Types of Energy and Energy Transformations Lesson 6.1

This lesson will help you practice working with concepts related to different types of energy and the transformation of energy from one type to another. Use it with core lesson 6. 1 Types of Energy and Energy Transformations to reinforce and apply your knowledge.

Key Concept

There are many types of energy that cause changes in the world around us. Energy of one type can be transformed into energy of another type, but the total amount of energy cannot be changed.

Core Skills and Practices

- Interpret Meaning of Mathematical Symbols
- Identify the Strengths and Weaknesses of a Scientific Investigation Design

What Is Energy?

Energy is the ability to do work or make things happen. Every action is connected to energy in one form or another. Objects can have energy due to either their movement or their position.

Directions: Answer the questions below.

1. A skateboard at the top of a ramp represents which of the following types of potential energy?

A. elastic

B. magnetic

C. electrical

D. gravitational

2. A student sets a computer with a mass of 6.50 kg on a shelf 3. 20 m above the floor. How much gravitational potential energy does the computer have with respect to the floor?

A. 204 J

B. 4. 82 J

C. 20. 8 J

D. 63. 7 J

3. In an experiment designed to test the energy efficiencies of several skateboards, the kinetic energies have been measured, along with the speeds and masses of the boards. Use the formula KE = 1/2 mv^2, and the speeds and mass values provided to complete the table.

4. 00 m/s	2. 50 m/s	1. 50 m/s	0. 75 kg	1. 50 kg

KE (J)	Mass (kg)	Speed (m/s)
6. 00		
4. 69		
12. 00		
2. 34		
0. 844		

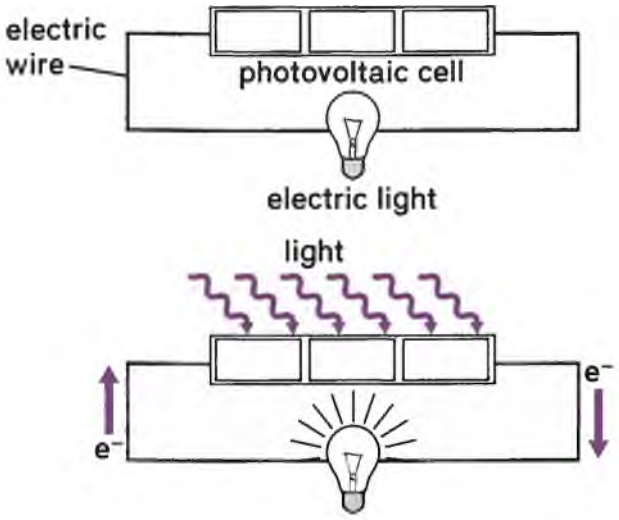
Test-Taking Tip

When answering a drag-and-drop question, it is important to read the question carefully before selecting items. When you are sure you understand the question, carefully read the items to select. First, select the items you feel confident you know; then go back and work on the items about which you are less sure.

Types of Energy

Many types of kinetic and potential energy, can take a different form under the appropriate conditions. Mechanic, thermal, chemical, nuclear and radiant are all types of energy.

Directions: Use the diagram below to answer questions 4-5.



4. A photovoltaic cell uses energy from _____.

5. What is the purpose of a photovoltaic cell?

A to change electrical energy into radiant energy

B. to change radiant energy into electrical energy

C. to change radiant energy into chemical energy

D. to change chemical energy into electrical energy

Electrical Energy and Magnetic Energy

Some forms of energy can affect objects from a distance due to a field that exists around the energy source. Electrical energy and magnetic energy are both produced by fields. These forms of energy are related to one another.

Directions: Use the passage and diagram below to answer questions 6-7.

In 1813, the Danish physicist and chemist Hans Christian 0rsted predicted that a connection soon would be found between electricity and magnetism. In 1820, he found that connection when he discovered that a current-carrying wire was surrounded by a magnetic field. The strength of the field depended on the distance from the wire and on the amount of electric current 0rsted's discovery helped scientists understand electric current, which they believed was a type of electric fluid. However, electrons, the particles that produce electric current, would not be discovered until seventy-five years later.

6. According to the passage, what can you infer about what scientists today believe gives rise to magnetism?

A. the movement of electrons

B. the strength of a magnetic field

C. the direction of electrostatic force

D. the number of copper atoms in a wire

7. Which of the following experiments could 0rsted have used to convince other scientists of his discovery?

A. A straight wire carrying current does not deflect a compass needle, but a coiled wire does.

B. A wire carrying current does not change its mass as the current is increased.

C. An iron nail, surrounded by a coil of wire carrying a current, does not attract iron.

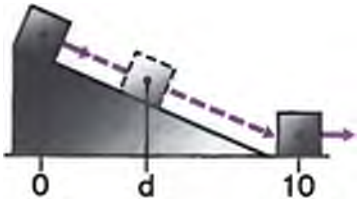
D. A wire carrying current causes the needle of a nearby compass to deflect.

