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CK-12 Physical Science For Middle School Workbook

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Jean Brainard, Ph.D. (JBrainard)
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AUTHORS
Jean Brainard, Ph.D. (JBrainard)
Jean Brainard, Ph.D.

EDITORS
Bradley Hughes, Ph.D. (BHughes)
Bradley Hughes, Ph.D.

Contents

CHAPTER 1 The World of Science Worksheets

Chapter Outline

1.1 What is Science?

Lesson 1.1: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Science is best defined as a body of knowledge.

_____ 2. Once a scientific idea is accepted, it never changes.

_____ 3. An example of a theory is Newton's theory of gravity.

_____ 4. Scientific laws answer "how" questions.

_____ 5. Albert Einstein is known as the "father of science."

_____ 6. The Scientific Revolution began when computers were invented in the 1900s.

_____ 7. Scientists propose theories and then look for evidence to support them.

_____ 8. "The sun always rises in the morning" is an example of a scientific law.

_____ 9. Science always evolves slowly in small steps.

_____ 10. Scientists may draw different conclusions from the same observations.

Lesson 1.1: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Scientific Theories and Scientific Laws

Some ideas in science gain the status of theories. A scientific theory is a broad explanation that is widely accepted because it is supported by a great deal of evidence. An example is the kinetic theory of matter. According to this theory, all matter consists of tiny particles that are in constant motion. Particles move at different speeds in matter in different states. These differences in particle motion explain why solids, liquids, and gases look and act differently. Think about how ice and water differ, or how water vapor differs from liquid water. The kinetic theory of matter explains the differences.

Scientific laws are often confused with scientific theories, but they are not the same thing. A scientific law is a statement describing what always happens under certain conditions in nature. It answers "how" questions but not "why" questions. An example of a scientific law is Newton's law of gravity. It describes how all objects attract each other. It states that the force of attraction is greater for objects that are closer together or have more mass. However, the law of gravity doesn't explain why objects attract each other in this way. Einstein's theory of general relativity explains why.

Questions

1. How is a scientific law different from a scientific theory?

2. Some people think that a theory may be "upgraded" to the status of a law if it is supported by enough evidence. Do you agree? Why or why not?
3. Do you think the following statement is a scientific theory or a scientific law? Explain your answer.

In chemical reactions, matter is neither created nor destroyed.

Lesson 1.1: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Characteristics of scientists include
   a. being curious.
   b. thinking logically.
   c. being good observers.
   d. all of the above
2. Induction means
   a. having knowledge.
   b. gathering evidence.
   c. rejecting previous ideas.
   d. none of the above.
3. Modern Western science began during the
   a. 1500s.
   b. 1700s.
   c. 1800s.
   d. 1900s.
4. Which event happened during the Scientific Revolution?
   a. Marie Curie discovered radiation.
   b. Copernicus proposed that the sun is the center of the solar system.
   c. Chinese scientists invented compasses and seismographs.
   d. Aristotle introduced the idea of empiricism.
5. Which scientist helped discover nuclear fission?
   a. Lise Meitner
   b. Isaac Newton
   c. Ellen Ochoa
   d. Shirley Ann Jackson
6. The methods of modern science are based on the ideas of
   a. Thales.
   b. Aristotle.
   c. Einstein.
   d. none of the above.
7. The first woman to win a Nobel prize in science was
   a. Maria Goeppert-Mayer.
   b. Ada Yonath.
   c. Marie Curie.
   d. Irene Joliot-Curie.

Lesson 1.1: Matching

Name___________________ Class______________ Date__________

Match each definition with the correct term

Definitions

_____ 1. beginning of modern Western science when many scientific advances were made

_____ 2. broad explanation that is widely accepted because it is supported by a great deal of evidence

_____ 3. idea that we can learn the truth about nature through observations and induction

_____ 4. drawing general conclusions from many individual observations

_____ 5. sound reasoning

_____ 6. statement describing what always happens under certain conditions in nature

_____ 7. way of learning about the natural world that is based on evidence and logic

Terms

a. science

b. induction

c. logic

d. scientific law

e. empiricism

f. scientific theory

g. Scientific Revolution

Lesson 1.1: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. Understanding the "hows" and "whys" of the world is the goal of __________.
2. The hallmark of scientific thinking is __________.
3. The idea that all matter consists of tiny particles in constant motion is an example of a(n) __________.
4. Newton's idea that all objects attract each other is an example of a(n) __________.
5. An ancient Greek philosopher named __________ proposed that natural events have natural causes.
6. The scientist who proposed that the sun is at the center of the solar system was __________.
7. Science is based on __________ and logic.

Lesson 1.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What does it mean to “think like a scientist?”

1.2 The Scope of Physical Science

Lesson 1.2: True or False

Name___________________ **Class**______________ **Date**________

Write true if the statement is true or false if the statement is false.

_____ 1. Physical science is all science that is not life science.

_____ 2. Energy is all the "stuff" that exists in the universe.

_____ 3. The focus of chemistry is atoms and molecules.

_____ 4. Physics concepts include motion, forces, and energy.

_____ 5. Matter is defined as anything that can be seen.

_____ 6. Electricity is a form of matter.

_____ 7. Chemistry concepts explain what happens to a candle when it burns.

_____ 8. Chemistry concepts explain how a rainbow forms.

_____ 9. Using lenses to correct vision problems involves both matter and energy.

_____ 10. An example of a career in physical science is chemist.

Lesson 1.2: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Defining Physical Science

Physical science can be defined as the study of matter and energy. Matter refers to all the "stuff" that exists in the universe. Energy is what gives matter the ability to move and change.

Physical science can be divided into chemistry and physics.

- Chemistry focuses on matter and energy at the scale of atoms and molecules. It is the study of the structure, properties, and interactions of matter. Important concepts in chemistry include physical changes such as liquids freezing and chemical reactions such as substances burning.
- Physics focuses on matter and energy at all scales—from atoms to outer space. It is the study of energy and how it interacts with matter. Important concepts in physics include motion, forces such as magnetism and gravity, and different forms of energy, such as electricity, heat, and light.

Questions

1. Assume you are describing the subject matter of physical science to a younger student. How would you describe it in your own words?

2. Which of these problems do you think would be studied by an expert in chemistry, and which do you think would be studied by an expert in physics? Why?
    a. create a fuel that produces less pollution when it burns
    b. design a car with a shape that has less air resistance

Lesson 1.2: Multiple Choice

Name___________________ **Class**______________ **Date**________

Circle the letter of the correct choice.

1. Physical science includes
    a. chemistry.
    b. life science.
    c. physics.
    d. two of the above.
2. Which question can be answered by concepts in chemistry?
    a. Why do baked goods rise in the oven?
    b. How do musical instruments make sounds?
    c. How do waves move in water?
    d. all of the above
3. Which question can be answered by physics concepts?
    a. How does a rainbow form?
    b. Why do fireworks explode?
    c. How do stalactites form?
    d. How do different cleaning products work?
4. Advances in physical science are responsible for
    a. artificial lights.
    b. motor vehicles.
    c. computers.
    d. all of the above.
5. Which of the following involve matter and energy?
    a. using a microwave oven to heat food
    b. combining ingredients and baking a cake
    c. mixing different colors of paint to produce new colors
    d. all of the above
6. Which career is most directly related to physical science?
    a. athletic trainer
    b. psychologist
    c. electrician
    d. math teacher

Lesson 1.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. professional who measures and records features on Earth's surface

_____ 2. study of energy and how it interacts with matter at all scales, from atoms to outer space

_____ 3. scientist who helps solve crimes

_____ 4. form of energy

_____ 5. professional who prepares and dispenses medicines

_____ 6. that which gives matter the ability to move and change

_____ 7. all of the "stuff" that exists in the universe

Terms

a. electricity

b. energy

c. surveyor

d. forensic scientist

e. pharmacist

f. matter

g. physics

Lesson 1.2: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. Physical science can be defined as the study of matter and __________.
2. Light is a form of __________.
3. __________ is the study of the structure, properties, and interactions of matter.
4. Magnetism and gravity are examples of __________.
5. Matter moves because it has __________.
6. Important concepts in __________ include motion, forces, and forms of energy.
7. Water freezing is an example of a(n) __________ change.

Lesson 1.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

It has been said that physical science underlies all science, including life science. Do you agree or disagree? Explain your answer.

CHAPTER 2 Scientific Research and Technology Worksheets

Chapter Outline

2.1 Scientific Investigation

Lesson 2.1: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. All scientific research involves experiments.

_____ 2. Most scientific investigations start with a question or problem.

_____ 3. Any idea can be a scientific hypothesis.

_____ 4. Researchers should always communicate their results.

_____ 5. Scientific research must be guided by ethical rules.

_____ 6. All questions can be answered by scientific research.

_____ 7. A hypothesis is tested by taking a survey of leading experts in the field.

_____ 8. There is only one scientific method.

_____ 9. Scientific research may involve creativity as well as reason.

_____ 10. Some problems must be investigated in the real world instead of in a lab.

Lesson 2.1: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Forming Hypotheses and Making Predictions

A hypothesis is a potential answer to a question that can be tested by gathering evidence. If it isn't possible to gather evidence to test a potential hypothesis, then it cannot be used as a scientific hypothesis. In fact, the question it addresses may not even be answerable by science.

You've probably seen the children's television show "Sesame Street." Supposedly, an elephant-like snuffalufagus named Snuffy exists on Sesame Street, but Snuffy disappears whenever anyone comes around. So the question "Is there a snuffalufagus on Sesame Street?" would be unanswerable by science. No evidence could be gathered to answer it because Snuffy would disappear as soon as a scientist showed up. If you hypothesized that Snuffy existed, the hypothesis could not be proven false—if indeed it was false and Snuffy did not exist.

Questions

1. What criterion must a statement meet to be used as a scientific hypothesis?
2. Give an original example of a statement that could be a scientific hypothesis. Explain your choice of example.

Lesson 2.1: Multiple Choice

Name____________________ Class_______________ Date___________

Circle the letter of the correct choice.

1. Which step generally occurs first in a scientific investigation?
   a. form a hypothesis
   b. analyze evidence
   c. ask a question
   d. gather evidence
2. Which of the following statements could be a scientific hypothesis?
   a. Green bread has mold growing on it.
   b. Green worms are yucky.
   c. Green eyes are pretty.
   d. all of the above
3. If you did an experiment to test the effect of sunlight on plant growth, what factors would you have to control?
   a. the type of plants used in the experiment
   b. the amount of water the plants receive
   c. the composition of the soil in which the plants are growing
   d. all of the above
4. In any experiment, there must be at least two
   a. controls.
   b. variables.
   c. hypotheses.
   d. replications.
5. The factor that is manipulated in an experiment is called the
   a. control factor.
   b. responding variable.
   c. independent variable.
   d. dependent variable.
6. How can scientists communicate their results?
   a. publish them in peer-reviewed journals
   b. present them at scientific meetings
   c. write them up in magazine articles
   d. do all of the above
7. Which of the following is an ethical rule for scientific research?
   a. Experiments cannot use human subjects.
   b. Research cannot be done on animals.
   c. Any risks of the research must be made public.
   d. Results should be published only if they support the hypothesis.

Lesson 2.1: Matching

Name____________________ Class_______________ Date_________

Match each definition with the correct term.

Definitions

_____ 1. controlled scientific study of a limited number of variables

_____ 2. investigation of a problem in a real-world setting

_____ 3. experimental variable that the researcher changes

_____ 4. potential answer to a question that can be tested with evidence

_____ 5. variable in an experiment that is held constant so it will not influence the outcome

_____ 6. experimental variable that is expected to change when the independent variable changes

_____ 7. rules for deciding between right and wrong

Terms

a. control

b. ethics

c. experiment

d. field study

e. hypothesis

f. manipulated variable

g. responding variable

Lesson 2.1: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. In a scientific investigation, the researcher gathers evidence to test the __________.
2. Any information that is gathered by the senses is called a(n) __________.
3. Another term for the responding variable in an experiment is the __________ variable.
4. Getting the same results when an experiment is repeated is called __________.
5. The final step in most scientific investigations is to __________ the results.
6. Any factor that can take on different values is a(n) __________.
7. An if-then statement based on a hypothesis is known as a(n) __________.

Lesson 2.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain the importance of following ethical rules in scientific research.

2.2 Science Skills

Lesson 2.2: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. The basic SI unit for length is the millimeter.

