Teacher Guide & Answers (continued)

Section 2 (pág. 25)
1. mecánica
2. nuclear
3. eléctrica
4. fricción
5. Caloria
6. luz
7. potencial
8. cinética
9. ley de conservación de la energía

Términos claves (pág. 26)
1. gravitatoria
2. conservación
3. julios
4. química
5. potencial
6. cinética
7. mecánica
8. elástica

Reinforcement (page 27)

Section 1
1. +
2. +
3. +
4. –; change can to cannot
5. +
6. +
7. –; change more to less
8. +
9. energy of motion
10. energy stored by things that are above Earth
11. joules
12. joules
13. mass, speed
14. mass, acceleration due to gravity, height above the ground.

Section 2 (page 28)
Note: Students’ answers may be more or less complex than those given.
1. Electrical energy changes into thermal energy.
2. Light energy changes into thermal energy.
3. Chemical potential energy changes into kinetic (and thermal) energy for the deputy and the horse.
4. The waiter’s chemical potential energy changes into kinetic energy of motion, and the switch’s kinetic energy transformed into electrical energy, which changes into light energy.
5. The swallow’s chemical potential energy changes into kinetic energy causing vibrations that result in sound. The sound energy changes into kinetic energy (vibrations) in the listener’s eardrum, which changes into electrical energy before reaching the listener’s brain.
6. Chemical potential energy changes into thermal energy, which powers the engine. The thermal energy changes to both kinetic and potential energy as the plane takes off.
7. Gravitational potential energy becomes kinetic energy.
8. The placekicker’s chemical potential energy changes into mechanical energy in the legs, which changes into kinetic and potential energy in the football.
9. Chemical potential energy transforms into kinetic energy, which changes to thermal energy as a result of friction between the runner and the ground.
10. Chemical potential energy is changed into thermal energy, which is converted to mechanical energy.

Enrichment
Section 1 (page 29)
1. Students’ descriptions can vary. Theoretically, the first pendulum falls quickly. It begins to slow down just after it passes the lowest point in the swing and enters the upward part of the swing. When the first pendulum hits the second pendulum, the first pendulum slows further and the second pendulum starts to swing. The two pendulums continue to swing. Each time the two pendulums make contact, some energy is transferred and the swing of each pendulum changes. Both pendulums stop swinging when all of the kinetic energy in the system has dissipated.
2. The energy of the first washer and string (pendulum) was transferred to the second washer and string (pendulum).
3. The mechanical energy changed into thermal energy due to friction.

Section 2 (page 30)
1. electrical
2. The electrical energy from the brain is converted to mechanical energy when the heart muscles contract. Also, some of the mechanical energy changes into heat energy.
3. All of the energy used in the body comes from the food we eat.
4. The brain never stops sending electricity to the heart. If it did, the heart would stop beating and the person would die.
Note-Taking Worksheet (page 31)
Refer to Teacher Outline; student answers are underlined.

Assessment

Chapter Review (page 35)
Part A. Vocabulary Review
1. f (4/2)
2. a (4/1)
3. g (4/1)
4. c (4/1)
5. d (4/2)
6. h (4/2)
7. j (4/2)(4/1)
8. i (4/2)(4/1)
9. e (4/2)(4/1)
10. k (4/1)
11. b (4/2)

Part B. Concept Review
1. velocity (4/1)
2. position (4/1)
3. chemical (4/1)
4. conservation of energy (4/2)
5. calorie (4/2)
6. law of conservation of energy (4/2)
7. friction (4/2)
8. constant (4/2)
9. gravitational potential (4/1)
10. kinetic (4/1)
11. 2,450 J (4/1)
12. 98 J (4/1)
13. Because the potential energy of the hammer doubles when its height above ground doubles, the kinetic energy of the hammer at impact also doubles. This assumes that there is no energy changed to thermal energy due to friction with the air. (4/1)
14. Friction causes some kinetic energy to be transformed into thermal energy, which reduces engine efficiency. Streamlining reduces friction. (4/2)

Chapter Test (page 37)
I. Testing Concepts
1. false; kinetic (4/1)
2. true (4/1)
3. false; potential (4/1)
4. true (4/2)
5. false; potential (4/1)
6. false; energy (4/1)
7. false; quadruple (4/1)
8. true (4/1)
9. false; elastic potential (4/1)
10. true (4/1)
11. false; different (4/1)
12. false; electrical (4/2)
13. true (4/2)
14. false; potential (4/1)
15. true (4/2)
16. c (4/1)
17. d (4/1)
18. a (4/2)
19. d (4/1)
20. b (4/1)
21. c (4/2)
22. a (4/2)
23. b (4/1)
24. d (4/2)
25. c (4/2)

