

Georgia Milestones

Assessment System



Study/Resource Guide for Students and Parents

Grade 8



The Study/Resource Guides are intended to serve as a resource for parents and students. They contain practice questions and learning activities for each content area. The standards identified in the Study/Resource Guides address a sampling of the state-mandated content standards.

For the purposes of day-to-day classroom instruction, teachers should consult the wide array of resources that can be found at www.georgiastandards.org.

Study/Resource Guide

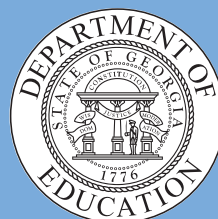


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SCIENCE

DESCRIPTION OF TEST FORMAT AND ORGANIZATION

The Grade 8 Science EOG assessment has a total of 75 selected-response (multiple-choice) items.

The test will be given in two sections.

- You may have up to 70 minutes per section to complete Sections 1 and 2.
- The total estimated testing time for the Grade 8 Science EOG assessment ranges from approximately 90 to 140 minutes.

CONTENT

The Grade 8 Science EOG assessment will measure the Grade 8 Science standards that are described at www.georgiastandards.org. The science items also relate to a Characteristics of Science standard. Because science consists of a way of thinking and investigating and includes a growing body of knowledge about the natural world, you will need to understand the **Characteristics of Science** standards and the **Content** standards for Science. The Characteristics of Science and Nature of Science standards can also be found at www.georgiastandards.org.

The content of the assessment covers standards that are reported under these domains:

- Structure of Matter
- Force and Motion
- Energy and Its Transformations

ITEM TYPES

The Science portion of the Grade 8 EOG assessment consists of selected-response (multiple-choice) items only.

SCIENCE DEPTH OF KNOWLEDGE EXAMPLE ITEMS

Example items that represent applicable DOK levels of the Science assessment are provided for you on the following pages. The items and explanations of what is expected of you to answer them will help you prepare for the test.

All example and sample items contained in this guide are the property of the Georgia Department of Education.

Example Item 1

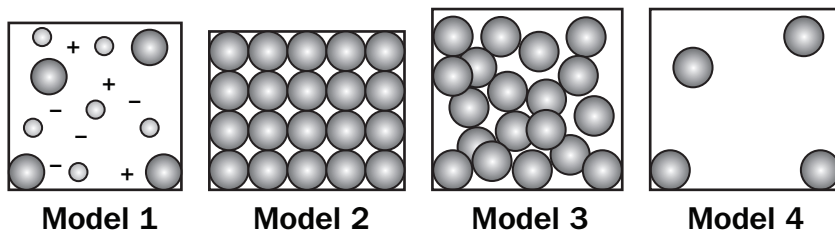
DOK Level 1: This is a DOK level 1 item because the question requires the student to recall information concerning a known relationship between scientific quantities.

Science Grade 8 Content Domain: Structure of Matter

Standard: S8P1. Students will examine the scientific view of the nature of matter. c. Describe the movement of particles in solids, liquids, gases, and plasma states.

Standard: S8CS9b. Scientific investigations usually involve collecting evidence, reasoning, devising hypotheses, and formulating explanations to make sense of collected evidence.

Look at the illustrations.



What illustration shows the structure and movement of particles in a solid?

- A. 1
- B. 2
- C. 3
- D. 4

Correct Answer: B

Explanation of Correct Answer: The correct answer is choice (B) 2. Solids are densely packed and vibrate in place. Choice (A) is incorrect because it shows plasma. The particles in plasma move more freely and have electrical charges. Choice (C) is incorrect because it represents a liquid in a container. Particles in a liquid move more freely than those in a solid. Liquids take the shape of their container. Choice (D) is incorrect because it shows a gas. Particles in a gas are spread far apart and move randomly.

Example Item 2

DOK Level 2: This is a DOK level 2 item because the question requires the student to apply learned information to abstract and real-life situations.

Science Grade 8 Content Domain: Force and Motion

Standard: S8P5. Students will recognize characteristics of gravity, electricity, and magnetism as major kinds of forces acting in nature. a. Recognize that every object exerts gravitational force on every other object and that the force exerted depends on how much mass the objects have and how far apart they are.

Standard: S8CS5a. Observe and explain how parts can be related to other parts in a system, such as the role of simple machines in complex machines.

How would the gravitational force between Earth and the Sun change if Earth's mass were doubled?

- A. The gravitational force would increase.
- B. The gravitational force would decrease.
- C. The gravitational force would be removed.
- D. The gravitational force would stay the same.

Correct Answer: A

Explanation of Correct Answer: The correct answer is choice (A) The gravitational force would increase. This question has to do with knowledge of the Law of Gravitation. This law states that the gravitational force of attraction is directly proportional to the product of the objects' masses and inversely proportional to the square of the distance separating them. In this case, by doubling the mass and not changing the distance, it would result in a force that was twice as large. Choice (B) is incorrect because doubling the mass of Earth would result in an increase of the gravitational force between Earth and the Sun. Choice (C) is incorrect. The gravitational force between Earth and the Sun would increase with an increase in both or either mass. Choice (D) is incorrect because according to the law, when the mass is changed the gravitational force will also change.

Example Item 3

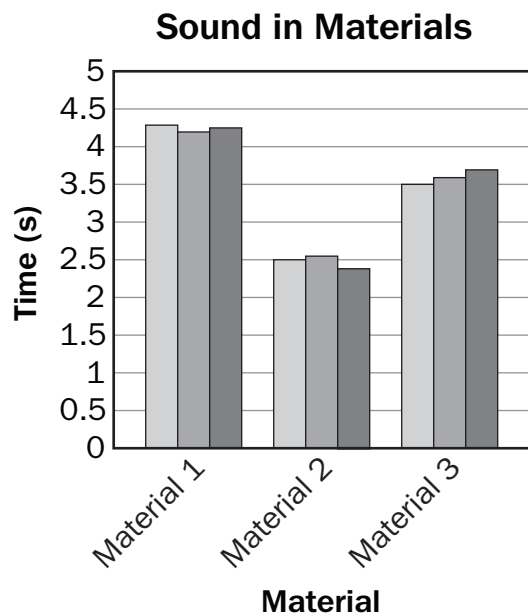
DOK Level 3: This is a DOK level 3 item because the question requires the student to make choices based on a reasoned argument.

Science Grade 8 Content Domain: Energy and Its Transformations

Standard: S8P4. Students will explore the wave nature of sound and electromagnetic radiation. d. Describe how the behavior of waves is affected by medium (such as air, water, solids).

Standard: S8CS6b. Write for scientific purposes incorporating information from a circle, bar, or line graph, data tables, diagrams, and symbols.

A new sound-generating device is being tested that will send waves through different types of materials. It is tested on a liquid, a solid, and a gas. The device is tested three times on each material. The time it takes for the wave to return is recorded for each test.



Which statement BEST identifies each material based on the time it takes for the sound wave to travel through the material?

- A. Material 1 is a gas; Material 2 is a liquid; Material 3 is a solid.
- B. Material 1 is a liquid; Material 2 is a solid; Material 3 is a gas.
- C. Material 1 is a solid; Material 2 is a gas; Material 3 is a liquid.
- D. Material 1 is a gas; Material 2 is a solid; Material 3 is a liquid.

Correct Answer: D

Explanation of Correct Answer: The correct answer is choice (D) Material 1 is a gas; Material 2 is a solid; Material 3 is a liquid. Wave speed is dependent on the medium in which it is traveling. Sound generally travels fastest through solids and slowest through gases. In the graph, Material 2 has the fastest times and therefore is a solid. Material 1 has the slowest times in the graph and is a gas. Material 3 has an intermediate set of times and is a liquid. Choice (A) is incorrect because Material 1 is a gas, but Material 2 is not a liquid and Material 3 is not a solid. Choice (B) is incorrect because Material 2 is a solid, but Material 1 is not a liquid and Material 3 is not a gas. Choice (C) is incorrect because Material 3 is a liquid, but Material 1 is not a solid and Material 2 is not a gas.

SCIENCE CONTENT DESCRIPTION AND ADDITIONAL SAMPLE ITEMS

In this section, you will find information about what to study in order to prepare for the Grade 8 Science EOG assessment. This includes main ideas and important vocabulary words. This section also contains practice questions, with an explanation of the correct answers, and activities that you can do with your classmates or family to prepare for the test.

All example and sample items contained in this guide are the property of the Georgia Department of Education.

