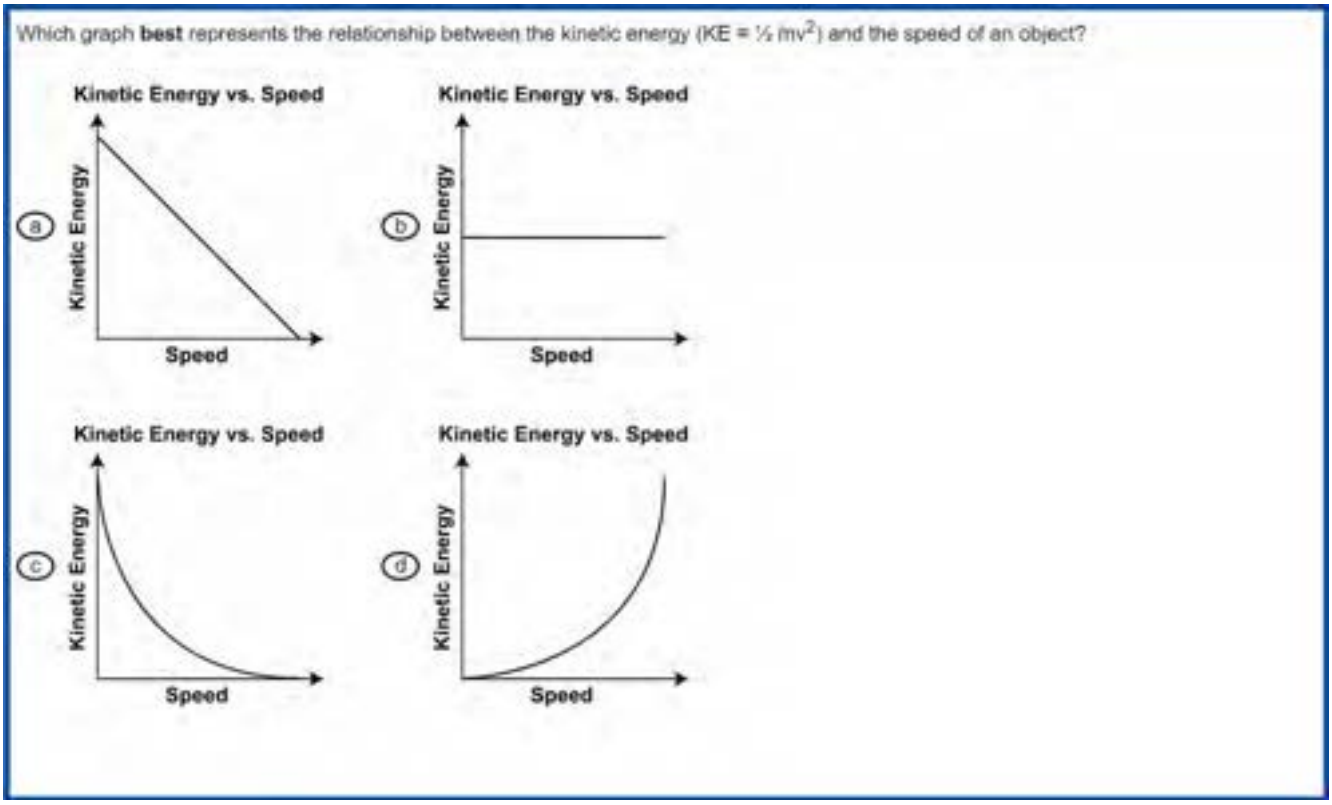
Sample Item 12



Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	
Page Reference	18	Force: repulsive Pith Ball 1: far left position Pith Ball 2: far right position
Alignment	PS.12	
Point Value	1	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