_____ 2. The freezing point of water on the Kelvin scale is 0 degrees.

_____ 3. A graduated cylinder is used to measure the volume of liquids.

_____ 4. Length is a derived quantity.

_____ 5. The mean gives you an idea of the typical measurement in a set of data.

_____ 6. You need to wear goggles in the lab only when you are using hazardous chemicals.

_____ 7. When combining an acid and water, you should always add the acid to the water.

_____ 8. An example of a model is a road map.

_____ 9. A kilometer equals 100 meters.

_____ 10. A 1-degree difference on the Kelvin scale equals a 1-degree difference on the Fahrenheit scale.

Lesson 2.2: Critical Reading

Name___________________ Class______________ Date__________

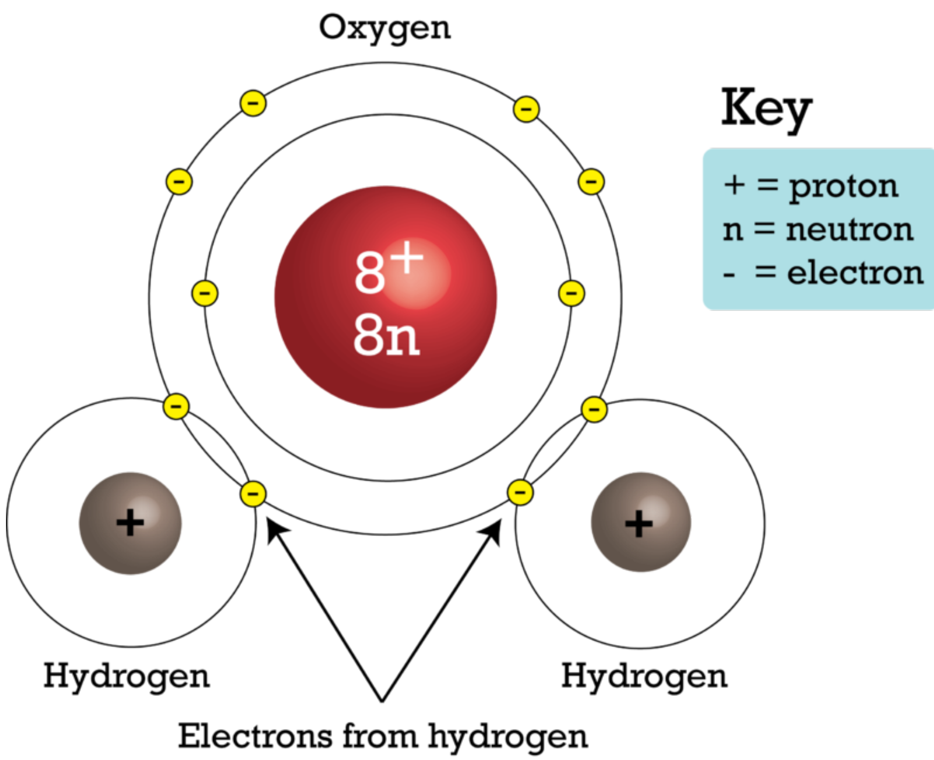
Read this passage from the text and answer the questions that follow.

Using Models

Did you ever read sketch an object or play with toy trucks or dolls? No doubt, the answer is yes. What do all these activities have in common? They all involve models. A model is a representation of an object, system, or process. Models are very useful in science. They provide a way to investigate things that are too small, large, complex, or distant to investigate directly. To be useful, a model must closely represent the real thing in important ways, but it must be simpler and easier to manipulate than the real thing

Questions

1. Below you can see an example of a model in chemistry. It represents a molecule of water. Based on the model, what can you infer about a water molecule?



2. Do you think the water molecule model in question 1 meets the criteria of a useful model in science? Why or why not?

Lesson 2.2: Multiple Choice

Name____________________ **Class**_______________ **Date**___________

Circle the letter of the correct choice.

1. The cubic meter is the basic SI unit for
   a. length.
   b. width.
   c. mass.
   d. volume.
2. A temperature of 273 Kelvin equals
   a. 0 °C.
   b. 100 °C.
   c. 212 °F.
   d. none of the above.
3. A balance is used to measure
   a. temperature.
   b. volume.
   c. length.
   d. mass.
4. Which measurement is most precise?
   a. 65 mL

   b. 66 mL
   c. 65.5 mL
   d. 66.55 mL

5. The correct number of digits in an answer is called the number of
   a. precise digits.
   b. derived digits.
   c. international units.
   d. significant figures.
6. Circle graphs are especially useful for showing
   a. percents of a whole.
   b. changes over time.
   c. how different types of things compare.
   d. ranges of data.
7. What does the following safety symbol represent?

   (a) biohazard
   (b) fire hazard
   (c) glassware hazard
   (d) heat hazard

Lesson 2.2: Matching

Name____________________ Class_______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. average value of a set of measurements

_____ 2. representation of an object, system, or process

_____ 3. exactness of a measurement

_____ 4. way of writing very large or very small numbers using exponents

_____ 5. SI scale for measuring temperature

_____ 6. closeness of a measurement to the true value

_____ 7. total spread of values in a set of measurements

Terms

a. accuracy

b. Kelvin

c. mean

d. model

e. precision

f. range

g. scientific notation

Lesson 2.2: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. The basic SI unit for mass is the __________.
2. The temperature 32 °F equals __________ °C.
3. The boiling point of water on the Kelvin scale is __________.
4. When you read the level of a liquid in a graduated cylinder, you read it at the bottom of the __________.
5. A metric ruler is used to measure __________.
6. The number 53,000 in scientific notation is __________.
7. The mean of the numbers 3, 7, 8, and 6 is __________.

Lesson 2.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain the value of using descriptive statistics and graphs to organize data in a scientific investigation.

2.3 Technology

Lesson 2.3: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Technology includes methods and processes as well as devices.

_____ 2. Many major advances in agriculture depend on technology.

_____ 3. The technological design process is similar to scientific investigation.

_____ 4. The first step in the technological design process is to create a model.

_____ 5. Cost is the only limit on technological design.

_____ 6. Technology and science have the same goals.

_____ 7. Electrons were discovered because of a technological device called the vacuum tube.

_____ 8. Technology helps science advance.

_____ 9. The technological design process is based only on creativity and luck.

_____ 10. The problems of society generally set the direction for technology.

Lesson 2.3: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Technological Design

The development of new technology is called technological design. It is similar to scientific investigation. Both processes use evidence and logic to solve problems. Steps of the technological design process include:

1. Identify a problem.
2. Research the problem.
3. Generate possible solutions.
4. Select the best solution.
5. Create a model of the solution.
6. Test the model.
7. Refine and retest the model as needed.
8. Communicate the final solution.

Consider the problem of developing a solar-powered car. Many questions would have to be researched in the design process. For example, what is the best shape for gathering the sun's rays? How will the energy from the sun be stored? Will a back-up energy source be needed? After researching the answers, possible designs are developed.

This takes imagination as well as reason. Then a model is made of the best design, and the model is tested. This allows any problems with the design to be worked out before a final design is selected.

Technological design always has constraints. Constraints are limits on the design. Common constraints include laws of nature such as the law of gravity, properties of the materials used, and costs of production. Ethical concerns are also constraints on many technological designs. Like scientists, engineers must follow ethical rules. For example, the technologies they design must be as safe as possible for people and the environment. Engineers must weigh the benefits and risks of new technologies, and the benefits should outweigh the risks.

Questions

1. How is technological design similar to scientific investigation?
2. What is the role of ethics in technological design?
3. What might be an ethical constraint on the design of a solar-powered car?

Lesson 2.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Technology is responsible for most of the major advances in
   a. transportation.
   b. communication.
   c. medicine.
   d. all of the above.
2. The technological design process involves
   a. forming a hypothesis.
   b. doing research.
   c. developing scientific laws.
   d. none of the above.
3. The evolution of modern computers began in the
   a. 1930s.
   b. 1950s.
   c. 1970s.
   d. 1990s.
4. Which statement is true about early computers?
   a. They were very small.
   b. They used vacuum tubes.
   c. They could do many tasks at once.
   d. They used software programs.
5. The invention of the seismometer led to the discovery that
   a. stars are very hot.
   b. the ocean is very deep.
   c. Earth has a solid inner core.
   d. electrons are negatively charged.
6. The Bessemer process is an example of technology. The Bessemer process

a. was invented in the 1950s.
b. is a cheap way to make steel.
c. was a major advance in medicine.
d. is used to make computers.

7. The invention of the microscope

a. let scientists see very distant objects.
b. occurred in the 1800s.
c. extended human vision.
d. two of the above.

Lesson 2.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. professional in technology

_____ 2. technology that measures properties of light

_____ 3. technology that records ground movements caused by earthquakes

_____ 4. development of new technology

_____ 5. application of knowledge to real-world problems

_____ 6. technology that uses sound waves to map the ocean floor

_____ 7. limit on technological design

Terms

a. technology

b. technological design

c. engineer

d. constraint

e. sonar

f. seismometer

g. spectrometer

Lesson 2.3: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. One meaning of __________ is devices such as computers and solar-powered cars.
2. When designing a new technology, an engineer creates and tests a(n) __________ of the technology.
3. The goal of __________ is to increase knowledge.

4. The goal of __________ is to use knowledge to solve people's problems.
5. Technology that manipulates matter at the level of atoms and molecules is known as __________.
6. The technology that uses transparent fibers to transmit light is called __________.
7. The first step of the technological design process is identifying a(n) __________.

Lesson 2.3: Critical Writing

Name__________________ Class_____________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Read the following quote by American scientist Edward Teller. Then explain whether you agree or disagree with it.

"The science of today is the technology of tomorrow."

CHAPTER 3 Introduction to Matter Worksheets

Chapter Outline

3.1 Properties of Matter

Lesson 3.1: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Sound is a form of matter.

_____ 2. Air is not matter.

_____ 3. The SI unit for weight is the kilogram.

_____ 4. The volume of a gas depends on the volume of its container.

_____ 5. Physical properties of matter are typically things you can detect with your senses.

_____ 6. Density refers to how closely packed the particles of matter are.

_____ 7. Chemical properties include freezing and boiling points.

_____ 8. Hardness is a physical property of matter.

_____ 9. The density of matter depends on its mass and volume.

_____ 10. After a log burns, it is still wood.

Lesson 3.1: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Mass vs. Weight

People often confuse the mass and weight of matter. Mass is how much matter an object contains. It is measured with a balance. The SI unit for mass is the kilogram (kg). Weight is a measure of the force of gravity pulling on an object. It is measured with a scale. The SI unit for weight is the Newton (N). The common English unit for weight is the pound (lb). This distinction between mass and weight holds even though some modern digital scales convert weight to mass and give the mass of the object at Earth gravity.

An object with more mass is pulled by gravity with greater force, so mass and weight are closely related. However, the weight of an object can change if the force of gravity changes, even while the mass of the object remains constant. Look at NASA astronaut Edwin E. Aldrin Jr. in the **Figure** 3.1. He was one of the first humans to walk on the moon and feel the force of its gravity. He weighed less on the moon than he did on Earth because the moon's gravity is weaker than Earth's.

Questions

1. Create a table comparing and contrasting mass and weight.
2. If an astronaut weighed 175 pounds on Earth, he would have weighed only 29 pounds on the moon. If his mass was 80 kg on Earth, what would his mass have been on the moon?

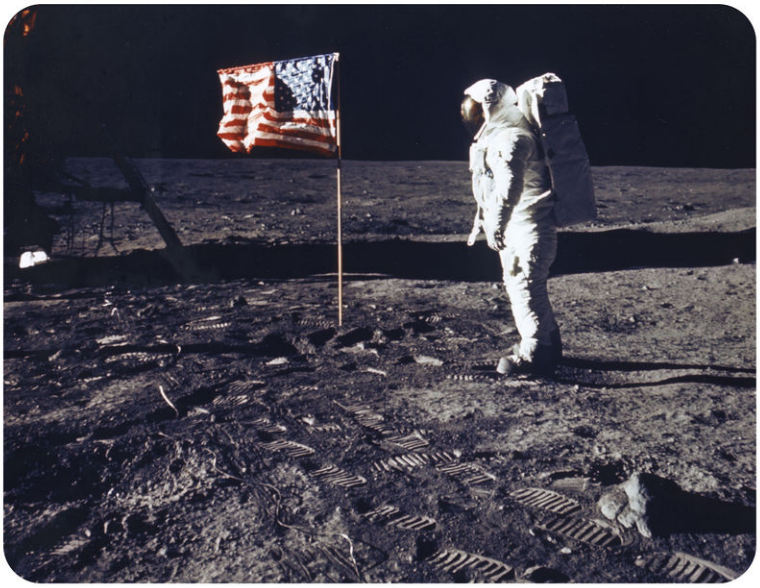


FIGURE 3.1
Edwin E. Aldrin Jr. walking on the moon.

Lesson 3.1: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Which of the following is not made of matter?
   a. light
   b. solid
   c. liquid
   d. gas
2. Mass is measured with a
   a. scale.
   b. balance.
   c. graduated cylinder.
   d. metric ruler.
3. Examples of physical properties of matter include
   a. color.
   b. odor.
   c. hardness.
   d. all of the above.
4. Which of the following is a chemical property of matter?
   a. ability to conduct heat
   b. ability to conduct electricity
   c. flammability
   d. all of the above
5. What is the density of an object that has a mass of 30 kg and a volume of 0.5 m^3?

a. 60 kg/m^3
b. 0.02 m^3/kg
c. 15 $m^3 \bullet kg$
d. none of the above

6. The ability of iron to rust is as example of

a. reactivity.
b. flammability.
c. displacement.
d. a physical property.