CONTENT DESCRIPTION

- Explain and demonstrate the Laws of Conservation of Energy and Conservation of Matter
- Explain heat transfer through matter and space
- Determine the relationship between force and motion
- Describe physical and chemical properties and physical and chemical changes of matter
- Explain how elements can be organized according to their properties
- Recognize the differences between pure substances and mixtures
- Investigate relationships between force, mass, and the motion (acceleration and velocity) of objects
- Describe the effect of simple machines on work
- Explore the wave nature of sound and electromagnetic radiation
- Explain the behavior of light and sound in terms of everyday experiences
- Identify gravity, electricity, and magnetism as forces acting in nature
- Demonstrate the advantages and disadvantages of series and parallel circuits and how they transfer energy
- Describe the relationship between electric currents and magnets

CHARACTERISTICS OF SCIENCE STANDARDS

- Recognize the value of hypothesis to construct possible explanations of natural phenomena
- Use standard safety practices while conducting laboratory and field investigations
- Analyze scientific data to interpret results that support explanations
- Apply appropriate technology to collect and store scientific information
- Use models to represent natural phenomena and support scientific explanations
- Communicate information in written and oral forms
- Organize information in different representations (i.e., tables, charts, and graphs) and identify the relationships they reveal
- Question claims and arguments based on scientific evidence
- Recognize that scientific investigations usually involve collecting evidence, reasoning, devising hypotheses, and formulating explanations to make sense of collected evidence
- Understand how science knowledge grows and changes

Unit 1: Sports

This unit will focus on developing a conceptual understanding of the nature of matter; the relationship between force, mass, and the motion of objects; and energy transformations that occur during sports activities. You will develop an understanding that all objects (e.g., sports equipment, uniforms, etc.) and substances in the natural world are composed of matter that is influenced by forces. You will explore the relationship between velocity and acceleration through graphical representations of the motion of objects. You will gain a qualitative understanding of the Universal Laws of Motion through scenarios in which forces act through direct physical contact between objects as well as examples in which forces act on objects at a distance (via gravitational force). Finally, you will apply your understanding of the Universal Laws of Motion to predict and explain how simple machines make work easier.

KEY TERMS

Substance is matter of any form that cannot be broken down into separate elements by physical means but can be broken down using chemical changes. (S8P1b)

Elements are pure chemical substances that are made up of one type of atom. **Atoms** are the smallest unit of matter that defines the chemical element. A **molecule** is made of two or more atoms that are held together by their chemical bonds. Molecules can be made of the same element or two different elements. Water is a molecule that is made up of two atoms of hydrogen and one atom of oxygen. (S8P1f)

A **compound** is a pure chemical substance that is made up of two or more different elements. A molecule of salt is made up of one atom of sodium and one atom of chlorine. (S8P1b)

A **mixture** is something that contains two or more substances that are not combined chemically. Salted popcorn is an example of a mixture. (S8P1b)

The **Law of Conservation of Energy** states that the total amount of energy in a system cannot change unless energy enters or leaves that system by some form and that energy cannot be created or destroyed. Energy can only change forms. An **energy transformation** refers to the changing of energy from one form to another. (S8P2a)

Potential energy is the energy stored in an object due to its position. The energy stored in a ball sitting at the top of a ramp is all potential energy. In the case of the ball, gravity is pulling down on the ball. Although the ball is not rolling down the hill, it has potential energy due to the pull of gravity. (S8P2b)

Kinetic energy is the energy of **motion**. As the ball starts to roll down the ramp, the potential energy of the ball transforms into kinetic energy. The energy in the system is converted from potential energy to kinetic energy. (S8P2b)

Velocity is a quantity that measures the rate of an object changing its position. If you take a step forward and then a step back to the original position, the velocity is unchanged because the motion did not result in a change in your position. If you take two steps forward, your position has changed. Your velocity is “two steps forward.” Velocity always describes a distance and a direction. (S8P3a)

Acceleration is a quantity that measures the rate at which an object changes its velocity. People often talk about an object decelerating when the object slows down. An object that slows down is actually experiencing a negative acceleration. This means the rate of change is a negative value. An object can have a velocity but not acceleration if it is moving at a constant velocity. Let's say you take a car trip that takes one hour. The velocity of the car is 40 miles east. The average speed of the trip is 40 miles per hour (mph). In the middle of the trip, the car accelerated to 50 mph for 10 minutes and then accelerated to 30 mph for 10 minutes. (S8P3a)

A **force** is a push or pull on an object. Force can be the result of contact, such as when you push a book across your desk. Forces can also result when objects are not in contact with each other. When you use one magnet to push another magnet, there is a force that acts on the magnets although the magnets are not in contact. (S8P3b)

When two or more forces act on an object but the object's velocity does not change, it is said the object is being acted on by **balanced forces**. A book on your desk that is not moving is said to be **stationary**. The book is said to be at **rest** in relation to the desk. Gravity is acting to pull the book down. The desk pushes up against the book, and the book is at rest in relation to the desk. (S8P3b)

An accelerating object is being acted on by **unbalanced forces**. When you push your book across your desk, you are applying force to one side of the book. The force of friction acts on the book in the opposite direction that it is moving, reducing the speed at which the book moves. Because the book still begins to move in the direction you are pushing it, we say that these forces are unbalanced. (S8P3b)

Friction is the force that resists motion between two surfaces. When you rub your hands together, friction creates heat. (S8P3b)

Inertia is the resistance to any change in the state of motion of any physical object. All matter has inertia until unbalanced forces act on it and cause it to move. (S8P3b)

Matter is anything that has mass and occupies space. Matter can be found in several states (solid, liquid, gas, plasma, etc.). (S8P1c)

Mass is the total amount of matter of an object. Mass is a numerical measure of its inertia. The mass of an object does not change regardless of where the object is located. (S8P3b)

Weight is a measure of the force of gravity pulling on a mass. If you could weigh yourself at sea level and then could instantly be in Denver (which is a mile above sea level) and weigh yourself again, you would have two different weights. The force of gravity is less the farther away it is from Earth's center, so the force of gravity would pull less on your mass in Denver than it would at sea level. (S8P3b, S8P5a)

Gravity is the force of attraction that exists between any two or more masses. Gravity can refer to the force that Earth exerts on everything. Because the force of gravity for each object is related to the mass of the object, larger objects, such as Earth, exert a greater gravitational force than objects that have less mass, such as a human. (S8P3b, S8P5a)

In physics, **work** is done when a force causes an object to move in the direction of the force. If you push on a building, you might start to sweat and breathe hard, but you have done no work until the building moves in the direction of your push. (S8P3c)

Simple machines are devices that change the direction or amount of force used to do work. There are six simple machines (lever, inclined plane, pulley, wedge, screw, and wheel and axle). (S8P3c)

The **lever** is a simple machine made up of a straight beam and a fulcrum, a point that the beam pivots on. Levers change the amount of force required to move an object. A seesaw is an example of a lever. (S8P3c)

An **inclined plane** is a simple machine that uses a flat surface to help raise or lower a load. Inclined planes spread the amount of force required to lift a load over a distance. Wheelchair ramps are an example of an inclined plane. (S8P3c)

A **wedge** is a simple machine made up of one or two inclined planes. Wedges change the direction of a force from a straight line to perpendicular to that force. A wedged doorstop is an example of a wedge. The door tries to close. By putting a wedged doorstop between the door and the floor, the force of the door closing is turned 90 degrees and applied to the floor. The floor then resists the door closing. Knives are also an example of a wedge. (S8P3c)

A **screw** is a simple machine that can be thought of as an inclined plane wrapped around an axle. Because of this, the force required to do something is spread out over a longer distance. (S8P3c)

The **wheel and axle** is a simple machine made up of a wheel and an attached axle. The wheel and axle transfers the force from the wheel to the axle. (S8P3c)

A **pulley** is a simple machine made up of a rope or chain that is led around a wheel and axle. Pulleys change the direction of a force. Certain pulley combinations can also change the amount of force required to move an object. (S8P3c)

Important Tips

- ✍ When thinking of energy transforming from one form to another, remember that in most cases, it is not a matter of one form of energy being transformed only into another form of energy. When you rub your hands together, the kinetic energy of your hands is transformed by friction into heat energy. You can also hear your hands rubbing together, which is the result of the friction converting some of the kinetic energy into sound energy. (S8P2a)
- ✍ When comparing mass and weight, recall that mass does not depend on location or gravitational forces. When objects travel to space or to the moon, their mass does not change, but their weight will change as the forces of gravity change on them throughout the entire trip. (S8P3)

Sample Items 1–4

Item 1

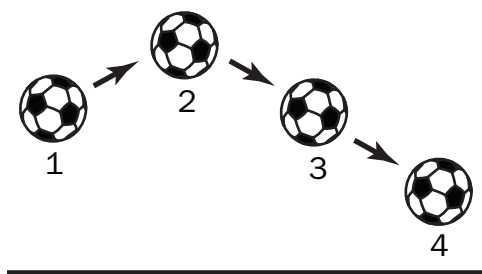
A teacher boils clear liquids in two beakers. Afterward, Beaker A has a white powder left in it, but Beaker B is empty. The teacher states that one beaker contained only water while the other beaker contained salt water. Student 1 reaches the conclusion that Beaker A contained a mixture whereas Beaker B contained a pure substance. Student 2 reaches the conclusion that Beaker A held only water while Beaker B held salt water.

Which student's conclusion is **MOST LIKELY** correct?

- A. Both students are correct.
- B. Both students are incorrect.
- C. Student 1 is correct, while Student 2 is incorrect.
- D. Student 1 is incorrect, while Student 2 is correct.

Item 2

A soccer ball is thrown into the game from the sidelines.



Which statement **BEST** describes the ball's travel in terms of potential and kinetic energy?

- A. The ball has maximum kinetic energy at Point 1 and maximum potential energy at Point 4.
- B. The ball has maximum potential energy at Point 1 and maximum kinetic energy at Point 3.
- C. The ball has maximum potential energy at Point 2 and maximum kinetic energy at Point 4.
- D. The ball has maximum kinetic energy at Point 2 and maximum potential energy at Point 3.