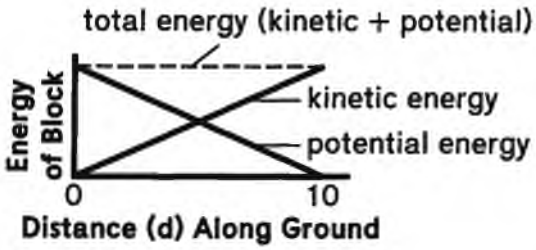
Conservation of Energy

Energy is neither created nor destroyed, but changes form from one type of energy to another. This is referred to as the law of conservation of energy.

Directions: Read the information below and examine the diagram and graph. Then answer questions 8-10.

A block slides without friction down a slick ramp, as shown in the figure below. The graph shows the values of both the gravitational potential energy (which depends only on the height of the block above the ground) and the kinetic energy as it slides.





8. Which statement about the block is true?

A. Only half of the block's original potential energy is changed to kinetic energy.

B. On the graph at the point where d = 0, the block's energy is all potential energy.

C. On the graph at the point where d = 0, the block's energy is all kinetic energy.

D. On the graph at the point where d = 10, half of the block's energy is kinetic energy.

9. What remains constant as the block moves down the ramp?

A. the difference between the block's potential energy and kinetic energy

B. the total kinetic energy of the block

C. the total potential energy of the block

D. the sum of the block's potential energy and kinetic energy

10. Suppose the dotted line for total energy in the graph was not horizontal, but sloped downward toward the right. What would this indicate?

Lesson 6.2 **Sources of Energy**

This lesson will help you practice working with concepts related to different types of energy resources used by humans. Use it with core lesson 6. 2 Sources of Energy to reinforce and apply your knowledge.

Key Concept

There are many sources of energy. Which type of energy source people choose to use depends on each source's advantages and disadvantages.

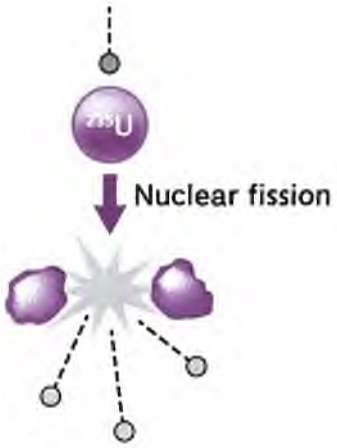
Core Skills & Practices

- Distinguish Between Cause and Effect
- Understand and Explain Textual Scientific Presentations

Sources of Energy

Energy resources are natural materials that are converted into energy forms that people can use.

Directions: Use the diagram to answer the question.



1. Uranium-235 is an isotope used in nuclear power plants. What happens when atoms of U-235 undergo nuclear fission?

A. It will not change.

B. It will split apart producing two more stable atoms and subatomic particles

C. It will cause the nucleus to double in size.

D. It will split apart creating two atoms that are identical.

Direction: Answer the following question.

2. A steam engine can transform the energy stored in fuel into kinetic energy. Complete the table by writing the terms in order to show each step in the process when a steam engine provides energy.

steam	pistons move	thermal energy	coal

Test-Taking Tip

When a test requires you to put steps or items in a cause-and-effect sequence, it is sometimes helpful to work backwards. Find the last item or the final result. Then work backwards from there. Continue until you have all the items placed in order.

Direction: Use the statement below to answer questions 3-5.

Many of Earth's natural energy sources, such as coal, are finite. Our goal is to use more renewable non-polluting energy sources. It will take time to reach that goal. However as we move toward that goal we should consider making nonrenewable nuclear energy one of our main energy choices.

3. Which information about nuclear energy supports this statement?

A. Use of nuclear energy does not pollute the air.

B. Generating nuclear energy is the only use for uranium.

C. No waste is produced when nuclear energy is generated.

D. Nuclear energy is safe and poses no threat to the environment

4. The word finite as used in the statement means

_____.

5. Based on the statement, you can infer that the use of natural energy sources causes

_____.

Renewable Energy Resources

Energy resources that are inexhaustible, or that can be replaced as they are used, are renewable energy resources.

Direction: Answer the following questions.