7. What is the SI unit for mass?

a. m^3
b. mL
c. cm^3
d. kg

Lesson 3.1: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. ability of matter to burn

_____ 2. amount of space taken up by matter

_____ 3. anything that has mass and volume

_____ 4. type of property that can be measured or observed only when matter changes to an entirely different substance

_____ 5. type of property that can be measured or observed without matter changing to a different substance

_____ 6. ability of a substance to combine chemically with other substances

_____ 7. amount of matter in a substance or object

Terms

a. chemical property

b. flammability

c. mass

d. matter

e. physical property

f. reactivity

g. volume

Lesson 3.1: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. The only thing that isn't matter is __________.
2. __________ is a measure of the force of gravity pulling on an object.
3. The SI unit for weight is the __________.
4. The __________ method is used to find the volume of an irregularly shaped solid.
5. The amount of mass in a given volume of matter is its __________.
6. Matter that is flammable is able to __________.

Lesson 3.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Answer the riddle at the beginning of the lesson. Apply lesson concepts to explain what you and a tiny speck of dust in outer space have in common.

3.2 Types of Matter

Lesson 3.2: True or False

Name____________________ Class_______________ Date___________

Determine if the following statements are true or false.

_____ 1. Each element has a unique set of properties.

_____ 2. The idea of elements was first introduced by John Dalton.

_____ 3. Most elements are found in compounds.

_____ 4. A compound has the same properties as the substances it contains.

_____ 5. A molecule consists of two or more atoms.

_____ 6. Table salt is an example of a compound that forms molecules.

_____ 7. The substances in a mixture may be elements or compounds.

_____ 8. A package of mixed seeds is a homogeneous mixture.

_____ 9. Mixtures are classified on the basis of particle size.

_____ 10. Components of mixtures rarely can be separated.

Lesson 3.2: Critical Reading

Name____________________ Class_______________ Date___________

Read this passage from the text and answer the questions that follow.

Elements

An element is a pure substance that cannot be separated into any other substances. There are more than 90 different elements that occur in nature. Some are much more common than others. Hydrogen is the most common element in the universe. Oxygen is the most common element in Earth's crust. Each element has a unique set of properties that make it different from all other elements. As a result, elements can be identified by their properties. For example, the elements iron and nickel are both metals that are good conductors of heat and electricity. However, iron is attracted by a magnet, whereas nickel is not.

The idea of elements is not new. About 2500 years ago, the Greek philosopher Aristotle thought that all matter consists of just four elements—earth, air, water, and fire. He thought that different kinds of matter contain only these four elements but in different combinations. Aristotle's ideas about elements were accepted for the next 2000 years. Then, scientists started discovering the many unique substances we call elements today. Scientists soon realized that there are far more than just four elements. Eventually, they discovered a total of 92 naturally occurring elements.

The smallest particle of an element that still has the element's properties is an atom. All the atoms of an element are alike, and they are different from the atoms of all other elements. For example, atoms of gold are the same whether they are found in a gold nugget or a gold ring. They all have the same structure and properties.

Questions

1. Explain why elements can be identified by their properties. What property could help you identify the element iron?
2. Outline the history of the idea of elements.
3. Relate atoms to elements.

Lesson 3.2: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. I am lighter than air and used to fill balloons. Which element am I?
   a. neon
   b. carbon
   c. oxygen
   d. helium
2. Iron and nickel are both
   a. elements.
   b. metals.
   c. compounds.
   d. two of the above.
3. Which statement is false about the atoms of a given element?
   a. They are all alike.
   b. They are the same as the atoms of all other elements.
   c. They have properties of the given element.
   d. They all have the same structure.
4. John Dalton made all the following contributions to our knowledge of atoms except
   a. doing research to show atoms exist.
   b. introducing modern ideas about atoms.
   c. developing a theory of the atom.
   d. arguing that atoms do not exist.
5. Which drink is an example of a compound?
   a. lemonade
   b. ice tea
   c. vanilla milkshake
   d. water
6. An example of a heterogeneous mixture is
   a. salt water.
   b. gelatin.
   c. milk.
   d. trail mix.
7. Which mixture has the largest particles?
   a. muddy water

b. salt water
c. milk
d. lemonade

Lesson 3.2: Matching

Name____________________ Class_______________ Date_________

Match each definition with the correct term.

Definitions

_____ 1. homogeneous mixture in which particles are too small to be seen

_____ 2. combination of two or more substances in any proportions

_____ 3. homogeneous mixture in which particles are big enough to reflect light

_____ 4. heterogeneous mixture

_____ 5. unique substance that forms when two or more elements combine chemically

_____ 6. rigid, lattice-like framework of many ions bonded together

_____ 7. pure substance that cannot be separated into any other substances

Terms

a. colloid

b. compound

c. element

d. mixture

e. solution

f. suspension

g. crystal

Lesson 3.2: Fill in the Blank

Name____________________ Class_______________ Date_________

Fill in the blank with the appropriate term.

1. The most common element in the universe is ___________.
2. A(n) ___________ is the smallest particle of an element that still has the element's properties.
3. There are a total of ___________ naturally occurring elements.
4. The smallest particle of a compound that still has the compound's properties is a(n) ___________.
5. A(n) ___________ mixture has the same composition throughout.
6. When sodium and chlorine combine chemically they form the compound ___________.
7. Compounds exist as molecules or ___________.

Lesson 3.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Assume that you combine two different elements. Explain what determines whether the outcome is a compound or a mixture.

3.3 Changes in Matter

Lesson 3.3: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Cracking an egg shell is an example of a chemical change in matter.

_____ 2. Crushing a metal can is an example of a physical change in matter.

_____ 3. Physical changes in matter are often easy to reverse.

_____ 4. Dissolving salt in water changes the water to an entirely different substance.

_____ 5. All chemical changes are rapid and dramatic.

_____ 6. Formation of a solid from a solution is a sign of a chemical change.

_____ 7. To reverse a chemical change requires another chemical change.

_____ 8. Boiling water is a chemical change because a gas is released.

_____ 9. A sign of a chemical change is a change in mass.

_____ 10. Matter can be created or destroyed if a chemical change occurs.

Lesson 3.3: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Physical Changes in Matter

You hit a baseball out of the park and head for first base. You're excited. The score is tied, and now your team has a chance of getting a winning homerun. Then you hear a crash. Oh no! The baseball hit a window in a neighboring house. The glass has a big hole in it, surrounded by a web of cracks. The glass has changed. It's been broken into jagged pieces. But the glass is still glass. Breaking the window is an example of a physical change in matter. A physical change in matter is a change in one or more of matter's physical properties. Matter may look different after a physical change occurs, but it's still the same substance with the same chemical properties.

Besides glass breaking, other examples of physical changes in matter include:

- cutting a log into smaller pieces.
- wearing away of rock by wind-blown sand.
- braiding hair.
- crushing a metal can.
- melting chocolate.

Because the type of matter remains the same with physical changes, the changes are often easy to undo. For example, braided hair can be unbraided again. Melted chocolate can be put in a fridge to reharden.

Questions

1. Based on the examples above, what are some ways matter may be different after a physical change has occurred?
2. How do you know that cutting a log into smaller pieces does not change its chemical properties?
3. Dissolving salt in water is an another example of a physical change. How do you think you could reverse it?

Lesson 3.3: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Which of the following is not a physical change in matter?
   a. cutting paper
   b. braiding hair
   c. melting ice
   d. frying eggs
2. Which of the following is not a chemical change in matter?
   a. removing tarnish from copper
   b. burning paper
   c. breaking glass
   d. baking cupcakes
3. After a physical change, matter may
   a. look different.
   b. have less mass.
   c. have different chemical properties.
   d. be an entirely different substance.
4. What is true of matter after a chemical change?
   a. It has more mass.
   b. It is the same substance.
   c. It has different chemical properties.
   d. Two of the above are true.
5. Which change in matter is easiest to reverse?
   a. chocolate melting
   b. milk souring
   c. leaves burning
   d. iron rusting
6. Which of the following indicates a change in a chemical property of matter?
   a. Matter has a different color.
   b. Matter consists of smaller pieces.
   c. Matter has a different shape.
   d. Matter has a different temperature.
7. When wood burns, it changes to

a. ashes.
b. carbon dioxide.
c. water vapor.
d. all of the above.

Lesson 3.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. type of change in which matter becomes an entirely different substance

_____ 2. example of a physical change

_____ 3. example of a chemical change

_____ 4. amount of matter in a substance or object

_____ 5. type of change in which only physical properties of matter change

_____ 6. production of an odor

_____ 7. matter cannot be created or destroyed

Terms

a. physical change

b. chemical change

c. law of conservation of mass

d. burning

e. sign of chemical change

f. mass

g. melting

Lesson 3.3: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. Breaking a window is an example of a(n) __________ change in matter.
2. After a physical change, matter still has the same __________ properties.
3. Mixing vinegar and baking soda results in a(n) __________ change in matter.
4. Leaves turn color in the fall because of __________ changes in the leaves.
5. When matter changes, its total __________ always remains the same.
6. A(n) __________ change occurs when a log is cut into smaller pieces.
7. The release of gas bubbles is a sign that a(n) __________ change has occurred.

Lesson 3.3: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Identify an original example of a physical change and an original example of a chemical change. Provide support for your choices.

3.4 References

1. Courtesy of Neil Armstrong and NASA. http://images.ksc.nasa.gov/photos/1969/captions/AS11-40-5875.html . Public Domain

CHAPTER 4 States of Matter Worksheets

Chapter Outline

4.1 Solids, Liquids, Gases, and Plasmas

Lesson 4.1: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. A liquid takes the volume of its container.

_____ 2. Particles of amorphous solids have no definite pattern.

_____ 3. A beef steak is an example of a crystalline solid.

_____ 4. Viscosity causes water to curve upward at the top rim of a glass.

_____ 5. There is more gas than any other state of matter in the universe.

_____ 6. All states of matter have a fixed mass and fixed volume.

_____ 7. The volume and shape of a solid can never change.

_____ 8. Surface tension explains why water forms droplets.

_____ 9. Water has greater viscosity than any other liquid.

_____ 10. A gas spreads out to fill all available space.

Lesson 4.1: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Energy and States of Matter

Why do different states of matter have different properties? It's because of differences in energy at the level of atoms and molecules, the tiny particles that make up matter. Energy is the ability to cause changes in matter. Energy that causes matter to move is called kinetic energy. According to the kinetic theory of matter, the particles that make up matter have kinetic energy and are constantly moving.

So why don't all the particles move apart? Particles of matter of the same substance, such as the same element, are attracted to one another. This force of attraction tends to pull the particles closer together. The particles need a lot of kinetic energy to overcome the force of attraction and move apart. It's like a tug of war between opposing forces. The kinetic energy of individual particles is on one side, and the force of attraction between different particles is on the other side. The outcome of the "war" depends on the state of matter.

- In solids, particles don't have enough kinetic energy to overcome the force of attraction between them. The particles are packed closely together and cannot move around. All they can do is wiggle, or vibrate, in place. This explains why solids have a fixed volume and a fixed shape.
- In liquids, particles have enough kinetic energy to partly overcome the force of attraction between them. They can slide past one another but not pull apart. This explains why liquids can change shape but have a fixed

volume.

- In gases, particles have a lot of kinetic energy. They can completely overcome the force of attraction between them and move apart. This explains why gases have neither a fixed volume nor a fixed shape.

Questions

1. Create a table comparing and contrasting solids, liquids, and gases.
2. Relate the kinetic theory of matter to states of matter.

Lesson 4.1: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. What happens when matter changes state?
    a. Its chemical properties change.
    b. Its physical properties change.
    c. The energy of its particles remains the same.
    d. two of the above
2. The volume and shape of a solid could be changed by
    a. placing it in a container with a different shape.
    b. putting it in a container with a different volume.
    c. cutting or breaking it.
    d. all of the above
3. An example of an amorphous solid is
    a. candle wax.
    b. table salt.
    c. cellulose.
    d. none of the above
4. Surface tension is a force that affects
    a. gases.
    b. plasmas.
    c. solids.
    d. liquids.
5. Which statement is true about plasma?
    a. It has a fixed volume.
    b. It has a fixed shape.
    c. It contains ions.
    d. It does not occur in nature.
6. Which state of matter has particles with the least energy?
    a. plasma
    b. gas
    c. liquid
    d. solid
7. The volume of a gas is

a. fixed.
b. viscous.
c. the same as its container.
d. equal to its mass.

Lesson 4.1: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. state of matter that lacks a fixed volume and a fixed shape

_____ 2. state of matter with a fixed volume and a fixed shape

_____ 3. energy that moves matter

_____ 4. ability to cause changes in matter

_____ 5. state of matter with a fixed volume but not a fixed shape

_____ 6. state of matter that consists of ions

_____ 7. solid, liquid, gas, or plasma

Terms

a. solid

b. liquid

c. gas

d. plasma

e. kinetic energy

f. state of matter

g. energy

Lesson 4.1: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. State of matter is a(n) __________ property of matter.
2. Water in the gaseous state is called __________.
3. Water in the solid state is called __________.
4. The force that pulls particles at the surface of a liquid toward other liquid particles is __________.
5. A liquid's resistance to flowing is known as __________.
6. The northern lights glow because of matter in the __________ state.
7. The particles of __________ solids are arranged in a regular repeating pattern.

Lesson 4.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe in detail the relationship between matter and energy.

