Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Science and Scientists (pp. 8–13)

1. What are two steps you can take to start being a scientist?

_____

_____

STARTING WITH A QUESTION

2. What is science?

_____

_____

3. Describe how you might practice science in your own neighborhood.

_____

_____

4. What are three different kinds of environments you might ask questions about?

_____

_____

_____

INVESTIGATION: THE SEARCH FOR ANSWERS

Match the correct definition with the correct term. Write the letter in the space provided.

_____ **5.** carefully looking and recording what you see

_____ **6.** performing an activity to answer questions

_____ **7.** looking up information in books or on the Internet

a. research

b. experimentation

c. observation

APPLYING THE ANSWERS

8. What are two ways science has made automobiles safer?

_____

_____

9. What are three natural resources that are saved by recycling steel?

_____

_____

_____

10. How have chlorofluorocarbons harmed the environment?

_____

_____

11. What are the results of damaging the ozone layer?

_____

_____

SCIENTISTS EVERYWHERE

Match the correct definition with the correct term. Write the letter in the space provided.

_____ **12.** a person who studies a community of organisms and their environment

_____ **13.** a person who draws scientific diagrams

_____ **14.** a scientist who studies the chemistry of rocks, minerals, and soil

_____ **15.** a person who studies the atmosphere

_____ **16.** a scientist who studies volcanoes

a. meteorologist
b. volcanologist
c. science illustrator
d. ecologist
e. geochemist

17. What are two careers that a meteorologist might have?

_____

_____

Directed Reading B *continued*

18. What are two questions a geochemist might try to answer?

19. What are four fields an ecologist might work in?

20. How can a volcanologist help save lives?

21. What two subjects do most science illustrators have a background in?

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Scientific Methods (pp. 14–21)

WHAT ARE SCIENTIFIC METHODS?

_____ **1.** What are the steps scientists use to answer questions and solve problems?
- **a.** observations
- **b.** formulations
- **c.** flowcharts
- **d.** scientific methods

2. List the steps that are included in the scientific methods.

_____

_____

_____

_____

_____

_____

ASKING A QUESTION

_____ **3.** What does asking questions help scientists to do?
- **a.** find answers with less investigation
- **b.** focus the purpose of an investigation
- **c.** ask questions and memorize answers
- **d.** know where to look up the answers

4. Any use of the senses to gather information is called

_____.

5. Observations made with tools are called _____.

6. Efficiency compares energy output with _____.

7. Why is the efficiency of a boat important?

_____

_____

_____

_____

8. What question did the two engineers James Czarnowski and Michael Triantafyllou explore?

FORMING A HYPOTHESIS

_____ **9.** After a scientist has asked questions and made observations, he or she is ready to
- **a.** answer the questions.
- **b.** explain the answers.
- **c.** start a different investigation.
- **d.** form a hypothesis.

_____ **10.** What is a hypothesis?
- **a.** an observation based on investigation
- **b.** a possible explanation based on observations
- **c.** a comparison of input and output
- **d.** a question based on conclusions

11. A good hypothesis should be _____.

12. What is wrong with a hypothesis that can't be tested?

13. What was the hypothesis that Czarnowski formed?

14. What observations did Czarnowski make before forming his hypothesis?

15. A good way to make a prediction about a hypothesis is by stating it in a(n) _____ statement.

16. How might the MIT scientists have stated their prediction in an if-then statement?

_____

_____

TESTING THE HYPOTHESIS

_____ **17.** Testing a hypothesis helps you determine if the hypothesis is
- **a.** a reasonable answer to your question.
- **b.** a controlled experiment.
- **c.** efficient.
- **d.** an adaptation.

_____ **18.** If your tests show that your hypothesis is way off the mark, you may have to
- **a.** change the topic you are studying.
- **b.** buy new measurement tools.
- **c.** repeat the tests until you get the results you want.
- **d.** change the hypothesis.

_____ **19.** A controlled experiment compares results from experimental groups with
- **a.** results from other experimental groups.
- **b.** results from other investigations.
- **c.** results from a control group.
- **d.** results from past experiments.

20. The purpose of a controlled experiment is to _____ a hypothesis.

21. In a controlled experiment, the control group and the experimental groups are the same except for a factor in the experimental groups called a(n) _____.

22. In a controlled experiment, the factors that are kept the same between groups are called _____.

23. How did Czarnowski and Triantafyllou decide to test their hypothesis?

_____

_____

24. Pieces of information gathered through observation or experimentation are called _____.

25. What was the only parameter the scientists changed in the *Proteus* experiment?

_____

26. What could the scientists tell from changing this parameter?

_____

_____

ANALYZING THE RESULTS

27. After you run an experiment and collect data, you must _____ the data to see if the results support your hypothesis.

28. Organizing data into _____ and _____ can make information easier to use.

DRAWING CONCLUSIONS

_____ **29.** What must you do at the end of an experiment?

a. Draw a conclusion.
b. Analyze a graph.
c. Draw a picture.
d. Analyze a chart.

30. Give examples of general conclusions you might draw after an investigation.

_____

_____

31. What did the two scientists conclude after the trials of the *Proteus*?

_____

_____

32. Why were the scientists able to reach this conclusion?

_____

_____

_____

_____

COMMUNICATING RESULTS

33. What are some ways to communicate the results of a scientific investigation?

34. Why is it important to communicate the results of a scientific investigation?

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Safety in Science (pp. 22–27)

KEEPING YOURSELF SAFE

1. What are three ways to take responsibility for your safety?

_____

_____

_____

2. Besides paying attention and watching what you are doing, how can you help avoid accidents?

_____

_____

3. What should you do if you have even a minor accident?

_____

_____

_____

ELEMENTS OF SAFETY

_____ **4.** What should you learn about safety symbols?
- **a.** how to draw them and where to find them
- **b.** how to recognize them and what they mean
- **c.** when to use them and who invented them
- **d.** where to find them and how to use them

_____ **5.** What should you do when you see a safety symbol?
- **a.** Take the precautions that the symbol requires.
- **b.** Ignore the symbol.
- **c.** Discuss what you should do with your lab partner.
- **d.** Stop doing the activity and leave the room.

_____ **6.** What is the most common cause of accidents in the laboratory?
- **a.** telling the teacher about accidents
- **b.** failing to read and follow directions
- **c.** handling hot objects
- **d.** paying attention to what is going on

_____ **7.** If you can't complete some activity directions, you should
- **a.** keep on working, and do what you think is correct.
- **b.** keep on working, but ask your friend for help.
- **c.** stop working, and start over.
- **d.** stop working, and ask your teacher for help.

_____ **8.** Why should you arrange your equipment and materials neatly during an experiment?
- **a.** because working in a cluttered area is unsafe
- **b.** because it makes your work area look nice
- **c.** because your teacher likes neatness
- **d.** so you can finish more quickly

_____ **9.** What should you wear whenever you enter the lab area?
- **a.** your headphones
- **b.** heat-resistant gloves
- **c.** rubber boots
- **d.** safety goggles

_____ **10.** If you handle hot objects, you should
- **a.** use your apron as a pot holder.
- **b.** get someone else to hold them for you.
- **c.** wear heat-resistant gloves.
- **d.** stop working on the activity.

_____ **11.** What should you do about burners and hot plates at the end of an activity?
- **a.** Ask your lab partner what to do.
- **b.** Leave them on for the next class.
- **c.** Make sure they are turned off.
- **d.** Turn them to a low setting.

12. What are some rules for handling animals in the science laboratory?

Match the correct example with the correct element of safety. Write the letter in the space provided.

_____ **13.** wearing goggles and an apron

_____ **14.** knowing what a picture of an electrical plug means

_____ **15.** returning materials and chemicals to their original places

_____ **16.** clearing books off the experiment work area

_____ **17.** reading the instructions before starting a science activity

a. recognizing safety symbols

b. reading and following directions

c. practicing neatness

d. using proper safety equipment

e. cleaning up properly

RESPONDING TO ACCIDENTS

18. Why should you know where emergency equipment for an accident is located?

19. What are two things you should do if an accident happens?

20. What is first aid?

21. What is the treatment for a heat burn?

Directed Reading B *continued*

22. What should you do if a chemical gets in your eyes?

_____

_____

_____

23. What should you do if someone gets a cut?

_____

_____

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Tools and Models in Science (pp. 42–49)

TOOLS IN SCIENCE

_____ **1.** What is a *tool?*
- **a.** anything with a handle
- **b.** anything that gives off energy
- **c.** anything that requires electricity
- **d.** anything that helps you do a task

_____ **2.** Which of the following is NOT something that tools are used for?
- **a.** to evaluate the importance of science
- **b.** to collect data
- **c.** to evaluate and analyze data
- **d.** to take accurate measurements

3. List four examples of tools used for taking measurements.

_____

_____

_____

_____

4. List three examples of tools that help you analyze or communicate data.

_____

_____

_____

MAKING MEASUREMENTS

5. List two examples of units of measure used many years ago.

_____

_____

6. A simple and reliable measurements system called the

_____ is also know as the metric system.

7. Why is changing from one unit to another easy when using the SI system of measurement?

_____

Directed Reading B *continued*

Match the correct description with the correct term. Write the letter in the space provided.

_____ **8.** a measure of the size of an object or region in three-dimensional space

_____ **9.** the ratio of the mass of a substance to the volume of the substance

_____ **10.** a measure of how hot or cold something is

_____ **11.** a measure of the amount of matter in an object

a. mass
b. temperature
c. volume
d. density

Match the correct description with the correct term. Write the letter in the space provided.

_____ **12.** the basic SI unit of length

_____ **13.** the basic SI unit of mass

_____ **14.** a unit used to express liquid volume

_____ **15.** a unit used to express the volume of larger solid objects

a. kilogram
b. liter
c. meter
d. cubic meter

16. A cubic meter is equal to 1,000 _____.

17. What unit of measure is used to express the volume of smaller objects?

_____

_____

18. How is density calculated?

_____

_____

_____

19. Name three units that are used to measure temperature.

_____

_____

_____

_____

MODELS IN SCIENCE

_____ **20.** What is a pattern, plan, representation, or description designed to show the structure or workings of an object, system, or concept called?
- **a.** a test
- **b.** a model
- **c.** a hypothesis
- **d.** a scale

_____ **21.** Which of the following uses something familiar to help you understand something that is not familiar?
- **a.** a model
- **b.** a tool
- **c.** data
- **d.** a test

22. List the three common types of scientific models.

_____

_____

_____

23. List three examples of a physical model.

_____

_____

_____

24. What type of model tries to put many ideas together to explain or summarize something?

_____

_____

_____

_____

Match the correct description with the correct type of model. Write the letter in the space provided.

_____ **25.** used to predict the weather

_____ **26.** used to explain why the universe seems to be expanding

_____ **27.** used to help understand how a real space shuttle blasts off into space

a. conceptual model
b. physical model
c. mathematical model

28. What can happen if a mathematical model contains a wrong value for a single variable?

29. What are models often used to represent?

30. Give one example of a model that is used to learn about things that cannot be seen.

31. Why is a model always limited in its usefulness?

USING MODELS FOR SCIENTIFIC PROGRESS

_____ **32.** Which of the following is NOT a way that models are used by scientists?
a. Models are used to communicate difficult information.
b. Models can make a molecule easier to visualize.
c. Models are used to validate inaccurate data.
d. Models can be used to summarize new information.

_____ **33.** A system of ideas that explains many related observations and is supported by a large amount of scientific evidence is called a(n)
a. model.
b. law.
c. variable.
d. theory.

Directed Reading B *continued*

34. Why do scientists use models in their search for new information?

35. A descriptive statement or equation that reliably predicts events under certain conditions is called a(n) _____.

36. What may happen when scientists make new observations that seem to show that a theory is wrong?

37. Define *law*.

38. What does a law tell you, and what does a law not tell you?

39. What law says that the total mass of materials formed during a chemical change is the same as the total mass of the starting materials?

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Organizing Your Data (pp. 50–55)

CREATING A DATA TABLE

_____ **1.** Which of the following can be the first step to take in organizing data?
- **a.** Choose a topic.
- **b.** Gather information.
- **c.** Create a data table.
- **d.** Analyze data.

_____ **2.** Which of the following should you do before an experiment starts?
- **a.** Determine what information is going to be gathered.
- **b.** Draw conclusions about the information before it is gathered.
- **c.** Miss information that might be important.
- **d.** Analyze the information after it is gathered.

3. A factor that is deliberately changed in an experiment is called a(n) _____.

4. Where do you find the independent variable in a data table?

_____

5. The factor that changes as a result of manipulation and is measured is called a(n) _____.

6. Where do you find the dependent variable in a data table?

_____

Variable and Controlled Parameters

7. What is the difference between controlled parameters and variable parameters?

_____

_____

CREATING A GRAPH

8. Graphs make it easy to do what two things?

_____

_____

_____

Directed Reading B *continued*

Match the correct description with the correct term. Write the letter in the space provided.

_____ **9.** is one of two or more reference lines that mark the borders of a graph

_____ **10.** usually represented by the x-axis in a data table

_____ **11.** usually represented by the y-axis in a data table

_____ **12.** found by subtracting the smallest value of a variable from the largest value of the same variable

_____ **13.** is the size used for each box or grid mark on a graph

_____ **14.** plotted by putting a dot on the graph for a pair of data in the table

_____ **15.** shows how data differ from the pattern; a smooth line drawn to include some but not all of the data points

a. range
b. dependent variable
c. axis
d. independent variable
e. scale
f. line of best fit
g. data point

16. The last step when creating a graph is giving the graph a(n)

_____.

17. What two things do scientists often include in the titles of their graphs?

_____

_____

PATTERNS SHOWN BY GRAPHS

Match the correct description with the correct term. Write the letter in the space provided.

_____ **18.** the pattern of data on a graph

_____ **19.** a graph in which the relationship between the independent variable and dependent variable can be shown with a straight line

_____ **20.** a graph in which the relationship between variables cannot be shown with a straight line

_____ **21.** a relationship in which the dependent variable increases as the independent variable increases

_____ **22.** a relationship in which one variable increases while the other variable decreases

a. nonlinear graph

b. linear graph

c. inverse

d. direct

e. trend

23. How are computers helpful to scientists?

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Analyzing Your Data (pp. 56–61)

WHY MATHEMATICS?

_____ **1.** Which of the following is NOT something that scientists use mathematics for?
- **a.** learning how to speak a foreign language
- **b.** seeing patterns in data to make predictions
- **c.** answering questions
- **d.** understanding and summarizing large amounts of data

2. How does a meteorologist use mathematics?

_____

_____

_____

3. Why is mathematics often called the "language of science"?

_____

_____

ACCURACY OF DATA

4. Name three reasons why scientists might get an inaccurate reading when conducting an experiment.

_____

_____

_____

REPRODUCIBILITY OF DATA

_____ **5.** Results of an experiment can be supported or accepted by other scientists if the data
- **a.** are not reproducible.
- **b.** are reproducible.
- **c.** cannot be converted into SI units.
- **d.** are supported only by the French Academy of Sciences.

DESCRIBING THE ENTIRE SET OF DATA

Match the correct definition with the correct term. Write the letter in the space provided.

_____ **6.** the number obtained by adding up the data for a given characteristic and dividing this sum by the number of individuals

_____ **7.** the value of the middle item when data are arranged in order by size

_____ **8.** the most frequently occurring value in a data set

a. mode
b. mean
c. median

9. When is using the median especially useful?

_____

_____

_____

SLOPE OF A LINE

10. A measure of the slant of a line is called the _____.

11. What does the rise represent?

_____

12. What does the run represent?

_____

13. How is the slope of a straight line calculated?

_____

14. The value of the slope between any two points on that line will be a(n)

_____ number.

15. In the equation $y = kx$, which letter represents the slope of the line, also known as the constant term?

_____

Match the correct description with the correct term. Write the letter in the space provided.

_____ **16.** displays a straight line

_____ **17.** displays a curved line

a. nonlinear graph
b. linear graph

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: What Is Matter? (pp. 78–83)

MATTER

1. What characteristic do a human, hot soup, the metal wires in a toaster, and the glowing gases in a neon sign have in common?

_____

2. What is matter?

_____

MATTER AND VOLUME

_____ **3.** Which of the following units would be best for expressing the amount of water in a lake?
- **a.** grams (g)
- **b.** liters (L)
- **c.** meters (m)
- **d.** milliliters (mL)

_____ **4.** Which of the following units would be best for expressing the volume of soda in a can?
- **a.** centimeters (cm)
- **b.** grams (g)
- **c.** liters (L)
- **d.** milliliters (mL)

5. What is volume?

_____

6. Things with _____ cannot share the same space at the same time.

7. To measure the volume of water in a graduated cylinder, you should look at the bottom of the curve at the surface of the water called the _____.

8. The volume of solid objects is commonly expressed in _____ units.

9. What three dimensions are needed to find the volume of a rectangular solid?

_____

_____

10. How could the volume of a 12-sided object be found using water and a graduated cylinder?

11. If the volume of water displaced by the 12-sided object is 8 mL, what is the volume of the 12-sided object in cubic units?

MATTER AND MASS

_____ **12.** The measure of the amount of matter in an object is its
- **a.** volume.
- **b.** length.
- **c.** meniscus.
- **d.** mass.

_____ **13** The measure of the gravitational force on an object is its
- **a.** mass.
- **b.** length.
- **c.** weight.
- **d.** volume.

_____ **14.** The SI unit of mass is the
- **a.** newton.
- **b.** liter.
- **c.** kilogram.
- **d.** pound.

_____ **15.** One newton is about equal to the weight of an object that has
- **a.** a mass of 100 g on the moon.
- **b.** a volume of 1 m^3 on Earth.
- **c.** a mass of 1 kg on Earth.
- **d.** a mass of 100 g on Earth.

16. What is the only way to change the mass of an object?

Directed Reading B *continued*

For each description, write whether it applies to mass or to weight.

_____ **17.** is always constant no matter where the object is located

_____ **18.** is measured using a spring scale

_____ **19.** is expressed in grams (g), kilograms (kg), or milligrams (mg)

_____ **20.** is expressed in newtons (N)

_____ **21.** is less on the moon than on Earth

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Physical Properties (pp. 84–89)

IDENTIFYING PHYSICAL PROPERTIES

_____ **1.** A characteristic of matter that can be observed or measured without changing the identity of the matter is a
- **a.** matter property.
- **b.** physical property.
- **c.** chemical property.
- **d.** volume property.

_____ **2.** Some examples of physical properties are
- **a.** color, odor, and reactivity.
- **b.** color, odor, and speed.
- **c.** color, odor, and mass.
- **d.** color, odor, and anger.

Match the correct example with the correct physical property. Write the letter in the space provided.

_____ **3.** Aluminum can be flattened into sheets of foil.

_____ **4.** Water is frozen into ice.

_____ **5.** Copper can be pulled into thin wires.

_____ **6.** Your hand grows warm from holding a cup of hot liquid.

_____ **7.** Flavored drink mix dissolves in water.

_____ **8.** An onion gives off a very distinctive smell.

_____ **9.** A golf ball has more mass than a table tennis ball.

- **a.** state
- **b.** solubility
- **c.** thermal conductivity
- **d.** malleability
- **e.** odor
- **f.** ductility
- **g.** density

10. Density is the _____ that describes the relationship between mass and volume.

11. The amount of matter in a given space, or volume, is called _____.

12. What is the equation for density?

_____

Directed Reading B *continued*

13. What do D, V, and m stand for in the equation for density?

14. The units for density consist of a mass unit divided by a(n)

_____ unit.

15. What happens to the density of a given substance if you increase the amount of the substance that you have?

16. What are two reasons why density is a useful physical property for identifying substances?

17. Why would 1 kilogram of lead be less awkward to carry around than 1 kilogram of feathers?

18. What will happen to a solid object made from matter with a greater density than water when it is dropped into water?

19. How will knowing the density of a substance help you determine whether an object made from that material will float in water?

20. If you pour different liquids into a graduated cylinder, the liquids will form layers based upon differences in their _____.

21. If you pour different liquids into a graduated cylinder, which layer of liquid will settle on the bottom?

_____

22. If you pour different liquids into a graduated cylinder, where will the layer of liquid with the lowest density be found?

_____

PHYSICAL CHANGES: NO NEW SUBSTANCES

23. A change that affects only the physical properties of a substance is known as a(n) _____.

24. What kind of changes are changes of state, such as melting and freezing?

_____

Identify which of the following activities represent physical changes by writing *PC* in the space provided. Put an *X* beside activities that do not.

_____ **25.** sanding a piece of wood

_____ **26.** baking bread

_____ **27.** crushing an aluminum can

_____ **28.** melting an ice cube

_____ **29.** dissolving sugar in water

_____ **30.** molding a piece of silver

31. When a substance undergoes a physical change, its _____ does not change.

32. What is changed when matter undergoes a physical change? Give an example to explain your answer.

_____

_____

_____

_____

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Chemical Properties (pp. 90–95)

IDENTIFYING CHEMICAL PROPERTIES

_____ **1.** A property of matter that describes its ability to change into new matter with different properties is known as a(n)
- **a.** chemical change.
- **b.** physical change.
- **c.** chemical property.
- **d.** physical property.

_____ **2.** The chemical property that describes the ability of substances to change and form one or more new substances is called
- **a.** reactivity.
- **b.** flammability.
- **c.** density.
- **d.** solubility.

_____ **3.** The ability of a substance to burn is a chemical property known as
- **a.** ductility.
- **b.** flammability.
- **c.** density.
- **d.** solubility.

_____ **4.** An iron nail is reactive with
- **a.** rubbing alcohol.
- **b.** other iron nails.
- **c.** wood in a house.
- **d.** oxygen in the air.

_____ **5.** Which of the following statements is true about characteristic properties of matter?
- **a.** Characteristic properties depend on the size of the sample.
- **b.** Characteristic properties may be either physical or chemical properties.
- **c.** Characteristic properties involve only chemical properties.
- **d.** Characteristic properties involve only the physical nature of the matter.

6. Describe how burning changes the nature of wood.

_____

_____

7. Observing the _____ properties of a substance involves changing the identity of the substance.

8. The properties that are most useful in identifying a substance are called _____ properties.

CHEMICAL CHANGES AND NEW SUBSTANCES

_____ **9.** Chemical changes are the processes by which substances
- **a.** move from place to place.
- **b.** change into new substances.
- **c.** change their physical properties.
- **d.** become greater in mass.

_____ **10.** Which of the following would NOT be considered an example of a chemical change?
- **a.** the bubbling action of effervescent tablets
- **b.** the formation of green coating on copper statues
- **c.** the melting of an ice cream bar
- **d.** the burning of rocket fuel

11. How do you know that baking a cake involves chemical changes?

_____

_____

_____

_____

12. List some signs or clues that show that a change you are observing is a chemical change.

_____

_____

_____

_____

13. An increase in the surrounding temperature is felt when a chemical change _____ heat.

14. A decrease in the surrounding temperature is felt when a chemical change _____ heat.

15. Because _____ changes cause a change in the identity of the substances involved, they are hard to reverse.

16. How could some chemical changes be reversed? Give an example.

_____

_____

_____

_____

PHYSICAL VERSUS CHEMICAL CHANGES

_____ **17.** What is the most important question to ask to determine whether a change is physical or chemical?
- **a.** Was there a color change?
- **b.** Did the composition change?
- **c.** Was there a change in size?
- **d.** Did the change involve a change in state?