II. Understanding Concepts
1. a. \[ GPE = \text{mass} \times 9.8 \text{ m/s}^2 \times \text{height} \]
   \[ = 10 \text{ kg} \times 9.8 \text{ m/s}^2 \times 1.5 \text{ m} \]
   \[ = 147 \text{ J} (4/1) \]
   b. \[ GPE = \text{mass} \times 9.8 \text{ m/s}^2 \times \text{height} \]
   \[ = 10 \text{ kg} \times 98 \text{ m/s}^2 \times \text{height} \]
   \[ = 98 \text{ J} (4/1) \]
2. \[ KE = \frac{1}{2} \text{mass} \times \text{velocity}^2 \]
   \[ = \frac{1}{2} \times 10 \text{ kg} \times (10 \text{ m/s})^2 \]
   \[ = 500 \text{ J} (4/1) \]
3. The maximum kinetic energy would equal the wood's gravitational potential energy on the carpenter's shoulder, or 147 J. (4/1)
4. The truck's speed is greater than the wood's as it drops. That difference is then squared. (4/1)
5. running (4/2)
6. sitting (4/2)
7. 317.5 Calories (4/2)
8. Walking uses about twice as many Calories as standing. (4/2)

III. Applying Concepts
1. Energy remains constant within the system. When the ball leaves your hand, it has maximum kinetic energy and minimum potential energy. As the ball rises, its kinetic energy decreases while its potential energy increases by the same amount. At its highest point, the ball has no kinetic energy and has its greatest potential energy. At any point during the throw, the mechanical energy equals the sum of the potential energy and kinetic energy. (4/1)
2. The law of the conservation of energy states that energy cannot be created or destroyed. Friction changes some of the mechanical energy of an object into thermal energy. The total energy of a system—potential and kinetic plus any converted energy—remains constant. (4/2)
3. Because mechanical energy remains constant, the kinetic energy of the satellite is greatest close to Earth, where its potential energy is least. Because kinetic energy depends on mass and velocity, velocity would be at its maximum close to Earth as long as the satellite's mass remains constant. (4/2)
4. \[ PE = \text{mass} \times 9.8 \text{ m/s}^2 \times \text{height} \]
   \[ = 200 \text{ kg} \times 9.8 \text{ m/s}^2 \times 10 \text{ m} \]
   \[ = 19,600 \text{ J (4/1)} \]

Section Focus Transparency 1 (page 42)

They’ve Got Potential

Transparency Teaching Tips

- This transparency introduces potential, or stored, energy, the common thread through the three pictures. Ask students to describe how energy relates to each of the pictures. Explain that there are different forms of potential energy. The tennis ball on the racket represents elastic potential energy, the waterfall illustrates gravitational potential energy, and the moose consuming food depicts chemical potential energy.
- Ask students to volunteer other examples of potential energy.

Content Background

- The scientific definition of work is force exerted over distance. The capacity to perform work is called energy.
- In the International System of Measurements (SI), the unit of work is the joule. A joule is equal to the work done by a force of one newton over a distance of one meter. In the English system of measurement, the unit of work is the foot-pound, the amount of work needed to lift one pound upward a distance of one foot.

Answers to Student Worksheet

1. The water picks up speed, due to gravity. As the water falls, stored energy changes to energy of motion.
2. While eating moss, moose exchange kinetic energy for chemical potential energy.
3. The ball releases its stored elastic potential energy and rebounds off the racket’s strings.

Section Focus Transparency 2 (page 43)

Power Plants

Transparency Teaching Tips

- The concepts covered with this transparency are conversion and conservation of energy. Explain that according to the law of conservation of energy, energy cannot be neither created nor destroyed. Ask students to describe the energy conversion process, from the Sun through plants to animals. (The Sun’s energy is converted by plants through photosynthesis to chemical potential energy; animals eat plants and use the stored chemical potential energy to live.)
- Ask students to define ‘calorie’ and explain its connection to the process just described.

Content Background

- A calorie is defined as the amount of energy needed to raise the temperature of one gram of water one degree Celsius. The food Calorie that nutritionists use (C) is actually a kilocalorie, or 1,000 calories. The food Calorie is capitalized in text and is sometimes called a large Calorie. The Caloric value of a meal represents how much energy those foods will yield if consumed. For example, a breakfast of scrambled eggs, potato wedges, sausage, and fruit will yield 659 Calories, while a breakfast of a soft-boiled egg, toast, and grapefruit will provide 275 Calories.
- Food not used to create energy is eliminated or stored in the body as fat.
- One ear of corn yields about 90 Calories and has three grams of protein, twenty grams of carbohydrates, and one gram of fat.

Answers to Student Worksheet

1. People eat plants, converting the stored chemical potential energy to various forms or energy to sustain life
2. Answers will vary. Energy is found in water held behind dams, wind, batteries, chemical bonds, compressed springs, etc.

Teaching Transparency (Page 45)

Kinetic Energy

Section 1

Transparency Teaching Tips

- Obtain a toy truck and a toy motorcycle. Have students explain how the motorcycle can start behind the truck, and after a certain distance, be even with the truck.
- Discuss the role that gravity plays in the movement of the truck and motorcycle.

Reteaching Suggestion

- Place a book at the edge of a table and allow it to fall. Point out that the falling book has kinetic energy.

Extensions

Activity: Have students create and write their own kinetic energy problem and solution.
Challenge: Have students use library resources to study kinetic energy and list ways it is part of everyday life.

Answers to Student Worksheet

1. Kinetic energy is energy in the form of motion. Anytime something moves, it has kinetic energy.
2. The truck’s mass and velocity affect its kinetic energy.
3. Energy is measured in joules.