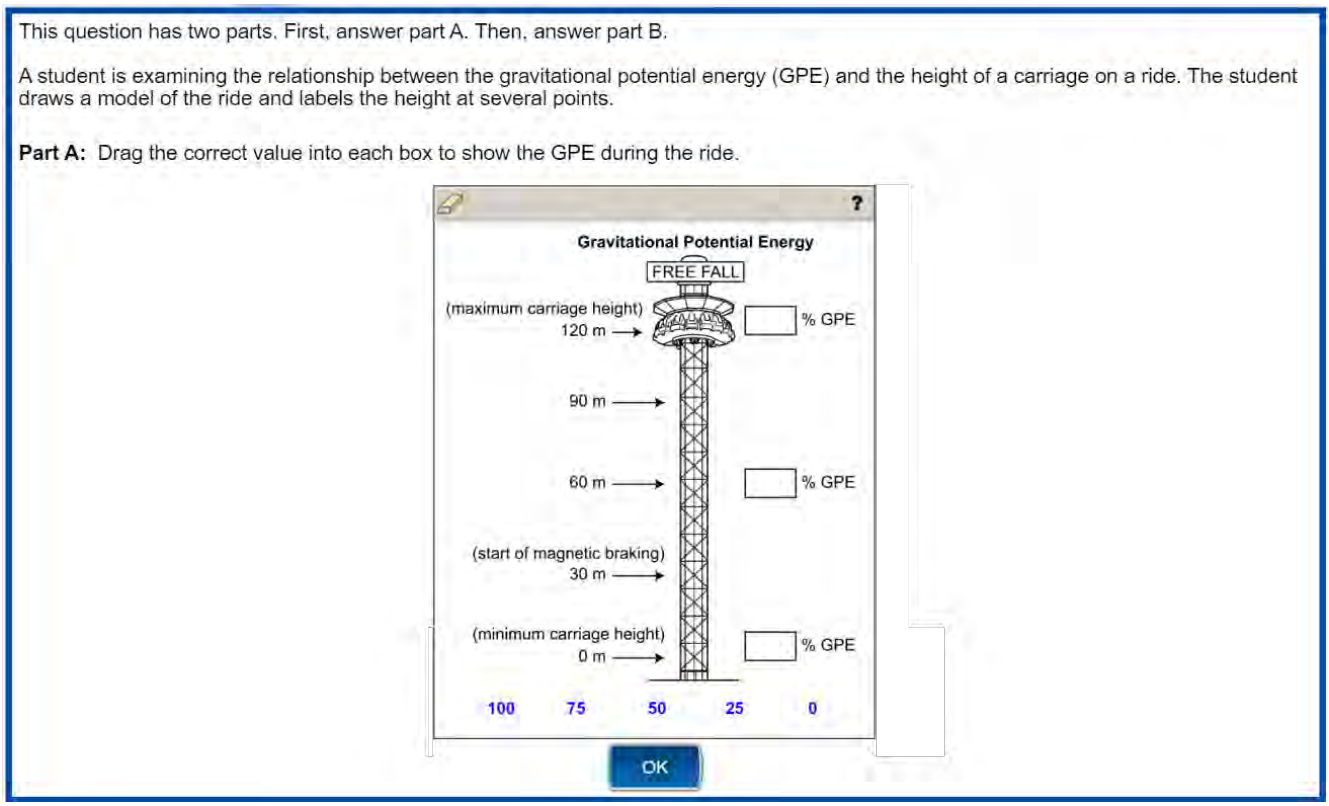
Sample Item 13



Item Information	
Item Type	Multiple Choice
Page Reference	19
Alignment	PS.13
Point Value	1
Depth of Knowledge	3
Answer Key	D

