2 Answer Key

2–1 Explore, page 5
The original source of energy for this activity would be the stored chemical energy in the dry cell battery. The chemical energy in the battery is converted to electrical energy, which is changed to mechanical energy in the running of the motor. Finally, the mechanical energy of the motor is converted to heat energy as the sandpaper rubs against the piece of metal.

2–1 Practice Problems, page 6
Answers marked with an asterisk denote additional practice problems that appear in the Teacher's Edition.

1. 0.025 1 Cal
2. 199,000 J
3. 0.060 0 kcal
4. 0.0958 Cal
5. 63,000 J
6. 2.00 x 10^5 cal
7. 418,000 J
8. 125,000 cal
9. 5.8 x 10^6 J
10. 24,800 J

2–1 Apply, page 7
1. The sun's rays are examples of radiant energy. The electricity stored in the battery is potential energy. The spinning motor in the clock has kinetic energy.
2. Neither one. The system just converts energy into different forms.
3. The electrical energy in the battery is converted into kinetic energy by the clock's motor. The energy in the battery was transferred but not destroyed.
4. Machines are never perfect, there is always friction and electrical resistance. Electrical resistance in the photoelectric cell, the wires, and battery will convert some of the energy into heat, and radiate it out of the system.

2–1 Review and Reinforcement, pages 8–9

1. energy
2. radiant
3. chemical potential
4. joule
5. created, destroyed
6. natural gas
7. kinetic
8. f
9. c
10. b
11. a
12. e
13. d
14. 22.7 J
15. 3.037 71 kJ
16. 14.4 cal
17. 160 cal
18. 9.5 x 10^4 J
19. The potential energy is converted to kinetic energy and sound energy.
20. Coal and oil are limited resources. They will only provide energy as long as they are available. Burning coal and oil also contributes to global warming by increasing the concentration of carbon dioxide in the atmosphere.

2–2 Explore, page 10
1. The thermometer can only be accurate within the range established by the melting and boiling points of water. Students may note that the expansion of water is not great enough to result in very precise calibrations.
2. Answers will vary depending on the degree of success in calibrating the thermometer. Inaccurate readings could be obtained if students prematurely marked the melting and boiling points on the thermometer. The limited expansion of the water could also result in difficulties in calibrating.
2 Answer Key (continued)

2-2 Practice Problems, page 11

Answers marked with an asterisk denote additional practice problems that appear in the Teacher's Edition.

*1. 320 K
2. 1273 K
3. 253 K
4. 173 K
*5. -61°C
6. -241°C
7. 3850°C
8. 28.0 °C
9. 293 K
10. 1337 K

2-2 Apply, page 12

1. He added 173 to the Celsius temperature instead of 273. The correct answer is 373 K.
2. The boiling point of water in Fahrenheit is 212°F. She should heat the candy to 224°F.
3. Absolute zero is measured on the Kelvin scale. The answer should be 0 K, or -273°C.
4. Judy used the wrong units. The answer should be 98.6°F.
5. Albert reversed the units. The answers should be aK = -273°C; 373 K = 100°C; 273 K = 0°C.
6. The freezing point of water is 0°C. Ana should read the temperature as either 16°F or -16°C.

2-2 Review and Reinforcement, pages 13-14

1. a. 288 K
   b. 280.2 K
   c. 37°C
   d. 147 K
   e. -42.8°C
   f. 107°C

3. The relationship between both scales is consistent for all temperatures, as shown by the straight line.

4. 

5. 482°F, 250°C, 523 K
6. A thermometer consists of a bulb filled with a liquid such as mercury or colored alcohol, connected to a sealed tube. As the bulb is heated, the liquid expands. The temperature scale is marked on the tube.
7. No, because it becomes more and more difficult to remove heat from supercooled atoms.
8. The degree is equivalent in both scales. The main difference between the Kelvin and Celsius scales is the location of the zero point.

2-3 Explore, page 15

1. Before mixing, the two liquids filled each graduated cylinder completely. After mixing, the resulting solution was not sufficient to fill both graduated cylinders completely.
2. The reduced volume of the solution is due to the ethanol molecules breaking the bonds between water molecules and filling in the resultant spaces.

2-3 Practice Problems, page 16

Answers marked with an asterisk denote additional practice problems that appear in the Teacher's Edition.

*1. neither
*2. chemical change
3. chemical change
4. physical change
5. physical change
6. neither
7. neither
2 Answer Key (continued)

8. physical change
9. neither
10. Physical changes: melting butter, wheat being ground into flour, cracking the egg, breaking bowl
    Chemical changes: lighting the gas in the oven, wheat converting energy from the sun, paper towel burning

2–3 Apply, page 17
2. Yes.
3. The tree uses water and nutrients from the ground and carbon dioxide from the air to build new cells, increasing the mass of the peach tree.
4. No. The experiment does not include measuring the water the tree uses, the nutrients it consumes, or the carbon dioxide it absorbs. Therefore it does not prove that matter can be created.
5. Matter undergoes both physical and chemical changes in this experiment. The water and nutrients are chemically altered. For example, the water, carbon dioxide, and nutrients absorbed by the plant are chemically rearranged to form the living material of the plant cells. The tree also undergoes physical changes on a macroscopic scale. It grows taller and may even lose leaves, but it remains a tree.