_____ **18.** The composition of a substance does not change during
- **a.** physical changes.
- **b.** chemical changes.
- **c.** reactivity.
- **d.** reversibility.

_____ **19.** The chemical changes that happen when a firework explodes are
- **a.** physical changes.
- **b.** easily reversed.
- **c.** almost impossible to reverse.
- **d.** changes only in state.

Identify whether the following changes are physical changes or chemical changes. Label each change either *PC* for physical change or *CC* for chemical change.

_____ **20.** effervescent tablets bubbling in water

_____ **21.** grinding baking soda into a powder

_____ **22.** souring milk

_____ **23.** freezing water into ice cubes

_____ **24.** burning a wooden match

_____ **25.** mixing drink mix into water

_____ **26.** bending an iron nail

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Four States of Matter (pp. 110–113)

MATTER: MOVING PARTICLES

1. What is a state of matter?

_____

_____

2. What are the three most familiar states of matter?

_____

_____

_____

3. Matter is made up of particles called _____ and _____.

Match the correct description with the correct state of matter. Write the letter in the space provided.

_____ **4.** Particles do not move fast enough to overcome the strong attraction between them.

_____ **5.** Particles move independently of one another.

_____ **6.** Particles are close together but can slide past one another.

a. solid
b. liquid
c. gas

SOLIDS

_____ **7.** The particles of matter that make up a solid
- **a.** have a weaker attraction than those of a liquid.
- **b.** do not move at all.
- **c.** do not move fast enough to overcome the force of attraction.
- **d.** move from place to place.

8. What is the definition of a solid in terms of shape and volume?

_____

_____

_____

LIQUIDS

9. How do the particles of a liquid make it possible to pour juice into a glass?

10. The juice in a beaker is poured into a graduated cylinder. The volume of juice in either container is 350 mL. What does this show you about the properties of a liquid?

GASES

11. What is the definition of a gas in terms of shape and volume?

12. How is it possible for one small tank of helium to fill hundreds of balloons?

PLASMAS

13. What state of matter makes up more than 99% of the matter in the universe?

14. How do plasmas behave differently than gases?

15. Give one example of a natural plasma and one example of an artificial plasma.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Changes of State (pp. 114–119)

ENERGY AND CHANGES OF STATE

_____ **1.** Which of the following have the most energy?
- **a.** particles in steam
- **b.** particles in liquid water
- **c.** particles in ice
- **d.** particles in freezing water

2. When a substance changes from one physical form to another, we say the substance has undergone a(n) _____.

3. List the five main kinds of changes of state.

_____

_____

_____

_____

_____

MELTING: SOLID TO LIQUID

4. Could you use gallium to make jewelry? Why or why not?

_____

_____

_____

_____

5. The temperature at which a substance changes from solid to liquid is the _____ of the substance.

FREEZING: LIQUID TO SOLID

6. A substance's _____ is the temperature at which it changes from a liquid to a solid.

7. What happens if energy is added to or removed from a glass of ice water?

_____

_____

_____

_____

EVAPORATION: LIQUID TO GAS

Match the correct definition with the correct term. Write the letter in the space provided.

_____ **8.** the change of a substance from a liquid to a gas

_____ **9.** the change of state from a liquid to a gas when the vapor pressure equals the atmospheric pressure

_____ **10.** the temperature at which a liquid boils

a. boiling point

b. evaporation

c. boiling

11. As you go higher above sea level, the _____ decreases and the _____ of a substance gets lower.

CONDENSATION: GAS TO LIQUID

12. The change of state from a gas to a liquid is called _____.

13. At a given pressure, the condensation point for a substance is the same as its _____.

14. For a substance to change from a gas to a liquid, particles must _____.

SUBLIMATION: SOLID TO GAS

15. Why is solid carbon dioxide called "dry ice"?

_____

_____

_____

16. The change of state from a solid directly to a gas is called _____.

TEMPERATURE AND CHANGES OF STATE

17. The speed of the particles in a substance changes when the _____ changes.

18. When a substance is undergoing a change of state, the temperature of the substance does not change until the _____ is complete.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Elements (pp. 134–137)

ELEMENTS, THE SIMPLEST SUBSTANCES

1. A pure substance that cannot be separated into simpler substances by physical or chemical means is called a(n) _____.

2. A substance in which all of the "building-block" particles are identical is called a(n) _____ substance.

3. The building-block particles for elements are called _____.

CLASSIFYING ELEMENTS

4. The amount of an element present does not affect the element's _____.

5. Why does a helium-filled balloon float up when it is released?

_____

_____

Look at each property listed below. If it is a characteristic property of elements, write *CP* in the space provided. If it is not a characteristic property, write *N*.

_____ **6.** size

_____ **7.** melting point

_____ **8.** density

_____ **9.** shape

_____ **10.** mass

_____ **11.** volume

_____ **12.** color

_____ **13.** hardness

_____ **14.** flammability

_____ **15.** weight

_____ **16.** reactivity with acid

GROUPING ELEMENTS

17. What are two common properties that most terriers share?

_____

_____

18. All elements can be classified as metals, metalloids, or

_____.

19. An element that is shiny and that conducts heat and electricity well is called a(n) _____.

20. An element that conducts heat and electricity poorly is called a(n) _____.

21. Elements that have properties of both metals and nonmetals are called _____.

Indicate whether the description applies to a metal, a nonmetal, or a metalloid. Write the correct letter in the space provided. Letters can be used more than once.

a. metalloids
b. nonmetals
c. metals

_____ **22.** are malleable

_____ **23.** are dull or shiny

_____ **24.** are poor conductors

_____ **25.** tend to be brittle and unmalleable as solids

_____ **26.** are almost always shiny

_____ **27.** are also called semimetals

_____ **28.** are almost always dull

_____ **29.** are somewhat ductile

_____ **30.** include boron, silicon, antimony

_____ **31.** include lead, tin, copper

_____ **32.** include sulfur, iodine, neon

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Compounds (pp. 138–141)

1. List three examples of compounds you encounter every day.

_____

_____

_____

COMPOUNDS: MADE OF ELEMENTS

2. When two or more elements are joined by chemical bonds to form a new pure substance, the new substance is called a(n) _____.

3. A compound is different from the _____ that make it up.

4. A(n) _____ is the process by which substances change into new substances.

PROPERTIES OF COMPOUNDS

_____ **5.** Which of the following statements is true about the properties of compounds?
- **a.** A property of all compounds is to react with acid.
- **b.** Each compound has its own physical properties.
- **c.** Compounds cannot be identified by their chemical properties.
- **d.** A compound has the same properties as the elements that form it.

_____ **6.** Which of the following is NOT true about compounds?
- **a.** Compounds are combinations of elements that join in specific ratios according to their masses.
- **b.** The mass ratio of a specific compound is always the same.
- **c.** Compounds are random combinations of elements.
- **d.** Different mass ratios mean different compounds.

7. Sodium and chlorine can be extremely dangerous in their elemental form. How is it possible that we can eat them in a compound?

_____

_____

_____

Match the correct description with the correct term. Write the letter in the space provided.

_____ **8.** a poisonous, greenish yellow gas

_____ **9.** table salt

_____ **10.** a soft, silvery white metal that reacts violently with water

a. sodium chloride
b. chlorine
c. sodium

BREAKING DOWN COMPOUNDS

11. What compound helps give carbonated beverages their "fizz"?

_____

12. Which elements make up the compound that helps give carbonated beverages their "fizz"?

_____

_____

_____

13. The only way to break down a compound is through a(n)

_____ change.

COMPOUNDS IN YOUR WORLD

14. Aluminum is produced by breaking down the compound

_____.

15. Plants use the compound _____ in photosynthesis to make carbohydrates.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Mixtures (pp. 142–147)

PROPERTIES OF MIXTURES

1. A combination of two or more substances that are not chemically combined is called a(n) _____.

2. When two or more materials combine chemically, they form a(n) _____.

3. Each substance in a mixture keeps its _____.

4. How can you tell that a pizza is a mixture?

_____

_____

5. Mixtures can be separated through _____ changes.

Match each substance with the correct method of separation. Write the letter in the space provided. Each method may be used only once.

_____ **6.** a mixture of aluminum and iron

_____ **7.** crude oil

_____ **8.** parts of blood

_____ **9.** sulfur and salt

a. distillation
b. magnet
c. filter
d. centrifuge

10. Granite can be pink, gray, or black, depending on the _____ of feldspar, mica, and quartz.

SOLUTIONS

_____ **11.** Which of the following is NOT true of solutions?

a. They contain a dissolved substance called a solute.
b. They are composed of two or more evenly distributed substances.
c. They contain a substance called a solvent, in which another substance is dissolved.
d. They appear to be more than one substance.

12. The process in which particles of substances separate and spread evenly through a mixture is known as _____.

13. In a solution, the _____ is the substance that is dissolved, and the _____ is the substance in which it is dissolved.

14. Salt is _____ in water because it dissolves in water.

15. When two gases or two liquids form a solution, the substance that is present in the largest amount is the _____.

16. A solid solution of metals or nonmetals dissolved in metals is a(n) _____.

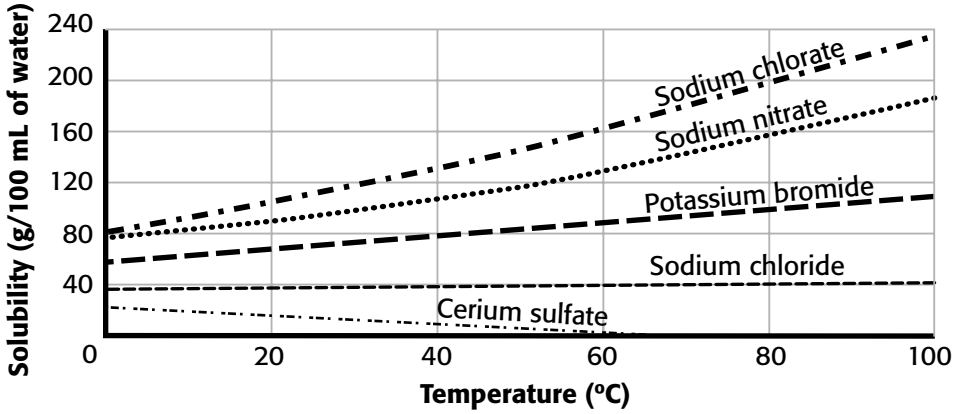
17. What can particles in solution NOT do because they are so small?

_____

_____

CONCENTRATION OF SOLUTIONS

Use the graph below to answer questions 18 and 19. Write the letter of the correct answer in the space provided.



_____ **18.** Look at the graph above. Which solid is less soluble at higher temperatures than at lower temperatures?
- **a.** sodium chloride
- **b.** sodium nitrate
- **c.** potassium bromide
- **d.** cerium sulfate

_____ **19.** Look at the graph above. Which compound's solubility is least affected by temperature changes?
- **a.** sodium chloride
- **b.** sodium nitrate
- **c.** potassium bromide
- **d.** cerium sulfate

Directed Reading B *continued*

20. A measure of the amount of solute dissolved in a given amount of solvent is called _____.

21. What is the difference between a dilute solution and a concentrated solution?

_____

_____

22. The ability of a solute to dissolve in a solvent at a certain temperature and pressure is called _____.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Development of the Atomic Theory (pp. 164–171)

THE BEGINNING OF ATOMIC THEORY

_____ **1.** The word *atom* comes from the Greek word *atomos*, which means
- **a.** "dividable."
- **b.** "invisible."
- **c.** "hard particles."
- **d.** "not able to be divided."

2. The smallest unit of an element that maintains the properties of that element is a(n) _____.

DALTON'S ATOMIC THEORY BASED ON EXPERIMENTS

_____ **3.** Which of the following was NOT part of Dalton's theory?
- **a.** All substances are made of atoms.
- **b.** Atoms of the same element are exactly alike.
- **c.** Atoms of different elements are alike.
- **d.** Atoms join with other atoms to make new substances.

4. Dalton experimented with different substances. What did his results suggest?

_____

_____

_____

THOMSON'S DISCOVERY OF ELECTRONS

5. In Thomson's experiments with a cathode-ray tube, he discovered that a(n) _____ charged plate attracted the beam. He concluded that the beam was made up of particles that have _____ electric charges.

6. The negatively charged subatomic particles that Thomson discovered are now called _____.

7. In Thomson's "plum-pudding" model, electrons are mixed throughout a(n) _____.

RUTHERFORD'S ATOMIC "SHOOTING GALLERY"

_____ **8.** Before his experiment, what did Rutherford expect the particles to do?
- **a.** He expected the particles to pass right through the gold foil.
- **b.** He expected the particles to deflect to the sides of the gold foil.
- **c.** He expected the particles to bounce straight back.
- **d.** He expected the particles to become negatively charged.

9. What were the surprising results of Rutherford's gold-foil experiment?

_____

_____

_____

THE NUCLEUS AND THE ELECTRONS

_____ **10.** In 1911, Rutherford revised the atomic theory. Which of the following is NOT part of that theory?
- **a.** Atoms are mostly empty space.
- **b.** The nucleus is a tiny, dense, positively charged region.
- **c.** Positively charged particles that pass close by the nucleus are pushed away by the positive charges in the nucleus.
- **d.** The nucleus is made up of protons and electrons.

11. How did Rutherford's model describe the atom?

_____

_____

Match the correct description with the correct term. Write the letter in the space provided.

_____ **12.** an atom's central region, made up of protons and neutrons

_____ **13.** region around the nucleus where electrons are likely to be found

_____ **14.** particles that Bohr suggested move around the nucleus in definite paths

- **a.** electrons
- **b.** electron cloud
- **c.** nucleus

15. Each electron's definite energy is based on its _____.

THE SIZE OF AN ATOM

_____ **16.** Which of the following statements is true?

a. A penny has about 20,000 atoms.
b. A penny has more atoms than Earth has people.
c. Aluminum is made up of large-sized atoms.
d. Aluminum atoms have a diameter of about 3 cm.

17. One of the tools that scientists now use to observe atoms is the _____.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: The Atom (pp. 172–179)

THE PARTS OF AN ATOM

Match the correct description with the correct term. Write the letter in the space provided.

_____ **1.** particle found in the nucleus that has no electrical charge

_____ **2.** particle found in the nucleus that is positively charged

_____ **3.** particle with an unequal number of protons and electrons

_____ **4.** negatively charged particle found outside the nucleus

_____ **5.** contains most of the mass of an atom

_____ **6.** SI unit that describes the mass of an atom or molecule

a. electron
b. atomic mass unit (amu)
c. nucleus
d. proton
e. ion
f. neutron

ATOMS AND ELEMENTS

7. The simplest atom is the _____ atom. It has one _____ and one _____.

8. Neutrons in the atom's _____ keep two or more protons from moving apart.

9. If you build an atom using two protons, two neutrons, and two electrons, you have built an atom of _____.

10. An atom does not have to have equal numbers of _____ and _____.

11. The number of protons in the nucleus of an atom is the _____ of that atom.

ISOTOPES

_____ **12.** Two different isotopes of the same atom have
- **a.** the same number of protons.
- **b.** the same number of neutrons.
- **c.** a different atomic number.
- **d.** the same mass.

_____ **13.** Which of the following is NOT true about unstable atoms?
- **a.** They are radioactive.
- **b.** They have a nucleus that always remains the same.
- **c.** They give off energy as they fall apart.
- **d.** They give off smaller particles as they fall apart.

_____ **14.** What is the mass number of an isotope that has 5 protons, 6 neutrons, and 5 electrons?
- **a.** 1
- **b.** 11
- **c.** 10
- **d.** 16

_____ **15.** If carbon has an atomic number of 6, how many neutrons does carbon-12 have?
- **a.** 12
- **b.** 8
- **c.** 6
- **d.** 18

16. Most elements contain a mixture of two or more _____.

17. The weighted average of the masses of all the naturally occurring isotopes of an element is the _____.

FORCES IN ATOMS

Match the correct definition with the correct term. Write the letter in the space provided.

_____ **18.** helps protons stay together in the nucleus

_____ **19.** pulls objects toward one another

_____ **20.** an important force in radioactive atoms

_____ **21.** holds the electrons around the nucleus

- **a.** gravitational force
- **b.** electromagnetic force
- **c.** strong force
- **d.** weak force

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Arranging the Elements (pp. 194–201)

1. Why do you think scientists might have been frustrated by the organization of the elements in the early 1860s?

_____

_____

_____

_____

_____

_____

DISCOVERING A PATTERN

_____ **2.** Which arrangement of elements did Mendeleev find produced a repeating pattern of properties?

- **a.** elements in order of increasing density
- **b.** elements in order of increasing melting point
- **c.** elements in order of increasing shine
- **d.** elements in order of increasing atomic mass

3. A word describing something that occurs or repeats at regular intervals is _____.

4. Mendeleev's table, which shows elements' properties following a pattern that repeats every seven elements, is called the _____ table of the elements.

5. How was it possible that Mendeleev was able to predict the properties of elements that no one knew about?

_____

_____

_____

_____

_____

_____

CHANGING THE ARRANGEMENT

_____ **6.** How did Moseley solve the problem of the elements that did not fit the pattern according to their properties?
- **a.** He rearranged the elements by atomic mass.
- **b.** He discovered protons, neutrons, and electrons.
- **c.** He discovered the periodic table of elements.
- **d.** He determined the elements' atomic numbers and then arranged them by atomic number.

_____ **7.** In what order are elements arranged horizontally on the periodic table?
- **a.** in order of increasing atomic number
- **b.** in order of decreasing atomic number
- **c.** in order of increasing density
- **d.** in order of decreasing density

PERIODIC TABLE OF THE ELEMENTS

_____ **8.** Which information is NOT included in each square of the periodic table in your text?
- **a.** atomic number
- **b.** chemical symbol
- **c.** melting point
- **d.** atomic mass

9. How can you tell on the periodic table that carbon is a solid at room temperature?

_____

_____

_____

THE PERIODIC TABLE AND CLASSES OF ELEMENTS

10. Elements are classified as metals, nonmetals, or metalloids, according to their _____.

11. The number of _____ in the outer energy level of an atom helps determine which category an element belongs in.

12. How can the zigzag line on the periodic table help you recognize the elements?

_____

_____

_____

13. Most elements are _____, which can be found to the left of the zigzag line on the periodic table.

14. Most metals are _____ at room temperature.

15. What metal is a liquid at room temperature?

_____

16. What elements are found to the right of the zigzag line on the periodic table?

_____

17. Semimetals, also called _____, are the elements that border the zigzag line on the periodic table.

DECODING THE PERIODIC TABLE

18. Some elements, such as _____, are named after scientists. Others, such as _____, are named after places.

19. For most elements, the _____ has one or two letters, with the first letter always capitalized.

20. Each horizontal row of elements on the periodic table is called a(n) _____.

21. Each vertical column of elements on the periodic table is called a(n) _____, or a(n) _____.

_____ **22.** Which elements often have similar properties?
- **a.** elements in a period
- **b.** elements in a group
- **c.** elements named after places
- **d.** elements in a horizontal row

_____ **23.** The physical and chemical properties of the elements change
- **a.** within a group.
- **b.** within a family.
- **c.** across each period.
- **d.** across each group.

24. The periodic _____ states that the repeating chemical and physical properties of elements change periodically with the atomic numbers of the elements.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Grouping the Elements (pp. 202–209)

_____ **1.** What gives elements in a family or group similar properties?
- **a.** the same atomic mass
- **b.** the same number of protons in their nuclei
- **c.** the same number of electrons in their outer energy level
- **d.** the same number of neutrons

_____ **2.** What makes elements reactive at the atomic level?
- **a.** Their atoms have the same number of neutrons.
- **b.** Their atoms have the same number of protons.
- **c.** Their atoms have the same number of electrons.
- **d.** Their atoms take, give, or share electrons with other atoms.

GROUP 1: ALKALI METALS

_____ **3.** Which of the following is NOT true of alkali metals?
- **a.** They can be cut with a knife.
- **b.** They are usually stored in water.
- **c.** They are the most reactive of all the metals.
- **d.** They can easily give away their outer-level electron.

4. Elements in Group 1 of the periodic table are called _____ metals.

GROUP 2: ALKALINE-EARTH METALS

5. Atoms of _____ metals have two outer-level electrons.

6. What are two products made from calcium compounds?

_____

_____

7. In what way does calcium help you?

_____

_____

8. Name three alkaline-earth metals besides calcium.

_____

_____

_____

GROUPS 3–12: TRANSITION METALS

_____ **9.** Which of the following characteristics does NOT describe transition metals?

a. They are good conductors of thermal energy.
b. They are more reactive than alkali and alkaline-earth metals.
c. They have one or two electrons in the outer energy level.
d. They are denser than elements in Groups 1 and 2.

10. Metals that are less reactive than alkali metals and alkaline-earth metals are called _____ metals.

11. The two rows of transition metals that are placed at the bottom of the periodic table to save space are called the _____ and the _____.

12. How is mercury different from other transition metals?

_____

_____

GROUP 13: BORON GROUP

13. The most common element from Group 13 and the most abundant metal in Earth's crust is _____.

14. What are some of the uses of aluminum?

_____

_____

_____

GROUP 14: CARBON GROUP

15. What are three compounds of carbon that are necessary for living things on Earth?

_____

_____

_____

16. The metalloids _____ and _____, both in Group 14, are used to make computer chips.

17. The hardest material known is _____.

18. What are some of the uses of diamond?

_____

_____

19. What form of carbon is used as a pigment in paints and crayons?

_____

GROUP 15: NITROGEN GROUP

20. Nitrogen is a(n) _____ at room temperature.

21. Each element in the nitrogen group has _____ electrons in the outer level.

22. Nitrogen from the air can react with what element to make ammonia for fertilizer?

_____

GROUP 16: OXYGEN GROUP

23. How is oxygen different from the other four elements in Group 16?

_____

_____

24. The element _____ can be found as a yellow solid in nature and is used to make sulfuric acid.

25. Why is oxygen important?

_____

_____

_____

GROUP 17: HALOGENS

26. The atoms of _____ need to gain only one electron to have a complete outer level.

27. What important use do the halogens iodine and chlorine have in common?

_____

_____

28. Halogens combine with most metals to form _____,

such as _____ chloride.

GROUP 18: NOBLE GASES

_____ **29.** Which of the following statements about noble gases is NOT true?

- **a.** They are colorless and odorless at room temperature.
- **b.** They have a complete set of electrons in their outer energy level.
- **c.** They normally react with other elements.
- **d.** All of them are found in Earth's atmosphere in small amounts.

30. Noble gases were first called _____ gases because scientists thought they would not react at all.

31. The atoms of _____ gases have a full set of electrons in their outer level.

32. The low _____ of helium makes blimps and weather balloons float.

HYDROGEN

_____ **33.** Which of the following statements about hydrogen is NOT true?

- **a.** It is useful as rocket fuel.
- **b.** It is the most abundant element in the universe.
- **c.** Its physical properties are closer to those of nonmetals than to those of metals.
- **d.** It has two electrons in its outer energy level.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Electrons and Chemical Bonding (pp. 226–229)

COMBINING ATOMS THROUGH CHEMICAL BONDING

_____ **1.** Which of the following substances results from combining atoms of carbon, hydrogen, and oxygen?
- **a.** sugar
- **b.** salt
- **c.** water
- **d.** sulfuric acid

_____ **2.** Which of the following is NEVER true about electrons when chemical bonds form?
- **a.** Electrons are shared.
- **b.** Electrons are lost.
- **c.** Electrons are destroyed.
- **d.** Electrons are gained.