Appendix A: Sample Items

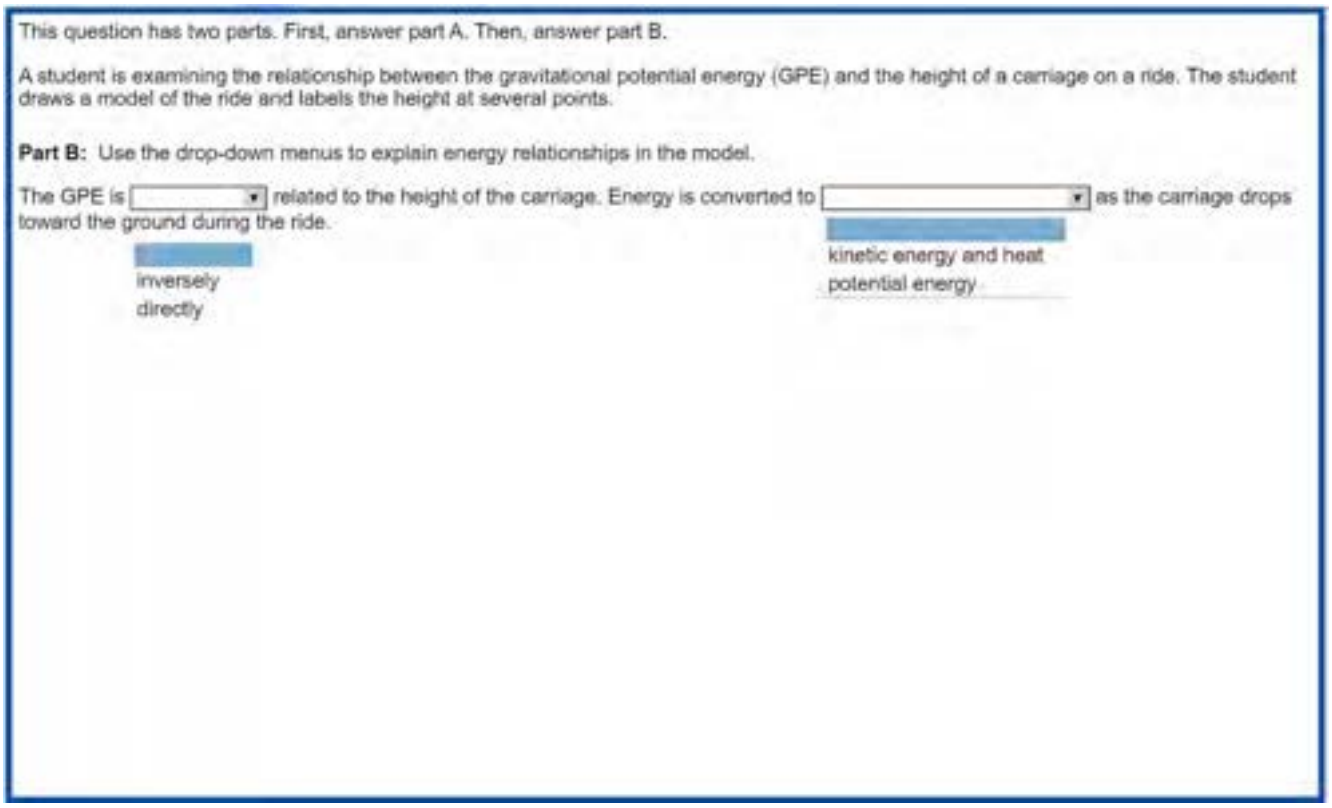
Sample Item 14: Part A



Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	
Page Reference	20	Part A: Top Down: 100, 50, 0
Alignment	PS.14	
Point Value	2	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 14: Part B

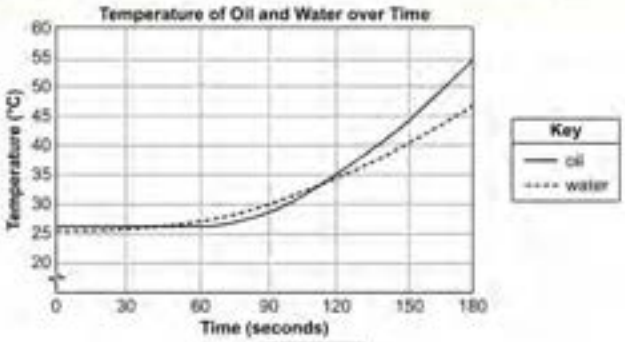


Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	
Page Reference	20	Part B: directly, kinetic energy and heat
Alignment	PS.14	
Point Value	2	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 15

During an experiment, a student separately heats equal masses of oil and water over time. The graph shows the student's data.