6. Which renewable energy resource can cause air pollution?

A. biomass

B. wind energy

C. solar energy

D. geothermal energy

8. Which renewable energy resource can be used nearly anywhere?

A. wind

B. water.

C. biomass

D. geothermal

7. Some people worry that too much land might be used for the growth of crops than can be converted to ethanol, such as com and switch grass. They think that using the land to provide energy resources could cause other problems. What might be their concern?

A. This practice could cause food shortage.

B. This practice could put farmers out of work.

C. There could not be enough seeds for the plants.

D. There could not be enough workers for these farms.

9. A town council wants to pass building rules that would require each new house built to use a renewable energy source for its heating and cooling systems. If you were the mayor in that town would you support the bill? Justify your answer.

_____

_____

_____

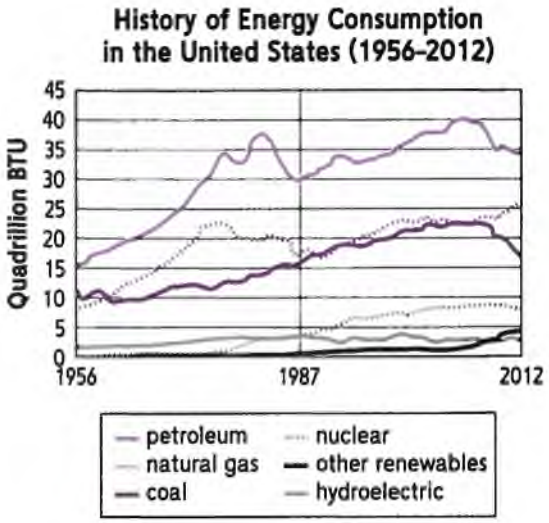
_____

_____

Choosing Sources of Energy

When choosing an energy source, many factors need to be studied, including the availability of the energy source, the cost of the energy source, and its impact on the environment.

Direction: Use the graph below to answer questions 10-11.



10. Look at the lines for the consumption of petroleum and natural gas. If the usage patterns continue, about when will the United States use more natural gas than petroleum?

A. 2012

B. 2020

C. 2030

D. 2040

11. When combined, which uses of energy sources equal the current use of petroleum?

A. coal and nuclear

B. coal and natural gas

C. nuclear and natural gas

D. other renewables and natural gas

Directions: Use the passage below to answer questions 12-13.

The technological advances needed to develop safe, affordable energy sources cost a great deal of money, much of which will be paid by taxpayers. For these reasons, the safety of energy production in the United States and elsewhere in the world depends on what we, as citizens, are willing to tolerate. In modem society, pollution control and technological advancement are political questions as well as scientific ones.

12. According to the passage above, why is pollution control a "political question as well as a scientific one? "

A. because it involves taxpayer money

B. because it involves safety of energy production

C. because it involves affordable energy sources

D. because it involves technological advances

13. Fracking is a technological advancement that can be used to increase the supply of natural gas but may cause environmental damage. Why might a technological advancement like this have political considerations?

This lesson will help you practice working with concepts related to heat and the transfer of energy as heat. Use it with core lesson 6. 3 Heat to reinforce and apply your knowledge.

Key Concept

When thermal energy is added to a substance, there is an increased movement of the particles that make up the substance. More movement of the particles means an increased kinetic energy. This increased kinetic energy can be transferred to other parts of the substance and to other substances.

Core Skills & Practices

- Express Scientific Information or Findings Verbally
- Evaluate Evidence

Principles of Heat

Heat is the transfer of thermal energy, which is a measure of the kinetic and potential energy of the particles that make up a substance.

Directions: Use the passage below to answer questions 1-2.

Heat is the transfer of the kinetic energy caused by the movement of atoms and molecules. When these particles move rapidly, an object feels hot. When they move slowly, the object feels cold. A more precise way of measuring the average kinetic energy of these particles is temperature. When heat transfers energy to an object, the temperature of the object increases. When the object gives off energy by heat, its temperature decreases.

When two objects of different temperature are brought into contact with each other, heat flows from the object at higher temperature to the object at lower temperature. Heat continues to flow until both objects reach the same temperature. When this occurs, the average kinetic energy of the particles of both objects is also the same.

1. Which statement best describes the nature of heat?

A. the transfer of the kinetic energy of an object's atoms or molecules

B. the flow of energy between two objects in contact and at the same temperature

C. the total energy contained within an object

D. the measure of the temperature of an object

2. When a piece of hot iron (98° C) is thrown into a barrel of cold water (22° C), what will happen?

A. Heat will flow from the water to the iron until both are the same temperature.

B. Heat will flow from the iron to the water until both are the same temperature.

C. The temperature of the iron will decrease until it reaches 22° C.

D. The temperature of the water will increase until it reaches 98° C.

Direction: Answer the question below.