Item 3

A student plans an experiment to test the Law of Conservation of Energy. The student sets up a pendulum and hypothesizes that the pendulum will not stop. The student finds that the pendulum eventually slows down and stops.

Explain these results in terms of the Law of Conservation of Energy.

- A. The pendulum stopped because air resistance slowed the pendulum, and according to the Law of Conservation of Energy, energy was destroyed.
- B. The pendulum stopped because there was not enough kinetic energy, and according to the Law of Conservation of Energy, the energy was destroyed.
- C. The pendulum stopped due to friction, and according to the Law of Conservation of Energy, no energy is lost, just changed from potential energy to thermal energy.
- D. The pendulum stopped due to gravity, and according to the Law of Conservation of Energy, no energy is lost, just changed from gravitational energy to potential energy.

Item 4

Two equal forces act at the same time on the same stationary object, but in opposite directions.

Which statement describes the object's resulting motion?

- A. The object will accelerate.
- B. The object will change direction.
- C. The object will remain stationary.
- D. The object will move at a constant speed.

Unit 2: Food and Cooking

In this unit, you will develop a conceptual understanding of the nature of matter, forms of energy, and how energy is transformed from one form to another. You will learn how these ideas connect to phenomena that occur during cooking. You will understand that in a chemical reaction, matter can neither be created nor destroyed, only transformed. You will learn about the characteristics of matter (i.e., physical and chemical properties) that are useful to classify and differentiate substances.

KEY TERMS

Atoms are the smallest unit of matter that defines the chemical element. **Elements** are pure chemical substances that are made up of one type of atom. A **molecule** is made of two or more atoms that are held together by their chemical bonds. Molecules can be made of the same element or more than one element. Water is a molecule that is made up of two atoms of hydrogen and one atom of oxygen. (S8P1a, b)

The **Periodic Table of Elements** is a table arranging all the known elements into groups with common properties. This arrangement also demonstrates trends based on those properties.

Periodic Table of Elements

1 1 H Hydrogen																	18 2 He Helium																														
3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon																														
11 Na Sodium	12 Mg Magnesium											13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon																														
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton																														
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon																														
55 Cs Cesium	56 Ba Barium																																														
		72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon																															
87 Fr Francium	88 Ra Radium	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Uut Ununtrium	114 Fl Flerovium	115 Uup Ununpentium	116 Lv Livermorium	117 Uus Ununseptium	118 Uuo Ununoctium																															
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57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium																																	
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Substance is matter of any form that cannot be broken down into separate elements by physical means but can be broken down using chemical changes. (S8P1b)

A **compound** is a pure chemical substance that is made up of two or more different elements. A molecule of salt is made up of one atom of sodium and one atom of chlorine. (S8P1b)

Matter is anything that has mass and occupies space. Matter can be found in several states (solid, liquid, gas, plasma, etc.). (S8P1c)

The states of matter are the different forms that matter can be found in. Water is a **liquid**, the state of matter that has a definite volume but no fixed shape. When water is ice, it is a **solid**. Solids have a definite shape and volume. Their shape and volume cannot be easily changed. When water is steam, or water vapor, it is a **gas**. Gases have no definite shape and take the shape of their container. **Plasma** is gas that is charged. Plasma conducts electricity easily. Stars and neon lights are examples of plasma. Plasma is different from the other states of matter in that it is a high-energy state of matter. (S8P1)

A **mixture** is something that contains two or more substances that are not combined chemically. Salted popcorn is an example of a mixture. (S8P1b)

Physical properties are any properties that are measurable and can be observed. Physical properties can be determined without changing the chemical properties of an object. Color, hardness, area, length, strength, and temperature are some examples of physical properties. (S8P1d, f)

Mass is the total amount of matter of an object. Mass is a numerical measure of the object's inertia. The mass of an object does not change regardless of where the object is located.

Volume is the amount of space that an object or substance occupies. Volume is a physical property.

Density is the physical property that describes how tightly matter is put together. A pure element, such as gold, will have a characteristic density and mass. (S8P1f)

Boiling point is the physical property that describes the temperature at which a substance will change from a liquid to a gas. Water boils at 100°C (212°F). (S8P1f)

Melting point is the physical property that describes the temperature at which a solid will become a liquid. Ice, a solid, will change into liquid water at 0°C (32°F). This is the melting point of water. (S8P1f)

Chemical properties are any properties that can only be measured by chemically changing an object. Paper starts to burn at around 450°F. At this temperature the paper combines with oxygen in the air and new substances are formed. (S8P1d)

Combustibility is the chemical property of how easily a substance will set on fire. (S8P1d)

Reactivity is the chemical property of the capacity of an atom or molecule to go through a chemical reaction with another atom or molecule. Sodium is a very reactive metal. Sodium reacts rapidly and energetically with other substances. Gold is a metal that is not very reactive. It won't tarnish from oxygen or water. (S8P1d)

A **physical change** happens when matter has a change in its physical properties but not its chemical properties. For example, salt can be dissolved in water, but if the water evaporates, the salt is still there. (S8P1e)

A **chemical change** happens when matter breaks down into two or more substances OR when more than one substance is combined to form a new substance. Hydrogen peroxide forming bubbles on its own is an example of matter breaking down into two substances. Vinegar and baking soda turning into bubbling foam is an example of two substances combining to create other substances. (S8P1e)

A **chemical reaction** is a process where two or more substances combine chemically in some way to form one or more other substances. When iron is combined with air and water, the iron is slowly converted into rust. (S8P1e)

A **precipitate** is a solid that is formed by a chemical reaction or by diffusion in a solid. Precipitates can form in a solution or inside another solid. (S8P1e)

The **Law of Conservation of Matter** states that the total amount of matter in a system cannot be created or destroyed. When a piece of paper burns, it becomes ash, water vapor, and carbon dioxide. If you could collect up the ash, water vapor, and carbon dioxide and mass it, you would find that it had the same mass as the paper before it was burnt. (S8P1g)


The **Law of Conservation of Energy** states that the total amount of energy in a system cannot change and that energy cannot be created or destroyed. Energy can only change forms. An energy transformation refers to the changing of energy from one form to another. (S8P2a)

Conduction is the movement of heat through an object or from one object to another when they are touching. In conduction, thermal energy is transferred between atoms when they collide with each other. Thermal energy moves from warmer areas, those with higher energy, to cooler areas, those with less energy. This is why ice in a glass of water melts on a warm day. The thermal energy flows toward the ice and the energy turns the ice into water. Warm air molecules collide with the molecules of the glass container and transfer thermal energy to them. The molecules in the container then pass the thermal energy between themselves by direct contact. Finally, the energy is transferred to the water and ice by the water molecules coming in contact with both. (S8P2d)

Convection is the movement of heat through fluids and gases. In convection, thermal energy is transferred due to differences in density caused by temperature variations. When you heat a pot of soup, the liquid becomes warm through convection. As the liquid at the bottom of the pot becomes warmer, its density decreases. The increased thermal energy causes the molecules to move faster, which spaces them farther apart, which increases the volume and thus decreases the density. The change in density causes the warm liquid to rise to the top of the soup. As the mass of warmer soup rises, it comes in contact with cooler soup above it and passes the thermal energy to it. The motion of the warmer mass is convection. (S8P2d)

Heat can also move by means of **radiation**. Thermal radiation does not require any form of matter to move through, as conduction and convection require. Thermal radiation energy moves via electromagnetic waves. Because of this, thermal radiation moves very fast. (S8P2d)

Important Tip

 The movement of particles within the different states of matter can vary greatly. Particles in solids are packed together very tightly, and they do not move around easily. This is why solids tend to be hard. Particles in a liquid move around and are packed loosely. Particles in gases move in all sorts of directions, and the particles are spread very far apart. (S8P1c)

Sample Items 5–8

Item 5

You inflate a balloon with helium. The balloon feels stiff.

Which properties of a gas **BEST** explain this observation?

- A. The particles are moving quickly and are far apart.
- B. The particles are closely packed and vibrate in place.
- C. The particles slide past each other and are close together.
- D. The particles are closely packed and are moving very quickly.

Item 6

Study the list of processes below.

1. A pencil is broken in half.
2. A nail is left outside and rusts.
3. Baking soda and vinegar are used in a model volcano.
4. Ice left on the counter melts.
5. Salt is combined with water to make a saltwater solution.
6. Milk that is left out of the refrigerator sours.

Which of these processes would produce a chemical change?

- A. 2, 3, 6
- B. 1, 4, 6
- C. 1, 4, 5
- D. 2, 3, 5

Item 7

A science teacher places a sealed microwave bag of popcorn on a balance and measures its mass.

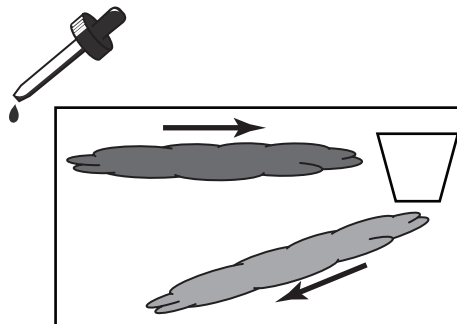
She microwaves the popcorn and finds the mass again before opening the bag. The masses are nearly the same.

Which scientific law does this BEST demonstrate?