The student conducts a second experiment and combines oil and water. The mass of the heterogeneous mixture is equal to the total mass of the substances used in the first experiment. Which statement **best** explains the likely result of heating the heterogeneous mixture?

(a) The mixture likely requires less than 180 seconds to heat to 55°C because water requires less time to heat than oil.

(b) The mixture likely requires more than 180 seconds to heat to 55°C because water requires less time to heat than oil.

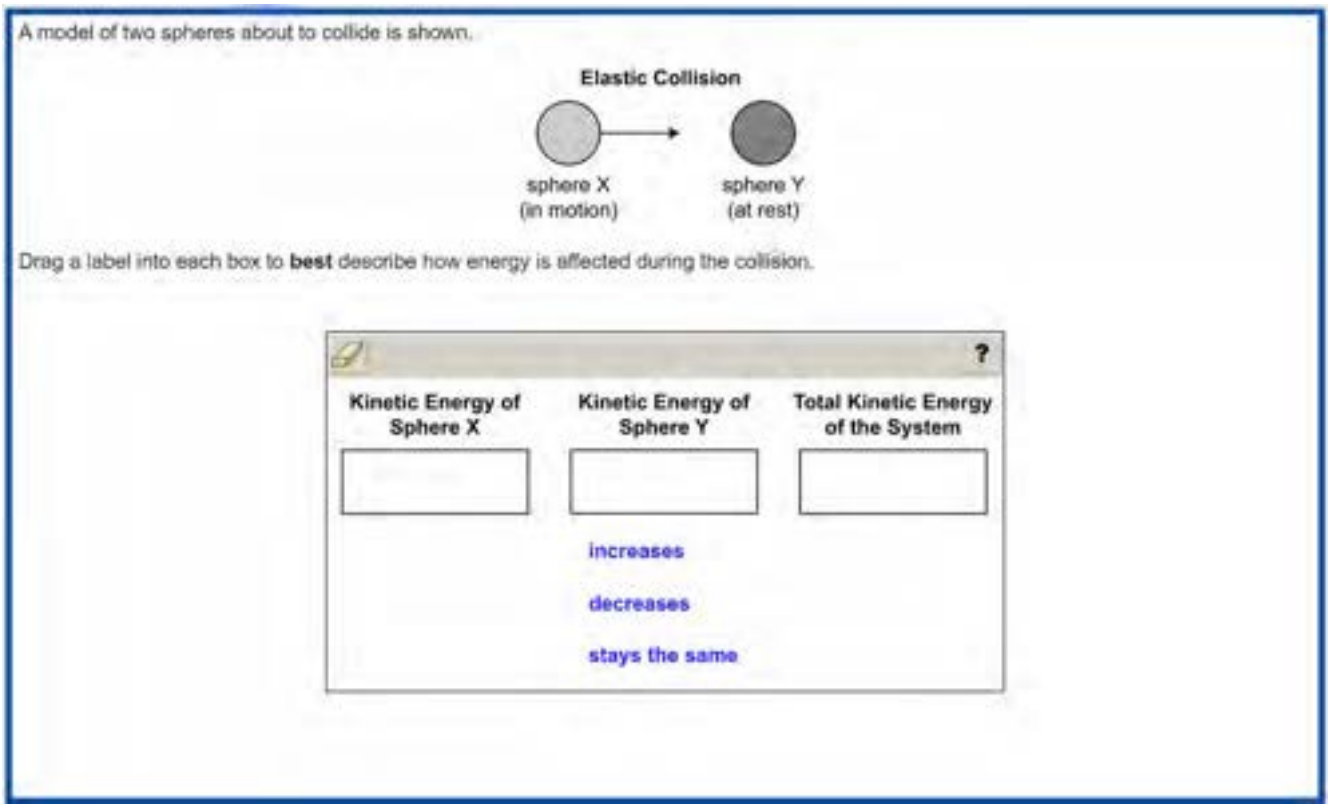
(c) The mixture likely requires less than 180 seconds to heat to 55°C because water requires more time to heat than oil.