4.2 Behavior of Gases

Lesson 4.2: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Particles of a gas move only when they are heated.

_____ 2. The pressure a gas exerts depends only on its volume.

_____ 3. For gas at a given temperature, volume and pressure change in opposite directions.

_____ 4. Gas bubbles in water get bigger when they are under less pressure.

_____ 5. Heating a gas causes its particles to move more slowly.

_____ 6. Air pressure in a tire increases after you start driving because the air gets warmer.

_____ 7. As you go higher above Earth's surface, the pressure of the atmosphere increases.

_____ 8. Cooling a gas in a closed container causes its pressure to decrease.

_____ 9. Adding more gas to a closed container has no effect on its pressure.

_____ 10. Adding energy to a gas raises its temperature.

Lesson 4.2: Critical Reading

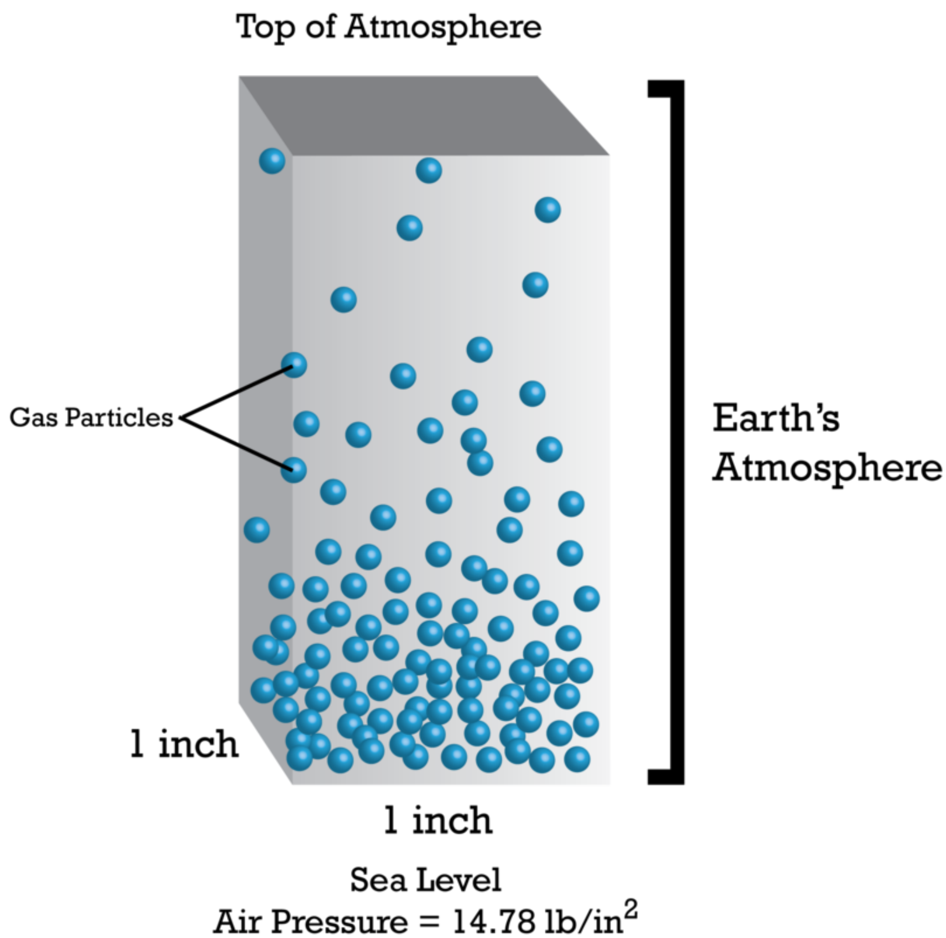
Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

What Is Pressure?

The molecules of a gas are constantly moving and bumping into things. The force of the particles against whatever they bump into creates pressure. Pressure is defined as the amount of force pushing against a given area. How much pressure a gas exerts depends on the amount of gas. The more gas particles there are, the greater the pressure.

You usually cannot feel it, but air has pressure. The gases in Earth's atmosphere exert pressure against everything they contact. The atmosphere rises high above Earth's surface and contains a huge number of individual gas particles (see diagram below). As a result, the pressure of the tower of air above a given spot on Earth's surface is substantial. If you were standing at sea level, the pressure would be 10.14 newtons per square centimeter (14.7 pounds per square inch).



Questions

1. Explain why gases exert pressure.
2. Describe how the pressure exerted by Earth's atmosphere changes with altitude. Explains why atmospheric pressure changes in this way.

Lesson 4.2: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. The molecules of gas in a closed container
   a. keep bumping into each other.
   b. are always moving.
   c. exert pressure.
   d. all of the above
2. For a fixed volume of gas, the gas's pressure depends on
   a. its mass.
   b. its temperature.
   c. the shape of its container.

d. two of the above

3. The pressure of a gas can be increased by
   a. increasing its temperature.
   b. decreasing its temperature.
   c. increasing its volume.
   d. decreasing its mass.
4. What *always* happens when a gas is heated?
   a. Its volume increases.
   b. Its pressure increases.
   c. Its particles gain kinetic energy.
   d. all of the above
5. If you put an inflated balloon inside a freezer, you can predict that it will shrink based on
   a. Boyles' law.
   b. Charles's law.
   c. Amontons's law.
   d. none of the above
6. Increasing the volume of a gas decreases its
   a. mass.
   b. pressure.
   c. temperature.
   d. kinetic energy.
7. At sea level, the pressure of Earth's atmosphere is
   a. 14.7 lb/cm^2
   b. 14.7 N/in^2
   c. 10.14 N/cm^2
   d. 10.14 lb/in^2

Lesson 4.2: Matching

Name____________________ **Class**_______________ **Date**_________

Match each definition with the correct term.

Definitions

_____ 1. law relating the temperature and pressure of a constant volume of gas

_____ 2. amount of force pushing against a given area

_____ 3. state of matter that lacks a fixed volume and a fixed shape

_____ 4. law relating the volume and pressure of gas at a constant temperature

_____ 5. average kinetic energy of particles of matter

_____ 6. amount of space that matter occupies

_____ 7. law relating the temperature and volume of gas at a constant pressure

Terms

a. Amontons's law

b. Boyle's law

c. Charles's law

d. pressure

e. volume

f. temperature

g. gas

Lesson 4.2: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. The force of gas particles bumping into the sides of their container creates __________.
2. The pressure of Earth's atmosphere is greatest at __________.
3. Pressure and volume of a gas have a(n) __________ relationship.
4. The gas laws describe the relationships among pressure, volume, and __________ of a given amount of gas.
5. If you heat a fixed volume of gas, its pressure __________.
6. A gas will take up more space if its temperature __________.
7. As the volume of a gas increases, its pressure __________.

Lesson 4.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

For a given amount of gas, describe the relationships among pressure, volume, and temperature of the gas.

4.3 Changes of State

Lesson 4.3: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Matter rarely changes state.

_____ 2. A gas changes directly to a solid by freezing.

_____ 3. The average kinetic energy of particles of matter can be measured with a thermometer.

_____ 4. All matter has the same freezing and boiling points.

_____ 5. A liquid can change to a gas without boiling.

_____ 6. The melting point of a substance is the same as its freezing point.

_____ 7. Iron melts at a lower temperature than water.

_____ 8. Evaporation occurs only at the exposed surface of a liquid.

_____ 9. Vaporization explains why a mud puddle dries up on a sunny day.

_____ 10. Ice changes directly to water vapor through the process of deposition.

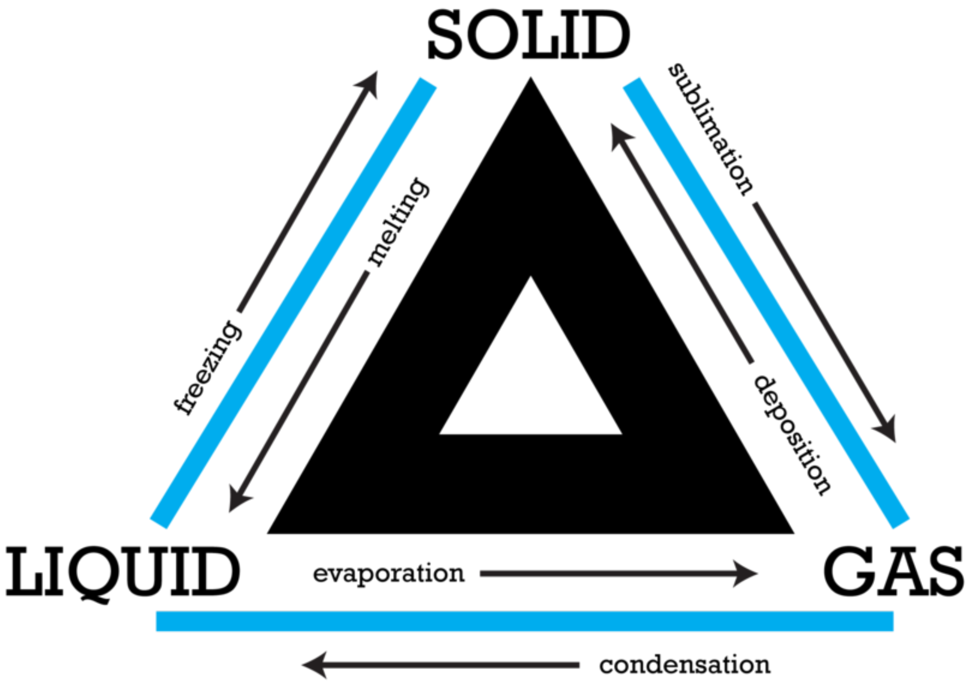
Lesson 4.3: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Changes of State

Changes of state are physical changes in matter. They are reversible changes that do not involve changes in matter's chemical makeup or chemical properties. Common changes of state include melting, freezing, sublimation, deposition, condensation, and vaporization. You can see how each process changes the state of matter in the diagram below.



The particles of matter are constantly moving. They move most quickly in gases, less quickly in liquids, and most slowly in solids. When matter changes state, it either loses or absorbs energy. For example, when matter changes from a liquid to a solid, it loses energy, because particles of solids have less energy than particles of liquids. When it changes from a solid to a liquid, it absorbs energy.

Questions

1. Which process changes a gas to a liquid? What happens during this process?
2. Create a table to show how energy changes in each of the processes in the diagram above.

Lesson 4.3: Multiple Choice

Name____________________ **Class**_______________ **Date**___________

Circle the letter of the correct choice.

1. The process in which clouds form is
   a. sublimation.
   b. evaporation.
   c. condensation.
   d. none of the above
2. Which statement is true about changes of state?
   a. They involve energy.
   b. They cannot be undone.
   c. They involve chemical processes.
   d. They change the chemical makeup of matter..
3. Liquid water changes to ice when
   a. the water loses energy.

   b. the water gains energy.
   c. melting occurs.
   d. two of the above

4. Melting point is the temperature at which matter changes to a
   a. gas.
   b. liquid.
   c. solid.
   d. plasma.
5. The boiling point of water is
   a. 0 °C.
   b. 32 °F.
   c. 98 °F.
   d. 100 °C.
6. The bubbles in boiling water contain
   a. air.
   b. salt.
   c. liquid water.
   d. water vapor.
7. Which statement is true about evaporation?
   a. It occurs when a liquid boils.
   b. It occurs when a liquid reaches its boiling point.
   c. It happens more quickly at higher temperatures.
   d. all of the above

Lesson 4.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. process in which a liquid changes to a gas without boiling

_____ 2. process in which a liquid changes to a solid

_____ 3. process in which a gas changes to a liquid

_____ 4. process in which a solid changes to a liquid

_____ 5. process in which a liquid boils and changes to a gas

_____ 6. process in which a gas changes directly to a solid

_____ 7. process in which a solid changes directly to a gas

Terms

a. condensation

b. deposition

c. evaporation

d. freezing

e. melting

f. sublimation

g. vaporization

Lesson 4.3: Fill in the Blank

Name____________________ Class_______________ Date_________

Fill in the blank with the appropriate term.

1. During a change of state ___________ is either lost or gained.
2. ___________ is the average kinetic energy of particles of matter.
3. The temperature at which a liquid changes to a solid is its ___________.
4. The melting point of ice is ___________ °C.
5. A gas condenses when it is cooled below its ___________.
6. Changes of state are ___________ changes in matter.
7. The process in which frost forms on a window is ___________.

Lesson 4.3: Critical Writing

Name____________________ Class_______________ Date_________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how temperature of matter is related to changes of state.

CHAPTER 5 Atoms Worksheets

Chapter Outline

5.1 Inside the Atom

Lesson 5.1: True or False

Name____________________ Class_______________ Date___________

Determine if the following statements are true or false.