_____ **3.** Which of the following is an interaction that holds two atoms together?
- **a.** a chemical hold
- **b.** a chemical bond
- **c.** a chemical interaction
- **d.** a bond of chemicals

4. The joining of atoms to form new substances is called _____.

5. People can use _____ to discuss how and why atoms form bonds.

ELECTRON NUMBER AND ORGANIZATION

_____ **6.** Which of the following is the same as the number of protons in an atom?
- **a.** valence number
- **b.** atomic number
- **c.** chemical number
- **d.** ionic number

_____ **7.** How many valence electrons are in an oxygen atom?
- **a.** 2
- **b.** 4
- **c.** 6
- **d.** 8

_____ **8.** What do elements within the same group have the same number of?
- **a.** valence electrons
- **b.** protons
- **c.** neutrons
- **d.** atoms

Match the correct description with the correct term. Write the letter in the space provided.

_____ **9.** an electron in the outermost energy level

_____ **10.** number of protons in an atom

_____ **11.** family on the periodic table to which an element belongs

- **a.** group
- **b.** valence electron
- **c.** atomic number

12. Which electrons in an atom make chemical bonds?

_____

_____

13. How can the periodic table help you determine the number of valence electrons?

_____

_____

TO BOND OR NOT TO BOND

_____ **14.** What determines whether an atom will form bonds?
- **a.** the number of electrons
- **b.** the number of valence electrons
- **c.** the number of protons
- **d.** the number of neutrons

_____ **15.** Which group on the periodic table contains elements that do not normally form chemical bonds?
- **a.** Group 2
- **b.** Group 6
- **c.** Group 10
- **d.** Group 18

16. The outermost energy level of most atoms is considered full if the level contains _____ electrons.

17. Helium atoms need only _____ valence electrons to have a filled outermost energy level.

Directed Reading B *continued*

18. The first energy level of any atom can hold only _____ electrons.

19. Why is it uncommon for noble gases to form chemical bonds?

20. Which is more likely to form bonds, an atom with 8 valence electrons or an atom with fewer than 8 valence electrons?

21. How can atoms with fewer than 8 valence electrons fill their outermost energy level? Use either sulfur or magnesium to explain the process.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Ionic Bonds (pp. 230–235)

FORMING IONIC BONDS

1. A chemical bond that forms when electrons are transferred from one atom to another is a(n) _____.

2. Charged particles that form when atoms gain or lose electrons are called _____.

3. A transfer of electrons between atoms changes the number of electrons in an atom, but the number of _____ stays the same.

4. Why is an atom neutral?

_____

_____

_____

5. Why are ions charged particles and thus no longer neutral?

_____

_____

_____

_____

FORMING POSITIVE IONS

_____ **6.** When an atom loses electrons through an ionic bond, it becomes
- **a.** positively charged.
- **b.** neutral.
- **c.** negatively charged.
- **d.** uncharged.

7. Most metals have few _____ and form positive ions.

8. If an aluminum atom loses its three valence electrons to another atom, the aluminum atom becomes an aluminum _____.

9. An aluminum ion has a charge of _____.

10. The chemical symbol for an aluminum ion is _____.

11. Pulling electrons away from atoms requires _____.

12. Where does the energy needed to take electrons from metal atoms come from?

_____

FORMING NEGATIVE IONS

_____ **13.** Some atoms gain electrons during chemical changes and acquire a(n)
- **a.** positive charge.
- **b.** negative charge.
- **c.** neutral charge.
- **d.** chemical charge.

_____ **14.** The symbol for the oxide ion is O^{2-}. How many electrons must an oxygen atom gain to become an oxide ion?
- **a.** 0
- **b.** 1
- **c.** 2
- **d.** 3

_____ **15.** What ending is used for the names of negative ions?
- **a.** *-ion*
- **b.** *-ade*
- **c.** *-ide*
- **d.** *-ite*

16. Atoms of Group _____ elements give off the most energy when they gain an electron.

17. When is energy given off by most nonmetals?

_____

_____

18. What conditions are required for an ionic bond to form between a metal and a nonmetal?

_____

_____

_____

FORMING IONIC COMPOUNDS

19. Why does the compound formed by an ionic bond have a neutral charge even though the ions that bond are charged?

IONIC COMPOUNDS

20. When ions bond, they form a repeating three-dimensional pattern called a(n) _____.

21. List three properties of ionic compounds.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Covalent and Metallic Bonds (pp. 236–241)

COVALENT BONDS

_____ **1.** What is formed when atoms share one or more pairs of electrons?
- **a.** a covalent bond
- **b.** a covalent compound
- **c.** an ionic bond
- **d.** an electric bond

_____ **2.** What usually consists of two or more atoms joined in a definite ratio?
- **a.** a bond
- **b.** a valence electron
- **c.** an atom
- **d.** a molecule

3. A model that shows only the valence electrons in an atom is a(n) _____.

COVALENT COMPOUNDS AND MOLECULES

4. What is the smallest particle into which a covalently bonded compound can be divided?

_____

5. What is the relationship between diatomic molecules and diatomic elements? Name one example of a diatomic element.

_____

_____

_____

_____

6. Name two examples of substances that contain complex molecules.

_____

_____

METALLIC BONDS

7. A bond formed by the attraction between positively charged metal ions and the electrons in the metal is a(n) _____.

8. What allows valence electrons in metals to move throughout the metal?

PROPERTIES OF METALS

9. Give an example of how metallic bonding allows metals to conduct electric current.

10. The property of _____ means that a metal can be drawn into wires.

11. The property of _____ means that a metal can be hammered into sheets.

12. Why doesn't a piece of metal break when it is bent?

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Forming New Substances (pp. 256–261)

1. The pigment that makes leaves green is called _____.

2. Why are leaves orange and yellow in the fall?

_____

_____

_____

CHEMICAL REACTIONS

3. A process in which one or more substances change to form new substances is called a(n) _____.

4. How do the properties of the new substances compare with the properties of the original substances after a chemical change takes place?

_____

_____

_____

5. A solid substance that is formed in a solution is called a(n) _____.

Match the correct example of a chemical reaction with the correct clue. Write the letter in the space provided.

_____ **6.** Thermal energy is given off.

_____ **7.** Precipitate forms.

_____ **8.** Nitrogen dioxide forms.

_____ **9.** Bleach spots form.

a. color change
b. energy change
c. solid formation
d. gas formation

10. When a gas is given off as a liquid boils, it is an example of a(n) _____ change, not a(n) _____ reaction.

11. What is the most important sign that a chemical reaction is occurring?

BONDS: HOLDING MOLECULES TOGETHER

12. What is a chemical bond?

13. How do new substances form during a chemical reaction?

14. What causes chemical bonds to break?

15. How many atoms make up a diatomic molecule?

16. What substance forms from the reaction of hydrogen and chlorine gas?

REACTIONS AND ENERGY

17. In an exothermic reaction, heat is _____. In an endothermic reaction, heat is _____.

18. What types of energy are released in exothermic reactions?

_____

19. What does the law of conservation of energy state?

_____

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Chemical Formulas and Equations (pp. 262–267)

CHEMICAL FORMULAS

1. All known substances are formed from about _____ elements.

2. A combination of chemical symbols and numbers that represents a substance is called a(n) _____.

3. What does a chemical formula show?

_____

_____

_____

_____ **4.** The subscript in the chemical formula H_2O tells you there are two
- **a.** atoms of hydrogen in the molecule.
- **b.** electrons on the hydrogen atom in the molecule.
- **c.** elements in the molecule.
- **d.** atoms of oxygen in the molecule.

_____ **5.** What is the chemical formula for oxygen?
- **a.** O_2
- **b.** $C_6H_{12}O_6$
- **c.** H_2O
- **d.** $Ca(NO_3)_2$

_____ **6.** What is the chemical formula for water?
- **a.** O_2
- **b.** $C_6H_{12}O_6$
- **c.** H_2O
- **d.** $Ca(NO_3)_2$

_____ **7.** What is the chemical formula for glucose?
- **a.** O_2
- **b.** $C_6H_{12}O_6$
- **c.** H_2O
- **d.** $Ca(NO_3)_2$

8. Simple covalent compounds are usually composed of two _____.

9. The formula for dinitrogen monoxide is _____.

10. The formula for carbon dioxide is _____.

11. Ionic compounds are composed of a(n) _____ and a(n) _____.

12. The overall charge of an ionic compound is _____.

Write the formula for each of the following ionic compounds.

13. sodium chloride _____

14. magnesium chloride _____

CHEMICAL EQUATIONS

15. What do musical notations and chemical equations have in common?

_____

_____

_____

_____

16. When chemical symbols and formulas are used to describe a chemical reaction, it is called a(n) _____.

17. A substance that forms in a chemical reaction is called a(n) _____.

18. A substance or molecule that participates in a chemical reaction is called a(n) _____.

19. When carbon reacts with oxygen to form carbon dioxide, carbon dioxide is the _____.

20. What will happen if the wrong chemical symbol or formula is used in a chemical equation?

_____

_____

_____

_____

21. In a chemical reaction, _____ are never gained or lost.

22. Antoine Lavoisier's work led to the _____.

23. What does the law of conservation of mass state?

_____

_____

_____

Directed Reading B *continued*

24. A chemical equation must show the same numbers and kinds of _____ on both sides of the arrow.

25. The number placed in front of a chemical symbol or formula is called a(n) _____.

26. How many oxygen atoms are contained in the formula $2H_2O$?

_____

27. When you balance an equation, only _____ are changed, not _____.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Ionic and Covalent Compounds (pp. 282–285)

_____ **1.** What is a chemical bond?
- **a.** the outermost energy level of an atom
- **b.** the interaction that holds atoms and ions together
- **c.** a repeating three-dimensional pattern
- **d.** a positively charged ion

_____ **2.** What are the electrons found in the outermost energy levels of an atom called?
- **a.** valence electrons
- **b.** ionic electrons
- **c.** covalent electrons
- **d.** compound electrons

IONIC COMPOUNDS AND THEIR PROPERTIES

_____ **3.** An ionic bond is an attraction between
- **a.** positively charged ions.
- **b.** oppositely charged ions.
- **c.** negatively charged ions.
- **d.** metallic ions.

_____ **4.** When a metal meets a nonmetal, the metal atoms become
- **a.** positively charged.
- **b.** neutral.
- **c.** negatively charged.
- **d.** chemically charged.

_____ **5.** When a metal meets a nonmetal, the nonmetal atom becomes
- **a.** positively charged.
- **b.** neutral.
- **c.** negatively charged.
- **d.** chemically charged.

_____ **6.** Table salt is formed when an electron is transferred from a sodium atom to a
- **a.** metal atom.
- **b.** chlorine atom.
- **c.** nonmetal atom.
- **d.** positively charged atom.

_____ **7.** Ionic compounds tend to be brittle solids
- **a.** at room temperature.
- **b.** at high temperatures.
- **c.** at any temperature.
- **d.** when wet.

_____ **8.** In a crystal lattice, each ion is bonded to the
- **a.** pattern it is made with.
- **b.** surrounding ions of the opposite charge.
- **c.** surrounding ions of the same charge.
- **d.** crystal's edge.

_____ **9.** When an ionic compound is hit, the pattern shifts, ions repel each other, and the crystal
- **a.** becomes more solid.
- **b.** forms a new lattice.
- **c.** breaks apart.
- **d.** becomes bonded.

_____ **10.** Because strong ionic bonds hold ions together, ionic compounds have
- **a.** a low melting point.
- **b.** a lukewarm melting point.
- **c.** a high melting point.
- **d.** a variable melting point.

_____ **11.** Many ionic compounds dissolve easily
- **a.** in air.
- **b.** at high temperatures.
- **c.** in water.
- **d.** in electric current.

12. When an ionic compound dissolves in water, why can it conduct electric current?

_____

_____

COVALENT COMPOUNDS AND THEIR PROPERTIES

_____ **13.** Covalent compounds are formed when atoms share
- **a.** uncharged particles.
- **b.** neutrons.
- **c.** protons.
- **d.** electrons.

_____ **14.** The group of atoms that make up a single unit of a covalent compound is called a(n)

a. bond.
b. electron.
c. molecule.
d. atom.

15. What does it mean if a substance is not soluble in water?

16. Why are some covalent compounds not soluble in water?

17. Why do covalent compounds tend to have lower melting points than ionic compounds?

18. Why doesn't sugar dissolved in water conduct electric current?

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Acids and Bases (pp. 286–291)

ACIDS AND THEIR PROPERTIES

_____ **1.** Any compound that increases the number of hydronium (H_3O^+) ions dissolved in water is called a(n)
- **a.** base.
- **b.** acid.
- **c.** indicator.
- **d.** neutral.

_____ **2.** To form hydronium ions, each hydrogen ion bonds with
- **a.** an oxygen atom.
- **b.** a water molecule.
- **c.** an acid.
- **d.** a base.

_____ **3.** When hydrogen ions (H^+) bond to water molecules (H_2O) they form
- **a.** hydrogen ions (H^+).
- **b.** hydronium ions (H_3O^+).
- **c.** water molecules (H_2O).
- **d.** bases.

_____ **4.** What flavor do acids have?
- **a.** sweet
- **b.** salty
- **c.** sour
- **d.** none

_____ **5.** Why should a person NEVER taste or touch an unknown chemical?
- **a.** Many are flavorless.
- **b.** Many are too sweet.
- **c.** Many are corrosive.
- **d.** Many are too salty.

_____ **6.** A compound that can reversibly change color depending on conditions such as pH is called a(n)
- **a.** indicator.
- **b.** color meter.
- **c.** color changer.
- **d.** water molecule.

_____ **7.** Two commonly used indicators are bromthymol blue and
- **a.** hydrochloric acid.
- **b.** silver nitrate.
- **c.** litmus paper.
- **d.** color changer.

_____ **8.** What color does blue litmus paper turn when acid is added to it?
- **a.** green
- **b.** red
- **c.** blue
- **d.** orange

_____ **9.** What is produced when acids react with some metals?
- **a.** oxygen gas
- **b.** other metals
- **c.** silver crystals
- **d.** hydrogen gas

_____ **10.** Since acids form hydronium ions in water, solutions of acids can
- **a.** make oxygen.
- **b.** break apart water molecules.
- **c.** conduct electric current.
- **d.** straighten hair.

Match each product with the correct acid. Write the letter in the space provided.

_____ **11.** rubber

_____ **12.** car batteries

_____ **13.** orange juice

_____ **14.** swimming pools

_____ **15.** soft drinks

- **a.** sulfuric acid
- **b.** nitric acid
- **c.** hydrochloric acid
- **d.** citric acid
- **e.** carbonic acid

BASES AND THEIR PROPERTIES

_____ **16.** Any compound that increases the number of hydroxide ions when dissolved in water is a(n)
- **a.** gas.
- **b.** sodium.
- **c.** acid.
- **d.** base.

_____ **17.** Bases get their properties from
- **a.** soaps.
- **b.** baking soda.
- **c.** hydroxide ions.
- **d.** chloride ions.

_____ **18.** The properties of bases include a bitter taste and a(n)
- **a.** strong bond.
- **b.** slippery feel.
- **c.** hydroxide lattice.
- **d.** unpleasant odor.

_____ **19.** What should you NEVER do to identify a chemical?
- **a.** add salt to it
- **b.** use an indicator
- **c.** taste or touch it
- **d.** look in a book

_____ **20.** What color does a base change red litmus paper to?
- **a.** blue
- **b.** purple
- **c.** green
- **d.** orange

_____ **21.** Because bases increase the number of hydroxide ions, OH^-, solutions of bases can
- **a.** indicate temperature.
- **b.** split atoms.
- **c.** conduct electric current.
- **d.** stop electric current.

Match each product with the correct base. Write the letter in the space provided.

_____ **22.** soap

_____ **23.** antacids

_____ **24.** cement

- **a.** magnesium hydroxide
- **b.** sodium hydroxide
- **c.** calcium hydroxide

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Solutions of Acids and Bases (pp. 292–295)

STRENGTHS OF ACIDS AND BASES

_____ **1.** What is the amount of acid or base dissolved in water called?
- **a.** concentration
- **b.** strength
- **c.** pH
- **d.** neutralization

_____ **2.** When an acid dissolves in water, which of the following is dependent on the number of molecules that break apart?
- **a.** the acid's concentration
- **b.** the acid's color
- **c.** the acid's durability
- **d.** the acid's strength

_____ **3.** In which of the following do all the molecules of an acid break apart in water?
- **a.** a strong acid
- **b.** a strong base
- **c.** a weak acid
- **d.** a weak base

_____ **4.** In which of the following do only a few of the molecules of an acid break apart in water?
- **a.** a strong acid
- **b.** a strong base
- **c.** a weak acid
- **d.** a weak base

_____ **5.** In which of the following do all the molecules of a base break apart?
- **a.** a strong acid
- **b.** a strong base
- **c.** a weak acid
- **d.** a weak base

_____ **6.** In which of the following do only a few molecules of a base break apart?
- **a.** a strong acid
- **b.** a strong base
- **c.** a weak acid
- **d.** a weak base

ACIDS, BASES, AND NEUTRALIZATION

_____ **7.** What is the reaction between acids and bases called?
- **a.** a neutralization reaction
- **b.** an explosion
- **c.** a strength reaction
- **d.** evaporation

_____ **8.** What do the H^+ ions of an acid and the OH^- ions of a base form when they react?
- **a.** oxygen
- **b.** water
- **c.** sugar
- **d.** hydrogen gas

_____ **9.** What can show whether a solution contains an acid or a base?
- **a.** an indicator
- **b.** pure water
- **c.** antacids
- **d.** salt

10. The _____ scale is used to express the acidity or basicity (alkalinity) of a system.

11. The pH of a solution shows the concentration of what type of ion?

_____

_____

Match the correct description with the correct term. Write the letter in the space provided.

_____ **12.** pH of a neutral solution

_____ **13.** pH of a basic solution

_____ **14.** pH of an acidic solution

- **a.** greater than 7
- **b.** less than 7
- **c.** 7

15. What are three examples of common materials with a pH of less than 7?

_____

_____

_____

_____

16. What are three examples of common materials with a pH of more than 7?

17. Name two types of pH indicators.

For each organism listed, write the preferred pH or pH range.

_____ **18.** pine trees

_____ **19.** lettuce

_____ **20.** fish

21. How does acid rain form, and what is its effect on nature?

SALTS

22. What two substances are produced when an acid neutralizes a base?

23. What is a salt, and how does it form?

24. Name three salts, and tell what they are used for.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Elements in Living Things (pp. 310–313)

THE BONDING OF CARBON ATOMS

1. Name two reasons why carbon has a central role in the chemistry of living organisms.

_____

_____

2. Each carbon atom has _____ valence electrons.

3. Each carbon atom can make a total of _____ bonds.

4. Models of carbon backbones show how _____.

5. A covalently bonded compound that contains carbon is called a(n) _____.

Match the correct description with the correct term. Write the letter in the space provided.

_____ **6.** type of bond carbon atoms most often form

_____ **7.** simplest example of an organic compound with a double bond

_____ **8.** compound whose carbon atoms have only single bonds

_____ **9.** organic compound that has triple bonds between carbon atoms

a. propane
b. ethyne
c. single bond
d. ethene

OTHER ELEMENTS IN LIVING ORGANISMS

10. What type of compounds do all living things depend on?

_____

_____

_____

Directed Reading B *continued*

11. Name the six elements that make up most of the human body.

12. What do carbon's special bonding abilities allow carbon to do?

13. Name two types of organic compounds that can be manufactured.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Compounds of Living Things (pp. 314–319)

Write the letter of the correct answer in the space provided.

_____ **1.** Carbohydrates, lipids, proteins, and nucleic acids are the four categories of
- **a.** living things.
- **b.** carbons.
- **c.** organic compounds.
- **d.** biochemicals.

CARBOHYDRATES

_____ **2.** Carbohydrates are biochemicals that are composed of one or more
- **a.** lipids.
- **b.** sugar molecules.
- **c.** organic compounds.
- **d.** starch molecules.

_____ **3.** Simple carbohydrates are made up of
- **a.** simple sugars.
- **b.** cellulose.
- **c.** proteins.
- **d.** lipids.

_____ **4.** Complex carbohydrates may be made of thousands of
- **a.** lipids.
- **b.** simple sugars.
- **c.** proteins.
- **d.** nucleic acids.

_____ **5.** Living things commonly use carbohydrates as a source of
- **a.** fat.
- **b.** genetic material.
- **c.** energy.
- **d.** protein.

LIPIDS

_____ **6.** Lipids are biochemicals that do not
- **a.** store excess energy.
- **b.** make up cell membranes.
- **c.** dissolve in water.
- **d.** store vitamins.

_____ **7.** Fats, oils, and waxes are
- **a.** lipids.
- **b.** carbohydrates.
- **c.** proteins.
- **d.** sugars.

PROTEINS

_____ **8.** Proteins are biochemicals made up of "building blocks" called
- **a.** sugars.
- **b.** amino acids.
- **c.** nucleic acids.
- **d.** lipids.

_____ **9.** An example of a protein is
- **a.** olive oil.
- **b.** sugar.
- **c.** hemoglobin.
- **d.** fiber.

10. List three roles that proteins have in the human body.

_____

_____

_____

11. What are the largest molecules made by living organisms called?

_____

12. What are nucleic acids made up of?

_____

13. How do nucleotides cause living things to differ from one another?

_____

_____

14. What are nucleic acids sometimes called because they contain all the information needed for a cell to make its proteins?

_____

15. What are the two main kinds of nucleic acids, and what are their functions?

_____

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Measuring Motion (pp. 336–343)

1. Name something in motion that you cannot see moving.

_____

MOTION AND REFERENCE POINTS

_____ **2.** An object in motion is usually seen moving in relation to an object that appears to
- **a.** stay in place.
- **b.** keep moving.
- **c.** maintain constant velocity.
- **d.** maintain constant acceleration.

_____ **3.** When an object changes position over time relative to a reference point, the object is
- **a.** at rest.
- **b.** a feature on Earth's surface.
- **c.** not moving.
- **d.** in motion.

4. For seeing motion, features on Earth's surface are often used as standard

_____.

5. Name two nonmoving objects that are useful reference points.

_____

_____

6. What type of object other than nonmoving objects can be used as reference points?

_____

7. The motion of an object moving to the right can be described in reference to a two-dimensional grid as a movement in the positive direction on the

_____-axis.

AVERAGE SPEED

8. The average speed of an object is the total _____ traveled divided by the total time taken to travel that distance.

9. One of the ways to express speed is by using the SI unit of _____.

10. Name two other units often used for expressing speed.

_____

_____

11. What is the equation for average speed?

_____

12. Speed can be represented on a graph where _____ is plotted on the x-axis and position of the object is plotted on the y-axis.

13. In the graph in your book illustrating the speed of a dog walking beside a fence, why does the distance traveled in a given second vary?