(d) The mixture likely requires more than 180 seconds to heat to 55°C because water requires more time to heat than oil.

Item Information	
Item Type	Multiple Choice
Page Reference	21
Alignment	PS.15
Point Value	1
Depth of Knowledge	3
Answer Key	D

Appendix A: Sample Items

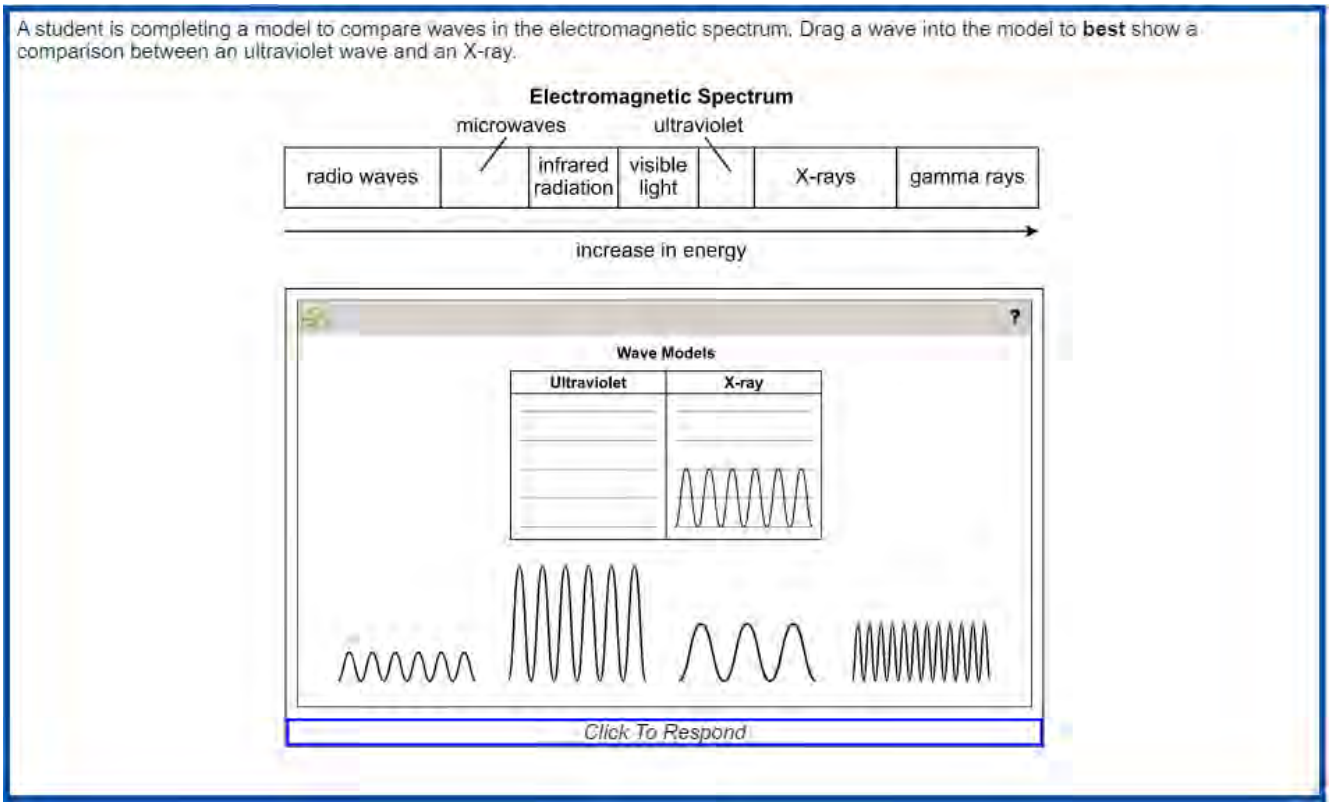
Sample Item 16



Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	Left to Right: decreases, increases, stays the same
Page Reference	22	
Alignment	PS.16	
Point Value	1	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