- A. Law of Cause and Effect
- B. Law of Thermodynamics
- C. Law of Conservation of Volume
- D. Law of Conservation of Matter

Item 8

A lab group places an aquarium filled with warm water on a working hot plate. A cup of blue ice with holes in the bottom is floating at one end of the aquarium. Red dye is dropped into the other end of the aquarium. The group then observes that the red dye starts to spread out from one end of the aquarium to the other. They also observe that at the same time, blue water from the cup of ice starts moving across the bottom of the aquarium. Over time, the red dye moves downward and the blue dye moves upward in a circular pattern. One student suggests that this shows how cold from the ice conducts the water around the aquarium.



Which statement is the BEST response to the student's theory?

- A. This shows how different colors of dyes cause water to move in different directions.
- B. This shows how the warm red water radiates heat toward the cool blue water, causing it to sink.
- C. This shows how convection currents move as the water warms and cools, causing it to rise or sink.
- D. This shows how the cold ice cubes in the cup transfer heat to the warm red water, causing it to sink.

Unit 3: Energy in Our Life

In this unit, you will develop an understanding that energy exists in many forms. You will learn that in a closed system energy can be transferred and transformed, but the total amount of energy available is always the same—it is conserved. You will also learn about two of the four main forces in the universe: gravitational and electromagnetic forces. You'll determine how these forces influence the motion of objects and are responsible for the work that a system does or for the work that is done on a system.

KEY TERMS

The **Law of Conservation of Energy** states that the total amount of energy in a system cannot change and that energy cannot be created or destroyed. Energy can only change forms. An **energy transformation** refers to the changing of energy from one form to another. (S8P2a)

Potential energy is the energy stored in an object due to its position. In the case of a ball at the top of an inclined plane, gravity is pulling down on the ball. Although the ball is not rolling down the inclined plane, it has potential energy due to the pull of gravity. (S8P2b)

Kinetic energy is the energy of **motion**. As the ball starts to roll down the inclined plane, the potential energy of the ball transforms into kinetic energy. The energy in the system is converted from potential energy to kinetic energy. (S8P2b, d)

Mechanical energy is the total of all the potential energy and kinetic energy in an object. Mechanical energy is the energy of position and motion of an object. (S8Pc)

Thermal energy is the flow of energy from an object that has a higher temperature to one that has a lower temperature. The kinetic energy (movement) of particles in a warm object is higher than the kinetic energy of particles in a cool object. Some of the kinetic energy flows from the warm object to the cool object, and the temperatures of the two objects even out. When you go outside on a cold day without a jacket on, the heat energy in your body starts to flow to the cooler air. (S8Pc, d)

Conduction is the movement of heat through an object or from one object to another when they are touching. In conduction, thermal energy is transferred between atoms when they collide with each other. Thermal energy moves from warmer areas, those with higher energy, to cooler areas, those with less energy. This is why ice in a glass of water melts on a warm day. The thermal energy flows toward the ice and the energy turns the ice into water. Warm air molecules collide with the molecules of the glass container and transfer thermal energy to them. The molecules in the container then pass the thermal energy between themselves by direct contact. Finally, the energy is transferred to the water and ice by the water molecules coming in contact with both. (S8P2d)

Convection is the movement of heat through fluids and gases. In convection, thermal energy is transferred due to differences in density caused by temperature variations. When you heat a pot of soup, the liquid becomes warm through convection. As the liquid at the bottom of the pot becomes warmer, its density decreases. The increased thermal energy causes the molecules to move faster, which spaces them farther apart, which increases the volume and thus decreases the density. The change in density causes the warm liquid to rise to the top of the soup. As the mass of warmer soup rises, it comes in contact with cooler soup above it and passes the thermal energy to it. The motion of the warmer mass is convection. (S8P2d)

Heat can also move by means of **radiation**. Thermal radiation does not require any form of matter to move through, as conduction and convection require. Thermal radiation energy moves via electromagnetic waves. Because of this, thermal radiation moves very fast. (S8P2d)

Electric energy is the energy of electrons moving through a conductor. Electricity is the name we give to the motion of electrons along the path formed by a conductor. (S8P2a)

Magnetic energy is produced when magnetic fields are generated. (S8P2a)

Gravity also refers to the **gravitational force** every object exerts on every other object. Because the force of gravity for each object is related to the mass of the object, larger objects, such as Earth, exert a greater gravitational force than objects that have less mass, such as a human. (S8P5a)

Mass is the total amount of matter of an object. Mass is a numerical measure of the object's inertia. The mass of an object does not change regardless of where the object is located. (S8P5a)

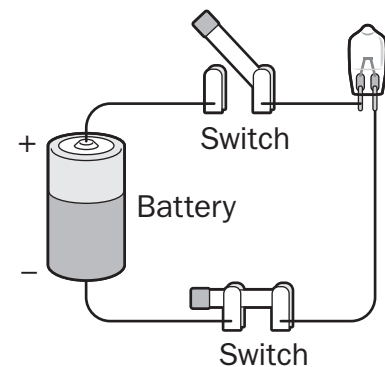
A **force** is a push or pull on an object. A force can be the result of contact, such as when you push a book across your desk. Forces can also result when objects are not in contact with each other. When you use one magnet to push another magnet, there is a force that acts on the magnets although the magnets are not in contact. (S8P3b)

When two or more forces act on an object but the object's velocity does not change, it is said the object is being acted on by **balanced forces**. A book on your desk that is not moving is said to be **stationary**. The book is said to be at **rest** in relation to the desk. Gravity is acting to pull the book down. The desk pushes up against the book and the book is at rest in relation to the desk. (S8P3b)

An accelerating object is being acted on by **unbalanced forces**. When you push your book across your desk, you are applying force to one side of the book. The force of friction acts on the book in the opposite direction that it is moving, reducing the speed at which the book moves. Because the book still begins to move in the direction you are pushing it, we say that these forces are unbalanced. (S8P3b)

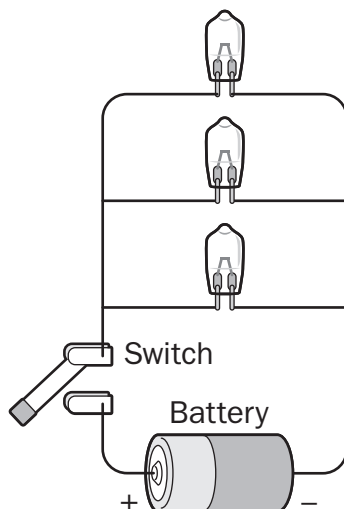
To make an **electric circuit** you need at least a power source and a path for the electric current to flow through. You can add other devices like resistors, such as a light bulb, along the path. You can also add a switch to start and stop the flow of an electric current to the circuit. (S8P5b)

Series circuits are electric circuits where the devices powered by the circuit are connected one after the other. The electrons can only flow in one direction. A series circuit is like a flight of stairs. If one step of the stairs is missing, you cannot move to the next step. In a series circuit, if one device fails, electricity stops flowing through the circuit. (S8P5b)



Series Circuit

Parallel circuits are electric circuits where the devices powered by the circuits have multiple paths for the electrons to flow. Think of a ladder. The legs of the ladder are the path the electricity flows along. Each rung is a device that draws electricity from the legs. If one rung is lost, the electricity would still be able to flow through the circuit. (S8P5b)



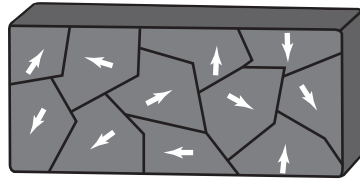
Parallel Circuit

Electric current is the flow of an **electric charge** through a conductor. When electric currents move through a conductor, they create heat and magnetic fields. Lightning, static electricity, and the movement of electricity in power lines are examples of electric currents. (S8P5b)

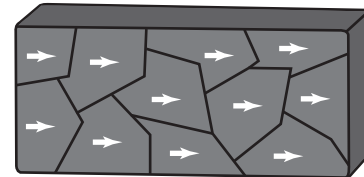
Electric force is the force of attraction between two electrically charged objects. When you use a balloon to pick up pieces of paper, the electric force between the balloon and pieces of paper is great enough to pick up the pieces of paper. Objects cling to each other when there is enough electric force to cause them to cling together. (S8P5b)

Electrons are particles found in atoms. Electrons carry a negative electric charge. When electricity flows through a wire, electrons bump into atoms. The electron that hits the atom knocks one electron off the atom and takes its place. The electron that was just knocked off its atom then repeats the process. The electricity that is found at the other end of a circuit consists of the electrons that have been repeatedly knocked from one atom to another. (S8P5b)

Magnetic materials have what is known as magnetic domains—they are sort of like pieces of a big puzzle, as shown in the illustration of magnetized material below. The two poles of a magnet result when these magnetic domains align in such a way that they point in the same direction. If you cut a magnet in half, the domains of each half will still line up so that the two new magnets each have a north pole and a south pole. In an object that is not magnetized, the domains lie in many different directions (as shown in the illustration below) and mostly cancel each other out. (S8P5c)




Not Magnetized



Magnetized

An **electromagnet** is created when a wire is coiled and an electric current flows through it. Generally, electromagnets have a metal core that helps to increase the strength of the electromagnet. Magnetic force is created by the movement of electrical charges through a wire. A magnetic field is created around the wire and this magnetic field lines up the domains in the core, turning the core into a temporary magnet. When the electric current is turned off, the magnetic field quickly fades. You can make an electromagnet using a circuit with a battery, switch, and wire wrapped around a nail. (S8P5c)

Important Tip

 In electric circuits, the electrons flow from the negative pole of the battery, where there is an excess of electrons, to the positive pole of the battery, where there is a deficit of electrons. An easy way to remember this is by looking at the symbols for each pole. The negative pole (shown by a $-$) looks like an arrow. It is shooting away from pole. The positive pole (shown by a $+$) looks like the addition symbol. It is trying to add electrons to its pole. (S8P5c)

Sample Items 9–12

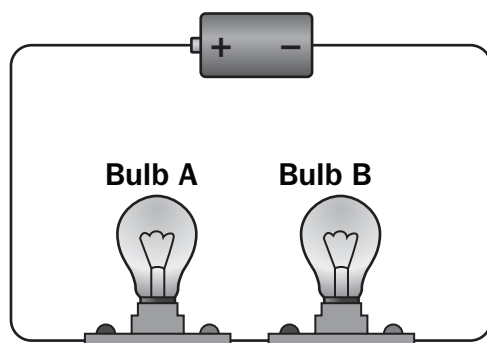
Item 9

What energy transformation causes the blades of an electric fan to move when an electric fan is turned on?