3. The data in the upper row of the table indicate the average kinetic energy of a substance. Sort the temperatures given by writing each temperature value in the appropriate space below the corresponding energy value.

90K	155K	205K	575K	1140K

Energy	4.3×10^{-21} J	2.4×10^{-20} J	1.9×10^{-21} J	3.2×10^{-21} J	1.2×10^{-20} J
Temperature					

Test-Taking Tip

When completing a sorting activity such as the one above, note whether the two sets of values being compared increase together or decrease together, or whether one decreases as the other increases. Once this has been determined, find the greatest or smallest values that correspond to the given quantities, and use the ratio between any two given values to find how the remaining numbers relate to each other.

Kinetic Heat Transfer

Heat can be transferred by one of three processes: conduction, convection, and radiation. Conduction involves the transfer of heat through a material by means of atomic or molecular motion. Convection involves the displacement of hot and cold fluids because of their different densities. Radiation involves energy transfer by electromagnetic radiation, which can travel through a vacuum.

Direction: Use the image below to answer question 4.

4. Which statement describes the role of conduction in the radiator shown in the illustration?

A. Electromagnetic waves transfer energy from the radiator surface to the air at its sides.

B. Electromagnetic waves transfer energy from the fluid inside the radiator to its surface.

C. Heat transfers energy from the fluid inside the radiator to its surface.

D. Heat transfers energy by convection to the air at the sides of the radiator.

Directions: Answer the questions below.

5. What happens to a heated fluid as convection occurs?

A. Increased motion pushes the particles of heated fluid upward past particles of the unheated fluid.

B. Increased particle motion causes the fluid to sink and displace the surrounding unheated fluid upward.

C. Increased particle motion causes the fluid to expand and become less dense than unheated fluid.

D. The heated fluid radiates energy away and becomes less dense than the surrounding unheated fluid.

6. Electrons move easily through the crystal structure of substance A. They do not move freely at all in substance B. Which statement predicts accurately the heat transfer properties of each substance?

A. Substance A will conduct heat more easily than substance B.

B. Substance B will conduct heat more easily than substance A.

C. Substance A will more easily transfer heat by convection than substance B.

D. Substance B will more easily transfer heat by convection than substance A.

Energy Conversions Involving Heat

Mechanical energy can be converted to heat, and heat can be converted to mechanical energy. Friction between surfaces is one of the more common ways in which mechanical energy in the form of kinetic energy is converted to heat.

Directions: Answer the following questions.

7. Suppose you are preparing for a long drive and need to fill your tires with air. Why is it important not to overinflate tires when they are cool?

A. The pressure from the air inside the tire causes the rubber of the tire to overheat, which can cause a possible blowout.

B. The heat radiated from the road through the rubber tire causes the air in the tire to expand, and possibly cause the tire to blow out.

C. Heat from the friction between the tires and the road will cause the air in the tire to expand, and possibly cause the tire to blow out.

D. Heat from the friction between the tires and the road causes air surrounding the tire to heat and form convection currents that can result in a blowout.

8. Water is often sprayed on high-speed drill bits to lower their temperature during the drilling process. Which of the following gives the best explanation, in terms of energy conversion, for why this is necessary?

A. The kinetic energy of the bit is converted into heat by the friction between the bit and drilled substance.

B. Thermal energy is conducted by heat from the drilled substance to the bit.

C. Thermal energy is conducted by heat away from the bit to the air.

D. Thermal energy is converted to mechanical energy by friction, which causes the drill to operate less effectively.

Lesson 6.4 **Waves**

This lesson will help you practice working with concepts related to waves and the transfer of energy by waves. Use it with core lesson 6. 4 Waves to reinforce and apply your knowledge.

Key Concept

Waves carry energy that spreads out as the wave travels. There are different types of waves that all exhibit properties of wavelength, frequency, and amplitude.

Core Skills & Practices

- Determine Details
- Use Data or Evidence to Form a Conclusion

The Nature of Waves

A wave is a repeating disturbance that transfers energy as it travels through matter or space. Sound waves, ocean waves, light waves, and radio waves are all types of waves.

Directions: Answer the questions below.