_____

_____

VELOCITY: DIRECTION MATTERS

14. How could two birds flying at the same speed from the same starting point end up at different destinations?

_____

_____

15. What is the difference between velocity and speed?

_____

_____

16. What can change when an object's velocity changes?

_____

_____

ACCELERATION

17. Acceleration is the rate at which _____ changes over time.

18. The units of _____ are the units of velocity divided by a unit of time.

Directed Reading B *continued*

19. A common unit for acceleration is meters per second per

_____.

20. An increase in speed is sometimes called _____ acceleration.

21. What are the two terms sometimes used to describe a decrease in speed?

_____

_____

22. Why is an object traveling in a circle considered to be accelerating?

_____

_____

_____

23. The type of acceleration that occurs when an object travels at a constant speed in circular motion is called _____ acceleration.

24. Acceleration can be shown on a graph of speed versus

_____.

25. In the graph in your book showing the acceleration of a radio-controlled toy car over 10 s, how can you tell acceleration is positive from 0 s to 5 s?

_____

_____

26. In the same figure, how can you tell that the speed of the radio-controlled car is constant between 5 s and 7 s?

_____

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: What Is a Force? (pp. 344–349)

1. In science, a push or a pull exerted on an object is known as a(n) _____.

2. All forces have two properties: _____ and _____.

3. The SI unit used to express force is called a(n) _____.

FORCES ACTING ON OBJECTS

4. Forces always act on _____.

5. Give two examples of objects on which you exert forces when you are doing your schoolwork.

_____

_____

6. Give one example of a force that does not cause an object to move.

_____

COMBINED EFFECT OF FORCES

7. The combination of all forces acting on an object is called _____.

8. How do you calculate the net force if two or more forces act in the same direction?

_____

_____

9. How do you find the net force when two forces act in opposite directions?

_____

_____

_____

BALANCED FORCES: NO CHANGE IN MOTION

10. What must the net force be equal to in order for the forces on an object to be balanced?

_____

11. A hanging light does not move because the force of gravity pulling down is balanced by the force of _____ in the cord pulling up.

UNBALANCED FORCES: VELOCITY CHANGES

12. Forces are unbalanced when the net force on an object is NOT equal to _____ newtons.

13. What type of force is needed to cause a static object to start moving?

_____

14. Give an example of an object that continues to move when an unbalanced force is removed.

_____

15. Give an example of an object that moves in a direction different from the direction of an unbalanced force acting on it.

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Friction: A Force That Opposes Motion (pp. 350–355)

1. What type of force is needed to change the velocity of objects?

_____

2. The force that opposes motion between two surfaces that are in contact is called _____.

THE SOURCE OF FRICTION

3. What are two factors that affect the magnitude of friction between two surfaces?

_____

_____

4. What happens to friction if the force pushing surfaces together increases?

_____

_____

5. Objects that weigh less exert _____ downward force than objects that weigh more.

6. Friction is usually _____ between materials that have rough surfaces compared to the amount of friction between smooth surfaces.

TYPES OF FRICTION

_____ **7.** What are the two main types of friction?
- **a.** smooth and rough
- **b.** kinetic and static
- **c.** light and heavy
- **d.** moving and nonmoving

_____ **8.** What is kinetic friction?
- **a.** friction between two heavy objects
- **b.** friction between two rough surfaces
- **c.** friction between two moving surfaces
- **d.** friction between two smooth surfaces

9. Two types of kinetic friction are _____ and _____.

10. Which type of kinetic friction is usually greater?

_____

11. What is one example of the use of sliding kinetic friction?

_____

12. What is one example of the use of rolling kinetic friction?

_____

13. When force applied to an object does not cause the object to move,

_____ friction occurs.

14. As soon as an object starts moving, what replaces static friction?

_____

FRICTION: HARMFUL AND HELPFUL

15. Friction by wind and water can cause _____.

16. What is a substance put on surfaces to reduce the friction between the surfaces called?

_____

17. Name three ways friction can be reduced.

_____

_____

_____

18. What are two ways friction can be increased?

_____

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Gravity: A Force of Attraction (pp. 370–375)

1. Why do astronauts on the moon bounce when they walk?

_____

_____

2. The force of attraction between two objects that is due to their masses is called _____.

THE EFFECTS OF GRAVITY ON MATTER

3. How can the force of gravity change the motion of an object?

_____

_____

_____

4. Why is all matter affected by gravity?

_____

_____

_____

5. The force that pulls you toward your pencil is the force of _____.

6. If all objects are attracted toward each other because of gravity, why don't you see the objects moving toward each other?

_____

_____

_____

_____

7. How are objects around you affected by the mass of Earth?

_____

_____

_____

NEWTON AND THE STUDY OF GRAVITY

8. What were the two questions that Sir Isaac Newton realized were actually two parts of the same question?

9. What connection does legend say that Newton made between the moon and a falling apple?

10. Newton summarized his ideas about gravity in what law?

THE LAW OF UNIVERSAL GRAVITATION

11. What does the law of universal gravitation state?

12. How does the law of universal gravitation explain why gravity between an elephant and Earth is greater than gravity between a cat and Earth?

13. How does the law of universal gravitation explain why astronauts on the moon bounce when they walk?

14. How does the gravitational force between objects that have small masses compare to the gravitational force between large objects?

15. Why doesn't the sun's gravitational force affect you more than Earth's gravitational force does?

16. How does the gravitational force between two objects that are close together compare to the gravitational force between two objects as they move farther apart?

WEIGHT AND GRAVITATIONAL FORCE

_____ **17.** The measure of the gravitational force on an object is called
- **a.** mass.
- **b.** force.
- **c.** weight.
- **d.** gravity.

_____ **18.** A measure of the amount of matter in an object is
- **a.** mass.
- **b.** force.
- **c.** weight.
- **d.** gravity.

_____ **19.** If an object is moved from Earth to a place with greater gravitational force,
- **a.** its mass will stay the same.
- **b.** its weight will stay the same.
- **c.** its mass will increase.
- **d.** its weight will decrease.

20. On Earth, why are the words *mass* and *weight* often used to mean the same thing?

_____

_____

_____

GRAVITY AND STATIC OBJECTS

21. Why doesn't the gravity on a picture on a shelf pull it downward?

_____

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Gravity and Motion (pp. 376–383)

1. Suppose a baseball and a marble are dropped at the same time from the same height. Which ball would land first according to Aristotle? Explain your answer.

_____

_____

GRAVITY AND FALLING OBJECTS

2. What Italian scientist argued that the mass of an object does not affect the time the object takes to fall to the ground?

_____

3. Why do objects fall to the ground at the same rate?

_____

_____

4. On what two factors does acceleration depend?

_____

_____

5. Does a heavier object or a lighter object experience a greater gravitational force?

_____

6. Why is a heavier object harder to accelerate than a lighter object?

_____

7. Why does a heavier object fall with the same acceleration as a lighter object?

_____

_____

8. What is the term for the rate at which velocity changes over time?

_____

9. At what rate do all objects accelerate toward Earth?

_____

_____

10. What equation is used to calculate the velocity (v) of a falling object?

_____

AIR RESISTANCE AND FALLING OBJECTS

_____ **11.** The force that opposes the motion of objects through air is called
- **a.** gravity.
- **b.** net force.
- **c.** velocity.
- **d.** air resistance.

12. What three factors affect the amount of air resistance acting on an object?

_____

_____

_____

13. What do you get when you subtract the force of air resistance from the force of gravity?

_____

14. When a falling object stops accelerating, it has reached

_____ velocity.

15. If there were no air resistance, what would be the velocities of hailstones during a hailstorm?

_____

16. The motion of a body when only the force of gravity is acting on the body is called _____.

17. Why can free fall occur only where there is no air?

_____

_____

18. What are two places that have no air resistance?

_____

_____

PROJECTILE MOTION AND GRAVITY

_____ **19.** The curved path that an object follows when thrown, launched, or otherwise projected near the surface of Earth is called
- **a.** terminal velocity.
- **b.** projectile motion.
- **c.** terminal motion.
- **d.** projectile velocity.

_____ **20.** The two independent components of projectile motion that combine to form a curved path are
- **a.** horizontal movement and vertical movement.
- **b.** parallel motion and vertical movement.
- **c.** horizontal movement and perpendicular motion.
- **d.** horizontal force and vertical force.

_____ **21.** The force that gives a thrown ball its horizontal movement is
- **a.** gravity.
- **b.** the force applied by the hand throwing the ball.
- **c.** air resistance.
- **d.** magnetism.

_____ **22.** Everything on Earth is pulled downward toward Earth's center by
- **a.** acceleration.
- **b.** projectile motion.
- **c.** gravity.
- **d.** air resistance.

_____ **23.** The force that gives a thrown ball its vertical movement is
- **a.** gravity.
- **b.** the force applied by the hand throwing the ball.
- **c.** air resistance.
- **d.** magnetism.

_____ **24.** Objects in projectile motion are pulled down by
- **a.** acceleration.
- **b.** horizontal movement.
- **c.** air resistance.
- **d.** gravity.

_____ **25.** Compared to a falling object, the downward acceleration of a thrown object is
- **a.** the same.
- **b.** faster.
- **c.** slower.
- **d.** constant.

_____ **26.** If you want to hit a target with a thrown or propelled object, you must
- **a.** aim directly at the target.
- **b.** aim below the target.
- **c.** aim above the target.
- **d.** aim at either side of the target.

ORBITING AND GRAVITY

27. An object moving around another object in space is doing what?

_____

28. What two movements come together to form an orbit?

_____

_____

29. What is centripetal force?

_____

_____

_____

_____

30. What force plays an important role in maintaining the shape of the solar system?

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Newton's Laws of Motion (pp. 384–391)

1. In 1686, what did Sir Issac Newton explain with his three laws of motion?

_____

_____

NEWTON'S FIRST LAW

2. What is Newton's first law of motion?

_____

_____

3. Which of Newton's laws of motion describes the motion of an object that has a net force of 0?

_____

4. What are two examples of objects at rest?

_____

_____

5. How could an unbalanced force work on a chair at rest on the floor to make it slide across the room?

_____

6. According to Newton's first law of motion, what will happen to the motion of objects moving with a certain velocity unless an unbalanced force acts on them?

_____

_____

7. If you were in a bumper car that stopped abruptly when it hit another car, would you continue to move forward? Explain your answer.

_____

_____

_____

8. What unbalanced force acts to stop a desk that is sliding across a floor?

_____

9. What does friction do to the motion of objects?

10. What is Newton's first law sometimes called?

11. What is the tendency of an object to resist being moved or, if the object is moving, to resist a change in speed or direction until an outside force acts on the object?

12. Why is it easier to change the motion of an object with a small mass than it is to change the motion of an object with a large mass?

NEWTON'S SECOND LAW OF MOTION

13. What is Newton's second law of motion?

14. What happens to the acceleration of an object if the force on the object stays the same as its mass decreases?

15. What happens to the acceleration of an object if the force on the object increases?

16. What is the relationship between an object's acceleration and the direction of the force on the object?

17. Why would a cart start moving faster if you gave it a hard push than if you gave it a soft push?

NEWTON'S THIRD LAW OF MOTION

18. What is Newton's third law of motion?

19. Explain why Newton's third law can be stated as "all forces act in pairs."

20. What action and reaction forces are present when you are sitting on a chair?

21. Since all forces act in pairs, what happens whenever a force is exerted?

22. When a ball falls to Earth, why is it hard to see the effect of the reaction force exerted by the ball on Earth?

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Fluids and Pressure (pp. 406–411)

1. Any material that can flow and takes the shape of its container is called a(n) _____.

2. Name two states of matter that are fluids.

_____

_____

3. What can particles in a fluid do?

_____

_____

FLUIDS AND PRESSURE

4. What happens when you pump up a bicycle tire?

_____

_____

_____

5. The amount of force exerted per unit area of a surface is called _____.

6. Force divided by area equals _____.

7. The SI unit of pressure is the _____.

8. The force of one newton exerted over an area of one square meter is one _____.

9. Why are gas bubbles round?

_____

_____

_____

_____

ATMOSPHERIC PRESSURE

Match the correct description with the correct term. Write the letter in the space provided.

_____ **10.** pressure caused by the weight of the atmosphere

_____ **11.** percentage of gases found within 10 km of Earth's surface

_____ **12.** force that holds the atmosphere in place

_____ **13.** number of newtons pressing on every square centimeter of your body

a. 10

b. atmospheric pressure

c. 80%

d. gravity

14. As you travel "deeper" into the atmosphere, how is atmospheric pressure affected?

_____

_____

_____

Number each location listed from 1 to 5 in order of lowest to highest pressure.

_____ **15.** top of Mount Everest

_____ **16.** La Paz, Bolivia

_____ **17.** airplane at 12,000 m

_____ **18.** beach at sea level

_____ **19.** space shuttle at 150,000 m above sea level

20. Why do your ears "pop" when you take off in an airplane?

_____

_____

WATER PRESSURE

_____ **21.** Water pressure increases as

a. gravity decreases.

b. air pressure decreases.

c. depth increases.

d. particles collide.

_____ **22.** Water pressure and atmospheric pressure affect total pressure on objects that are
- **a.** underground.
- **b.** above sea level.
- **c.** in a car.
- **d.** underwater.

_____ **23.** Water pressure does NOT depend on
- **a.** atmospheric pressure.
- **b.** the amount of fluid present.
- **c.** air pockets.
- **d.** gravity.

_____ **24.** Water is about 1,000 times more dense than
- **a.** air.
- **b.** pressure.
- **c.** gravity.
- **d.** oil.

25. The amount of matter in a given volume, or mass per unit volume, is called _____.

26. Why does water exert more pressure than air?

_____

27. The pressure at 500 m below the surface is about _____ kPa.

28. The pressure at 8,000 m below the surface is about _____ kPa.

PRESSURE DIFFERENCES AND FLUID FLOW

29. Describe the pressure changes as you sip a drink through a straw.

_____

_____

_____

30. What happens when pressure is lower inside the lungs than outside the lungs?

_____

31. How do pressure differences affect the direction in which fluids flow?

_____

_____

32. How do pressure differences explain the destructive effects of a tornado's winds?

_____

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Buoyancy and Density (pp. 412–419)

1. The upward force that fluids exert on all matter is called _____.

BUOYANT FORCE AND FLUID PRESSURE

2. In a fluid, buoyant force exists because the pressure at the _____ of an object is greater than the pressure at the top.

3. State Archimedes' principle.

_____

_____

_____

_____

4. The weight of displaced fluid determines the _____ on an object.

WEIGHT VERSUS BUOYANT FORCE

_____ **5.** If the weight of the water an object displaces is equal to the weight of the object, the object
- **a.** sinks.
- **b.** floats.
- **c.** flies.
- **d.** is buoyed up.

_____ **6.** If the weight of the water an object displaces is less than the weight of the object, the object
- **a.** sinks.
- **b.** floats.
- **c.** flies.
- **d.** is buoyed up.

_____ **7.** If the weight of the water an object displaces is greater than the object's weight, the object
- **a.** sinks.
- **b.** floats.
- **c.** flies.
- **d.** is buoyed up.

Match the correct description with the correct formula. Write the letter in the space provided.

_____ **8.** when a rock sinks

_____ **9.** when a duck is buoyed up

_____ **10.** when a fish is suspended in the water

a. Buoyant force is less than weight.

b. Buoyant force equals weight.

c. Buoyant force is greater than weight.

DENSITY AND FLOATING

11. How does the density of a rock affect its ability to float?

12. Why does an ice cube float in water?

13. Why does a helium balloon float in air?

DETERMINING DENSITY

_____ **14.** The volume of a regular solid can be determined by

a. multiplying together the lengths of its sides.

b. dividing the length of one side by another.

c. adding the lengths of its sides.

d. multiplying its height and weight.

_____ **15.** The volume of an irregular solid equals
- **a.** the volume of water it displaces when fully submerged.
- **b.** the volume of water it contains.
- **c.** the volume of air it contains.
- **d.** the volume of the regular solid that it would fit inside of.

CHANGING OVERALL DENSITY

16. A ship's hollow shape increases its _____ and decreases its overall _____, allowing it to float.

17. If a steel ship were NOT hollow, it would _____.

18. What is the purpose of a submarine's ballast tanks?

19. How is compressed air used in a submarine?

20. How does a fish's swim bladder affect its overall density?

21. How do fish without swim bladders keep from sinking?

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Stars (pp. 436–443)

1. What is a star made of?

_____

_____

2. To learn about stars, astronomers study _____.

COLOR OF STARS

_____ **3.** What color are the hottest stars?
- **a.** blue
- **b.** yellow
- **c.** white
- **d.** red

4. What can we conclude about stars that differ in color?

_____

_____

COMPOSITION OF STARS

_____ **5.** The band of colors produced when white light passes through a prism is a(n)
- **a.** color wheel.
- **b.** emission line.
- **c.** ultraviolet light.
- **d.** spectrum.

_____ **6.** A hot, solid object gives off a(n)
- **a.** continuous spectrum.
- **b.** absorption spectrum.
- **c.** emission line.
- **d.** partial spectrum.

_____ **7.** What colors are shown in a continuous spectrum?
- **a.** primary colors
- **b.** cool colors
- **c.** warm colors
- **d.** all colors

_____ **8.** The colors that appear when a chemical element emits light are called
- **a.** continuous lines.
- **b.** absorption lines.
- **c.** color lines.
- **d.** emission lines.

_____ **9.** Each element in a hot gas can be identified by
- **a.** a unique set of bright emission lines.
- **b.** a unique set of bright absorption lines.
- **c.** a set of emission lines shared with other elements.
- **d.** a set of absorption lines shared with other elements.

10. Why is the spectrum of a star called an *absorption spectrum*?

11. How is an absorption spectrum produced?

12. What do the black lines of a star's spectrum represent?

13. In what ways is the pattern of lines in a star's absorption spectrum unique?

14. Why is it often difficult to identify a star's elements from its absorption spectrum?

15. What are the two main elements found in stars?

16. What are the three most common trace elements found in stars?

_____

_____

_____

CLASSIFYING STARS

_____ **17.** In the 1800s, astronomers classified stars according to
- **a.** their elements.
- **b.** their temperature.
- **c.** their age.
- **d.** their size.

_____ **18.** Stars are now classified by
- **a.** their elements.
- **b.** their temperature.
- **c.** their age.
- **d.** their size.

_____ **19.** Class O stars, the hottest stars, are
- **a.** yellow.
- **b.** orange.
- **c.** red.
- **d.** blue.

20. Early astronomers called the brightest stars in the sky

_____ stars.

21. What type of numbers are used to represent the magnitudes of dim stars?

_____

22. What type of numbers are used to represent the magnitudes of very bright stars?

_____

HOW BRIGHT IS THAT STAR?

23. The brightness of a star as seen from Earth is its _____.

24. The brightness that a star would have at a distance of 32.6 light-years from Earth is its _____.

25. Why is the sun the brightest object in the sky?

DISTANCE TO THE STARS

_____ **26.** What unit of measurement do astronomers use to measure the distance from Earth to the stars?

a. a solar year
b. a parallax
c. a light-year
d. magnitude

27. The distance that light travels in one year; about 90.46 trillion kilometers, is called a(n) _____.

28. An apparent shift in the position of an object when seen from different locations is called _____.

MOTIONS OF STARS

29. Explain why you see different constellations in the sky at different times of the year.

30. What causes the stars to appear to make one complete circle around Polaris every 24 hours?

31. Why is the actual motion of the stars difficult to see?

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: The Life Cycle of Stars (pp. 444–449)

TYPES OF STARS

1. List seven ways that stars are classified.

_____

_____

_____

_____

2. Why would the classification of a star change as it ages?

_____

_____

THE LIFE CYCLE OF SUNLIKE STARS

Match the correct description with the correct term. Write the letter in the space provided.

_____ **3.** the first stage of a star's life cycle, when gravity pulls gas and dust into a sphere

_____ **4.** the second and longest stage of a star's life cycle; energy is generated in its core

_____ **5.** a star uses all of its hydrogen, the center of the star shrinks, and the atmosphere grows large and cools

_____ **6.** the final stage of a star's life cycle; the leftover center of a red giant no longer generates energy by nuclear fusion

a. red giant or red supergiant
b. white dwarf
c. main-sequence
d. protostar

A TOOL FOR STUDYING STARS

_____ **7.** The H-R diagram shows the relationship between a star's surface temperature and its
a. absolute magnitude.
b. color.
c. apparent magnitude.
d. age.

8. Where is temperature indicated on the H-R diagram?

_____

9. Where is absolute magnitude indicated on the H-R diagram?

_____

10. Where does a star spend most of its lifetime as indicated on the H-R diagram?

_____

Match the correct description with the correct term. Write the letter in the space provided.

_____ **11.** part of the H-R diagram where hot (blue) stars are indicated

_____ **12.** part of the H-R diagram where cool (red) stars are indicated

_____ **13.** part of the H-R diagram where bright stars are indicated

_____ **14.** part of the H-R diagram where dim stars are indicated

a. right side
b. top
c. left side
d. bottom

15. As they age, how do main-sequence stars move on the H-R diagram?

_____

_____

_____

_____

THE AGING OF MASSIVE STARS

Match the correct description with the correct term. Write the letter in the space provided.

_____ **16.** a gigantic explosion in which a massive star collapses and throws its outer layers into space

_____ **17.** the center of a collapsed star contracts into a small, dense ball of neutrons

_____ **18.** a spinning neutron star sends out beams of radiation that sweep across space

_____ **19.** the contraction of a collapsed star leaves an object so dense and massive that light cannot escape its gravity

a. neutron star
b. black hole
c. supernova
d. pulsar

20. How are black holes detected by astronomers?

_____

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Galaxies (pp. 450–453)

1. A collection of stars, dust, and gas bound together by gravity is called a(n) _____.

TYPES OF GALAXIES

Each of the following statements is true of a spiral galaxy, an elliptical galaxy, or an irregular galaxy. Write *S* for a spiral galaxy, *E* for an elliptical galaxy, and *I* for an irregular galaxy in the space provided.

_____ **2.** These galaxies have stopped making stars.

_____ **3.** The Milky Way is this type of galaxy.

_____ **4.** Some of these are formed when galaxies collide.

_____ **5.** The arms of these galaxies are made up of gas, dust, and new stars.

_____ **6.** These galaxies are round or oval, like cosmic snowballs.

_____ **7.** These galaxies can contain from 10 million to several billion stars.

_____ **8.** These galaxies have a bulge in the center and spiral arms.

CONTENTS OF GALAXIES

_____ **9.** A large cloud of gas and dust in interstellar space where stars are born is called a(n)
- **a.** globular cluster.
- **b.** open cluster.
- **c.** quasar.
- **d.** nebula.

_____ **10.** A highly concentrated group of up to one million stars is called a(n)
- **a.** globular cluster.
- **b.** open cluster.
- **c.** quasar.
- **d.** nebula.

_____ **11.** A relatively close group of up to 100 to 1,000 stars, usually located along the disk of a spiral galaxy, is called a(n)
- **a.** globular cluster.
- **b.** open cluster.
- **c.** quasar.
- **d.** nebula.