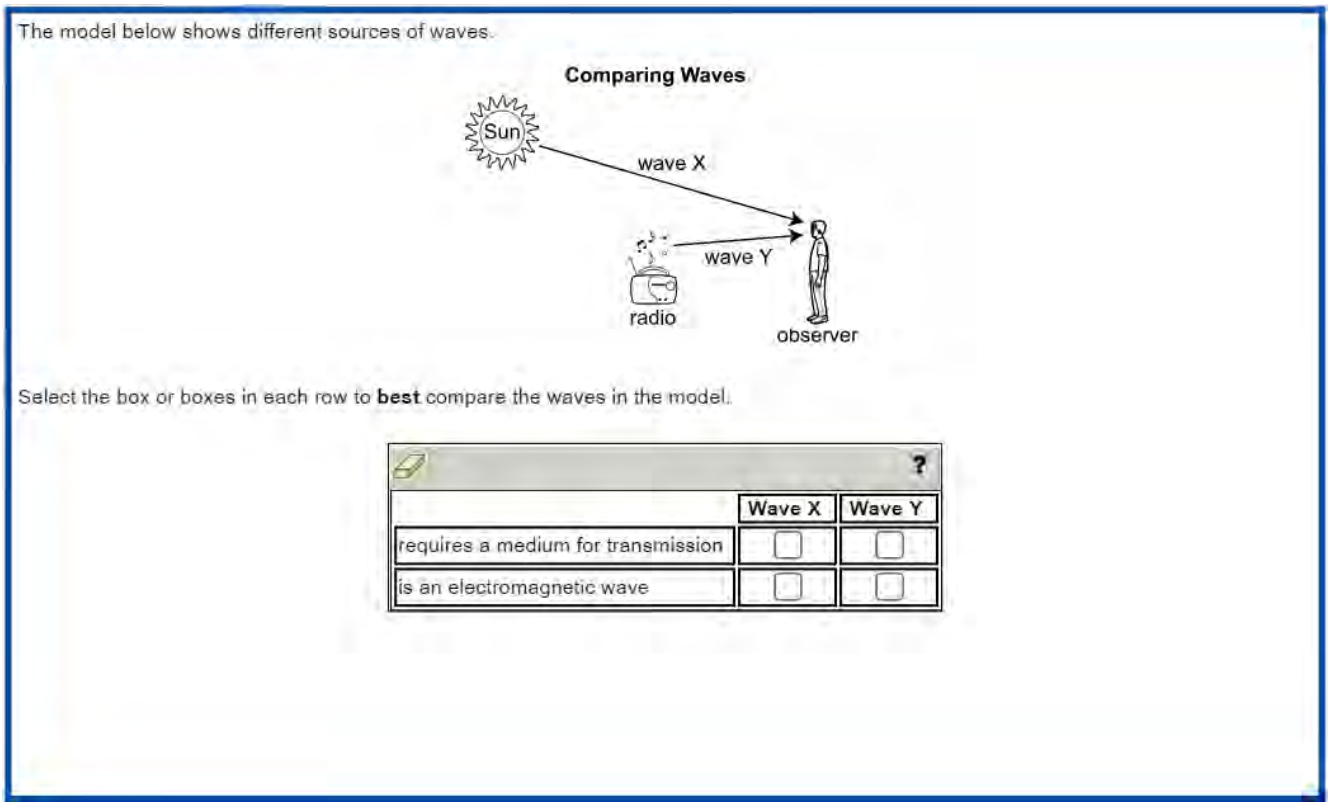
Sample Item 17



Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	3rd wave from left
Page Reference	23	
Alignment	PS.17	
Point Value	1	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