_____ 1. Atoms are the smallest particles of matter.

_____ 2. An atom always has the same number of electrons as neutrons.

_____ 3. The nucleus is at the center of the atom.

_____ 4. Atoms have no electric charge.

_____ 5. The strong force keeps electrons moving around the nucleus.

_____ 6. Electrons have almost no mass.

_____ 7. The mass of an atom equals the sum of its protons and neutrons.

_____ 8. For most elements, isotopes are named for their atomic number.

_____ 9. Each proton consists of three quarks.

_____ 10. Quarks are held together by gluons.

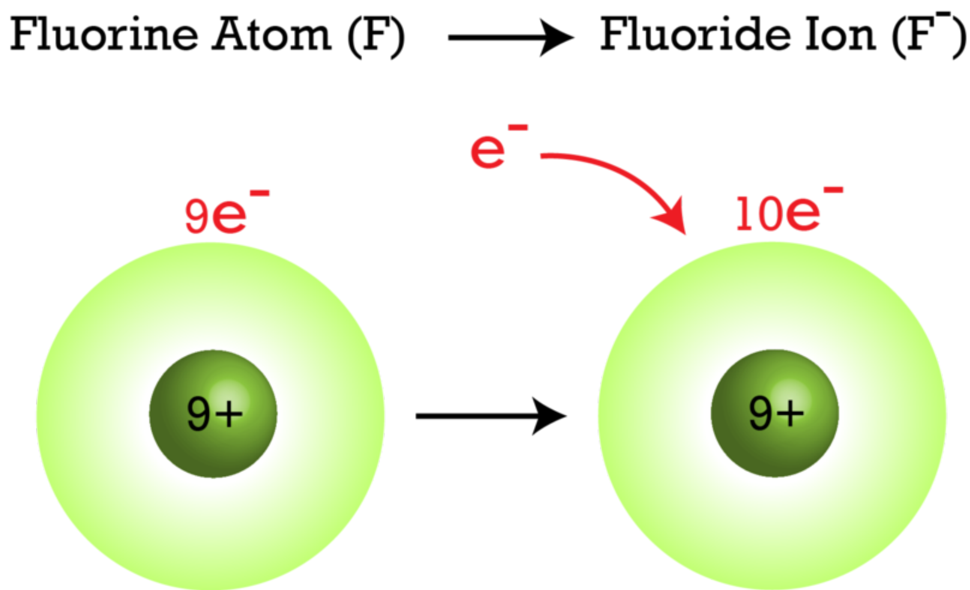
Lesson 5.1: Critical Reading

Name____________________ Class_______________ Date___________

Read this passage from the text and answer the questions that follow.

Ions and Isotopes

Sometimes atoms lose or gain electrons and become ions. Ions are particles that have a positive or negative charge. That's because they do not have the same number of electrons as protons. If atoms lose electrons, they become positive ions, or cations. If atoms gain electrons, they become negative ions, or anions. Consider the example of fluorine shown in the diagram below. A fluorine atom has nine protons and nine electrons, so it is electrically neutral. If a fluorine atom gains an electron, it becomes a fluoride ion with a negative charge of minus one.



Some atoms of the same element differ in their number of neutrons. These atoms are called isotopes. Many isotopes occur naturally. Usually one or two isotopes of an element are the most stable and common. Different isotopes of an element generally have the same chemical properties. That's because they have the same numbers of protons and electrons. Isotopes are generally named for their mass number. For example, carbon atoms with the usual 6 neutrons have a mass number of 12 (6 protons + 6 neutrons = 12), so they are called carbon-12. Carbon atoms with 7 neutrons have an atomic mass of 13 (6 protons + 7 neutrons = 13). These atoms are the isotope called carbon-13.

Questions

1. How do ions differ from atoms? How do ions form?
2. What are isotopes? Why do different isotopes of the same element usually have the same properties?
3. Some carbon atoms have eight neutrons. What is the name of this isotope of carbon?

Lesson 5.1: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. If an atom were the size of a football stadium, the nucleus would be about the size of a
    a. microwave oven.
    b. basketball.
    c. pea.
    d. car.
2. The number of protons in atoms is
    a. the same for all atoms.
    b. unique for each element.
    c. always equal to the number of neutrons.
    d. none of the above
3. The strong force
    a. affects only nearby particles.

b. is stronger than electric force.
c. is not effective if the nucleus is too big.
d. all of the above

4. A neutron has the same mass as a(n)

a. nucleus.
b. electron.
c. proton.
d. quark.

5. A nitrogen atom has an atomic number of 7 and a mass number of 14. How many protons, neutrons, and electrons does it have?

a. 7 protons, 14 neutrons, 7 electrons
b. 14 protons, 7 neutrons, 7 electrons
c. 7 protons, 7 neutrons, 7 electrons
d. 7 protons, 7 neutrons, 14 electrons

6. If an atom loses electrons, it becomes a(n)

a. isotope.
b. cation.
c. anion.
d. gluon.

7. How many neutrons are there in the most common isotope of hydrogen?

a. zero
b. one
c. two
d. three

Lesson 5.1: Matching

Name____________________ Class_______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. electrically neutral atomic particle inside the nucleus of an atom

_____ 2. atom that differs in its number of neutrons from other atoms of the same element

_____ 3. negatively charged atomic particle that moves around the nucleus of an atom

_____ 4. positively charged atomic particle inside the nucleus of an atom

_____ 5. type of particle that makes up protons and neutrons

_____ 6. charged particle that forms when atom gains or loses electron(s)

_____ 7. tiny region at the center of an atom that contains protons and neutrons

Terms

a. electron

b. ion

c. isotope

d. neutron

e. nucleus

f. proton

g. quark

Lesson 5.1: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. The smallest particle of an element that still has the element's properties is a(n) __________.
2. Most of an atom's mass is contained in the __________.
3. Atoms have the same number of electrons as __________.
4. Protons and neutrons are held together in the nucleus by the __________ force.
5. The SI unit for the mass of an atom is the __________.
6. The number of protons in an atom is its __________ number.
7. The number of protons plus neutrons in an atom is its __________ number.

Lesson 5.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Atoms of the same element always have the same atomic number but may vary in their mass number. Explain why.

5.2 History of the Atom

Lesson 5.2: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Aristotle rejected Democritus's idea of the atom.

_____ 2. Dalton thought that atoms could be created or destroyed.

_____ 3. Dalton's atomic theory was later completely rejected.

_____ 4. Ernest Rutherford discovered neutrons.

_____ 5. Thomson showed that electric charge is carried by particles of matter.

_____ 6. The pudding in the plum pudding model represents positive charge.

_____ 7. Democritus represented atoms with solid wooden balls.

_____ 8. In the gold foil experiments, most of the alpha particles were deflected backward from the gold foil.

_____ 9. Dalton was the first scientist to observe atoms with a microscope.

_____ 10. Electrons flow through a vacuum tube from the negative end to the positive end.

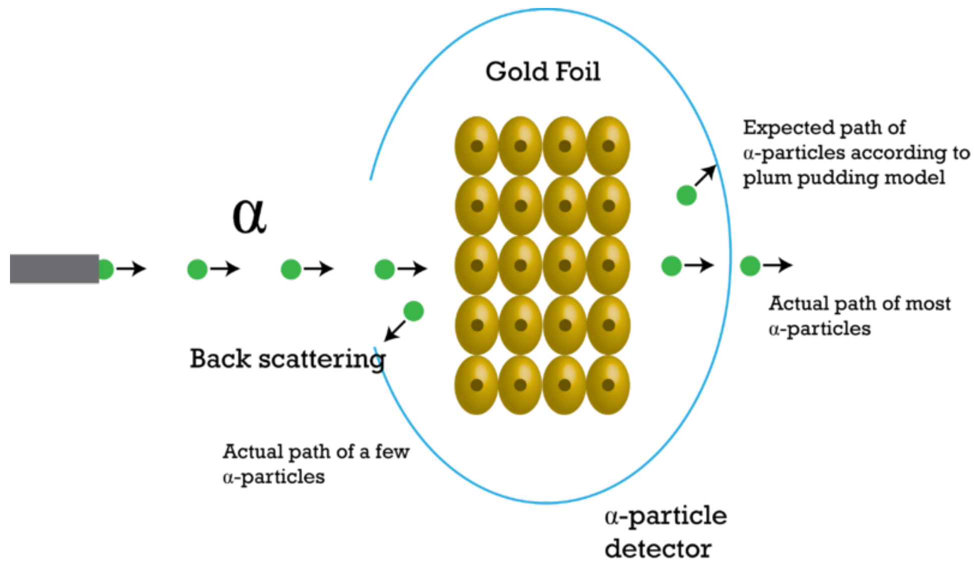
Lesson 5.2: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Rutherford's Gold Foil Experiments

Ernest Rutherford discovered that some elements give off positively charged particles, which he named alpha particles (α). He used alpha particles to study atoms. As shown in the diagram below, Rutherford aimed a beam of alpha particles at a very thin sheet of gold foil. Outside the foil, he placed a screen of material that glowed when alpha particles struck it.



If Thomson's plum pudding model were correct, the alpha particles should be deflected a little as they passed through the foil. Why? The positive "pudding" part of gold atoms would slightly repel the positive alpha particles. This would cause the alpha particles to deflect a little from their original path. But Rutherford got a surprise. Most of the alpha particles passed straight through the foil as though they were moving through empty space. Even more surprising, a few of the alpha particles bounced back from the foil as though they had struck a wall. This is called back scattering. It happened only in very small areas at the centers of the gold atoms.

Based on his results, Rutherford concluded that all the positive charge of an atom is concentrated in a small central area. He called this area the nucleus. Rutherford later discovered that the nucleus contains positively charged particles, which he named protons.

Questions

1. What hypothesis did Rutherford test with his gold foil experiment?
2. Did his results support the hypothesis? Why or why not?
3. What conclusion did Rutherford draw from the results of his experiments?

Lesson 5.2: Multiple Choice

Name____________________ **Class**_______________ **Date**___________

Circle the letter of the correct choice.

1. The history of the atom began almost
   a. 2500 years ago.
   b. 700 years ago.
   c. 500 years ago.
   d. 100 years ago.
2. Dalton's research provided evidence that
   a. atoms exist.
   b. gases consist of tiny particles in constant motion.
   c. a compound always consists of the same elements in the same ratio.
   d. all of the above

3. Which statement is part of Dalton's atomic theory?
    a. All substances are made of atoms.
    b. Atoms can be divided into smaller particles.
    c. Atoms form when compounds join together.
    d. All atoms of the same element have the same number of protons.
4. Dalton's atomic models were most similar to
    a. bowling balls.
    b. plum puddings.
    c. planetary orbits.
    d. blades of a fan.
5. Thomson's research involved
    a. gold foil and alpha particles.
    b. electric current and a vacuum tube.
    c. gases and pressure.
    d. neutrons and back scattering.
6. In the plum pudding model of the atom, the plums represent
    a. protons.
    b. neutrons.
    c. nuclei.
    d. electrons.
7. In the planetary model, the planets represent
    a. alpha particles.
    b. gold atoms.
    c. electrons.
    d. positive charges.

Lesson 5.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. scientist who discovered electrons.

_____ 2. philosopher who thought the idea of the atom was ridiculous

_____ 3. Thomson's atomic model

_____ 4. philosopher who introduced the idea of the atom

_____ 5. Rutherford's atomic model

_____ 6. scientist who developed atomic theory

_____ 7. scientist who discovered the nucleus

Terms

a. Democritus

b. Aristotle

c. John Dalton

d. J. J. Thomson

e. Ernest Rutherford

f. plum pudding model

g. planetary model

Lesson 5.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. Democritus's idea of the atom was revived by __________.
2. Dalton thought that __________ are the smallest particles of matter.
3. The first subatomic particle to be discovered was the __________.
4. Protons were discovered by __________.
5. James Chadwick discovered __________.
6. The term *atom* is based on a Greek word that means __________.
7. Dalton theorized that atoms join together to form __________.

Lesson 5.2: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

How did Rutherford use indirect evidence to find the nucleus?

5.3 Modern Atomic Theory

Lesson 5.3: True or False

Name____________________ Class_______________ Date___________

Determine if the following statements are true or false.