Quasars

12. Starlike sources of energy located in the centers of galaxies are called

_____.

ORIGIN OF GALAXIES

13. Why is looking through a telescope like looking back through time?

_____

_____

_____

_____

14. Why do scientists study distant galaxies?

_____

_____

_____

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Formation of the Universe (pp. 454–457)

1. The study of the origin, structure, and future of the universe is called _____.

THE BIG BANG THEORY

_____ **2.** What have scientists learned by studying the movement of galaxies?
- **a.** Most galaxies are moving apart, and the universe is expanding.
- **b.** Most galaxies are getting closer together, and the universe is getting smaller.
- **c.** Galaxies do not move, and the universe is not expanding.
- **d.** Galaxies rotate within the same portion of the universe.

_____ **3.** The standard model used to explain the expansion of the universe is
- **a.** the theory of universal expansion.
- **b.** the theory of cosmology.
- **c.** the theory of fundamental forces.
- **d.** the big bang theory.

4. The theory that all matter and energy was compressed into an extremely small volume billions of years ago, then exploded and expanded in all directions, is _____.

5. According to the big bang theory, about how long ago did the universe begin?

_____

6. Describe *cosmic background radiation.*

_____

_____

_____

_____

_____

_____

_____

GRAVITY AND THE UNIVERSE

7. How does gravity act on matter and galaxies to control the size and shape of the universe?

_____

_____

_____

8. What are three structures in the universe to which Earth belongs?

_____

_____

_____

HOW OLD IS THE UNIVERSE?

_____ **9.** The oldest stars in the Milky Way galaxy are called
- **a.** protostars.
- **b.** blue stars.
- **c.** yellow stars.
- **d.** white dwarfs.

10. After studying white dwarf stars, why do scientists believe the universe must be approximately 14 billion years old?

_____

_____

_____

A FOREVER-EXPANDING UNIVERSE

_____ **11.** What makes up the smallest amount of total matter in the universe?
- **a.** dark energy
- **b.** dark matter
- **c.** matter making up stars and planets
- **d.** hydrogen

_____ **12.** How can dark matter be detected?
- **a.** by its light
- **b.** by its temperature
- **c.** by its elements
- **d.** by its gravity

_____ **13.** Most of the universe is composed of
- **a.** stars and planets.
- **b.** light energy.
- **c.** dark energy.
- **d.** dark matter.

14. What does dark energy seem to be doing?

15. Describe what might happen if the expansion rate of the universe continues to grow.

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: A Solar System Is Born (pp. 472–479)

1. The planets, the sun, and many moons and other small bodies are part of our _____.

THE SOLAR NEBULA

_____ **2.** Nebulas are found in the empty regions of space
- **a.** between the planets.
- **b.** outside the force of gravity.
- **c.** inside the stars.
- **d.** between the stars.

_____ **3.** Nebulas are mixtures of gases and
- **a.** planets.
- **b.** air.
- **c.** dust.
- **d.** rock.

_____ **4.** Which elements are mainly found in the gases of nebulas?
- **a.** hydrogen and helium
- **b.** hydrogen and oxygen
- **c.** carbon dioxide and helium
- **d.** carbon dioxide and oxygen

5. The matter of a nebula is held together by the force of _____.

6. A measure of the average kinetic energy, or the energy of motion, of the particles in an object is _____.

7. How does pressure keep a nebula from collapsing under the force of gravity?

_____

_____

_____

UPSETTING THE BALANCE

8. What two events can upset the balance between gravity and pressure in a nebula?

_____

_____

9. The cloud of gas and dust that formed our solar system is called the _____.

HOW THE SOLAR SYSTEM FORMED

_____ **10.** As the solar nebula collapsed,
- **a.** stars ignited.
- **b.** it began to rotate.
- **c.** planets began to grow.
- **d.** moons formed.

_____ **11.** The center of the rotating cloud of gas and dust became
- **a.** very light and cool.
- **b.** very light and hot.
- **c.** very dense and cool.
- **d.** very dense and hot.

_____ **12.** What happened to the solar nebula over time?
- **a.** It became cooler and lighter.
- **b.** It stopped rotating.
- **c.** It formed a rotating disk.
- **d.** It expanded into a large sphere.

13. The collision of particles formed bodies the size of boulders and asteroids called _____.

14. What pulled matter in the solar nebula together into spheres?

_____

_____

15. Why are the sun, the planets, and most moons spherical?

_____

_____

16. How did the sun form?

_____

_____

_____

_____

THE STRUCTURE OF THE SUN

17. Name the three layers of the interior of the sun.

18. Name the three layers of the exterior of the sun.

ENERGY PRODUCTION IN THE SUN

19. According to Einstein's formula, what can matter change into?

20. The process by which two or more nuclei fuse to form another nucleus is called _____.

21. What conditions must be in place in order for hydrogen to fuse into helium?

22. Describe the three steps of fusion of hydrogen in the sun.

MEASURING INTERPLANETARY DISTANCES

23. One _____ is the average distance between the sun and Earth.

24. What is a light-minute?

_____

_____

THE INNER AND OUTER SOLAR SYSTEMS

25. What are the four planets closest to the sun called?

_____

26. What are the four planets farthest from the sun called?

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: The Inner Planets (pp. 480–485)

_____ **1.** Why are the inner planets called terrestrial planets?
- **a.** because they are very hot
- **b.** because they are very dense and rocky
- **c.** because most are gas giants
- **d.** because they can support life

2. Name three ways the inner planets differ from the outer planets.

_____

_____

_____

MERCURY: CLOSEST TO THE SUN

3. What is Mercury's high density due to?

_____

_____

4. Why does Mercury's day last almost 59 Earth days?

_____

_____

Match the correct definition with the correct term. Write the letter in the space provided.

_____ **5.** the time that a planet takes to go around the sun once

_____ **6.** the motion of a body orbiting another body in space

_____ **7.** the amount of time that an object takes to rotate once

_____ **8.** the time that an object takes to complete one orbit

- **a.** period of rotation
- **b.** period of revolution
- **c.** year
- **d.** revolution

VENUS: EARTH'S TWIN?

_____ **9.** Why does the sun rise in the west and set in the east on Venus?
- **a.** because Venus has a retrograde rotation
- **b.** because Venus has a prograde rotation
- **c.** because the sun rotates in the same direction
- **d.** because Earth has a prograde rotation

_____ **10.** Which of the terrestrial planets has the densest atmosphere?
- **a.** Earth
- **b.** Mars
- **c.** Mercury
- **d.** Venus

_____ **11.** What is the atmosphere of Venus composed of?
- **a.** mainly oxygen and nitrogen
- **b.** mainly carbon dioxide and acid
- **c.** mainly hydrogen and helium
- **d.** mainly water vapor and acids

_____ **12.** What causes the high surface temperature on Venus?
- **a.** the nitrogen in its atmosphere
- **b.** the low atmospheric pressure
- **c.** the density of its atmosphere
- **d.** the water in its atmosphere

_____ **13.** What technology did the *Magellan* spacecraft use to map Venus?
- **a.** geological surveys
- **b.** video
- **c.** radar
- **d.** sonar

14. A planet with a(n) _____ rotation appears to spin counterclockwise as seen from above its North Pole.

15. A planet with a(n) _____ rotation appears to spin clockwise as seen from above its North Pole.

16. What four features did the *Magellan*'s maps reveal on the surface of Venus?

_____

_____

_____

_____

_____

EARTH: AN OASIS IN SPACE

17. What two factors are required for life as we know it to exist on a planet?

18. List five interrelated aspects of Earth's global system that are studied by NASA's *Earth Science Enterprise* program.

MARS: THE RED PLANET

_____ **19.** How does the air pressure on Mars compare with that on Earth?

- **a.** The air pressure is about the same as on Earth.
- **b.** The air pressure is greater on Mars.
- **c.** The air pressure is lower on Mars.
- **d.** The air pressure is lower on Earth.

20. Give two reasons why Mars is a cold planet.

21. What kinds of features suggest that there was once liquid water on Mars?

22. Besides the polar icecaps, where may some of the lost water on Mars be found?

Directed Reading B *continued*

23. What is the name of the largest mountain in the solar system?

24. Why did Olympus Mons grow so high?

25. What did the rovers *Spirit* and *Opportunity* find on Mars in 2004?

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: The Outer Planets (pp. 486–491)

1. A planet that has a deep, massive atmosphere is called a(n) _____.

2. Which outer planet is farthest from the sun?

_____

JUPITER: A GIANT AMONG GIANTS

_____ **3.** Which of the following is the largest planet in our solar system?
- **a.** Jupiter
- **b.** Earth
- **c.** Saturn
- **d.** Neptune

_____ **4.** Which of the following is Jupiter mostly composed of?
- **a.** oxygen and nitrogen
- **b.** organic molecules
- **c.** hydrogen and helium
- **d.** water and carbon dioxide

_____ **5.** What is Jupiter's Great Red Spot?
- **a.** thick layers of clouds
- **b.** a huge storm
- **c.** metallic hydrogen
- **d.** colorful organic molecules

6. What is the reason that Jupiter radiates more energy into space than it receives from the sun?

_____

7. What did the Galileo mission's atmospheric probe discover about Jupiter's storms?

_____

_____

SATURN: THE RINGED WORLD

8. How does Saturn's density compare to the density of the other planets?

_____

_____

9. What are the rings of Saturn made of?

10. Name three things about Saturn that the *Cassini* spacecraft has provided information about.

URANUS: A SMALL GIANT

11. What gives Uranus its greenish tinge?

12. What is unusual about Uranus's axis of rotation?

13. How do scientists explain what may have caused Uranus's axis to be unusual in this way?

NEPTUNE: THE BLUE WORLD

14. What is Neptune's Great Dark Spot?

15. How fast do Neptune's winds travel?

PLUTO: A DWARF PLANET

_____ **16.** What is Pluto made of?
- **a.** hydrogen and helium
- **b.** organics and ice
- **c.** hydrogen and water
- **d.** rock and ice

_____ **17.** Pluto's thin atmosphere is composed of
- **a.** oxygen and ammonia.
- **b.** nitrogen and helium.
- **c.** methane and nitrogen.
- **d.** hydrogen and oxygen.

_____ **18.** What does the sun look like from the surface of Pluto?
- **a.** a ball the size of the moon
- **b.** a distant bright star
- **c.** a bright ringed object
- **d.** a ball half the size of the moon

19. What is unusual about Pluto's moon?

_____

_____

20. The region of the solar system that contains small bodies that are made mostly of ice is called the _____.

21. What was discovered in the Kuiper belt in 2003?

_____

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Moons (pp. 492–499)

1. Natural or artificial bodies that revolve around larger bodies such as planets are called _____.

2. Except for Mercury and Venus, all the planets have natural satellites called _____.

LUNA: THE MOON OF EARTH

_____ **3.** What is Earth's moon also called?
- **a.** Luna
- **b.** terrae
- **c.** maria
- **d.** Galilean satellite

_____ **4.** How old were the lunar rocks brought back by the Apollo missions?
- **a.** 3 billion years
- **b.** about 3.8 billion years
- **c.** about 4.5 billion years
- **d.** more than 5 billion years

5. What does the age of the lunar rocks tell us about our solar system?

6. What happens to the surfaces of bodies without an atmosphere and no erosion?

7. What two features is the moon's surface composed of?

8. What is the current theory about the origin of the moon?

Directed Reading B *continued*

9. What evidence supports the current theory about the origin of the moon?

10. Why is the moon a sphere?

11. What causes the moon to shine?

12. Why do you always see the same side of the moon from Earth?

13. Describe how the moon's face changes during the month.

14. The different appearances of the moon due to its changing position are called _____.

15. What causes the different appearances of the moon?

16. When the moon is _____, the sunlit fraction that we can see from Earth is getting larger.

17. When the moon is _____, the sunlit fraction that we can see from Earth is getting smaller.

18. When the shadow of one celestial body falls on another, a(n) _____ occurs.

Match the correct description with the correct term. Write the letter in the space provided.

_____ **19.** when the shadow of the moon falls on part of Earth

_____ **20.** when the shadow of Earth falls on the moon

_____ **21.** when a thin ring of the sun shows around the moon's outer edge

_____ **22.** when the disk of the moon completely covers the disk of the sun

a. solar eclipse
b. lunar eclipse
c. total solar eclipse
d. annular eclipse

23. Why don't we see solar and lunar eclipses every month?

THE MOONS OF OTHER PLANETS

_____ **24.** Which of the following statements about moons in our solar system is NOT correct?
a. Some moons orbit their planet backward.
b. Many moons may be captured asteroids.
c. Some moons have very elliptical orbits.
d. There are no moons as large as the terrestrial planets.

25. Name the two moons of Mars.

26. Jupiter's four largest moons are known as the _____.

27. Which of Jupiter's moons is the most volcanically active body in the solar system?

28. What evidence supports the idea that life could exist on Europa?

29. How does Titan's atmosphere compare with the atmospheres of other satellites in the solar system?

30. What effect did an impact have on Uranus's moon Miranda?

31. In what kind of orbit does Triton revolve around Neptune?

32. Why does one side of Pluto always face its moon, Charon?

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading B

Section: Small Bodies in the Solar System (pp. 500–505)

1. Name three kinds of bodies in the solar system besides moons and planets.

_____

_____

_____

COMETS

_____ **2.** What materials are comets made of?

a. iron, nickel, and rock
b. ice, rock, and cosmic dust
c. lighter elements and water ice
d. frozen gases and metals

3. A spherical cloud of gas and dust, called a(n) _____, surrounds the nucleus of a comet.

4. Describe the ion tail of a comet.

_____

_____

_____

5. Describe the dust tail of a comet.

_____

_____

_____

6. What two regions in space do comets come from?

_____

_____

7. How can studying comets help us learn about our solar system's history?

_____

_____

_____

8. Comets that take more than 200 years to complete one orbit of the sun are called _____.

9. Comets that take less than 200 years to complete one orbit of the sun are called _____.

ASTEROIDS

10. Rocky bodies that revolve around the sun and that are much smaller than planets are called _____.

11. A region of space between the orbits of Mars and Jupiter in which asteroids orbit the sun is called the _____.

12. What does the composition of asteroids depend on?

_____

_____

13. Asteroids that have wide, elliptical orbits that bring them close to Earth are called _____.

METEOROIDS

Match the correct description with the correct term. Write the letter in the space provided.

_____ **14.** rocky bodies that reach Earth's surface

_____ **15.** the glowing trails that result when bodies burn up in Earth's atmosphere

_____ **16.** dust and debris from asteroids and comets that travel through space

a. meteors
b. meteoroids
c. meteorites

17. Name the three major types that meteorites can be classifed into.

_____

_____

_____

18. Meteorites that are similar in composition to rocks on Earth are called _____.

19. Meteorites with a distinctive metallic appearance are called _____.

Directed Reading B *continued*

20. Meteorites that contain iron and stone are called _____.

21. What causes meteor showers?

_____

_____

_____

22. How often do large objects that could cause a global catastrophe strike Earth?

_____

_____

Answer Key

Directed Reading A

SECTION: SCIENCE AND SCIENTISTS

1. B
2. A
3. D
4. research
5. observation
6. experimentation
7. C
8. A
9. C
10. B
11. D
12. A
13. E
14. C
15. B

SECTION: SCIENTIFIC METHODS

1. D
2. B
3. C
4. B
5. D
6. A
7. C
8. A
9. B
10. D
11. B
12. A
13. C
14. C
15. A
16. B
17. C
18. experimental group
19. variable parameter
20. controlled experiment
21. controlled parameter
22. D
23. B
24. B
25. C
26. A
27. C
28. A
29. C

SECTION: SAFETY IN SCIENCE

1. C
2. A
3. B
4. B
5. C
6. A
7. B
8. A
9. C
10. C
11. D
12. C
13. B
14. D
15. A
16. C
17. E
18. D
19. A
20. B
21. B
22. D
23. accident
24. first aid
25. B
26. C

Directed Reading B

SECTION: SCIENCE AND SCIENTISTS

1. Answers may vary. Sample answer: observing the world and asking questions about the observations
2. the knowledge gained about the natural world by investigation
3. Answers may vary. Sample answer: I might look at something in a new way and ask a question about it.
4. Accept all reasonable answers. Answers should list three different places that one could ask questions about.
5. C
6. B
7. A
8. Answers may vary. Sample answer: designing and building cars with stronger materials and designing air bags

9. Answers may vary. Answers should include any three of the following: limestone, ore, coal, energy, water, air
10. They have had a role in damaging the ozone layer.
11. Higher levels of UV light reach the ground, which could lead to higher rates of skin cancer.
12. D
13. C
14. E
15. A
16. B
17. Answers may vary. Sample answer: weather forecasting and studying tornadoes
18. Answers may vary. Sample answer: what the economic value of rocks, minerals, and soil is; what the environment was like when these materials formed and what has happened to them since
19. Answers may vary. Sample answer: wildlife management, agriculture, forestry, and conservation
20. by learning to predict when a volcano will erupt
21. art and science

SECTION: SCIENTIFIC METHODS

1. D
2. ask a question, make observations, form a hypothesis, test the hypothesis, analyze results, draw conclusions
3. B
4. observation
5. measurements
6. energy input
7. Answers may vary. Sample answer: A small increase in efficiency would save millions of liters of fuel per year.
8. How can boat propulsion systems be made more efficient?
9. D
10. B
11. testable
12. There is no way to show whether the hypothesis is right or wrong.
13. A propulsion system that imitates the way that a penguin swims will be more efficient than a propulsion system that uses a propeller.
14. He observed penguins swimming and noticed how quickly and easily the penguins moved through the water.
15. if-then
16. If two flippers are attached to a boat, then the boat will be more efficient than a boat powered by propellers.
17. A
18. D
19. C
20. test
21. variable parameter
22. controlled parameters
23. They built a boat with flippers like a penguin, which they called *Proteus*.
24. data
25. the flapping rate
26. They could tell the effect that the flapping rate had on *Proteus's* efficiency.
27. analyze
28. tables; graphs
29. A
30. Answers may vary. Sample answer: The results support your hypothesis; the results do not support your hypothesis; more information is needed.
31. They concluded that their hypothesis was supported—that the penguin-like propulsion system was more efficient than a propeller propulsion system.
32. Answers may vary. Sample answer: because of repeated tests of variable and controlled parameters, which helped make sure that the data were not accidental
33. Answers may vary. Sample answer: write a scientific paper, make a presentation, create a Web site
34. Telling others what you learned keeps science going and allows other scientists to continue your work or verify your results with their own experiments.

SECTION: SAFETY IN SCIENCE

1. Answers may vary. Sample answer: Take every precaution to prevent accidents; wear appropriate safety equipment; use all lab materials in a safe and correct way.
2. Answers may vary. Sample answer: Follow directions.

3. Let your teacher know immediately.
4. B
5. A
6. B
7. D
8. A
9. D
10. C
11. C
12. Answers may vary. Sample answer: Follow your teacher's directions on handling the animals, including wearing gloves, not injuring the animals, and washing your hands thoroughly afterward.
13. D
14. A
15. E
16. C
17. B
18. because your teacher may need you to get the equipment if an accident happens
19. First, make sure that you are safe. Then, tell your teacher about the accident.
20. emergency medical care for someone who has been hurt or who is sick
21. Hold the burned area under cold water for at least 15 minutes.
22. Wash your eyes in an eye bath for 15 minutes. Then, cover your eyes with a clean cloth.
23. Rinse the cut gently. Then, apply slight pressure to the cut with a clean paper towel.

Vocabulary and Section Summary A

SECTION: SCIENCE AND SCIENTISTS

1. science: the knowledge obtained by observing natural events and conditions in order to discover facts and formulate laws or principles that can be verified or tested

SECTION: SCIENTIFIC METHODS

1. scientific methods: a series of steps followed to solve problems
2. observation: the process of obtaining information by using the senses
3. hypothesis: a testable idea or explanation that leads to scientific investigation
4. data: any pieces of information acquired through observation or experimentation

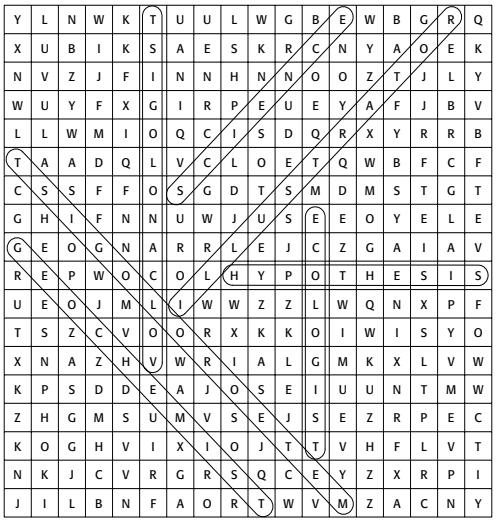
SECTION: SAFETY IN SCIENCE

1. first aid: emergency medical care for someone who has been hurt or who is sick

Vocabulary and Section Summary B

SECTION: SCIENCE AND SCIENTISTS

1. meteorologist
2. hypothesis
3. geochemist
4. ecologist
5. science
6. illustrator
7. volcanologist



SECTION: SCIENTIFIC METHODS

Across

1. hypothesis
5. experiment
6. variable
7. scientific
8. data

Down

2. observation
3. controlled
4. efficiency

SECTION: SAFETY IN SCIENCE

1. D
2. A
3. E
4. B
5. C

Answer Key

Directed Reading A

SECTION: TOOLS AND MODELS IN SCIENCE

1. A
2. C
3. B
4. A
5. D
6. B
7. B
8. C
9. D
10. A
11. mass
12. kilogram
13. volume
14. liter
15. density
16. A
17. A
18. C
19. D
20. physical model
21. variable
22. conceptual model
23. mathematical model
24. A
25. C
26. B
27. B
28. A
29. C

SECTION: ORGANIZING YOUR DATA

1. C
2. A
3. C
4. A
5. D
6. C
7. B
8. D
9. axis
10. independent variable
11. dependent variable
12. range
13. scale
14. line of best fit
15. title
16. B
17. A
18. C
19. D
20. C

SECTION: ANALYZING YOUR DATA

1. B
2. C
3. A
4. B
5. D
6. A
7. A
8. B
9. A
10. mean
11. median
12. mode
13. C
14. A
15. B
16. B
17. C
18. linear graph
19. nonlinear graph

Directed Reading B

SECTION: TOOLS AND MODELS IN SCIENCE

1. D
2. A
3. Answers may vary. Sample answer: stopwatch, meterstick, spring scale, thermometer
4. Answers may vary. Sample answer: calculator, computer, pencil and graph paper
5. Answers may vary. Sample answer: three grains of barley placed end to end, the human foot
6. International System of Units (SI)
7. because all SI units are expressed in multiples of 10
8. C
9. D
10. B
11. A
12. C

13. A
14. B
15. D
16. liters
17. cubic centimeters
18. by dividing mass by volume
19. degrees Celsius, degrees Fahrenheit, kelvins
20. B
21. A
22. physical models, conceptual models, mathematical models
23. Answers may vary. Sample answer: model airplane, doll, drawing
24. a conceptual model
25. C
26. A
27. B
28. Answers may vary. Sample answer: The model can make highly inaccurate predictions.
29. Answers may vary. Sample answer: things that are very small or very large
30. Answers may vary. Sample answer: A coiled spring toy is often used as a model of sound waves.
31. A model is not exactly the same as the real object or system.
32. C
33. D
34. Answers may vary. Sample answer: Models can help scientists find information that supports a theory or shows that the theory is wrong.
35. law
36. Scientists may change the theory.
37. A law is a descriptive statement or equation that reliably predicts events under certain conditions.
38. A law tells you only what happens, not why it happens.
39. the law of conservation of mass

SECTION: ORGANIZING YOUR DATA

1. C
2. A
3. independent variable
4. in the first column
5. dependent variable
6. in the second column
7. Controlled parameters are factors that stay constant throughout the experiment. Variable parameters are factors that change throughout the experiment.
8. identify trends and make predictions
9. C
10. D
11. B
12. A
13. E
14. G
15. F
16. title
17. the independent and dependent variables
18. E
19. B
20. A
21. D
22. C
23. Answers may vary. Sample answer: Computers help scientists collect, organize, process, and display large amounts of data.