1. Which feature is characteristic of a wave?

A. the presence of light

B. the presence of sound

C. the presence of vibration

D. the presence of a liquid medium

2. What evidence demonstrates that energy is transferred by a wave?

A. Energy passing through a medium is always accompanied by light energy from the source.

B. Energy causes a disturbance that is passed through a medium, and energy must be conserved.

C. Energy pushes matter through the medium in the form of a disturbance, or wave.

D. Energy, which is conserved, disturbs and is conveyed by matter moving in the medium.

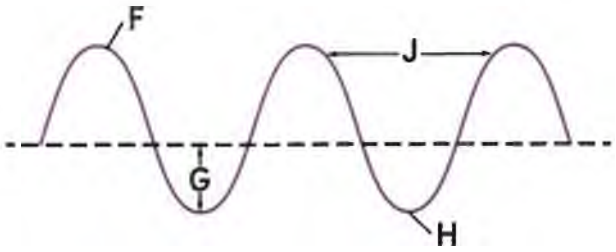
3. Use your knowledge of the nature of waves to explain why, when an explosion occurs, you hear a "boom" and, at the same time, the windows rattle.

4. You observe a disturbance on the surface of a lake. A buoy floats on the lake's surface. Describe what evidence you would have to observe in order to conclude that the disturbance is a wave.

Wave Types and Their Properties

Waves can be either transverse or longitudinal and possess the properties of wave speed, frequency, wavelength, and amplitude.

Directions: Use the diagram below to answer questions 5-6.



5. If the wave in the figure is moving up and down with a frequency of 25 Hz, and the wavelength is 0. 030 m, what is the correct value for the speed of the wave?

A. 1. 3 m/s

B. 830 m/s

C. 0. 75 m/s

D. 0. 0012 m/s

6. Point F indicates the [1 Select . . .] of the wave, whereas point H indicates the [2 Select . . .] of the wave. These displacements in a [3 Select . . .] wave are a measure of the distance from the rest position, which is called the [4 Select . . .] of the wave. This property of a wave, indicated by the point, is related to the amount of energy that the wave transfers.

[1 Select . . .]

A. crest

B. trough

C. amplitude

D. wavelength

[2 Select . . .]

A. crest

B. trough

C. amplitude

D. wavelength

[3 Select . . .]

A. transverse

B. rarefaction

C. compressed

D. longitudinal

[4 Select . . .]

A. crest

B. trough

C. amplitude

D. wavelength

Test-Taking Tip

When answering a drop-down question, try to read the passage and think of the answer on your own before looking at the answer choices. This will help you quickly eliminate answer choices that do not fit the context of the passage.

The Electromagnetic Spectrum

Electromagnetic waves make up the electromagnetic spectrum, which includes visible light.

Directions: Use the passage below to answer questions 7-8.

Although both light and sound are forms of wave energy, the speed of light is much greater than the speed of sound. Light travels at about 300, 000 kilometers per second. Sound travels at only about 350 meters per second. One way to distinguish the difference between the speed of light and the speed of sound is to make observations during a lightning storm.

Lightning is caused by separated electrical charges rushing together in the atmosphere. At the instant the charges come together, both a flash of light and a loud sound are created (thunder). Although the flash of lightning reaches your eyes almost at once, the sound of thunder may not reach your ears until several seconds later.

You can use the relative speeds of light and sound to find out how far away the lightning is: when you see a flash of lightning, start counting slowly, spacing your counts one second apart. For each 3 seconds you count before you hear the thunder, you know that the lightning is about 1 kilometer away. If you see a flash and count 6 seconds before hearing thunder, the lightning flash occurred about 2 kilometers from you.

7. Assume you know that both light and sound are created at the instant that lightning occurs but that you do not know either the speed of light or the speed of sound. Which statement supports the understanding that light travels faster than sound?

A. Light and sound are both independent of the properties of the medium.

B. Light and sound are both forms of wave energy.

C. As you move toward a lightning storm, the sound of thunder becomes fainter.

D. You always see a lightning flash before you hear the thunder that is created with it.

8. Suppose the speed of light in air is 10, 000 times slower than it is in a vacuum. What do you need to take into consideration if you see a flash of lightning and then hear thunder 30 seconds later?

A. Light cannot be assumed to reach the observer instantaneously.

B. Neither sound nor light can be detected after 30 seconds.

C. The time of travel is very nearly the same for both types of waves.

D. The distances traveled by the two different kinds of waves are different.

Direction: Answer the question below.

9. Which sequence of the wavelengths listed below correctly lists electromagnetic radiation in order from lowest to highest energy?

95 m	7.5×10^2 m	3.0×10^3 m	8.5×10^1 m
LOWEST ENERGY			HIGHEST ENERGY