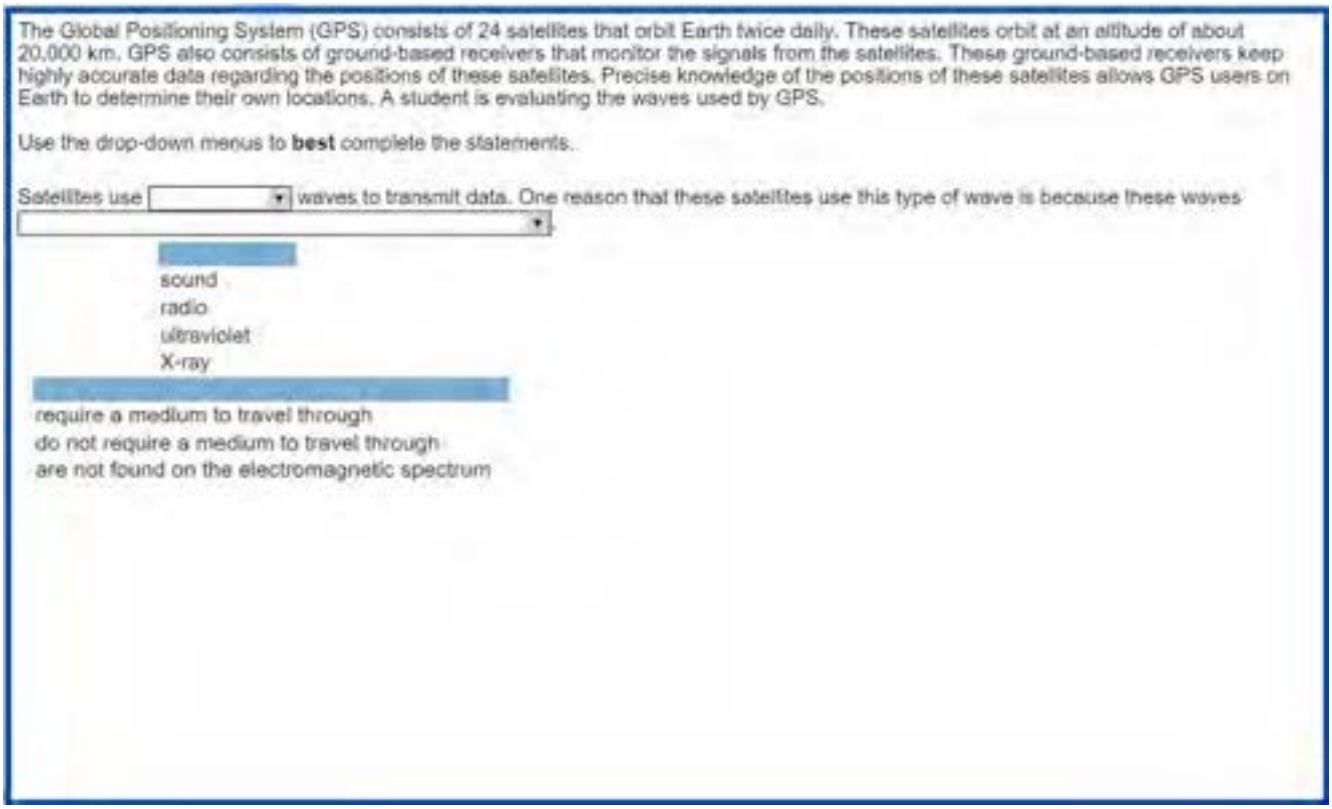
Sample Item 18



Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	Row 1: Wave Y Row 2: Wave X
Page Reference	24	
Alignment	PS.18	
Point Value	1	
Depth of Knowledge	2	
Answer Key	(see description)	

Appendix A: Sample Items

Sample Item 19



Item Information		Answer Key(s) Description
Item Type	Technology Enhanced	
Page Reference	25	radio, do not require a medium to travel through
Alignment	PS.19	
Point Value	1	
Depth of Knowledge	2	
Answer Key	(see description)	