SECTION: ANALYZING YOUR DATA

1. A
2. Answers may vary. Sample answer: A meteorologist uses mathematics to see patterns in data. For example, a meteorologist could find patterns in hurricane data, then use these patterns to predict where future hurricanes might hit land.
3. because it allows scientists to easily share their findings with each other in a language that everyone understands
4. Answers may vary. Sample answer: The scientist might be using broken equipment, using the wrong tool, or using a tool incorrectly.
5. B
6. B
7. C
8. A
9. when one data point is much smaller or larger than the rest of the data points
10. slope
11. a vertical change
12. a horizontal change
13. by dividing the rise by the run

14. constant
15. k
16. B
17. A

Vocabulary and Section Summary A

SECTION: TOOLS AND MODELS IN SCIENCE

1. mass: a measure of the amount of matter in an object
2. volume: a measure of the size of an object or region in three-dimensional space
3. density: the ratio of the mass of a substance to the volume of the substance
4. temperature: a measure of how hot (or cold) something is; specifically, a measure of the average kinetic energy of the particles in an object
5. model: a pattern, plan, representation, or description designed to show the structure or workings of an object, system, or concept
6. theory: a system of ideas that explains many related observations and is supported by a large body of evidence acquired through scientific investigation
7. law: a descriptive statement or equation that reliably predicts events under certain conditions

SECTION: ORGANIZING YOUR DATA

1. independent variable: in an experiment, the factor that is deliberately manipulated
2. dependent variable: in an experiment, the factor that changes as a result of manipulation of one or more other factors (the independent variables)
3. axis: one of two or more reference lines that mark the borders of a graph

SECTION: ANALYZING YOUR DATA

1. mean: the number obtained by adding up the data for a given characteristic and dividing this sum by the number of individuals
2. median: the value of the middle item when data are arranged in order by size
3. mode: the most frequently occurring value in a data set
4. slope: a measure of the slant of a line; the ratio of rise over run

Vocabulary and Section Summary B

SECTION: TOOLS AND MODELS IN SCIENCE

Across

1. volume
4. density
6. law
7. temperature

Down

2. model
3. mass
5. theory

SECTION: ORGANIZING YOUR DATA

1. axis
2. independent variable
3. trend
4. dependent variable
5. controlled parameter
6. direct

SECTION: ANALYZING YOUR DATA

1. slope
2. mode
3. median
4. mean
5. rise
6. run

B	I	V	R	X	T	N	P	I	A	T	C	K	Q	W
A	W	I	L	W	R	C	M	R	X	R	E	N	P	I
D	S	X	K	C	S	G	K	R	G	I	S	D	U	A
E	A	E	O	O	Z	L	T	U	B	C	S	Y	S	R
B	J	X	J	Q	D	F	O	C	Z	X	X	F	J	R
X	M	Y	G	O	M	C	L	P	I	M	M	H	U	F
E	U	Z	E	Z	L	V	C	D	E	T	A	N	D	D
X	X	Z	U	W	U	L	I	S	E	V	Z	P	G	T
X	W	L	J	T	M	M	T	K	L	Y	L	G	O	Z
L	H	N	D	I	X	B	Q	Q	O	O	Y	M	Y	V
M	E	D	I	A	N	G	N	F	A	P	P	U	Z	Z
C	V	U	W	U	S	K	W	Q	Y	T	S	E	E	M
A	K	H	Q	E	S	K	L	P	X	P	X	I	Q	E
F	B	B	D	U	L	X	T	O	I	A	Q	M	V	A
P	Q	K	T	H	N	E	D	O	M	U	S	L	Q	N

Answer Key

Directed Reading A

SECTION: WHAT IS MATTER?

1. C
2. B
3. C
4. A
5. B
6. D
7. meniscus
8. cubic
9. volume
10. irregular solid
11. milliliter
12. cubic centimeters
13. B
14. C
15. B
16. D
17. C
18. D
19. A
20. mass
21. kilogram
22. newton

SECTION: PHYSICAL PROPERTIES

1. A
2. C
3. C
4. B
5. A
6. B
7. C
8. A
9. A
10. B
11. D
12. B
13. D
14. A
15. B
16. D
17. B
18. C
19. physical change
20. state
21. identity
22. B
23. C
24. C
25. B

SECTION: CHEMICAL PROPERTIES

1. chemical property
2. reactivity
3. flammability
4. nonflammability
5. B
6. C
7. A
8. B
9. D
10. C
11. property
12. change
13. B
14. C
15. A
16. C
17. D
18. B
19. B
20. A

Directed Reading B

SECTION: WHAT IS MATTER?

1. They are all made of matter.
2. Matter is anything that has mass and takes up space.
3. B
4. D
5. Volume is the amount of space taken up by an object (or the size of a region of space).
6. volume
7. meniscus
8. cubic
9. length, width, and height
10. Answers may vary. Sample answer: The volume could be measured by submerging the object in a graduated cylinder with water. The volume of water displaced is the volume of the object.
11. 8 cm^3
12. D
13. C
14. C

15. D
16. The only way to change the mass of an object is to change the amount of matter the object contains.
17. mass
18. weight
19. mass
20. weight
21. weight

SECTION: PHYSICAL PROPERTIES

1. B
2. C
3. D
4. A
5. F
6. C
7. B
8. E
9. G
10. physical property
11. density
12. $D = \frac{m}{V}$
13. density; volume; mass
14. volume
15. The density will not change because the density of a given substance remains the same no matter how much of it you have.
16. Answers may vary. Sample answer: because a substance's density is always the same at a given temperature and pressure and because each substance has a unique density
17. because 1 kg of lead would take up much less space than 1 kg of feathers
18. The object will sink.
19. Answers may vary. Sample answer: If you know the density of the substance, you can compare it with the density of water. If the density of the object is less than the density of water, it will float.
20. densities
21. The densest layer will settle on the bottom.
22. The layer with the least density will be found on top.
23. physical change
24. physical changes
25. PC
26. X
27. PC
28. PC
29. PC
30. PC
31. identity
32. Answers may vary. Sample answer: When matter undergoes a physical change, one or more physical properties are changed. For example, if a lump of copper is drawn out into a thin wire, its shape is changed, but not its identity.

SECTION: CHEMICAL PROPERTIES

1. C
2. A
3. B
4. D
5. B
6. Answers may vary. Sample answer: The burning changes wood to smoke and ashes.
7. chemical
8. characteristic
9. B
10. C
11. Answers may vary. Sample answer: Baking a cake involves chemical changes because the cake has completely different properties than its original ingredients.
12. Answers may vary. Sample answer: The creation of new substances with new properties shows that a chemical change is taking place. Other signs include fizzing or foaming, a change in color or odor, and the production of heat, sounds, or light.
13. liberates *(or releases)*
14. absorbs
15. chemical
16. Answers may vary. Sample answer: Some chemical changes can be reversed with more chemical changes. For example, the water formed in a space shuttle's rockets can later be split back into hydrogen and oxygen using an electric current.
17. B
18. A
19. C
20. CC
21. PC
22. CC

23. PC
24. CC
25. PC
26. PC

Vocabulary and Section Summary A

SECTION: WHAT IS MATTER?

1. matter: anything that has mass and takes up space
2. volume: a measure of the size of a body or region in three-dimensional space
3. meniscus: the curve at a liquid's surface by which one measures the volume of the liquid
4. mass: a measure of the amount of matter in an object
5. weight: a measure of the gravitational force exerted on an object; its value can change with the location of the object in the universe

SECTION: PHYSICAL PROPERTIES

1. physical property: a characteristic of a substance that does not involve a chemical change, such as density, color, or hardness
2. density: the ratio of the mass of a substance to the volume of the substance
3. physical change: a change of matter from one form to another without a change in chemical properties

SECTION: CHEMICAL PROPERTIES

1. chemical property: a property of matter that describes a substance's ability to participate in chemical reactions
2. chemical change: a change that occurs when one or more substances change into entirely new substances with different properties

Vocabulary and Section Summary B

SECTION: WHAT IS MATTER?

Across

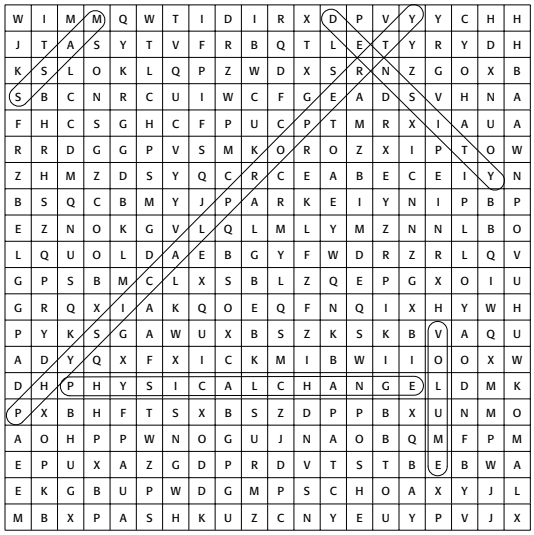
2. meniscus
3. weight
4. volume

Down

1. mass
2. matter

SECTION: PHYSICAL PROPERTIES

1. physical property
2. density
3. physical change
4. volume
5. mass



SECTION: CHEMICAL PROPERTIES

1. chemical property
2. reactivity
3. chemical change
4. characteristic properties
5. flammability
6. composition

Reinforcement

A MATTER OF DENSITY

1. Green liquid: 0.75 kg/L; Blue liquid: 0.9 kg/L; Red liquid: 1.2 kg/L; Black liquid: 0.8 kg/L
2. First (bottom): red; Second: blue; Third: black; Fourth (top): green
3. B
4. The layers of the diagram should be shaded/labeled in the following order from the top: green, black, blue, red.
5. Accept all reasonable answers. Sample answer: I could open the spigot at the bottom of the tank and let the red liquid out.

Critical Thinking

1. The cube's volume increased, and its mass remained the same.

Answer Key

Directed Reading A

SECTION: FOUR STATES OF MATTER

1. B
2. A
3. A
4. C
5. B
6. A
7. C
8. C
9. A
10. D
11. A
12. A
13. D
14. C

SECTION: CHANGES OF STATE

1. D
2. C
3. A
4. C
5. D
6. B
7. B
8. A
9. C
10. D
11. A
12. D
13. A
14. B
15. C
16. D
17. C
18. D
19. A
20. B

Directed Reading B

SECTION: FOUR STATES OF MATTER

1. A state of matter is a physical form in which a substance can exist.
2. The three most familiar states of matter are solid, liquid, and gas.
3. atoms, molecules
4. A
5. C
6. B
7. C
8. A solid is the state of matter that has a definite shape and volume.
9. The particles in the liquid move quickly and slide past each other until the liquid takes the shape of the glass.
10. It shows that even when liquids change shape, they don't change volume.
11. A gas is a state of matter that has no definite shape or volume.
12. The tank contains helium particles that are forced close together. As helium enters the balloons, the atoms spread out, and the amount of empty space in the gas increases.
13. plasma
14. Plasmas conduct electric current, while gases do not. Electric and magnetic fields affect plasmas but do not affect gases.
15. Answers may vary. Sample answer: natural plasma: lighting; artificial plasma: fluorescent lights

SECTION: CHANGES OF STATE

1. A
2. change of state
3. melting, freezing, evaporation, condensation, sublimation
4. No, gallium's melting point is lower than your body temperature. It would melt in your hand.
5. melting point
6. freezing point
7. If energy is added, melting occurs. If energy is removed, freezing occurs.
8. B
9. C
10. A
11. atmospheric pressure, boiling point
12. condensation
13. boiling point
14. clump together
15. Solid carbon dioxide is called "dry ice" because instead of melting, it changes from a solid directly into a gas through sublimation.

16. sublimation
17. temperature
18. change of state

Vocabulary and Section Summary A

SECTION: FOUR STATES OF MATTER

1. states of matter: the physical forms of matter, which include solid, liquid, and gas
2. solid: the state of matter in which the volume and shape of a substance are fixed
3. liquid: the state of matter that has a definite volume but not a definite shape
4. gas: a form of matter that does not have a definite volume or shape
5. plasma: in physical science, a state of matter that starts as a gas and then becomes ionized; it consists of free-moving ions and electrons, it takes on an electric charge, and its properties differ from the properties of a solid, liquid, or gas

SECTION: CHANGES OF STATE

1. change of state: the change of a substance from one physical state to another
2. melting: the change of state in which a solid becomes a liquid by adding heat
3. evaporation: the change of state from a liquid to a gas
4. boiling: the conversion of a liquid to a vapor when the vapor pressure of the liquid equals the atmospheric pressure
5. condensation: the change of state from a gas to a liquid
6. sublimation: the process in which a solid changes directly into a gas

Vocabulary and Section Summary B

SECTION: FOUR STATES OF MATTER

1. plasma
2. solids
3. gases
4. liquids
5. states of matter
6. the way its particles interact

SECTION: CHANGES OF STATE

1. melting
2. condensation
3. sublimation
4. boiling
5. evaporation
6. change of state

G	D	I	T	H	P	I	J	B	H	Y	P	N	A	X
G	K	G	T	O	A	W	P	A	O	K	O	X	B	S
N	R	W	I	S	E	B	J	L	S	I	K	J	F	N
O	P	Y	U	U	N	T	O	P	T	L	L	N	O	W
I	Y	A	F	Z	D	U	Y	A	V	B	Z	I	Y	W
T	O	I	S	O	N	I	M	Y	L	S	T	J	N	L
A	P	A	Z	G	V	I	V	X	G	A	G	Y	D	G
R	K	U	Y	K	L	U	U	A	S	F	U	K	Q	I
O	I	N	S	B	F	T	V	N	Y	J	M	Y	S	K
P	H	W	U	H	D	N	E	L	H	D	E	I	D	S
A	Z	S	B	P	B	D	K	W	O	P	L	N	Z	I
V	H	C	H	A	N	G	E	O	F	S	T	A	T	E
E	J	I	Y	O	Z	U	I	B	J	Z	I	Y	B	W
E	P	X	C	P	S	T	S	O	H	K	N	W	O	X
A	O	U	W	I	J	U	I	A	U	O	G	T	Y	T

Reinforcement

MAKE A STATE-MENT

Liquid: Particles are close together; changes shape when placed in a different container; does not change in volume

Gas: Particles break away completely from one another; changes shape when placed in a different container; amount of empty space can change; changes volume to fill its container

Solid: Particles are close together; particles vibrate in place; particles are held tightly in place by other particles; has definite shape; does not change in volume

Critical Thinking

1. Answers may vary. Sample answer: It may be necessary to carry oxygen in portable containers because oxygen will probably not surround the planet evenly.
2. Answers may vary. Sample answer: Yes, it would be possible to make a fire, but only for a short time. In areas where oxygen is not present, oxygen may have to be supplied to the fire manually. Also, the wood will sublime at high temperatures, leaving no fuel for the fire.

Answer Key

Directed Reading A

SECTION: ELEMENTS

1. C
2. B
3. A
4. A
5. B
6. B
7. A
8. C
9. D
10. elements
11. metals
12. nonmetals
13. metalloids
14. C
15. A
16. B
17. D
18. A
19. C
20. B

SECTION: COMPOUNDS

1. C
2. B
3. C
4. A
5. B
6. C
7. B
8. carbonic acid
9. carbon dioxide
10. chemical change
11. B
12. A
13. D
14. B

SECTION: MIXTURES

1. mixture
2. compound
3. identity
4. physical
5. A
6. D
7. B
8. C
9. A
10. D
11. B
12. A
13. B
14. soluble
15. solvent
16. alloy
17. particles
18. solution
19. B
20. A
21. C
22. D
23. D
24. solubility
25. temperature

Directed Reading B

SECTION: ELEMENTS

1. element
2. pure
3. atoms
4. characteristic properties
5. A helium-filled balloon will float up when released because helium is less dense than air.
6. N
7. CP
8. CP
9. N
10. N
11. N
12. CP
13. CP
14. CP
15. N
16. CP
17. Answers may vary. Sample answer: Terriers are small, and they have short hair.
18. nonmetals
19. metal
20. nonmetal
21. metalloids
22. C
23. A
24. B
25. B
26. C

27. A
28. B
29. A
30. A
31. C
32. B

SECTION: COMPOUNDS

1. Answers may vary. Sample answer: salt, water, and sugar
2. compound
3. elements
4. chemical reaction
5. B
6. C
7. Answers may vary. Sample answer: A compound has different properties from the elements that react to form it. Although sodium and chlorine are dangerous individually, they combine to form sodium chloride, a safe substance also known as table salt.
8. B
9. A
10. C
11. carbonic acid
12. carbon, oxygen, and hydrogen
13. chemical
14. aluminum oxide
15. carbon dioxide

SECTION: MIXTURES

1. mixture
2. compound
3. identity
4. Answers may vary. Sample answer: You can see each component in the pizza. Each component has the same chemical makeup as it did before the pizza was made.
5. physical
6. B
7. A
8. D
9. C
10. ratio
11. D
12. dissolving
13. solute; solvent (answers must be in this order)
14. soluble
15. solvent
16. alloy
17. Answers may vary. Sample answer: Particles in solution are so small that they can never settle out, cannot be removed or filtered out, and cannot scatter light.
18. D
19. A
20. concentration
21. Answers may vary. Sample answer: A dilute solution contains less solute than a concentrated solution does.
22. solubility

Vocabulary and Section Summary A

SECTION: ELEMENTS

1. element: a substance that cannot be separated or broken down into simpler substances by chemical means
2. pure substance: a sample of matter, either a single element or a single compound, that has definite chemical and physical properties
3. metal: an element that is shiny and that conducts heat and electricity well
4. nonmetal: an element that conducts heat and electricity poorly
5. metalloid: an element that has properties of both metals and nonmetals

SECTION: COMPOUNDS

1. compound: a substance made up of atoms of two or more different elements joined by chemical bonds

SECTION: MIXTURES

1. mixture: a combination of two or more substances that are not chemically combined
2. solution: a homogeneous mixture throughout which two or more substances are uniformly dispersed
3. solute: in a solution, the substance that dissolves in the solvent
4. solvent: in a solution, the substance in which the solute dissolves
5. concentration: the amount of a particular substance in a given quantity of a mixture, solution, or ore
6. solubility: the ability of one substance to dissolve in another at a given temperature and pressure

Answer Key

Directed Reading A

SECTION: DEVELOPMENT OF THE ATOMIC THEORY

1. D
2. D
3. C
4. A
5. D
6. B
7. positively
8. particles
9. electrons
10. A
11. A
12. B
13. A
14. B
15. C
16. D
17. A
18. D
19. C
20. B
21. B

SECTION: THE ATOM

1. A
2. C
3. E
4. D
5. C
6. A
7. B
8. C
9. electron
10. hydrogen
11. helium
12. neutrons
13. atomic number
14. element
15. periodic table
16. A
17. B
18. C
19. A
20. B
21. B
22. D
23. strong force
24. gravitational force
25. weak force
26. electromagnetic force

Directed Reading B

SECTION: DEVELOPMENT OF THE ATOMIC THEORY

1. D
2. atom
3. C
4. Dalton's results suggested that elements combine in specific proportions because they are made of atoms.
5. positively, negative
6. electrons
7. atom
8. A
9. Most of the particles passed right through the gold foil, some of the particles were deflected, and some of the particles bounced straight back.
10. D
11. Rutherford's model of the atom showed electrons surrounding the nucleus at a distance.
12. C
13. B
14. A
15. location around the nucleus
16. B
17. scanning tunneling electron microscope

SECTION: THE ATOM

1. F
2. D
3. E
4. A
5. C
6. B
7. hydrogen, proton, electron (no particular order for proton and electron)
8. nucleus
9. helium
10. protons and neutrons (either order)
11. atomic number
12. A
13. B
14. B

15. C
16. isotopes
17. atomic mass
18. C
19. A
20. D
21. B

Vocabulary and Section Summary A

SECTION: DEVELOPMENT OF THE ATOMIC THEORY

1. atom: the smallest unit of an element that maintains the properties of that element
2. electron: a subatomic particle that has a negative charge
3. nucleus: in physical science, an atom's central region, which is made up of protons and neutrons
4. electron cloud: a region around the nucleus of an atom where electrons are likely to be found

SECTION: THE ATOM

1. proton: a subatomic particle that has a positive charge and that is located in the nucleus of an atom; the number of protons in the nucleus is the atomic number, which determines the identity of an element
2. atomic mass unit: a unit of mass that describes the mass of an atom or molecule
3. neutron: a subatomic particle that has no charge and that is located in the nucleus of an atom
4. atomic number: the number of protons in the nucleus of an atom; the atomic number is the same for all atoms of an element
5. isotope: an atom that has the same number of protons (or the same atomic number) as other atoms of the same element do but that has a different number of neutrons (and thus a different atomic mass)
6. mass number: the sum of the numbers of protons and neutrons in the nucleus of an atom
7. atomic mass: the mass of an atom expressed in atomic mass units

Vocabulary and Section Summary B

SECTION: DEVELOPMENT OF THE ATOMIC THEORY

Across

6. plum pudding model

Down

1. electron cloud
2. electron
3. nucleus
4. atom
5. orbitals

SECTION: THE ATOM

1. atomic mass
2. proton
3. neutron
4. isotopes
5. atomic number
6. atomic mass unit
7. mass number

Reinforcement

ATOMIC TIMELINE

A. Rutherford, 1909–1911
B. Rutherford, 1909–1911
C. Thomson, 1897
D. Bohr, 1913
E. Dalton, 1803
F. Thomson, 1897
G. Rutherford, 1909–1911
H. Democritus, 440 BCE
I. Dalton, 1803
J. Bohr, 1913
K. Schrödinger and Heisenberg, 20th century
L. Thomson, 1897
M. Rutherford, 1909–1911
N. Dalton, 1803
O. Schrödinger and Heisenberg, 20th century
P. Democritus, 440 BCE
Q. Rutherford, 1909–1911
R. Dalton, 1803

Critical Thinking

1. Because the nucleus is positively charged, the suit also must have been positively charged to create this repulsion.

Answer Key

Directed Reading A

SECTION: ARRANGING THE ELEMENTS

1. D
2. A
3. C
4. B
5. C
6. A
7. C
8. C
9. A
10. periodic table
11. nonmetals
12. metals
13. semimetals
14. mendelevium
15. californium
16. chemical symbol
17. B
18. C
19. C
20. B
21. B
22. D
23. A
24. D
25. B

SECTION: GROUPING THE ELEMENTS

1. C
2. D
3. B
4. A
5. D
6. D
7. B
8. A
9. C
10. A
11. C
12. aluminum
13. metal
14. boron
15. oxygen
16. nonmetal
17. carbon
18. silicon
19. tin
20. B
21. D
22. A
23. B
24. C
25. C
26. A
27. B
28. B
29. C
30. C
31. A
32. C