_____ 1. Energy level 1 has the most energy.

_____ 2. Electrons can move from one energy level to another.

_____ 3. Scientists can now determine the exact location of any given electron.

_____ 4. Electrons are attracted to the nucleus because of the strong force.

_____ 5. Some regions of the electron cloud are denser than others.

_____ 6. There is a maximum of two orbitals per energy level.

_____ 7. Fireworks give off light when their electrons split in two.

_____ 8. Since the 1920s, physicists have known that electrons travel in fixed paths.

_____ 9. Wavelike particles in the atom exist only where the wave is stable.

_____ 10. All energy levels have the same maximum number of electrons.

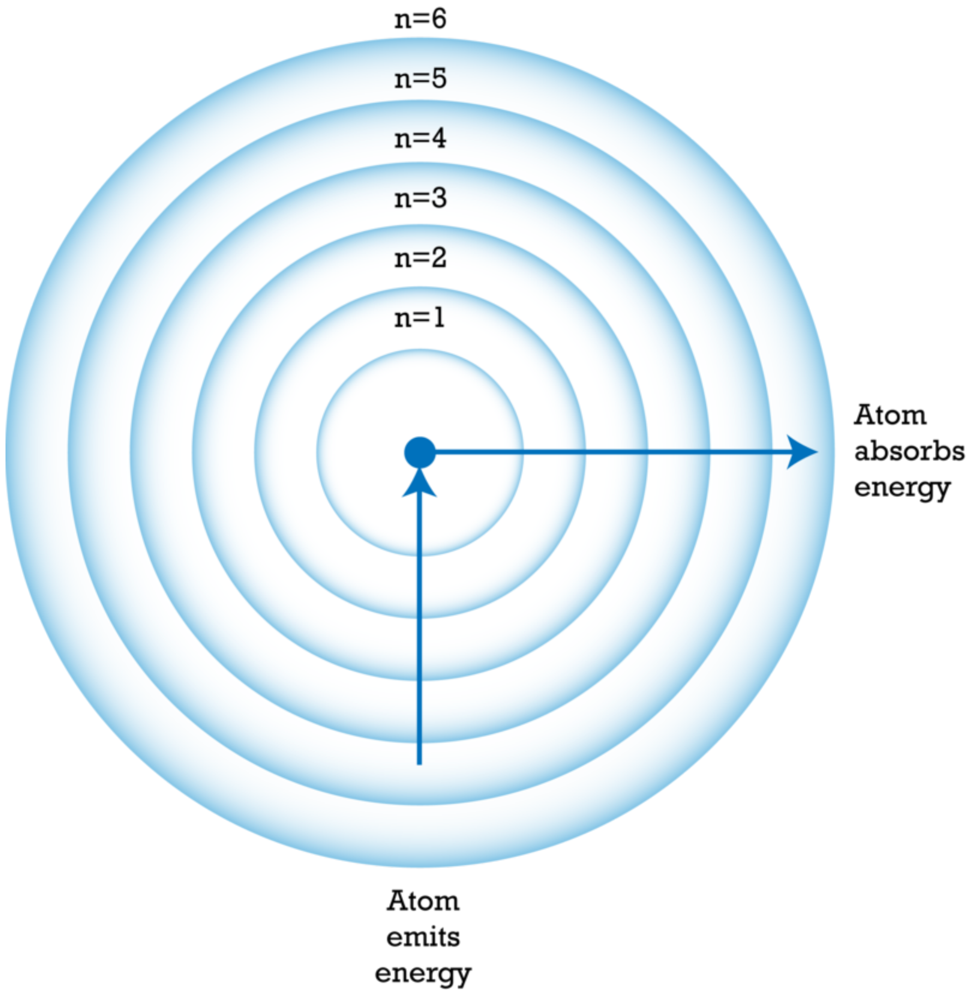
Lesson 5.3: Critical Reading

Name____________________ Class_______________ Date___________

Read this passage from the text and answer the questions that follow.

Energy Levels

Energy levels are areas located at fixed distances from the nucleus of the atom. They are the only places where electrons can be found. Energy levels are little like rungs on a ladder. You can stand on one rung or another but not between the rungs. The same goes for electrons. They can occupy one energy level or another but not the space between energy levels. The model of an atom shown below has six energy levels (n = 1, 2, 3, 4, 5, and 6). The level with the least energy is the one closest to the nucleus, or n = 1. As you go farther from the nucleus, the levels have more and more energy.



Electrons can jump from one energy level to another. If an atom absorbs energy, some of its electrons jump to a higher energy level. When the electrons jump back to the lower energy level, the atom emits, or gives off, energy. Energy levels explain fireworks. When chemicals in fireworks explode, their atoms absorb energy and some of their electrons jump to a higher energy level. When the electrons jump back to their original lower energy level, the atoms give off energy as light. Different chemicals have different arrangements of electrons and give off light of different colors.

Questions

1. What are energy levels? Why are they like the rungs of a ladder?
2. In the model atom shown above, which energy level has the most energy?
3. How do energy levels explain the light given off by fireworks?

Lesson 5.3: Multiple Choice

Name____________________ Class_______________ Date__________

Circle the letter of the correct choice.

1. Bohr's research focused on
   a. electrons.

b. neutrons.
c. protons.
d. none of the above

2. Which statement about energy levels is false?
   a. They are located at fixed distances from the nucleus.
   b. They are the only places where electrons can be found.
   c. They have more energy when they are farther from the nucleus.
   d. There are only two of them.
3. Fireworks give off light energy when their electrons
   a. flow to different atoms.
   b. jump to a lower energy level.
   c. produce electric current.
   d. change from matter to energy.
4. Energy levels farther from the nucleus have
   a. less energy.
   b. more orbitals.
   c. a greater maximum number of electrons.
   d. two of the above
5. How many orbitals are there at energy level 3?
   a. 1
   b. 4
   c. 9
   d. 16
6. Electrons bend around the nucleus instead of falling toward it because electrons behave like
   a. protons.
   b. orbitals.
   c. clouds.
   d. waves.
7. Where would you *not* be likely to find electrons in an atom?
   a. inside the nucleus
   b. attached to the nucleus
   c. between energy levels
   d. all of the above

Lesson 5.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. number of orbitals in the first energy level

_____ 2. area surrounding the nucleus of an atom where electrons are likely to be

_____ 3. scientist who thought that electrons orbit the nucleus like planets orbit the sun

_____ 4. maximum number of electrons per orbital

_____ 5. area located at a fixed distance from the nucleus of an atom where electrons can orbit the nucleus

_____ 6. wavelike particles that move around the nucleus of an atom

_____ 7. scientist who discovered energy levels

Terms

a. electron cloud

b. energy level

c. Rutherford

d. Bohr

e. electron

f. two

g. one

Lesson 5.3: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. In __________ atomic model, electrons orbit the nucleus only at fixed energy levels.
2. The energy level with the least energy is the one closest to the __________.
3. Electrons can jump to a higher energy level if an atom absorbs __________.
4. Electrons behave like both particles and __________.
5. __________ are places in the electron cloud where electrons are most likely to be.
6. The second energy level has four orbitals and a maximum of __________ electrons.
7. If atoms lose energy, some of their electrons may jump to a(n) __________ energy level.

Lesson 5.3: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Relate the wave nature of electrons to the electron cloud model of the atom.

CHAPTER 6 Periodic Table Worksheets

Chapter Outline

6.1 How Elements Are Organized

Lesson 6.1: True or False

Name____________________ **Class**_______________ **Date**___________

Determine if the following statements are true or false.

Write true if the statement is true or false if the statement is false.

_____ 1. Mendeleev developed his periodic table in the 1860s.

_____ 2. Mendeleev named the columns of his table periods.

_____ 3. Elements within a group of the periodic table are identical to each other.

_____ 4. In Mendeleev's table, each period contains 18 elements.

_____ 5. Mendeleev's used his table to predict unknown elements.

_____ 6. The elements Mendeleev predicted were never discovered.

_____ 7. Lanthanide elements are placed in period 2 of the modern periodic table.

_____ 8. The chemical symbol for lead is Pb.

_____ 9. Most elements in the modern periodic table are metalloids.

_____ 10. Krypton is a gaseous metal in group 18 of the periodic table.

Lesson 6.1: Critical Reading

Name____________________ **Class**_______________ **Date**___________

Read this passage from the text and answer the questions that follow.

Modern Periodic Table

In the modern periodic table of the elements, the elements are organized by atomic number. Atomic number is the number of protons in an atom of an element, and this number is unique for each element. Atomic number increases from left to right across each row and from top to bottom within each column of the periodic table.

Rows of the modern table are called periods. From left to right across a period, each element has one more proton than the element before it. Within each period, elements change from metals on the left side of the table, to metalloids, and then to nonmetals on the right. Some periods in the modern periodic table are longer than others. For example, period 1 contains only two elements. Periods 6 and 7, in contrast, are so long that some of their elements are placed below the main part of the table. These elements are called the lanthanides (period 6) and actinides (period 7).

Columns of the periodic table are called groups, or families. There are a total of 18 groups in the modern table. Elements in the same group have similar properties. For example, all elements in group 18 are colorless, odorless gases.

Questions

1. The periodic table has a repeating pattern. In most periods of the modern periodic table, how many elements are placed in a period before the pattern repeats?
2. Describe the pattern of elements within each period of the table.
3. How do elements vary within each group of the periodic table?

Lesson 6.1: Multiple Choice

Name____________________ Class_______________ Date___________

Circle the letter of the correct choice.

1. Scientist first started looking for a way to organize the elements in the
   a. 1700s.
   b. late 1800s.
   c. early 1900s.
   d. 1980s.
2. How many groups are there in Mendeleev's periodic table?
   a. 18
   b. 16
   c. 12
   d. 8
3. Examples that illustrate the meaning of periodic include
   a. phases of the moon.
   b. day and night.
   c. months of the year.
   d. all of the above
4. How many elements are represented in the modern periodic table?
   a. fewer than 50
   b. exactly 18
   c. about 65
   d. more than 100
5. Which of the following could be the chemical symbol of an element?
   a. SI
   b. si
   c. Si
   d. iS
6. Elements on the right side of the periodic table are
   a. metals.
   b. metalloids.
   c. nonmetals.
   d. actinides.
7. Which sentence is true about periods of the periodic table?
   a. All the periods are the same length.

b. There are a total of 18 periods.
c. Some periods are longer than others.
d. two of the above

Lesson 6.1: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. number of protons in an atom

_____ 2. row of the periodic table

_____ 3. table based on the atomic number of elements

_____ 4. how an element is represented in the periodic table

_____ 5. table based on the atomic mass of elements

_____ 6. column of the periodic table

_____ 7. amount of matter in an atom

Terms

a. group

b. period

c. atomic number

d. atomic mass

e. chemical symbol

f. Mendeleev's periodic table

g. modern periodic table

Lesson 6.1: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. The first successful periodic table was created by __________.
2. Atomic number __________ from left to right across each period of the periodic table.
3. Atomic number __________ from top to bottom within each group of the periodic table.
4. Groups of the periodic table are also called __________.
5. Elements on the left side of the periodic table are classified as __________.
6. The shortest period in the modern periodic table is period __________.
7. The number of groups in the modern periodic table is __________.

Lesson 6.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare and contrast Mendeleev's periodic table of the elements and the modern periodic table.

6.2 Classes of Atoms

Lesson 6.2: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Metals have relatively high melting points.

_____ 2. Carbon is an example of a metalloid.

_____ 3. Almost all nonmetals are solids are room temperature.

_____ 4. Some nonmetals are semiconductors.

_____ 5. Silicon is the most common metalloid on Earth.

_____ 6. Metals generally have fewer valence electrons than nonmetals.

_____ 7. The number of valence electrons determines an element's reactivity.

_____ 8. Elements that "want" to gain electrons are usually metals.

_____ 9. The ability of an element to conduct electricity depends on its number of neutrons.

_____ 10. Neon is more reactive than fluorine.

Lesson 6.2: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Valence Electrons and Reactivity

The electrons in the outer energy level of an atom are called valence electrons. It is valence electrons that are potentially involved in chemical reactions. The number of valence electrons determines an element's reactivity, or how likely the element is to react with other elements. The number of valence electrons also determines whether the element can conduct electric current. That's because electric current is the flow of electrons. These properties vary in elements from different classes.

- Metals such as lithium have an outer energy level that is almost empty, They "want" to give up their few valence electrons so they will have a full outer energy level. As a result, metals are very reactive and good conductors of electricity.
- Metalloids such as boron have an outer energy level that is about half full. These elements need to gain or lose too many electrons for a full outer energy level to come about easily. As a result, these elements are not very reactive. They may be able to conduct electricity but not very well.
- Some nonmetals, such as fluorine, have an outer energy level that is almost full. They "want" to gain electrons so they will have a full outer energy level. As a result, these nonmetals are very reactive. Because they only accept electrons and do not give them up, they do not conduct electricity.

- Other nonmetals, such as neon, have a completely full outer energy level. Their electrons are already in the most stable arrangement possible. They are unreactive and do not conduct electricity.

Questions

1. What are valence electrons?
2. How are valence electrons related to reactivity?
3. Why are some nonmetals very reactive while other nonmetals are unreactive?

Lesson 6.2: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Most metals are
   a. shiny.
   b. good conductors of heat.
   c. solids are room temperature.
   d. all of the above
2. If an element is ductile, this means that it can be
   a. used as an insulator.
   b. pulled into long thin shapes.
   c. used to conduct electricity.
   d. crushed into a powder.
3. Nonmetals tend to have properties that are
   a. very similar to the properties of metals.
   b. in between those of metals and metalloids.
   c. more variable than the properties of metals.
   d. none of the above
4. Solid nonmetals are
   a. malleable.
   b. brittle.
   c. dull.
   d. two of the above
5. Which of the following elements is a nonmetal?
   a. sulfur
   b. aluminum
   c. silver
   d. zinc
6. Which of the following elements is a metalloid?
   a. copper
   b. helium
   c. phosphorus
   d. germanium
7. Which element has a completely filled outer energy level?

a. lithium
b. boron
c. fluorine
d. neon

Lesson 6.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. class of elements that do not conduct electricity

_____ 2. word that describes most solid nonmetals

_____ 3. smallest class of elements

_____ 4. only nonmetal that is a liquid at room temperature

_____ 5. word that describes most metals

_____ 6. only metal that is a liquid at room temperature

_____ 7. class of elements that conduct electricity

Terms

a. metals

b. metalloids

c. nonmetals

d. mercury

e. ductile

f. bromine

g. brittle

Lesson 6.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. The largest class of elements is the __________.
2. Most metals can be formed into thin sheets without breaking because they are __________.
3. The second largest of class of elements is the __________.
4. Boron is an element in the __________ class.
5. Electrons in the outer energy level of an atom are called __________ electrons.
6. All metalloids are in the __________ state at room temperature.
7. Sodium is an element in the __________ class.