- A. sound to motion
- B. heat to electricity
- C. electricity to motion
- D. motion to electricity

Item 10

Study the circuit diagram.

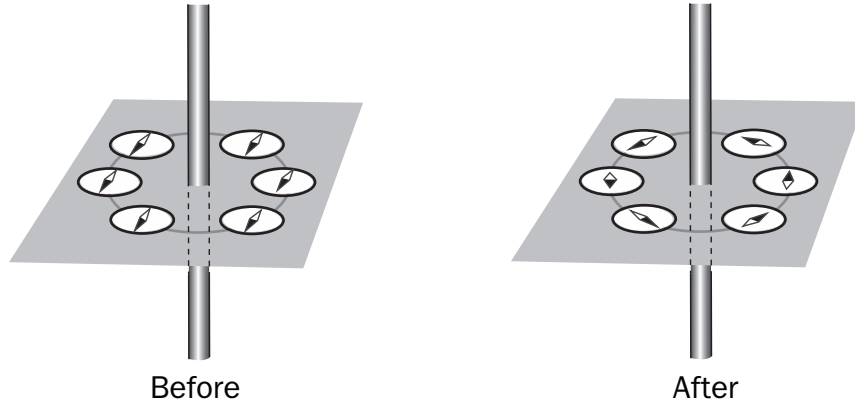


If Bulb B burns out, what will happen to Bulb A?

- A. It will get brighter.
- B. It will get dimmer.
- C. It will stop working.
- D. It will stay the same.

Item 11

A student is investigating how a compass works. The student places several compasses around a wire. The compasses are 5 centimeters away from each other.

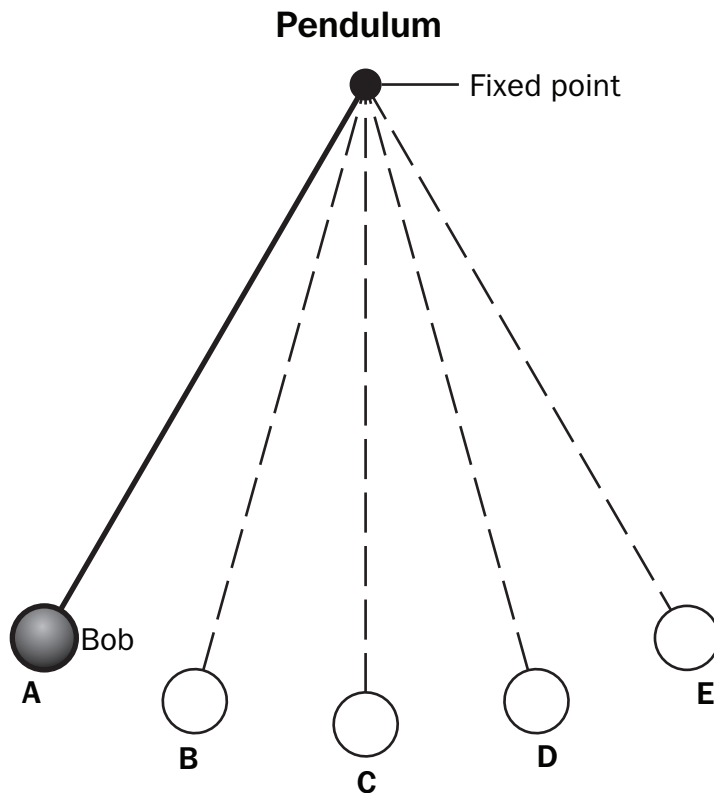


What can the student do to cause the needles of the compasses to change as shown?

- A. move the wire back and forth
- B. run electricity through the wire
- C. bend the wire around the compasses
- D. bring the compasses closer to the wire

Item 12

A student is investigating the motion of a pendulum. The student holds the bob in Position A and then releases it.



Which statement is correct about the energy of the bob?

- A. The kinetic energy of the bob is greatest in Position A.
- B. The potential energy of the bob is greatest in Position C.
- C. Kinetic energy changes to potential energy as the bob moves from Position D to Position E.
- D. Potential energy changes to kinetic energy as the bob moves from Position C to Position D.

Unit 4: Light and Sound Show

In this unit, you will acquire a conceptual understanding of the nature of sound and electromagnetic radiation. You will also learn to apply the Law of Conservation of Energy to explain how energy is transferred as waves propagate. You will study how sound behaves in the presence of different obstacles and how light is manipulated by positioning mirrors and lenses in its path.

KEY TERMS

Waves are constant fluctuations that can travel through matter or space. When you throw a rock in a puddle, the water forms waves that move outward from the place where the rock hit the water. Waves can move through solids, liquids, gases, and empty space. (S8P4a)

Frequency is the number of vibrations per a unit of time that a wave possesses. If you counted the number of wave peaks from throwing the rock in a puddle that occurred in a minute, you could determine the wavelength of that vibration. (S8P4a)

Wavelengths are the distance from one peak of a wave to the next peak of the wave. (S8P4a)

Amplitude is the property of a wave that describes half the distance between the height of the peak of a wave and the trough (the bottom) of a wave. In a surf wave, the amplitude represents the amount of water displaced, which can be very large. (S8P4a)

The **characteristics of a wave** are determined by the wavelength, frequency, and amplitude of the wave. (S8P4a)

Electromagnetic radiation is a term that is used to describe radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays, and gamma rays. Radio waves have the smallest frequency and the longest wavelength. Gamma rays are at the other end of the electromagnetic radiation spectrum. Gamma rays have the largest frequency and the shortest wavelength. (S8P4a)

Electromagnetic waves do not require a medium to move through. Electromagnetic waves transport energy that is stored in the electric and magnetic field. (S8P4a)

Mechanical waves are caused by a disturbance or vibration that causes the molecules in matter to bump into each other and transfer the energy from one molecule to the next in a set direction. Matter is required as a **medium** for the waves to move through, so mechanical waves cannot occur in the vacuum of space. (S8P4a)

Sound is a mechanical wave that can be heard as it moves through a medium, such as air, and displaces the air, creating zones of high and low pressure. When fireworks go off on the Fourth of July, you can hear the sound. With some of the larger fireworks, you can also feel the air as the pressure from the firework exploding pushes the air away from the firework. (S8P4e)

When people refer to the **pitch** of a sound, they are referring to the sensation of the frequency of the wave. The **intensity** of a sound is related to the amplitude of the wave. (S8P4f)

When people refer to **light**, they are usually referring to the visible light they can see. Light is not considered matter and has no mass. The behavior of light can be explained by the introduction of a massless particle called a photon or by studying the way that electromagnetic waves interact with matter. (S8P4b)

There are several processes that light can go through as it encounters matter.

Reflection occurs when light bounces off a medium. When light is reflected, not all the light is reflected. **Refraction** occurs when light moves through a medium and bends as the medium slows down the light as it moves through the medium. When you look through a glass of water and an object behind the glass appears to change shape, the light reflected by that object has been refracted by the glass. **Diffraction** occurs when light encounters an obstacle and slightly bends as it passes around the object. If you hold a CD and see the colors of the rainbow, this is the light being diffracted by the surface of the CD. **Absorption** occurs when light strikes a surface and the energy of the photon is taken up by the matter. An object lying in the sun will warm up as the sunlight transforms into heat energy. (S8P4b)

When the human eye sees **colors**, it is seeing the parts of the spectrum of light that are reflected from an object. A blue object reflects the wavelengths of light that we see as blue. (S8P4c)

Important Tip

✍ The way waves travel is known as wave propagation. As waves propagate, some of the energy is transferred. When light travels through a glass of water, it slows down and is refracted. Some of the energy that is lost—and that causes the light to slow down—is transferred into the water and glass as thermal energy. (S8P4a)

Sample Items 13–16

Item 13

As a race car drives away from an observer, the observer notes that the sound from the car gets quieter and the pitch lowers.

Which statement **BEST** describes how the sound wave changes as the race car drives away?

- A. The frequency increases and the amplitude increases.
- B. The frequency increases and the amplitude decreases.
- C. The frequency decreases and the amplitude increases.
- D. The frequency decreases and the amplitude decreases.