Directed Reading B

SECTION: ARRANGING THE ELEMENTS

1. Answers may vary. Sample answer: Scientists might have been frustrated because the elements weren't organized, and therefore their properties couldn't be predicted.
2. D
3. periodic
4. periodic
5. Mendeleev was able to predict the properties of unknown elements by using the pattern of properties in the periodic table.
6. D
7. A
8. C
9. Chemical symbols are color coded on the periodic table according to the element's physical state at room temperature. The color of the chemical symbol for carbon is red, which corresponds to a solid.
10. properties
11. electrons
12. Answers may vary. Sample answer: The zigzag line can help me recognize which elements are metals, which are nonmetals, and which are metalloids.
13. metals
14. solid
15. mercury
16. nonmetals
17. metalloids

18. Answers may vary. The first answer should be an element named after a person, and the second should be an element named after a place. Sample answer: mendelevium; californium
19. chemical symbol
20. period
21. group; family
22. B
23. C
24. law

SECTION: GROUPING THE ELEMENTS

1. C
2. D
3. B
4. alkali
5. alkaline-earth
6. cement and chalk
7. Answers may vary. Sample answer: Calcium is an important part of a compound that keeps your bones and teeth healthy.
8. Answers may vary. Accept three from this list: beryllium, magnesium, strontium, barium, and radium.
9. B
10. transition
11. lanthanides; actinides
12. Mercury is in a liquid state at room temperature.
13. aluminum
14. Answers may vary. Sample answer: Aluminum is used in making aircraft parts, lightweight automobile parts, foil, cans, and siding.
15. Answers may vary. Sample answer: proteins, fats, and carbohydrates
16. silicon; germanium (order may be reversed)
17. diamond
18. Answers may vary. Sample answer: used as a jewel and on cutting tools, such as saws, drills, and files
19. soot
20. gas
21. five
22. hydrogen
23. Answers may vary. Sample answer: Oxygen is a gas at room temperature. The other four elements in Group 16 are solid at room temperature.
24. sulfur
25. Answers may vary. Sample answer: Oxygen is important because it makes up about 20% of the air we breathe and is important to most living things. It is also necessary for substances to burn.
26. halogens
27. Both are used as disinfectants.
28. salts; Second part of answer may vary. Sample answers: sodium, potassium
29. C
30. inert
31. noble
32. density
33. D

Vocabulary and Section Summary A

SECTION: ARRANGING THE ELEMENTS

1. periodic: describes something that occurs or repeats at regular intervals
2. period: in chemistry, horizontal row of elements in the periodic table
3. group: a vertical column of elements in the periodic table; elements in a group share chemical properties
4. periodic law: the law that states that the repeating chemical and physical properties of elements change periodically with the atomic numbers of the elements

SECTION: GROUPING THE ELEMENTS

1. alkali metal: one of the elements of Group 1 of the periodic table (lithium, sodium, potassium, rubidium, cesium, and francium)
2. alkaline-earth metal: one of the elements of Group 2 of the periodic table (beryllium, magnesium, calcium, strontium, barium, and radium)
3. halogen: one of the elements of Group 17 of the periodic table (fluorine, chlorine, bromine, iodine, and astatine); halogens combine with most metals to form salts
4. noble gas: one of the elements of Group 18 of the periodic table (helium, neon, argon, krypton, xenon, and radon); noble gases are unreactive

Answer Key

Directed Reading A

SECTION: ELECTRONS AND CHEMICAL BONDING

1. A
2. A
3. B
4. C
5. D
6. C
7. atomic number
8. energy levels
9. group
10. valence electron
11. B
12. D
13. electrons
14. eight
15. two
16. helium

SECTION: IONIC BONDS

1. B
2. A
3. A
4. B
5. A
6. ion
7. energy
8. positive ions
9. valence electrons
10. negative ions
11. B
12. C
13. C
14. A
15. D
16. C
17. B

SECTION: COVALENT AND METALLIC BONDS

1. B
2. A
3. D
4. A
5. B
6. A
7. B
8. A
9. A
10. A
11. diatomic
12. complex
13. carbon
14. four
15. metallic bond
16. electrons
17. C
18. C
19. C
20. B
21. A
22. D

Directed Reading B

SECTION: ELECTRONS AND CHEMICAL BONDING

1. A
2. C
3. B
4. chemical bonding
5. models
6. B
7. C
8. A
9. B
10. C
11. A
12. Valence electrons (electrons in the outermost energy level) make bonds.
13. Answers may vary. Sample answer: Atoms of elements in Groups 1 and 2 have the same number of valence electrons as their group number. Atoms of elements of Groups 13–18 have 10 fewer valence electrons than their group number, except for helium, which has only 2 valence electrons.
14. B
15. D
16. 8
17. 2
18. 2
19. They already have a full outer energy level.
20. an atom with fewer than 8 electrons

21. Answers may vary. Sample answer: An atom of sulfur has 6 valence electrons. It can get 8 by sharing 2 electrons with or gaining 2 electrons from other atoms. An atom of magnesium has 2 valence electrons. It can get 8 by losing 2 electrons.

SECTION: IONIC BONDS

1. ionic bond
2. ions
3. protons
4. The number of electrons equals the number of protons, so the charges cancel each other out.
5. The number of electrons changes but the number of protons stays the same, so the negative and positive charges no longer cancel each other out. It then becomes an ion.
6. A
7. valence electrons
8. ion
9. 3+
10. Na^{3+}
11. energy
12. the formation of negative ions
13. B
14. C
15. C
16. 17
17. when they gain electrons
18. The nonmetal must release more energy than is needed to take electrons from the metal.
19. The charges of the ions cancel each other out.
20. crystal lattice
21. Answers may vary. Answers should include three of the following: brittleness, high melting point, high boiling point, high solubility in water.

SECTION: COVALENT AND METALLIC BONDS

1. A
2. D
3. electron-dot diagram
4. a molecule
5. Answers may vary. Sample answer: Diatomic molecules are molecules made up of two atoms. Elements found in nature as diatomic molecules are diatomic elements. An example is oxygen.
6. Answers may vary. Sample answer: soap and plastic
7. metallic bond
8. Metal atoms are so close together that their outermost energy levels overlap.
9. Answers may vary. Sample answer: When you turn on a lamp, electrons move within the copper wire to the outlet. The electrons that move are the valence electrons in the copper atoms.
10. ductility
11. malleability
12. Answers may vary. Sample answer: The piece does not break because the positively charged ions are attracted to the electrons in the metal, even if they move. So, the moving electrons can hold the metallic bond even if the shape of the metal changes.

Vocabulary and Section Summary A

SECTION: ELECTRONS AND CHEMICAL BONDING

1. chemical bonding: the combining of atoms to form molecules or ionic compounds
2. chemical bond: an interaction that holds atoms or ions together
3. valence electron: an electron that is found in the outermost shell of an atom and that determines the atom's chemical properties

SECTION: IONIC BONDS

1. ionic bond: the attractive force between oppositely charged ions, which form when electrons are transferred from one atom to another
2. ion: a charged particle that forms when an atom or group of atoms gains or loses one or more electrons
3. crystal lattice: the regular pattern in which a crystal is arranged

SECTION: COVALENT AND METALLIC BONDS

1. covalent bond: a bond formed when atoms share one or more pairs of electrons

Answer Key

Directed Reading A

SECTION: FORMING NEW SUBSTANCES

1. C
2. B
3. A
4. A
5. chemical reaction
6. precipitate
7. B
8. chemical bond
9. molecules
10. substances
11. diatomic
12. A
13. B
14. D
15. C

SECTION: CHEMICAL FORMULAS AND EQUATIONS

1. B
2. A
3. A
4. D
5. B
6. A
7. C
8. C
9. chemical equation
10. reactant
11. product
12. D
13. C
14. A
15. C
16. B
17. C
18. C

Directed Reading B

SECTION: FORMING NEW SUBSTANCES

1. chlorophyll
2. Answers may vary. Sample answer: The green chlorophyll breaks down to form new substances that have different colors. When chlorophyll is no longer present, the other pigments can be seen.
3. chemical reaction
4. They differ in chemical and physical properties.
5. precipitate
6. B
7. C
8. D
9. A
10. physical, chemical
11. The most important sign that a chemical reaction is occurring is the formation of new substances that have different properties.
12. A chemical bond is a force that holds two atoms together in a molecule.
13. Answers may vary. Sample answer: In a chemical reaction, the bonds between atoms in molecules break, the atoms rearrange, and new chemical bonds form. The new arrangement of atoms results in new substances with different properties.
14. Answers may vary. Sample answer: If molecules bump into each other with enough energy, chemical bonds break.
15. two
16. hydrogen chloride
17. released; required (or taken in)
18. Answers may vary. Sample answer: light energy, heat, electrical energy
19. It states that energy cannot be created or destroyed but can be changed from one form to another.

SECTION: CHEMICAL FORMULAS AND EQUATIONS

1. 100
2. chemical formula
3. A chemical formula shows how many atoms of each kind are present in a molecule.
4. A
5. A
6. C
7. B
8. nonmetals
9. N_2O

10. CO_2
11. metal, nonmetal
12. zero
13. NaCl
14. $MgCl_2$
15. Answers may vary. Sample answer: They both use symbols to communicate information in ways that are easy to understand by people who can read those symbols, no matter what language they speak.
16. chemical equation
17. product
18. reactant
19. product
20. The equation will not correctly describe the reaction.
21. atoms
22. law of conservation of mass
23. The law of conservation of mass states that mass cannot be created or destroyed in ordinary chemical and physical changes.
24. atoms
25. coefficient
26. two
27. coefficients, subscripts

Vocabulary and Section Summary A

SECTION: FORMING NEW SUBSTANCES

1. chemical reaction: the process by which one or more substances change to produce one or more different substances
2. precipitate: a solid that is produced as a result of a chemical reaction in solution
3. exothermic reaction: a chemical reaction in which heat is released to the surroundings
4. endothermic reaction: a chemical reaction that requires heat
5. law of conservation of energy: the law that states that energy cannot be created or destroyed but can be changed from one form to another

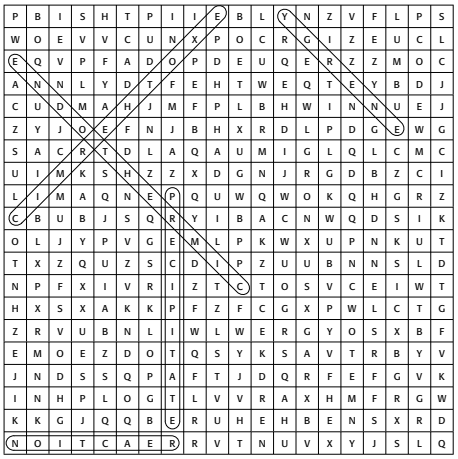
SECTION: CHEMICAL FORMULAS AND EQUATIONS

1. chemical formula: a combination of chemical symbols and numbers to represent a substance
2. chemical equation: a representation of a chemical reaction that uses symbols to show the relationship between the reactants and the products
3. reactant: a substance or molecule that participates in a chemical reaction
4. product: a substance that forms in a chemical reaction
5. law of conservation of mass: the law that states that mass cannot be created or destroyed in ordinary chemical and physical changes

Vocabulary and Section Summary B

SECTION: FORMING NEW SUBSTANCES

1. endothermic
2. reaction
3. energy
4. exothermic
5. precipitate



SECTION: CHEMICAL FORMULAS AND EQUATIONS

1. product
2. chemical formula
3. chemical equation
4. reactant
5. law of conservation of mass

Answer Key

Directed Reading A

SECTION: IONIC AND COVALENT COMPOUNDS

1. B
2. D
3. ions
4. ionic compounds
5. metals
6. sodium chloride
7. B
8. D
9. ionic compounds
10. solids
11. B
12. C
13. B
14. C
15. C
16. B
17. B
18. A
19. C
20. B
21. C

SECTION: ACIDS AND BASES

1. B
2. D
3. C
4. acids
5. citric
6. corrosive
7. D
8. A
9. D
10. B
11. C
12. C
13. B
14. D
15. A
16. B
17. C
18. A
19. D
20. B
21. D
22. D
23. B
24. C
25. A

SECTION: SOLUTIONS OF ACIDS AND BASES

1. C
2. D
3. A
4. C
5. neutralization
6. water
7. salt
8. C
9. B
10. A
11. B
12. B
13. B
14. A
15. C
16. B
17. D
18. B
19. C
20. A
21. C
22. B
23. A

Directed Reading B

SECTION: IONIC AND COVALENT COMPOUNDS

1. B
2. A
3. B
4. A
5. C
6. B
7. A
8. B
9. C
10. C
11. C
12. The ions are charged and able to move freely past one another.
13. D
14. C
15. The substance doesn't dissolve or mix well in water.

16. The attraction between water molecules is stronger than their attraction to covalent molecules.
17. The forces of attraction within covalent compounds are weaker than the forces of attraction within ionic compounds, so covalent compounds melt at lower temperatures.
18. Sugar does not form ions when it dissolves in water, so there are no charged particles to conduct electric current in the solution.

SECTION: ACIDS AND BASES

1. B
2. B
3. B
4. C
5. C
6. A
7. C
8. B
9. D
10. C
11. B
12. A
13. D
14. C
15. E
16. D
17. C
18. B
19. C
20. A
21. C
22. B
23. A
24. C

SECTION: SOLUTIONS OF ACIDS AND BASES

1. A
2. D
3. A
4. C
5. B
6. D
7. A
8. B
9. A
10. pH
11. hydronium
12. C
13. A
14. B
15. Answers may vary, and may include three of the following: lemon juice, soft drink, milk, human saliva, acid rain, clear rain, human stomach contents.
16. Answers may vary, and may include three of the following: sea water, detergents, household ammonia, tap water.
17. Answers may vary. Sample answer: pH paper, a pH meter
18. 4–6
19. 8–9
20. about 7
21. Answers may vary. Sample answer: Rainwater reacts with compounds in polluted air, creating acids and lowering rainwater's pH. This acid rain collects in lakes and streams, killing fish and other organisms.
22. water and a salt
23. A salt is an ionic compound formed from the positive ion of a base and the negative ion of an acid.
24. Answers may vary. Sample answer: sodium chloride, to season food; sodium nitrate, to preserve food; calcium sulfate, to make wallboard

Vocabulary and Section Summary A

SECTION: IONIC AND COVALENT COMPOUNDS

1. chemical bond: an interaction that holds atoms or ions together
2. ionic compound: a compound made of oppositely charged ions
3. covalent compound: a chemical compound that is formed by the sharing of electrons

SECTION: ACIDS AND BASES

1. acid: any compound that increases the number of hydronium ions when dissolved in water
2. indicator: a compound that can reversibly change color depending on conditions such as pH
3. base: any compound that increases the number of hydroxide ions when dissolved in water

Answer Key

Directed Reading A

SECTION: ELEMENTS IN LIVING THINGS

1. A
2. C
3. D
4. D
5. B
6. A
7. C
8. double bond
9. petroleum
10. single bond
11. triple bond
12. B
13. B
14. D
15. C

SECTION: COMPOUNDS OF LIVING THINGS

1. A
2. carbohydrates
3. polymer
4. simple
5. complex
6. B
7. A
8. D
9. proteins
10. hemoglobin
11. amino acids
12. proteins
13. nucleic acids
14. nucleotides
15. C
16. B
17. A
18. C
19. D
20. A

Directed Reading B

SECTION: ELEMENTS IN LIVING THINGS

1. Carbon atoms can form long chains with other carbon atoms, and carbon atoms can also bond with atoms of other elements.
2. four
3. four
4. the atoms are connected
5. organic compound
6. C
7. D
8. A
9. B
10. organic (or carbon-based) compounds
11. carbon, hydrogen, oxygen, nitrogen, sulfur, and phosphorus (answers may be in any order)
12. form lots of different compounds
13. Answers may vary. Answers should include two types of manufactured organic compounds, which may include the following: medicines, drugs, vitamins, hormones, and other supplements.

SECTION: COMPOUNDS OF LIVING THINGS

1. D
2. B
3. A
4. B
5. C
6. C
7. A
8. B
9. C
10. Answers should include any three of the following: regulate chemical processes; control blood-sugar levels; carry oxygen to cells throughout the body; build and repair body structures.
11. nucleic acids
12. nucleotides
13. Each living thing has a different order of nucleotides.
14. the blueprints of life
15. Answers may vary. Sample answer: The two main kinds of nucleic acids are DNA and RNA. DNA is the genetic material of the cell. RNA is involved in building proteins needed by the cell.

Answer Key

Directed Reading A

SECTION: MEASURING MOTION

1. B
2. A
3. D
4. A
5. B
6. D
7. speed
8. average speed
9. meters
10. D
11. B
12. C
13. B
14. C
15. A
16. acceleration
17. positive
18. negative
19. deceleration
20. D
21. A

SECTION: WHAT IS A FORCE?

1. force
2. direction, magnitude [order may be reversed]
3. newton
4. B
5. D
6. B
7. B
8. D
9. A
10. D
11. A
12. B
13. tension
14. compression
15. balanced
16. unbalanced
17. velocity
18. static
19. force
20. C
21. C

SECTION: FRICTION: A FORCE THAT OPPOSES MOTION

1. C
2. D
3. B
4. A
5. B
6. A
7. B
8. moving
9. sliding
10. rolling
11. A
12. D
13. A
14. C
15. B
16. A
17. C
18. B
19. D
20. A
21. C

Directed Reading B

SECTION: MEASURING MOTION

1. Answers may vary. Sample answer: I cannot see Earth moving, yet I know it moves (revolves) around the sun.
2. A
3. D
4. reference points
5. Answers may vary. Sample answer: buildings; trees
6. Moving objects can also be used as reference points.
7. x
8. distance
9. m/s, or meters per second
10. Answers may vary. Sample answer: miles per hour; feet per second
11. Average speed equals the total distance traveled divided by the total time taken to travel that distance. Equation form: *average speed* = *total distance* ÷ *total time*
12. time
13. The distance varies because the speed is not constant.

14. The birds would end up at different destinations if they were traveling in different directions.
15. Velocity includes direction; speed does not include direction.
16. In order for an object's velocity to change, the object's speed, direction, or both must change.
17. velocity
18. acceleration
19. second
20. positive
21. negative acceleration; deceleration
22. because it is always changing direction
23. centripetal
24. time
25. Answers may vary. Sample answers: because the car's speed increases as time passes; because the line between 0 s and 5 s is sloping upward
26. Answers may vary. Sample answer: The speed of the car is constant between 5 s and 7 s because the slope of the graph is zero.

SECTION: WHAT IS A FORCE?

1. force
2. direction, magnitude [order may be reversed]
3. newton
4. objects
5. Answers may vary. Sample answer: I exert a force on a book when I pull it open; I exert a force when I press the keys of a computer keyboard.
6. Answers may vary. Sample answer: When I sit on a chair, the force I exert on the chair does not make it move.
7. net force
8. Add the forces together to determine the net force.
9. Subtract the smaller force from the larger force.
10. The net force must be 0 N.
11. tension
12. 0 [zero]
13. an unbalanced force
14. Answers may vary. Sample answer: A soccer ball that has been kicked continues to roll on the ground long after it is kicked.
15. Answers may vary. Sample answer: twirling a ball on a string

SECTION: FRICTION: A FORCE THAT OPPOSES MOTION

1. an unbalanced force
2. friction
3. Answers may vary. Sample answer: the force pushing the surfaces together and the roughness of the surfaces
4. The hills and valleys of the surfaces come into closer contact, and friction between the surfaces increases.
5. less
6. greater
7. B
8. C
9. sliding kinetic friction; rolling kinetic friction [order may be reversed]
10. sliding kinetic friction
11. Answers may vary. Sample answer: applying the brakes on a bicycle
12. Answers may vary. Sample answer: putting a heavy piece of furniture on wheels and rolling it
13. static
14. kinetic friction
15. erosion
16. a lubricant
17. Answers may vary. Sample answer: Use lubricants; switch from sliding kinetic friction to rolling kinetic friction; make surfaces that rub against each other smoother.
18. Answers may vary. Sample answer: Make surfaces rougher; increase the force pushing the surfaces together.

Vocabulary and Section Summary A

SECTION: MEASURING MOTION

1. motion: an object's change in position relative to a reference point
2. average speed: the total distance traveled divided by the total time taken
3. velocity: the speed of an object in a particular direction
4. acceleration: the rate at which velocity changes over time; an object accelerates if its speed, direction, or both change

Answer Key

Directed Reading A

SECTION: GRAVITY: A FORCE OF ATTRACTION

1. B
2. D
3. C
4. B
5. B
6. B
7. C
8. A
9. C
10. D
11. B
12. C
13. D
14. B
15. C
16. A
17. B
18. A

SECTION: GRAVITY AND MOTION

1. B
2. A
3. A
4. B
5. C
6. A
7. B
8. C
9. A
10. D
11. D
12. B
13. A
14. B
15. B
16. A
17. D
18. C
19. C
20. D
21. A
22. C
23. A

SECTION: NEWTON'S LAWS OF MOTION

1. B
2. D
3. C
4. D
5. A
6. D
7. D
8. D
9. B
10. A
11. B
12. B
13. D
14. D
15. B
16. B
17. A

Directed Reading B

SECTION: GRAVITY: A FORCE OF ATTRACTION

1. The moon has less gravity than Earth.
2. gravity
3. The force of gravity can change the motion of an object by changing its velocity (speed, direction, or both).
4. All matter is affected by gravity because all matter has mass.
5. gravity
6. The mass of most objects is too small to cause a force large enough to move objects toward each other.
7. Earth has an enormous mass, so its gravitational force is very large. Therefore, objects are pulled by Earth's gravity toward Earth's center rather than being pulled by a smaller force of gravity toward smaller objects.
8. The two questions were: (1) why do objects fall toward Earth? and (2) what keeps the planets moving in the sky?

9. Newton proposed that the same unbalanced force that pulled an apple toward Earth was the same unbalanced force that kept the moon in orbit around Earth.
10. the law of universal gravitation
11. All objects in the universe attract each other through gravitational force. The size of the force depends on the masses of the objects and the distance between objects.
12. Answers may vary. Sample answer: Gravitational force increases as mass increases. An elephant has a larger mass than a cat does, so the amount of gravity between an elephant and Earth is greater than the amount of gravity between a cat and Earth.
13. Since the moon has less mass than Earth does, the moon's gravitational force is less than Earth's. Astronauts on the moon are not being pulled down by as much force as they would be on Earth.
14. Gravitational force is small between objects that have small masses and large when the mass of both objects is large.
15. Answers may vary. Sample answer: Gravitational force decreases as distance increases. I am 150 million kilometers away from the sun, and at this distance, the gravitational force between me and the sun is very small.
16. Answers may vary. Sample answer: Gravitational force is strong when the distance between two objects is small, but as the distance between two objects increases, gravitational force decreases rapidly.
17. C
18. A
19. A
20. Gravitational force is about the same everywhere on Earth, so the weight of an object is about the same everywhere. Since mass and weight are both constant on Earth, the words *mass* and *weight* are often used to mean the same thing.
21. Answers may vary. Sample answer: The gravity on the picture is balanced by elastic forces due to compression in the shelf.