Lesson 6.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why metals are good conductors of electricity whereas nonmetals cannot conduct electricity.

6.3 Groups of Elements

Lesson 6.3: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Hydrogen is an alkali metal.

_____ 2. Alkali metals are found only in compounds.

_____ 3. Some alkali metals can float on water.

_____ 4. Calcium is an alkali metal.

_____ 5. There is just one group of transition metals.

_____ 6. Many of the actinides do not occur in nature.

_____ 7. Elements in the oxygen group have eight valence electrons.

_____ 8. Selenium is an alkaline Earth metal.

_____ 9. The halogen group includes only gases.

_____ 10. Noble gases are found only in combination with other elements.

Lesson 6.3: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Groups Containing Metalloids

Groups 13–16 all contain one or more metalloids. The groups are named for the first element in the group.

- Group 13 is called the boron group. The only metalloid in this group is boron (B). The other four elements are metals. All group 13 elements have three valence electrons and are fairly reactive. All are solids at room temperature.
- Group 14 is called the carbon group. Carbon (C) is a nonmetal. The next two elements are metalloids, and the final two are metals. All the elements in the carbon group have four valence electrons. They are not very reactive. All are solids at room temperature.
- Group 15 is called the nitrogen group. The first two elements in this group are nonmetals. These are followed by two metalloids and one metal. All the elements in the nitrogen group have five valence electrons, but they vary in their reactivity. Nitrogen (N) in not reactive at all. Phosphorus (P), in contrast, is quite reactive. In fact, it is found naturally only in combination with other substances. Nitrogen is a gas at room temperature. The other group 15 elements are solids.
- Group 16 is called the oxygen group. The first three elements in this group are nonmetals. They are followed by one metalloid and one metal. All the elements in the oxygen group have six valence electrons, and all are

reactive. Oxygen (O), for example, readily reacts with metals to form compounds such as rust. Oxygen is a gas at room temperature. The other four elements in group 16 are solids.

Questions

1. What do groups 13–16 have in common?
2. Create a table comparing and contrasting groups 13–16.

Lesson 6.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Elements in group 1 include
   a. hydrogen.
   b. alkali metals.
   c. alkaline Earth metals.
   d. two of the above
2. Alkali metals are
   a. soft.
   b. high in density.
   c. not very reactive.
   d. all of the above
3. Which statement about alkaline Earth metals is true?
   a. They are more reactive than alkali metals.
   b. They are always found combined with other elements.
   c. Some of them are liquids at room temperature.
   d. They are all gold in color.
4. Transition metals tend to
   a. be shiny.
   b. boil at low temperatures.
   c. be very soft.
   d. be extremely reactive.
5. The only nonmetal in the carbon group is
   a. nitrogen.
   b. boron.
   c. carbon.
   d. oxygen.
6. Halogens form salts when they combine with
   a. alkali metals.
   b. alkaline Earth metals.
   c. transition metals.
   d. all metals.
7. Nobles gases are
   a. colorless.

b. odorless.
c. reactive.
d. two of the above

Lesson 6.3: Matching

Name____________________ Class_______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. column of elements in the periodic table

_____ 2. element in group 18 of the periodic table

_____ 3. metal in group 1 of the periodic table

_____ 4. radioactive transition metal

_____ 5. metal in group 2 of the periodic table

_____ 6. metal in group 3 of the periodic table

_____ 7. nonmetal in group 17 of the periodic table

Terms

a. alkali metal

b. alkaline Earth metal

c. halogen

d. noble gas

e. transition metal

f. group

g. actinide

Lesson 6.3: Fill in the Blank

Name____________________ Class_______________ Date________

Fill in the blank with the appropriate term.

1. Elements in the same ___________ of the periodic table have the same number of valence electrons.
2. The most reactive of all metals are ___________ metals.
3. All alkaline Earth metals have ___________ valence electron(s).
4. The lanthanides are metals known as ___________ metals.
5. Groups 13–16 of the periodic table all contain one or more ___________.
6. The most reactive nonmetals belong to the group called the ___________.
7. The least reactive elements are in the group called the ___________.

Lesson 6.3: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Relate the reactivity of groups of elements to their number of valence electrons.

CHAPTER 7 Chemical Bonding Worksheets

Chapter Outline

7.1 Introduction to Chemical Bonds

Lesson 7.1: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. A hydrogen atom has two electrons.

_____ 2. Each element is represented by a unique chemical formula.

_____ 3. The compound carbon dioxide has twice as many oxygen atoms as carbon atoms.

_____ 4. The same elements may combine in different ratios to form the same compound.

_____ 5. Any molecule that contains only hydrogen and oxygen is water.

_____ 6. Different types of compounds differ in the types of bonds that hold their atoms together.

_____ 7. Both coal and diamond consist of atoms of carbon that are bonded together.

_____ 8. Most of the unique substances on Earth are compounds.

_____ 9. When atoms combine chemically they form mixtures.

_____ 10. A chemical bond consists of matter that connects two different atoms.

Lesson 7.1: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Chemical Bonding

Elements form compounds when they combine chemically. This is called chemical bonding. Atoms of different elements join together to form molecules, crystals, or other structures. The atoms are held together by chemical bonds. A chemical bond is a force of attraction between atoms or ions. It occurs when they share or transfer valence electrons. Valence electrons are the electrons in the outer energy level of an atom.

Consider water as an example. A water molecule consists of two atoms of hydrogen and one atom of oxygen. A hydrogen atom has just one electron, and an oxygen atom has six valence electrons. In a water molecule, each hydrogen atom shares a pair of valence electrons with the oxygen atom. One electron in the pair comes from hydrogen and one comes from oxygen. By sharing electrons, each atom has electrons available to fill its sole or outer energy level. This gives it a more stable arrangement of electrons that takes less energy to maintain.

Questions

1. Describe the chemical bonds that hold together the atoms in a water molecule.
2. Explain why atoms share electrons.

Lesson 7.1: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Subscripts in a chemical formula are used to show the number of
   a. molecules in a substance.
   b. atoms of each element in a compound.
   c. different elements in a compound.
   d. protons in an element.
2. Which chemical formula represents the compound hydrogen peroxide?
   a. H_2O
   b. HO_2
   c. H_2O_2
   d. H_2O_3
3. The chemical formula HCl represents the compound named
   a. hydrogen chloride.
   b. hydrogen carbide.
   c. methane.
   d. none of the above
4. Which statement is true about carbon dioxide and carbon monoxide?
   a. Both compounds consist of carbon and oxygen.
   b. Both compounds have all the same properties.
   c. Both compounds are harmless gases.
   d. all of the above
5. How many valence electrons does an oxygen atom have?
   a. 2
   b. 4
   c. 6
   d. 8
6. A given compound always has the same
   a. chemical formula.
   b. composition.
   c. volume.
   d. two of the above
7. When there is just one atom of an element in a molecule, what subscript is used for the element?
   a. 1
   b. 0
   c. 2
   d. No subscript is used.

Lesson 7.1: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. pure substance that cannot be separated into any other substances

_____ 2. unique substance that forms when elements combine chemically

_____ 3. particle of a compound that forms when atoms bond together

_____ 4. one of three types of chemical compounds

_____ 5. symbol representing a chemical compound

_____ 6. particle in the outer energy level of an atom

_____ 7. force of attraction between atoms or ions that share or transfer electrons

Terms

a. chemical bond

b. chemical formula

c. compound

d. valence electron

e. element

f. molecule

g. ionic

Lesson 7.1: Fill in the Blank

Name__________________ Class_____________ Date________

Fill in the blank with the appropriate term.

1. A molecule of __________ consists of two atoms of hydrogen and one atom of oxygen.
2. The chemical formula for water is __________.
3. Each hydrogen atom in a water molecule shares __________ valence electron(s) with the oxygen atom.
4. The chemical formula for carbon dioxide is __________.
5. The chemical formula CO represents the compound __________.
6. Atoms or ions in compounds are held together by chemical __________.
7. Three types of chemical bonds are covalent, ionic, and __________ bonds.

Lesson 7.1: Critical Writing

Name__________________ Class_____________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

There are fewer than 100 naturally occurring elements in the universe, but there are millions of different unique substances. Explain how this can be true.

7.2 Ionic Bonds

Lesson 7.2: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Ionic compounds form when ions share electrons.

_____ 2. In sodium chloride, sodium loses an electron to chlorine.

_____ 3. Ionic bonds form only between atoms of nonmetals.

_____ 4. The amount of energy needed to form an ion depends only on the number of valence electrons.

_____ 5. Francium has the same number of valence electrons as lithium.

_____ 6. Alkali metals release the most energy when they become ions.

_____ 7. Salt consists of molecules of sodium and chloride ions.

_____ 8. When an atom of iodine becomes an ion, it is named iodide.

_____ 9. Ionic compounds are usually liquids at room temperature.

_____ 10. Water is an example of an ionic compound.

Lesson 7.2: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Properties of Ionic Compounds

The crystal structure of ionic compounds is strong and rigid. It takes a lot of energy to break all those strong ionic bonds. As a result, ionic compounds are solids with high melting and boiling points. For example, the melting point of sodium chloride is 801 °C and the boiling point is 1413 °C. Contrast these figures with the melting and boiling points of water, which is not an ionic compound. Water melts at 0 °C and boils at 100 °C. The rigid crystals of ionic compounds are also brittle and more likely to break than bend when struck. As a result, ionic crystals tend to shatter easily.

Solid ionic compounds are poor conductors of electricity. The strong bonds between ions lock them into place in the crystal. However, ionic compounds are good conductors of electricity when they are in the liquid state or when they are dissolved in water. Most ionic compounds dissolve easily in water. When they dissolve, they separate into individual ions, which can move freely and carry electric current. Dissolved ionic compounds are called electrolytes.

Questions

1. Describe the crystal structure of ionic compounds.
2. List properties of ionic compounds.

3. Explain why ionic compounds are solids at room temperature and why they cannot conduct electricity in the solid state.

Lesson 7.2: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. When metallic elements become ions they
   a. gain electrons.
   b. become positively charged.
   c. become negatively charged.
   d. two of the above
2. Which two elements could form an ionic compound?
   a. carbon and oxygen
   b. hydrogen and nitrogen
   c. lithium and fluorine
   d. boron and neon
3. Which statement about energy and ionic bonds is true?
   a. It takes energy to form a negative ion.
   b. Halogens need the most energy to become ions.
   c. It takes energy to remove valence electrons from an atom.
   d. It takes more energy to gain two electrons than one electron.
4. Which of the following compounds is not an ionic compound?
   a. barium oxide
   b. lithium oxide
   c. carbon dioxide
   d. calcium chloride
5. Properties of ionic compounds include
   a. high melting points.
   b. high boiling points.
   c. brittleness.
   d. all of the above
6. Ionic compounds are good conductors of electricity when they are
   a. shaped into wires.
   b. dissolved in water.
   c. formed into crystals.
   d. made of two metals.
7. In which of the following elements is the valence electron farthest from the nucleus?
   a. lithium (Li)
   b. sodium (Na)
   c. potassium (K)
   d. rubidium (Rb)

Lesson 7.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. dissolved ionic compound

_____ 2. unique substance that forms when a metal and a nonmetal combine chemically

_____ 3. example of an alkali metal

_____ 4. force of attraction that holds together positive and negative ions

_____ 5. example of a negative ion

_____ 6. charged particle that forms when an atom gains or loses electrons

_____ 7. structure that forms when many positive and negative ions bond together

Terms

a. ion

b. ionic bond

c. ionic compound

d. crystal

e. electrolyte

f. sodium

g. chloride

Lesson 7.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. A compound that forms when elements transfer electrons is called a(n) __________ compound.
2. Metals form ions that have a(n) __________ electric charge.
3. To become an ion, sodium __________ an electron.
4. To have a full outer energy level, a chlorine atoms must gain __________ electron(s).
5. Energy is released when an atom __________ an electron and becomes an ion.
6. When an ionic compound is named, the __________ ion is named first.
7. In the ionic compound iron bromide, the negative ion is __________.

Lesson 7.2: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Relate ionic bonds to the properties of ionic compounds.

7.3 Covalent Bonds

Lesson 7.3: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Covalent bonds are found only in covalent compounds.

_____ 2. Some covalent compounds contain atoms of just one element.

_____ 3. Formaldehyde is an example of a covalent compound.

_____ 4. Oxygen gas consists of individual oxygen atoms.

_____ 5. An oxygen atom forms two covalent bonds.

_____ 6. Oxygen always becomes negatively charged when it forms covalent bonds.

_____ 7. In naming a covalent compound, the element closest to the right of the periodic table is named first.

_____ 8. The second element named in a covalent compound gets the suffix –ide.

_____ 9. Polar compounds tend to have higher boiling points than nonpolar compounds.

_____ 10. If a bond forms between calcium and chlorine, the bond is covalent.

Lesson 7.3: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Covalent Compounds

Covalent compounds are compounds in which atoms of different nonmetal elements are joined together by covalent bonds. In a covalent bond, two atoms share a pair of valence electrons. The smallest, simplest covalent compounds have molecules with just two atoms. An example is hydrogen chloride (HCl). It consists of one hydrogen atom and one chlorine atom. The largest, most complex covalent molecules have thousands of atoms. Examples include proteins and carbohydrates, which are compounds in living things.