Item 14

An advertisement claims that a new type of cotton cloth looks red because of the way the cloth is woven and not because of the dye used on the cloth.

Which statement **BEST** explains why the chemical dye is responsible for the red appearance of the cloth?

- A. The chemical absorbs the light from the visible spectrum except for red that is reflected to the eye.
- B. The chemical absorbs all the red light from the visible spectrum that is reflected to the eye.
- C. The light is refracted and the longest wavelength shows through the one that is red.
- D. The chemical reaction produces a red light that is emitted, so the cloth looks red.

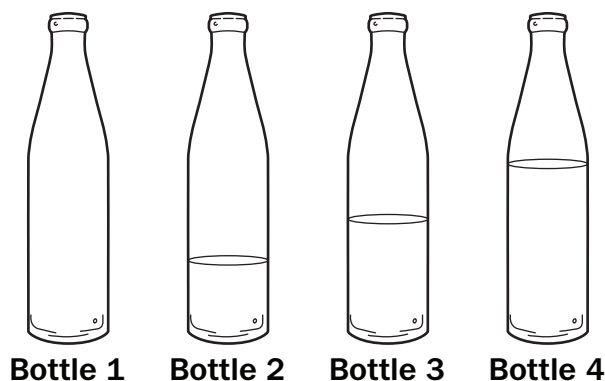
Item 15

Which of these will remain unchanged when a sound wave travels from the air to water?

- A. amplitude
- B. frequency
- C. speed
- D. wavelength

Item 16

A lab group designs an experiment to test which of four identical bottles will produce the sound with the highest pitch when air is blown across the opening at the top. Their initial hypothesis is that the highest pitches are produced when equal amounts of water and air are in the bottle. When blowing air across the tops of the bottles, Bottle 4 produces the sound with the highest pitch.



Which would be the **BEST** hypothesis based on their results?

- A. The pitch of the sound produced when air is blown across a bottle does not depend on the contents of the bottle, but only on the size of the bottle.
- B. The highest pitches are produced when the total mass of air in the bottle is greater than the total mass of the water in the bottle.
- C. Sounds with the highest pitch are produced when all air is removed from the bottle.
- D. The pitch of the sound increases as the amount of air in the bottle decreases.

Unit 5: Science with Toys

In this unit, you will focus on acquiring a conceptual understanding of energy conservation; heat transfer processes; and the relationships between force, mass, and acceleration through the study of familiar toys. You will investigate how simple machines can be combined to build toys that are capable of completing a task with minimal or no human intervention. Throughout this unit, you will be expected to analyze scientific data by collecting, using, interpreting, and comparing experimental results.

KEY TERMS

Velocity is a quantity that measures the rate of an object changing its position. If you take a step forward and then a step back to the original position, the velocity is unchanged because the motion did not result in a change in your position. If you take two steps forward, your position has changed. Your velocity is “two steps forward.” Velocity always describes a distance and a direction. (S8P3a)

Acceleration is a quantity that measures the rate at which an object changes its velocity. People often talk about an object decelerating when the object slows down. An object that slows down is actually experiencing a negative acceleration. This means the rate of change is a negative value. An object can have a velocity but not acceleration if it is moving at a constant speed. Let’s say you take a car trip that takes one hour. The velocity of the car is 40 miles east. The average speed of the trip is 40 miles per hour (mph). In the middle of the trip, the car accelerated to 50 mph for 10 minutes and then accelerated to 30 mph for 10 minutes. (S8P3a)

A **force** is a push or pull on an object. Force can be the result of contact, such as when you push a book across your desk. Forces can also result when objects are not in contact with each other. When you use one magnet to push another magnet, there is a force that acts on the magnets although the magnets are not in contact. (S8P3b)

When two or more forces act on an object but the object’s velocity does not change, it is said the object is being acted on by **balanced forces**. A book on your desk that is not moving is said to be **stationary**. The book is said to be at **rest** in relation to the desk. Gravity is acting to pull the book down. The desk pushes up against the book and the book is at rest in relation to the desk. (S8P3b)

An accelerating object is being acted on by **unbalanced forces**. When you push your book across your desk, you are applying force to one side of the book. The force of friction acts on the book in the opposite direction that it is moving, reducing the speed at which the book moves. Because the book still begins to move in the direction you are pushing it, we say that these forces are unbalanced. (S8P3b)

Friction is the force that resists motion between two surfaces. When you rub your hands together, friction creates heat. (S8P3b)

Inertia is the resistance to any change in the state of motion of any physical object. All matter has inertia until unbalanced forces act on it and cause it to move. (S8P3b)

Gravity is the force of attraction that exists between any two or more masses. Gravity can refer to the force that Earth exerts on everything. Because the force of gravity for each object is related to the mass of the object, larger objects, such as Earth, exert a greater gravitational force than objects that have less mass, such as a human. (S8P3b)

Simple machines are devices that change the direction or amount of force used to do work. There are six simple machines (lever, inclined plane, pulley, wedge, screw, and wheel and axle). (S8P3c)

The **lever** is a simple machine made up of a straight beam and a fulcrum, a point that the rod pivots on. Levers change the amount of force required to move an object. A seesaw is an example of a lever. (S8P3c)

An **inclined plane** is a simple machine that uses a flat surface to help raise or lower a load. Inclined planes spread the amount of force required to lift a load over a distance. Wheelchair ramps are an example of an inclined plane. (S8P3c)

A **pulley** is a simple machine made up of a wheel around an axle. Pulleys change the direction of a force. Certain pulley combinations can also change the amount of force required to move an object. (S8P3c)

A **wedge** is a simple machine made up of one or two inclined planes. Wedges can change the direction of a force from a straight line to perpendicular to that force. A wedged doorstop is an example of a wedge. The door tries to close. By putting a wedged doorstop between the door and the floor, the force of the door closing is turned 90 degrees and applied to the floor. The floor then resists the door closing. Knives are also an example of a wedge. (S8P3c)

A **screw** is a simple machine that can be thought of as an inclined plane wrapped around an axle. Because of this, the force required to do something is spread out over a longer distance. (S8P3c)

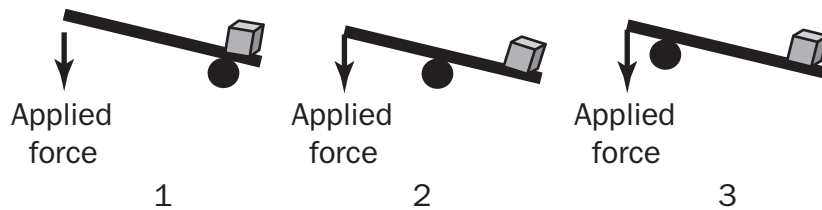
The **wheel and axle** is a simple machine made up of a wheel and an attached axle. The wheel and axle transfers the force from the wheel to the axle. (S8P3c)

Important Tip

✍ Simple machines can be found all around us in our daily lives. Wheelbarrows, bottle openers, and even your elbows are all levers. The inside of a screw-top lid is actually a screw. Doorknobs, wrenches, steering wheels, and even Ferris wheels are all wheel and axles. Pulleys are used in elevator cabling. Wedges can be found in scissors and even zippers! (S8P3c)

Sample Items 17–20**Item 17**

Identical materials are used to construct the systems shown to lift a large toy block.



Which statement is **TRUE** about the diagrams shown?

- A. Diagram 1 will give the greatest mechanical advantage because the fulcrum is placed close to the load (toy block).
- B. Diagram 3 will give the greatest mechanical advantage because the fulcrum is placed far from the load (toy block).
- C. Diagram 3 will give the greatest mechanical advantage because the fulcrum is placed closest to the applied force (toy block).
- D. Diagram 2 will give the greatest mechanical advantage because the fulcrum is placed evenly between the load (toy block) and the applied force.

Item 18

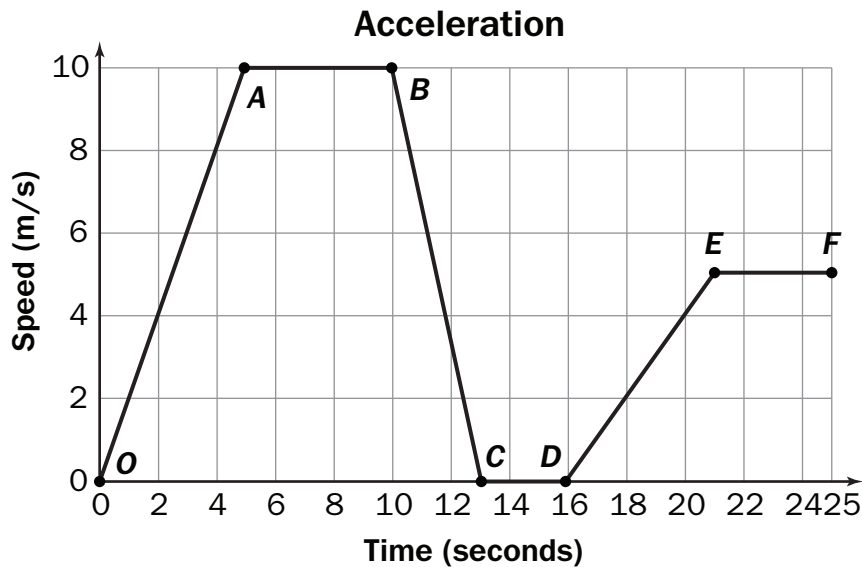
A student placed a stuffed animal on the dashboard of a car. When the car accelerated quickly, the stuffed animal flew back onto the seat.