2–3 Review and Reinforcement, pages 18–19
1. matter
2. solid, liquid
3. gas, plasma
4. chemical, physical
5. P
6. C
7. P
8. P
9. C
10. C
11. P
12. P
13. P
14. C
15. The kinetic energy of molecules decreases from gases to liquids to solids.
16. If new properties appear that suggest a new chemical substance is present, matter has undergone a chemical change.
17. Both glass and plastic are transparent and transmit microwaves. Glass is more brittle than plastic and requires different molding processes.
18. No. Although chemical properties describe how elements chemically react with each other, in the case of inert elements, a descriptive property would be “non-reactive.”

2–4 Explore, page 20
1. Oxygen gas supports combustion. It allows a glowing splint to burn.
2. When oxygen is combined in the compound it does not support combustion. The glowing splint showed no change in step 4.
3. hydrogen

2–4 Apply, page 21
1. The symbol for gold is Au. Gold is an element.
2. Their symbols are Fe, Pb, and Cu, respectively.
3. A compound is formed from two or more elements. Elements cannot be broken into simpler substances by chemical changes.
4. If you react two or more elements together, they form a compound. Gold is an element, not a compound. Therefore, it is impossible to make gold by reacting other elements.

2–4 Enrich, page 22
Vegetarians do not consume red meats or seafood (and possibly eggs) and may need an additional source of iron.

2–4 Review and Reinforcement, pages 23–24
1. Sodium, Na
2. Copper, cuprum
3. Pb, plumbum
4. Tungsten, wolfram
5. Iron, Fe
6. Tin, stannum
7. K, kalium
8. gold, Au
9. Hg, hydrargyrum
10. Silver, argentum
11. elements
12. symbols, letters
13. periodic table
14. compound
15. carbon dioxide
16. pure, properties
17. element
18. compound
19. element
20. compound
21. element
22. compound
23. compound
24. element
25. element
26. compound
27. carbon and hydrogen
28. Possible answers include einsteinium, fermium, and nobelium.
29. No, because compounds contain two or more elements combined in a fixed proportion.

2-5 Explore, page 25
1. Colors will vary depending on the type of ink. The colors are all found in the ink, but when mixed together they appear black.
2. A mixture is composed of several different substances that can be easily separated.

2-5 Apply, page 26
1. homogeneous mixture, or solution
2. The burner provides the heat needed to vaporize the liquids. No, the sample must boil to be separated.
3. The liquid with the lowest boiling point has reached its boiling point and has begun to vaporize. As it cools, the vapor condenses and drips into the collection flask as a liquid.
4. Once the first liquid has boiled off, replacing the flask prevents the second liquid from mixing with the first when it boils off.
5. The second liquid in the solution has begun to boil.
6. The solution contained three different liquids because three distinct boiling points were observed.
7. The substance is probably a salt. It was dissolved in the original solution and could not be seen.

2-5 Enrich, page 27
1. Although you may never have thought about it, a washing machine acts as a centrifuge. During the spin cycle, a washing machine spins the tub at a very high rate. The centrifugal force generated by the spinning tub helps to separate the water from the clothes. The excess water is then drained away.
2. The centrifuge separates substances by density.

2-5 Review and Reinforcement, pages 28–29
1. heterogeneous
2. pure
3. heterogeneous
4. pure
5. homogeneous
6. heterogeneous
7. homogeneous
8. heterogeneous
9. homogeneous
10. pure
11. filtration
12. filtration
13. crystallization
14. distillation
15. chromatography
16. electrolysis
17. distillation
18. A magnet could be used to separate them because iron is attracted to a magnet but aluminum is not.
19. No. Distillation could only be used if these gases were in the liquid state.
20. By definition, a solution is a homogeneous mixture, but all mixtures are not homogeneous. Thus, not all mixtures are solutions.
21. Milk appears homogeneous until the milk is allowed to separate from the fat (cream).

Chapter Test, pages 32–35

1. c
2. d
3. c
4. d
5. d
6. b
7. c
8. d
9. a
10. a
11. a
12. d
13. a
14. e
15. h
16. g
17. b
18. f
19. c
20. 740 kCal; 180 g
21. a. 373
   b. 0
   c. 293
   d. 310
   e. –273
22. 60.7 g
23. First remove the paper clips with a magnet or your hand. Then filter the sand from the water. Finally, distill the salt water and collect the pure water.
24. Students may suggest a wide variety of answers. Make sure that their answers reveal the understanding that physical changes do not alter the identity of a substance and that chemical changes, such as burning, digesting, and rusting, do involve the formation of a new substance.
25. Answers may include the use of energy to move matter, the conversion of matter into energy, or the use of temperature scales to measure energy changes in matter.
26. 1.61 J
27. 320°F (160°C)
28. 6.0 x 10^5 cal
29. The water containing the impurities is boiled in the distilling flask. The water boils off, leaving the solids behind. The vaporized water travels through a condenser which cools and condenses it to a liquid. The liquid is collected in a separate flask.
30. The alcohol is more volatile than water and evaporates quickly when the wine is heated during cooking.
31. Absolute zero is the temperature at which atoms would stop moving entirely. The closer atoms get to absolute zero, however, the harder it becomes to remove any more heat.