SECTION: GRAVITY AND MOTION

1. According to Aristotle, the baseball would land first. He thought the rate at which an object falls depends on its mass.
2. Galileo Galilei
3. The acceleration due to gravity is the same for all objects.
4. force and mass
5. a heavier object
6. because it has more mass
7. The extra mass of the heavy object exactly makes up for the additional gravitational force.
8. acceleration
9. 9.8 meters per second per second (9.8 m/s/s, or 9.8 m/s^2)
10. $v = g \times t$
11. D
12. size, shape, speed
13. net force
14. terminal
15. Hailstones would hit Earth at velocities near 350 m/s.
16. free fall
17. Free fall occurs only when no other force but gravity is acting on an object. Since air resistance is a force, free fall can only occur when there is no air.
18. in outer space, in a vacuum
19. B
20. A
21. B
22. C
23. A
24. D
25. A
26. C
27. orbiting
28. forward movement and free fall
29. Centripetal force is the unbalanced force that causes objects to move in an elliptical or circular path. The word *centripetal* means "toward the center."
30. gravity

SECTION: NEWTON'S LAWS OF MOTION

1. the relationship between force and the motion of an object

2. An object at rest remains at rest, and an object in motion remains in motion at a constant speed and in a straight line unless acted on by an unbalanced force.
3. Newton's first law of motion
4. Answers may vary. Sample answer: a chair on the floor and a golf ball balanced on a tee
5. Answers may vary. Sample answer: A chair will slide across the room if you push it.
6. They will continue to move forever.
7. Answers may vary. Sample answer: I would continue to move. Although the bumper car would be stopped by the unbalanced force created by another bumper car, I would continue to move until another unbalanced force (such as from a seat belt) stopped me.
8. friction
9. Friction changes the motion of objects by slowing them down.
10. the law of inertia
11. inertia
12. Mass is a measure of inertia. An object that has a small mass has less inertia than an object that has a large mass does. So, changing the motion of an object that has a small mass is easier than changing the motion of an object that has a large mass.
13. The acceleration of an object depends on the mass of the object and the amount of force applied.
14. Its acceleration increases.
15. Its acceleration increases.
16. Objects accelerate in the same direction as the net force applied.
17. An object's acceleration increases as the force on the object increases.
18. Whenever an object exerts a force on a second object, the second object exerts an equal and opposite force on the first.
19. Answers may vary. Sample answer: For each force that acts on an object, another force occurs that is equal to the first force and is exerted in the opposite direction. In this way, every force is paired with an opposing force.
20. The action force is your weight pushing down on the chair. The reaction force is the force of the chair pushing up on your body.
21. When a force is exerted, there is always a reaction force.
22. It is hard to see the effect of the reaction force, which is Earth being pulled upward, because Earth's mass is so much larger than the ball's mass. Earth's acceleration is therefore so small that you can't see or feel it.

Vocabulary and Section Summary A

SECTION: GRAVITY: A FORCE OF ATTRACTION

1. gravity: a force of attraction between objects that is due to their masses
2. weight: a measure of the gravitational force exerted on an object; its value can change with the location of the object in the universe
3. mass: a measure of the amount of matter in an object

SECTION: GRAVITY AND MOTION

1. terminal velocity: the constant velocity of a falling object when the force of air resistance is equal in magnitude and opposite in direction to the force of gravity
2. free fall: the motion of a body when only the force of gravity is acting on the body
3. projectile motion: the curved path that an object follows when thrown, launched, or otherwise projected near the surface of Earth

SECTION: NEWTON'S LAWS OF MOTION

1. inertia: the tendency of an object to resist being moved or, if the object is moving, to resist a change in speed or direction until an outside force acts on the object

Answer Key

Directed Reading A

SECTION: FLUIDS AND PRESSURE

1. fluid
2. liquids
3. move
4. increases
5. pressure
6. pascal
7. force
8. D
9. D
10. C
11. A
12. B
13. D
14. B
15. A
16. A
17. D
18. C
19. C
20. D
21. B
22. B
23. D
24. A
25. D

SECTION: BUOYANCY AND DENSITY

1. C
2. depth
3. Archimedes' principle
4. weight
5. sink
6. float
7. A
8. B
9. C
10. A
11. A
12. B
13. C
14. B
15. B
16. D
17. B
18. D
19. C
20. A
21. B
22. B

Directed Reading B

SECTION: FLUIDS AND PRESSURE

1. fluid
2. liquids and gases
3. They can move easily past each other.
4. Answers may vary. Sample answer: You pump in air particles that collide against each other and against the inside of the tire. The forces of the particles in these collisions creates pressure.
5. pressure
6. pressure
7. pascal
8. pascal
9. Answers may vary. Sample answer: The air inside the bubble exerts equal pressure in all directions, so the bubble expands equally in all directions and creates a round shape.
10. B
11. C
12. D
13. A
14. Answers may vary. Sample answer: The farther down you go through the atmosphere, the greater the pressure is.
15. 3
16. 4
17. 2
18. 5
19. 1
20. Answers may vary. Sample answer: The pressure on my eardrums changes as atmospheric pressure changes. The fluids in my body have to adjust to maintain equal pressure.
21. C
22. D
23. B
24. A
25. density

26. Answers may vary. Sample answer: Water exerts more pressure than air because water is more dense than air and therefore weighs more.
27. 5,000
28. 80,000
29. Answers may vary. Sample answer: As I sip, I remove some of the air in the straw, causing the pressure in the straw to drop. The greater pressure outside the straw pushes on the liquid and forces it up through the straw.
30. Air flows into the lungs.
31. Fluids flow from areas of high pressure to areas of low pressure.
32. Answers may vary. Sample answer: Air pressure inside a tornado is much lower than the air pressure outside the tornado. This difference creates a vacuum-cleaner type of effect, so air and objects are pushed into the tornado.

SECTION: BUOYANCY AND DENSITY

1. buoyant force
2. bottom
3. Archimedes' principle states that the buoyant force on an object in a fluid is an upward force that is equal to the weight of the volume of fluid that the object displaces.
4. buoyant force
5. B
6. A
7. D
8. A
9. C
10. B
11. Answers may vary. Sample answer: A rock is more dense than water. As a result, the weight of the fluid the rock displaces weighs less than the rock does, so the rock sinks.
12. The ice cube floats because it is less dense than water.
13. The balloon floats because helium is less dense than air.
14. A
15. A
16. volume, density
17. sink
18. Answers may vary. Sample answer: Ballast tanks control density by filling with air so the submarine can float, or filling with water so the submarine can dive below the surface.
19. Compressed air is used to blow water out of ballast tanks so the submarine can rise.
20. Answers may vary. Sample answer: As the swim bladder fills with gases, the fish's overall density decreases and the fish rises. As the swim bladder empties of gases, the fish's overall density increases and the fish sinks.
21. Fish without swim bladders must swim constantly to keep from sinking.

Vocabulary and Section Summary A

SECTION: FLUIDS AND PRESSURE

1. fluid: a nonsolid state of matter in which the atoms or molecules are free to move past each other, as in a gas or liquid
2. pressure: the amount of force exerted per unit area of a surface
3. pascal: the SI unit of pressure (symbol, Pa)
4. atmospheric pressure: the pressure caused by the weight of the atmosphere

SECTION: BUOYANCY AND DENSITY

1. buoyant force: the upward force that keeps an object immersed in or floating on a liquid
2. Archimedes' principle: the principle that states that the buoyant force on an object in a fluid is an upward force equal to the weight of the volume of fluid that the object displaces

Vocabulary and Section Summary B

SECTION: FLUIDS AND PRESSURE

1. atmosphere
2. density
3. fluid
4. atmospheric
5. pascal
6. pressure

Answer Key

Directed Reading A

SECTION: STARS

1. B
2. C
3. A
4. C
5. A
6. D
7. continuous spectrum
8. emission lines
9. D
10. B
11. A
12. B
13. A
14. C
15. A
16. D
17. C
18. B
19. A
20. A
21. B
22. B
23. apparent magnitude
24. absolute magnitude
25. light-year
26. parallax
27. A
28. C

SECTION: THE LIFE CYCLE OF STARS

1. B
2. D
3. C
4. D
5. A
6. B
7. D
8. B
9. A
10. B
11. D
12. C
13. D
14. C
15. B
16. A
17. supernova
18. neutron star
19. pulsar
20. black hole

SECTION: GALAXIES

1. D
2. C
3. D
4. A
5. B
6. B
7. C
8. D
9. B
10. B
11. B
12. B

SECTION: FORMATION OF THE UNIVERSE

1. D
2. B
3. A
4. D
5. B
6. A
7. C
8. C
9. B
10. A
11. C
12. C
13. C
14. C
15. B
16. D

Directed Reading B

SECTION: STARS

1. Answers may vary. Sample answer: A star is a huge, hot, bright ball of gas.
2. starlight
3. A
4. Stars that differ in color also differ in temperature.
5. D
6. A
7. D
8. D
9. A

10. Answers may vary. Sample answer: The cooler atmosphere of a star absorbs colors of light instead of emitting them.
11. Answers may vary. Sample answer: An absorption spectrum is produced when light from a hot solid or dense gas passes through a less dense, cooler gas. The cooler gas absorbs portions of the spectrum.
12. The black lines of a star's spectrum represent portions of the spectrum that are absorbed by the star's atmosphere.
13. The pattern of lines in a star's absorption spectrum is unique to that star and to the stage that the star occupies in its life cycle.
14. A star is a mixture of elements, and all of the different lines for a star's elements appear together in its spectrum.
15. hydrogen and helium
16. carbon, nitrogen, oxygen
17. A
18. B
19. D
20. first-magnitude
21. positive numbers
22. negative numbers
23. apparent magnitude
24. absolute magnitude
25. Answers may vary. Sample answer: Although the absolute magnitude of the sun is +4.8, which is ordinary for a star, the sun's apparent magnitude is -26.8 because it is so close to Earth.
26. C
27. light-year
28. parallax
29. Answers may vary. Sample answer: During each different season of the year, Earth faces a different part of the sky at night.
30. Earth's rotation
31. Answers may vary. Sample answer: Even though each star is moving in space, their actual motions are difficult to see because stars are so distant.

SECTION: THE LIFE CYCLE OF STARS

1. Stars can be classified by mass, size, brightness, color, temperature, composition, and age.
2. Answers may vary. Sample answer: The classification of a star changes as its properties change.
3. D
4. C
5. A
6. B
7. A
8. Temperature appears along the bottom of the H-R diagram (along the horizontal axis).
9. Absolute magnitude appears along the left side of the H-R diagram (along the vertical axis).
10. in the main sequence
11. C
12. A
13. B
14. D
15. As they age, main-sequence stars move up and to the right to become giants or supergiants, then move down and to the left to become white dwarfs.
16. C
17. A
18. D
19. B
20. Black holes do not give off light. Gas and dust from nearby stars may spiral into the black hole and give off X rays that astronomers can detect.

SECTION: GALAXIES

1. galaxy
2. E
3. S
4. I
5. S
6. E
7. I
8. S
9. D
10. A
11. B
12. quasars
13. It takes time for light to travel through space, so looking through a telescope is like looking back through time. The farther out one looks, the farther back in time one sees.
14. Scientists study distant galaxies to learn what early galaxies looked like. This gives them information about how galaxies change over time and what may have caused them to form.

SECTION: FORMATION OF THE UNIVERSE

1. cosmology
2. A
3. D
4. the big bang theory
5. Answers may vary. Sample answers: between 13 and 15 billion years ago; about 14 billion years ago; about 13.7 billion years ago
6. Answers may vary. Sample answer: Cosmic background radiation is energy left over from the original big bang explosion that was distributed in every direction as the universe expanded.
7. Answers may vary. Sample answer: After the big bang, gravitational attraction caused matter to form galaxies, and the attraction between galaxies caused galaxies to cluster.
8. Earth is part of the solar system; the solar system is part of the Milky Way galaxy, and the Milky Way is part of a galaxy cluster
9. D
10. The oldest white dwarfs are between 12 and 13 billion years old. It took about one billion years after the big bang for the first white dwarfs to form, so the universe must be approximately 14 billion years old.
11. C
12. D
13. C
14. Dark energy seems to be accelerating the expansion of the universe, counteracting the effect of gravity.
15. Answers may vary. Sample answer: If the expansion rate of the universe continues to grow, stars will age and die, the universe will become cold and dark, but the universe will continue to expand forever.

Vocabulary and Section Summary A

SECTION: STARS

1. spectrum: the band of colors produced when white light passes through a prism
2. apparent magnitude: the brightness of a star as seen from Earth
3. absolute magnitude: the brightness that a star would have at a distance of 32.6 light-years from Earth
4. light-year: the distance that light travels in one year; about 9.46 trillion kilometers
5. parallax: an apparent shift in the position of an object when viewed from different locations

SECTION: THE LIFE CYCLE OF STARS

1. main sequence: the location on the H-R diagram where most stars lie; it has a diagonal pattern from the lower right (low temperature and luminosity) to the upper left (high temperature and luminosity)
2. H-R diagram: Hertzsprung-Russell diagram, a graph that shows the relationship between a star's surface temperature and absolute magnitude
3. supernova: a gigantic explosion in which a massive star collapses and throws its outer layers into space

SECTION: GALAXIES

1. galaxy: a collection of stars, dust, and gas bound together by gravity
2. nebula: a large cloud of gas and dust in interstellar space; a region in space where stars are born

SECTION: FORMATION OF THE UNIVERSE

1. big bang theory: the theory that all matter and energy in the universe was compressed into an extremely small volume that exploded 13 billion to 15 billion years ago and began expanding in all directions

Vocabulary and Section Summary B

SECTION: STARS

1. spectrum
2. apparent magnitude
3. absolute magnitude
4. light-year
5. parallax

SECTION: THE LIFE CYCLE OF STARS

1. main sequence
2. H-R diagram
3. supernova
4. neutron star
5. pulsar
6. black hole

Answer Key

Directed Reading A

SECTION: A SOLAR SYSTEM IS BORN

1. D
2. D
3. C
4. A
5. C
6. A
7. temperature
8. pressure
9. B
10. C
11. A
12. B
13. D
14. A
15. D
16. C
17. A
18. B
19. D
20. C
21. A
22. C
23. B
24. A
25. B
26. A

SECTION: THE INNER PLANETS

1. D
2. B
3. D
4. B
5. B
6. C
7. D
8. C
9. B
10. A
11. C
12. A
13. B
14. A
15. D
16. B
17. D
18. B
19. A
20. B
21. A
22. C
23. B
24. C
25. D
26. A
27. B
28. C

SECTION: THE OUTER PLANETS

1. C
2. B
3. A
4. C
5. D
6. B
7. A
8. D
9. C
10. C
11. A
12. B
13. A
14. D
15. A
16. B
17. D
18. D
19. B
20. C
21. A

SECTION: MOONS

1. D
2. satellites
3. moons
4. C
5. A
6. B
7. C
8. A
9. D
10. B
11. phases
12. waxing
13. waning
14. C
15. B
16. A
17. D
18. C
19. B
20. D
21. C
22. B
23. C
24. C
25. D
26. A
27. D
28. C
29. B
30. C

SECTION: SMALL BODIES IN THE SOLAR SYSTEM

1. D
2. C
3. B
4. C
5. A
6. B
7. C
8. D
9. A
10. B
11. asteroid
12. asteroid belt
13. C
14. D
15. C
16. A
17. B
18. B
19. C
20. A
21. A
22. B

Directed Reading B

SECTION: A SOLAR SYSTEM IS BORN

1. solar system
2. D
3. C
4. A
5. gravity
6. temperature
7. Outward pressure balances the inward gravitational pull in a nebula and keeps the cloud from collapsing.
8. The balance between gravity and pressure in a nebula can be upset if two nebulas collide or if a nearby star explodes.
9. solar nebula
10. B
11. D

12. C
13. planetesimals
14. the gravity of planetesimals
15. because a sphere is the only geometric form in which all points on the surface are an equal distance from the center
16. Answers may vary. Sample answer: The center of the solar nebula became so dense and hot that hydrogen atoms fused to form helium. Huge amounts of energy were released. When the gas stopped collapsing, our sun was born.
17. core, radiative zone, convective zone
18. photosphere, chromosphere, corona
19. energy
20. nuclear fusion
21. Answers may vary. Sample answer: Temperature and pressure must be very high so that the hydrogen nuclei are forced close enough together to overcome the repulsive force.
22. Answers may vary. Sample answer: First step: Two hydrogen nuclei collide and fuse to become a proton-neutron pair. Second step: Another proton combines with the proton-neutron pair to produce a nucleus made up of two protons and one neutron. Third step: Two nuclei made up of two protons and one neutron collide and fuse, and two protons are released. The remaining two protons and two neutrons fuse and form a helium nucleus.
23. astronomical unit (or AU)
24. the distance light travels in 1 minute
25. the inner solar system
26. the outer solar system

SECTION: THE INNER PLANETS

1. B
2. Answers may vary. Sample answer: The inner planets are smaller, denser, and rockier than the outer planets.
3. Mercury's interior is composed of a large, iron core.
4. because its period of rotation is so slow
5. C
6. D
7. A
8. B
9. A
10. D
11. B
12. C
13. C
14. prograde
15. retrograde
16. impact craters, moutains, lava plains, volcanoes
17. water and an energy source
18. the atmosphere, land, ice, the oceans, and living things
19. C
20. because of its thinner atmosphere and its greater distance from the sun
21. Answers may vary. Sample answer: surface features characteristic of erosion and deposition by water
22. frozen just beneath Mars's surface
23. Olympus Mons
24. Answers may vary. Sample answer: because the volcano has erupted constantly for a longer period of time than corresponding volcanoes on Earth
25. strong evidence that water once existed on the surface of Mars

SECTION: THE OUTER PLANETS

1. gas giant
2. Neptune
3. A
4. C
5. B
6. Jupiter's interior is very hot.
7. Jupiter has thunderstorms that are much larger than those on Earth.
8. Saturn is the least dense of all the planets.
9. trillions of particles of water ice and dust
10. Saturn's rings, its northern polar region, and its storms
11. Methane in its atmosphere filters incoming sunlight.
12. Uranus is tipped over on its side, so its axis of rotation is tilted 98°.
13. Early in its history, Uranus may have been hit by a massive object that tipped the planet over.
14. a storm the size of Earth
15. more than 1,000 km/h
16. D
17. C
18. B
19. Charon is a little more than half the size of Pluto.

20. Kuiper belt
21. a body larger than Pluto called 2003UB313

SECTION: MOONS

1. satellites
2. moons
3. A
4. C
5. The solar system must be at least 4.5 billion years old.
6. Without an atmosphere or erosion, they preserve a record of almost all the impacts of objects that have struck them.
7. highlands, or terrae, and plains, or maria
8. The current theory is that a large, Mars-sized object collided with Earth while Earth was still forming. Material was blasted into orbit around Earth to form the moon.
9. The composition of lunar rock samples is very similar to that of Earth's mantle.
10. Answer may vary. Sample answer: A sphere forms when gravity attracts matter toward other matter. This attracted matter arranges itself around a center.
11. The moon shines because it reflects light from the sun.
12. because the moon's period of rotation is the same as its period of revolution
13. Answers may vary. Sample answer: The moon's Earthward face changes from a fully lit circle to a thin crescent and then back to a circle.
14. phases
15. Answers may vary. Sample answer: The different appearances of the moon are caused by the changing positions of the moon relative to the sun and Earth. As the moon revolves around Earth, the amount of sunlight on the side of the moon that faces Earth changes.
16. waxing
17. waning
18. eclipse
19. A
20. B
21. D
22. C
23. Answers may vary. Sample answer: The moon's orbit around Earth is tilted relative to Earth's orbit around the sun. Thus, the moon is usually out of Earth's shadow for most full moons. It also places Earth out of the moon's shadow for most new moons.
24. D
25. Phobos and Deimos
26. Galilean satellites
27. Io
28. Answers may vary. Sample answer: Recent pictures suggest that liquid water may lie beneath Europa's icy surface.
29. Answers may vary. Sample answer: Unlike other satellites in the solar system, Titan has a thick atmosphere. Titan's atmosphere is 700 km thick and is made mostly of molecular nitrogen.
30. The impact caused Miranda to re-form in a mixed-up state.
31. a retrograde orbit
32. Charon has a period of revolution that is the same as Pluto's period of rotation.

SECTION: SMALL BODIES IN THE SOLAR SYSTEM

1. comets, asteroids, meteoroids
2. B
3. coma
4. Answers may vary. Sample answer: The ion tail of a comet is gas that streams from the comet's head. The ion tail points away from the sun.
5. Answers may vary. Sample answer: The dust tail is made of dust and curves backward along the comet's orbit. Some dust tails are more than 80 million kilometers long.
6. the Oort cloud and the Kuiper belt

7. Answers may vary. Sample answer: Scientists think that comets are made of matter that was left over from the formation of the solar system. Therefore, by studying comets, scientists can understand the early history of the solar system.
8. long-period comets
9. short-period comets
10. asteroids
11. asteroid belt
12. where they are located within the asteroid belt
13. near-Earth asteroids
14. C
15. A
16. B
17. stony, metallic, stony-iron
18. stony meteorites
19. metallic meteorites
20. stony-iron meteorites
21. Answers may vary. Sample answer: A meteor shower happens because Earth intersects the orbits of comets that have left behind a trail of dust. As these particles burn up in Earth's atmosphere, meteors streak across the sky.
22. once every 50 million to 100 million years

Vocabulary and Section Summary A

SECTION: A SOLAR SYSTEM IS BORN

1. nebula: a large cloud of gas and dust in interstellar space; a region in space where stars are born
2. solar nebula: a rotating cloud of gas and dust from which the sun and planets formed
3. astronomical unit: the average distance between Earth and the sun; approximately 150 million kilometers (symbol, AU)

SECTION: THE INNER PLANETS

1. terrestrial planet: one of the highly dense planets nearest to the sun; Mercury, Venus, Mars, and Earth
2. prograde rotation: the counterclockwise spin of a planet or moon as seen from above the planet's North Pole; rotation in the same direction as the sun's rotation
3. retrograde rotation: the clockwise spin of a planet or moon as seen from above the planet's North Pole

SECTION: THE OUTER PLANETS

1. gas giant: a planet that has a deep, massive atmosphere, such as Jupiter, Saturn, Uranus, or Neptune

SECTION: MOONS

1. satellite: a natural or artificial body that revolves around a planet
2. phase: the change in the sunlit area of one celestial body as seen from another celestial body
3. eclipse: an event in which the shadow of one celestial body falls on another

SECTION: SMALL BODIES IN THE SOLAR SYSTEM

1. comet: a small body of ice, rock, and cosmic dust that follows an elliptical orbit around the sun and that gives off gas and dust in the form of a tail as it passes close to the sun
2. asteroid: a small, rocky object that orbits the sun; most asteroids are located in a band between the orbits of Mars and Jupiter
3. meteoroid: a relatively small, rocky body that travels through space
4. meteor: a bright streak of light that results when a meteoroid burns up in Earth's atmosphere
5. meteorite: a meteoroid that reaches Earth's surface without burning up completely

Vocabulary and Section Summary B

SECTION: A SOLAR SYSTEM IS BORN

1. nebula
2. solar nebula
3. planetesimals
4. nuclear fusion
5. astronomical unit