Which principle **BEST** describes the motion of the stuffed animal as the car accelerated?

- A. gravity
- B. inertia
- C. momentum
- D. speed

Item 19

Students are exploring the relationship between velocity and acceleration. This graph shows the acceleration of a remote-controlled toy car.

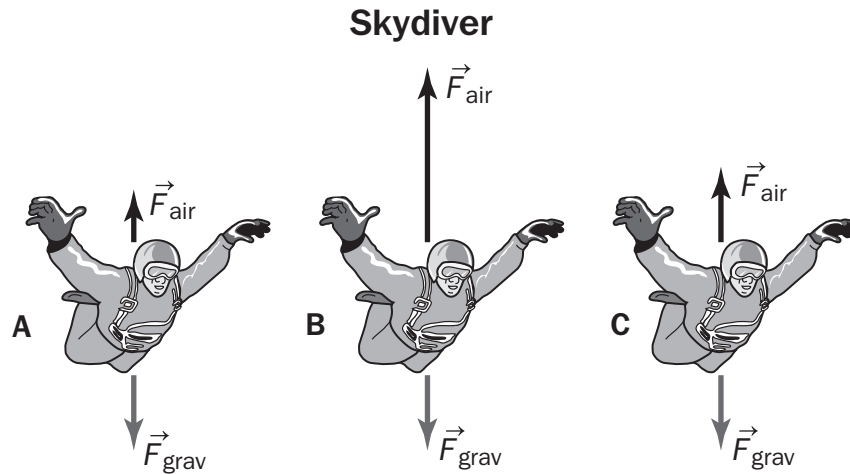


Which statement is TRUE based on the graph?

- A. Segment BC and Segment EF show constant speed.
- B. Segment OA and Segment BC show constant speed.
- C. Segment AB and Segment CD show positive acceleration.
- D. Segment OA and Segment DE show positive acceleration.

Item 20

A skydiver jumps from an airplane. The skydiver experiences the force of gravity, F_{grav} and the force of air resistance, F_{air} . The diagram shows three different stages in the skydiver's motion.



Which statement about the skydiver's motion is TRUE?

- A. The skydiver is not moving at Stage B.
- B. The skydiver is speeding up at Stage B.
- C. The skydiver is slowing down at Stage A.
- D. The skydiver is moving at constant speed at Stage C.

SCIENCE ADDITIONAL SAMPLE ITEM KEYS

Item	Standard/ Element	Characteristics of Science	DOK Level	Correct Answer	Explanation
1	S8P1b	S8CS9b	2	C	<p>The correct answer is choice (C) Student 1 is correct, while Student 2 is incorrect. Beaker A had a clear liquid, part of which boiled off and part of which formed a solid powder. This indicates it was most likely a mixture, and therefore, the salt water. Beaker B also had a clear liquid, but all of it boiled off so it was most likely the pure water, and therefore, a pure substance. Choice (A) is incorrect because Student 2 incorrectly identifies the identities of the liquids. Choice (B) is incorrect because Student 1 correctly identifies the mixture and the pure substance. Choice (D) is incorrect because Student 1 is correct and Student 2 is incorrect, as previously explained.</p>

Item	Standard/ Element	Characteristics of Science	DOK Level	Correct Answer	Explanation
2	S8P2b	S8CS5a	2	C	<p>The correct answer is choice (C) The ball has maximum potential energy at Point 2 and maximum kinetic energy at Point 4. When the ball reaches maximum height, its gravitational potential energy is greatest. When it is at its lowest point, that gravitational potential energy has been converted into kinetic energy. Therefore, Point 2 will be the point of maximum potential energy and Point 4 represents the point of maximum converted kinetic energy. Choice (A) is incorrect because gravitational potential energy is greatest when the ball is highest, not lowest. Choice (B) is incorrect because although the ball has some amount of gravitational potential energy at Point 1, it is not the maximum. Point 3 is not the maximum kinetic energy; this is at Point 4. Choice (D) is incorrect because potential energy is changing to kinetic energy at Point 3. It is not a maximum for either. At Point 2, the ball is changing direction so its kinetic energy is not at a maximum.</p>

Item	Standard/ Element	Characteristics of Science	DOK Level	Correct Answer	Explanation
3	S8P2a	S8CS1b	3	C	<p>The correct answer is choice (C) The pendulum stopped due to friction, and according to the Law of Conservation of Energy, no energy is lost, just changed from potential energy to thermal energy. According to the Law of Conservation of Energy, energy cannot be created or destroyed. The total amount of energy is the same before or after any practice. In this case, the pendulum encountered friction and the mechanical energy was converted to thermal energy. No energy was lost in the experiment; it was transformed. Choices (A) and (B) are incorrect because they use an incorrect definition of the Law of Conservation of Energy. This law states that energy cannot be lost. Choice (D) is incorrect because it incorrectly attributes a loss of energy to gravity. No energy is lost according to the Law of Conservation of Energy.</p>
4	S8P3b	S8CS5a	2	C	<p>The correct answer is choice (C) The object will remain stationary. The forces are balanced in opposite directions and would cancel each other out; therefore, no motion would occur. Choice (B) is incorrect because since no motion is occurring, a direction change would not occur. Choices (A) and (D) are incorrect because the forces are balanced, so no motion would occur.</p>

Item	Standard/ Element	Characteristics of Science	DOK Level	Correct Answer	Explanation
5	S8P1c	S8CS5a	1	A	The correct answer is choice (A) The particles are moving quickly and are far apart. A gas is composed of particles that are moving quickly and spread out. Gases will expand to take the shape of a container because gases will spread out across any volume in a consistent manner so all the atoms are spaced equally. Choice (B) is incorrect because it is the definition of a solid. Choice (C) is incorrect because it is the definition of a liquid. Choice (D) is incorrect because gas particles are not packed tightly together.
6	S8P1e	S8CS9b	2	A	The correct answer is choice (A) 2, 3, 6 because these three processes result in a chemical change. Choice (B) is incorrect because processes 1 and 4 are examples of physical changes. Choice (C) is incorrect because all processes are examples of physical processes. Choice (D) is incorrect because process 5 is an example of a physical process.
7	S8P1g	S8CS9b	2	D	The correct answer is choice (D) Law of Conservation of Matter. According to the Law of Conservation of Matter, during any physical or chemical change, the total mass of the products remains equal to the total mass of the reactants. Choices (A), (B), and (C) are incorrect because they either identify other scientific laws or ideas that are not scientific laws.

Item	Standard/ Element	Characteristics of Science	DOK Level	Correct Answer	Explanation
8	S8P2d	S8CS7c	2	C	<p>The correct answer is choice (C) This shows how convection currents move as the water warms and cools, causing it to rise or sink. The blue ice water is denser and it sinks. It is then heated by the hot plate, which causes its density to decrease. As a result, the blue water rises. The warm red water stays near the top of the aquarium. Near the surface and near the cup of ice, it cools. This causes its density to increase, so it sinks. It is then heated and a circular convection current is formed. The temperature of the water continuously changes as it is heated and cooled. Choice (A) is incorrect because the dye only makes it easier to trace the movement of the water. It does not affect the speed or direction of motion. Choice (D) is incorrect because heat is transferred from warmer matter to cooler matter, so it would be transferred from the warm red water to the ice cubes in the cup or the cool water coming out of the cup. Choice (B) is incorrect because the heating does not occur through radiation and the cold water will rise upon heating, not sink.</p>

Item	Standard/ Element	Characteristics of Science	DOK Level	Correct Answer	Explanation
9	S8P2c	S8CS5a	2	C	The correct answer is choice (C) electricity to motion. The fan receives electrical energy and converts this to motion energy to move the spinning blades. Choice (A) is incorrect because sound energy is not being converted into motion. Choice (B) is incorrect because heat is lost from the system, not used by the system. Choice (D) is incorrect because a fan is an example of electricity being converted into motion energy. This is presented in reverse.
10	S8P5b	S8CS5b	2	C	The correct answer is choice (C) It will stop working. This is a series circuit, and in a series circuit, if one of the bulbs stops working, all the bulbs stop working. Choices (A) and (D) are incorrect for a series circuit. If it were a parallel circuit, Bulb A would not go out but would stay lit and might get brighter depending on the type of bulb, but it is a series circuit, not a parallel circuit. Choice (B) is incorrect; the bulb would stop working, not just get dimmer, since the circuit is a series circuit.
11	S8P5c	S8CS5a	2	B	The correct answer is choice (B) run electricity through the wire. The needle of a compass is diverted when it is brought near a current-carrying wire. Choice (A) is incorrect because the motion of a wire does not create a magnetic force. Choice (C) is incorrect because bending a wire does not create a force on a magnet. Choice (D) is incorrect because bringing a compass closer to a magnet might cause the needle to move, but moving it closer to a wire will not.

Item	Standard/ Element	Characteristics of Science	DOK Level	Correct Answer	Explanation
12	S8P2b	S8CS5a	2	C	<p>The correct answer is choice (C) Kinetic energy changes to potential energy as the bob moves from Position D to Position E. Kinetic energy, which is the energy of motion, is greatest at the bottom of the swing where height is lowest. As the bob moves to Position E, it gets slower and higher, so its potential energy increases. Choice (A) is incorrect because in Position A, the bob is not yet released, so it has no motion and its height is greatest. Thus all of its energy is potential energy. Choice (B) is incorrect because in Position C, the bob is moving at the greatest speed and is in the lowest position. Its gravitational potential energy is at its lowest in the pendulum motion at this point. Choice (D) is incorrect because potential energy changes to kinetic wherever the bob is moving downward and getting faster. This occurs from Position A to Position C.</p>
13	S8P4a	S8CS9b	2	D	<p>The correct answer is choice (D) The frequency decreases and the amplitude decreases. The sound getting quieter is an effect of the decrease in amplitude. A lowering in pitch is a decrease in the frequency. Choices (A), (B), and (C) are incorrect because they do not correctly explain how the wave changes.</p>

Item	Standard/ Element	Characteristics of Science	DOK Level	Correct Answer	Explanation
14	S8P4b	S8CS7a	2	A	The correct answer is choice (A) The chemical absorbs the light from the visible spectrum except for red that is reflected to the eye. The surface of the cloth absorbs all the colored light rays, except for those corresponding to red, and reflects this color to the human eye. Choice (B) is incorrect because all the colors of the visible spectrum EXCEPT for red are absorbed. Choice (C) is incorrect because light is reflected, not refracted. Choice (D) is incorrect because the chemical does not produce light, but light is reflected.
15	S8P4d	S8CS5a	2	B	The correct answer is choice (B) frequency. Frequency relies only on the source making the sound wave and is not affected by the medium. Choices (A), (C), and (D) are incorrect because the medium affects all these properties of the sound wave.
16	S8P4e	S8CS5a	2	D	The correct answer is choice (D) The pitch of the sound increases as the amount of air in the bottle decreases. Choice (A) is incorrect because the experiment showed that changing the contents of the bottle did change the pitch of the sound produced. Choice (B) is incorrect because Bottle 4 has more water than air. The mass of the water is greater than the mass of air. Choice (C) is incorrect because none of the bottles in the experiment were filled completely with water and no air. The students could not form this hypothesis based on their observations.

Item	Standard/ Element	Characteristics of Science	DOK Level	Correct Answer	Explanation
17	S8P3c	S8CS5a	2	A	The correct answer is choice (A) Diagram 1 will give the greatest mechanical advantage because the fulcrum is placed close to the load (toy block). The fulcrum is placed close to the load, and this will allow movement of the load with a small applied force. Choice (B) is incorrect because the fulcrum is close to the area of the applied force. This will require much more force and therefore reduce the mechanical advantage. Choice (C) is incorrect because this will require more force. Choice (D) is incorrect because the fulcrum is halfway between the force and the load, so there is no mechanical advantage.
18	S8P3b	S8CS5a	2	B	The correct answer is choice (B) inertia. The definition of inertia is an object's tendency to resist a change in motion. The stuffed animal was at rest and resisted the change in forward motion. Choice (A) is incorrect because, although gravity is present in this situation, it is not causing the stuffed animal to appear to move backward. Choice (C) is incorrect because momentum is mass in motion and is defined as the mass times the velocity. Choice (D) is incorrect because speed would be the distance an object traveled divided by the time.

Item	Standard/ Element	Characteristics of Science	DOK Level	Correct Answer	Explanation
19	S8P3a	S8CS6c	2	D	The correct answer is choice (D) Segment <i>OA</i> and Segment <i>DE</i> show positive acceleration. Both show positive acceleration because as the time increases, so does the speed as shown by the upward-sloping line. Choice (A) is incorrect because Segment <i>BC</i> shows negative acceleration and Segment <i>EF</i> shows constant speed. Choice (B) is incorrect because Segment <i>OA</i> shows positive acceleration and Segment <i>BC</i> shows negative acceleration, not constant speed. Choice (C) is incorrect because Segment <i>AB</i> shows constant speed as shown by the straight line. Segment <i>CD</i> shows no speed because the segment is plotted at 0.
20	S8P3b	S8CS5a	2	D	The correct answer is choice (D) The skydiver is moving at constant speed at Stage C. The forces of gravity and air resistance are balanced at Stage C, so the skydiver continues to fall, but the speed does not change. Choice (A) is incorrect because the downward force of gravity is less than the upward force of air resistance, so the skydiver is slowing down. Choice (B) is incorrect because the force of air resistance is greater than the force of gravity, so the skydiver is slowing down. Choice (C) is incorrect because the downward force of gravity is greater than the upward force of air resistance, so the skydiver is speeding up.

ACTIVITY

The following activity develops skills in Unit 2: Food and Cooking (Structure of Matter).

Standards: S8P1e, S8P1g

Before beginning, gather the following materials:

- 3 plastic cups
- electronic balance or digital scale
- effervescent tablets (such as those used for indigestion)
- water
- iodine (can be found in the first-aid section of many stores)
- stirrers (such as spoons or straws)
- cornstarch

You can try two experiments to demonstrate the Law of Conservation of Mass.

Experiment 1

Step 1: Measure the mass of the empty cup. Then place a small amount of water (about $\frac{1}{2}$ cup) and a teaspoonful of cornstarch into the cup and mix.

Step 2: Measure the mass of the cup, water, and cornstarch and record the measurements in your science journal.

Step 3: Zero the balance with the second empty cup. This will allow you to get the mass of the iodine by itself in Step 4.

Step 4: Add 5 drops of iodine to a second cup and record the mass. Add the mass of the water-cornstarch mixture and the mass of the iodine together.

Step 5: Add the iodine to the cornstarch mixture and stir. Record results.

Step 6: Evidence in Step 5 indicates a chemical change has taken place. Measure the mass of the new mixture and record the measurements in your science journal. Compare the mass of the mixtures before and after they were combined.

Questions:

- *Did the mass change before and after the reaction?*
- *How do you know that a chemical reaction took place? Cite evidence from the experiment to support your answer.*
- *How can you explain the results in terms of the Law of Conservation of Mass?*

Experiment 2

Step 1: Zero the balance with the empty beaker or cup. This will allow you to get the mass of the reactants by themselves in Step 2.

Step 2: Place a small amount of water (about half the total volume) into the cup.

Step 3: Put the effervescent tablet on the balance beside the cup, but do not put it in the water yet. Record the total starting mass in your science journal.

Step 4: Leave the cup on the balance and drop the tablet into the cup of water. Record your observations.

Step 5: Evidence in Step 4 indicates a chemical change has taken place. After the reaction has finished, measure the mass of the new mixture and record the measurement in your science journal.

Questions:

- *Did the mass change before and after the reaction?*
- *How do you know that a chemical reaction took place? Cite evidence from the experiment to support your answer.*
- *Does this experiment agree with the Law of Conservation of Mass? How can you explain the results in terms of the Law of Conservation of Mass?*

ACTIVITY

The following activity develops skills in Unit 5: Science with Toys.

Standards: S8P3a, S8P3b, S8P5a

Gather the following materials:

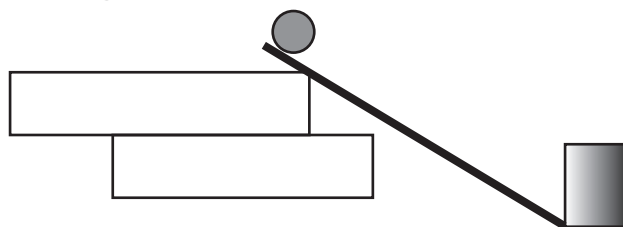
- 3 marbles of different weights/mass
- inclined plane/track for rolling marbles
- books for changing height of track
- empty carton or box
- ruler

Experiment 1

Step 1: Using books and the track, set up a track so marbles will roll easily. The track does not have to be very high.

Step 2: Place the carton in front of the track so when the marble leaves the end of the track, it will hit the carton. Using the smallest marble, start it at the top of the track and release it. (See Diagram 1)

Diagram 1



Step 3: Measure how far from the track the marble pushed the carton in centimeters and record the measurement in your science journal.

Step 4: Repeat this two (2) more times and average all three (3) distances together. Record this result in your science journal.

Step 5: Using the next-largest marble, repeat Steps 2–4 by releasing the marble three (3) times down the track and recording the distance the carton was moved each time. Average all times.

Step 6: Repeat the process again with the largest marble. Record distances in your science journal and average all three (3) distances together.

Questions:

- Which marble had the most potential energy? How do you know that?
- What statement can you make about the relationship of mass and potential energy?

Experiment 2

- Step 1:** Add books to the track from Experiment 1 so that it is twice as high as it was in Experiment 1.
- Step 2:** Place the carton in front of the track so when the marble leaves the end of the track, it will hit the carton. Release the smallest marble from the top of the track.
- Step 3:** Measure how far from the track the marble pushed the carton in centimeters and record the distance in your science journal.
- Step 4:** Repeat this two (2) more times and average all three (3) distances together. Record your observations in your science journal.
- Step 5:** Using the next-largest marble, repeat Steps 2–4.
- Step 6:** Repeat the process again with the largest marble.

Questions:

- *Compare the average distance the smallest marble pushed the carton in Experiment 1 and Experiment 2. In which experiment did the carton go the farthest?*
- *What statement can you make about the relationship of height and potential energy?*
- *Where did the marble have the greatest potential energy?*
- *Where did the marble have the greatest kinetic energy?*