Covalent compounds have different properties than ionic compounds because of their bonds. Covalent compounds exist as individual molecules rather than as crystals. It takes less energy for individual molecules than ions in a crystal to pull apart. As a result, covalent compounds have lower melting and boiling points than ionic compounds. Many covalent compounds are gases or liquids at room temperature. Covalent compounds have shared electrons. The electrons are not free to move like the transferred electrons of ionic compounds. This makes covalent compounds poor conductors of electricity. Many covalent compounds also do not dissolve in water as ionic compounds do.

Questions

1. What is a covalent bond? What is a covalent compound?

2. List properties of covalent compounds.
3. Explain why covalent compounds are poor conductors of electricity.

Lesson 7.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Covalent bonds may form between
    a. atoms of different elements.
    b. atoms of the same element.
    c. ions of different elements.
    d. two of the above
2. Elements that normally occur as diatomic molecules include
    a. hydrogen.
    b. iodine.
    c. oxygen.
    d. all of the above
3. Shared electrons in covalent bonds are always attracted to
    a. both nuclei.
    b. both nuclei equally.
    c. one nucleus more than the other.
    d. one nucleus only.
4. How many covalent bonds must a hydrogen atom form to have a full outer energy level?
    a. 0
    b. 1
    c. 2
    d. 3
5. An example of a polar molecule is
    a. H_2O.
    b. CO_2.
    c. O_2.
    d. H_2.
6. Which statement about hydrogen bonds is true?
    a. They are very strong.
    b. They form between molecules.
    c. They form within molecules.
    d. two of the above
7. Compared with ionic compounds, covalent compounds
    a. have lower melting points.
    b. have higher boiling points.
    c. are better conductors of electricity.
    d. are more likely to dissolve in water.

Lesson 7.3: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. any compound consisting of two or more nonmetals

_____ 2. covalent bond in which neither atom has an electric charge

_____ 3. covalent bond between two atoms of the same element

_____ 4. force of attraction holding together two atoms that share a pair of electrons

_____ 5. weak bond that forms between oppositely charged ends of two molecules

_____ 6. covalent bond in which the two atoms are oppositely charged

_____ 7. compound in which molecules have oppositely charged ends

Terms

a. covalent bond

b. hydrogen bond

c. polar bond

d. nonpolar bond

e. diatomic bond

f. polar compound

g. covalent compound

Lesson 7.3: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. Covalent bonds are bonds in which atoms __________ electrons.
2. Covalent bonds form only between atoms of __________.
3. Covalent bonds give atoms a more stable arrangement of __________.
4. With six valence electrons, oxygen needs __________ more electron(s) to fill its outer energy level.
5. In a water molecule, the __________ atom attracts shared electrons more strongly.
6. Few covalent compounds are in the __________ state at room temperature.
7. The type of bond that forms between water molecules is a(n) __________ bond.

Lesson 7.3: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why water has a relatively high boiling point for a covalent compound.

7.4 Metallic Bonds

Lesson 7.4: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Special bonds form in metals that do not form in other classes of elements.

_____ 2. A metallic lattice is more rigid than an ionic crystal.

_____ 3. Metallic bonds explain some of the unique properties of metals.

_____ 4. Metal ions form bonds with the valence electrons around them.

_____ 5. Examples of metals include iron, zinc, and carbon.

_____ 6. A metallic lattice is held together by ionic bonds.

_____ 7. Iron is stronger than steel.

_____ 8. Most metal objects are made of alloys.

_____ 9. Bronze is a compound of copper and tin.

_____ 10. Gold jewelry is usually made of pure gold.

Lesson 7.4: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Metallic Bonding

Metallic bonding is the force of attraction between positive metal ions and valence electrons. The positive ions form a lattice-like structure. The ions are held together in the lattice by bonds with the valence electrons around them. These valence electrons include their own and those of other ions. Why does metallic bonding occur? Metals "want" to give up their valence electrons. This means that their valence electrons move freely. The valence electrons form a "sea" of negative charge surrounding the positive ions.

A metallic lattice may resemble a rigid ionic crystal, but it is much more flexible. If you strike a metal it may change shape, but it is unlikely to shatter as an ionic crystal would. The ions of the metal can move within the "sea" of valence electrons without breaking the metallic bonds that hold them together. The ions can shift closer together or farther apart. In this way, the metal can change shape without breaking

Questions

1. What is metallic bonding? Explain why it occurs.
2. Describe a metallic lattice.
3. Why can metals change shape without breaking?

Lesson 7.4: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Which statement about metallic bonds is true?
   a. They form between metals and nonmetals.
   b. They form between negative and positive ions.
   c. They form a lattice-like structure.
   d. two of the above
2. Which statement is true about all metals?
   a. They have one valence electron.
   b. They have freely moving electrons.
   c. They have more electrons than protons.
   d. They always gain electrons.
3. Because of metallic bonds, metals
   a. are good conductors of electricity.
   b. can change shape without breaking.
   c. are ductile and malleable.
   d. all of the above
4. An alloy is a
   a. pure metal.
   b. compound of two or more metals.
   c. solid solution.
   d. mixture of nonmetals.
5. Metal ions are surrounded by a “sea” of
   a. electrons.
   b. positive ions.
   c. negative ions.
   d. positive charges.
6. The alloy that contains iron, carbon, nickel, and chromium is called
   a. stainless steel.
   b. bronze.
   c. brass.
   d. gold.

Lesson 7.4: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. type of ion a metal forms

_____ 2. structure formed by metallic bonding

_____ 3. example of an alloy

_____ 4. any element that is a good conductor of electricity

_____ 5. example of a metal

_____ 6. mixture of a metal with one or more other elements

_____ 7. force of attraction between a metal ion and valence electrons it shares with other ions of the metal

Terms

a. alloy

b. metallic bond

c. metal

d. cation

e. iron

f. steel

g. metallic lattice

Lesson 7.4: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. Metal ions always have a(n) __________ electric charge.
2. Metals have freely moving __________.
3. A substance that is __________ can be shaped into wires.
4. A substance that is __________ can be shaped into thin sheets.
5. Steel is a mixture of iron and small amounts of __________.
6. The first alloy ever made was __________.
7. Brass is an alloy of __________ and zinc.

Lesson 7.4: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe metallic bonds and explain how they are related to the properties of metals.

CHAPTER 8 Chemical Reactions Worksheets

Chapter Outline

8.1 Introduction to Chemical Reactions

Lesson 8.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Most chemical reactions take place in labs.

_____ 2. All changes in matter involve chemical reactions.

_____ 3. Evaporation is an example of a chemical change.

_____ 4. Reactants and products can be elements or compounds.

_____ 5. Chemical reactions may occur quickly or slowly.

_____ 6. Some chemical reactions can proceed in just one direction.

_____ 7. An example of a chemical change is water boiling.

_____ 8. Freezing involves a chemical reaction.

_____ 9. A banana turning brown is a chemical change.

_____ 10. Wax melting is an example of a chemical reaction.

Lesson 8.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

What Is a Chemical Reaction?

A chemical reaction is a process in which some substances change into different substances. Substances that start a chemical reaction are called reactants. Substances that are produced in the reaction are called products. Reactants and products can be elements or compounds. Bonds break in the reactants and new bonds form in the products. The reactants and products contain the same atoms, but they are rearranged during the reaction. As a result, the atoms are in different combinations in the products than they were in the reactants.

Questions

1. What is a chemical reaction?
2. Compare and contrast reactants and products of a chemical reaction.

Lesson 8.1: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. What do the formation of rust and the formation of cottage cheese have in common?
    a. Both occur very quickly.
    b. Both involve chemical reactions.
    c. Both are changes of state.
    d. Both are physical processes.
2. Which of the following changes does not involve chemical reactions?
    a. clouds forming
    b. candles burning
    c. leaves turning color
    d. fire extinguishers foaming
3. During chemical reactions, atoms are
    a. rearranged.
    b. created or destroyed.
    c. changed to new elements.
    d. two of the above
4. There is no overall change in reactants and products whenever a chemical reaction
    a. goes in just one direction.
    b. goes in two directions.
    c. reaches equilibrium.
    d. proceeds slowly.
5. Evidence of chemical reactions include changes in
    a. state.
    b. color.
    c. temperature.
    d. two of the above

6. What does the following equation represent? Reactants $\leftrightarrow$ Products
    (a) any chemical reaction
    (b) a reversible chemical reaction
    (c) a chemical reaction in equilibrium
    (d) all of the above

Lesson 8.1: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. substance produced in a chemical reaction

_____ 2. force of attraction that breaks and reforms in a chemical reaction

_____ 3. substance that starts a chemical reaction

_____ 4. example of chemical change

_____ 5. balance between opposing changes

_____ 6. process in which some substances become different substances

_____ 7. example of a physical change

Terms

a. chemical reaction

b. melting

c. equilibrium

d. chemical bond

e. product

f. rusting

g. reactant

Lesson 8.1: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. In chemical reactions, bonds __________ in reactants.
2. The point at which forward and reverse reactions occur at the same rate is called __________.
3. A change in color may be evidence that a(n) __________ has occurred.
4. New bonds form in __________ of chemical reactions.
5. The direction in which a chemical reaction occurs is represented by a(n) __________.
6. Products and reactants contain the same __________ but in different combinations.
7. A(n) __________ is a solid that settles out of a liquid solution in a chemical reaction.

Lesson 8.1: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe chemical reactions and explain how they change matter.

8.2 Chemical Equations

Lesson 8.2: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. The general form of a chemical equation is Reactants = Products.

_____ 2. The symbol CO_2 represents two molecules of carbon monoxide.

_____ 3. The symbol $2H_2$ represents two atoms of hydrogen.

_____ 4. Coefficients are used to balance chemical equations.

_____ 5. In balancing chemical equations, you should use the smallest subscripts possible.

_____ 6. The number of each type of molecule must be the same on both sides of a chemical equation.

_____ 7. Changing coefficients changes the substances involved in a chemical reaction.

_____ 8. Chemists use a standard method to represent chemical reactions.

_____ 9. The chemical equation $H_2CO_3 \rightarrow H_2O + CO_2$ is balanced.

_____ 10. Water is the reactant in the chemical equation $H_2O \rightarrow H_2 + O_2$.

Lesson 8.2: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Conserving Mass

Matter cannot be created or destroyed in chemical reactions. This is the law of conservation of mass. In every chemical reaction, the same mass of matter must end up in the products as started in the reactants. Balanced chemical equations show that mass is conserved in chemical reactions.

How do scientists know that mass is always conserved in chemical reactions? Careful experiments in the 1700s by a French chemist named Antoine Lavoisier led to this conclusion. Lavoisier measured the mass of reactants and products in many different chemical reactions. He carried out the reactions inside a sealed jar. As a result, any gases involved in the reactions were captured and could be measured. In every case, the total mass of the jar and its contents was the same after the reaction as it was before the reaction took place. This showed that matter was neither created nor destroyed in the reactions.

Questions

1. State the law of conservation of mass.
2. How did Lavoisier's experiments demonstrate this law?

Lesson 8.2: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. A shorthand way of showing how atoms are rearranged in a chemical reaction is a chemical
   a. symbol.
   b. formula.
   c. equation.
   d. letter.
2. When there is more than one reactant in a chemical equation, they are separated by
   a. arrows.
   b. subscripts.
   c. plus signs.
   d. coefficients.
3. In the reaction represented by the chemical equation $2Cu + O_2 \rightarrow 2CuO$, new bonds are formed in
   a. 2Cu.
   b. O_2.
   c. CuO.
   d. none of the above
4. Chemical equations must be balanced because matter cannot be
   a. created.
   b. destroyed.
   c. changed.
   d. two of the above
5. Which chemical equation is balanced?
   a. $2Na + Cl_2 \rightarrow 2NaCl$
   b. $Na + 2Cl_2 \rightarrow 2NaCl$
   c. $2Na + 2Cl_2 \rightarrow 2NaCl$
   d. $Na + Cl_2 \rightarrow NaCl$
6. What is the missing coefficient in the following chemical equation? $?NO + O_2 \rightarrow 2NO_2$?
   a. 0
   b. 1
   c. 2
   d. 4

Lesson 8.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. symbolic representation of a chemical reaction

_____ 2. example of a coefficient

_____ 3. symbol of a chemical compound

_____ 4. example of a subscript

_____ 5. number showing how many atoms or molecules of a given element or compound are involved in a chemical equation

_____ 6. symbol of an chemical element

_____ 7. number showing how many atoms of a given element are in a molecule

Terms

a. chemical symbol

b. coefficient

c. H_2

d. chemical equation

e. 2H

f. subscript

g. chemical formula

Lesson 8.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. In the chemical equation $C + O_2 \rightarrow CO_2$, the product is __________.
2. To balance the chemical equation $2H_2 + O_2 \rightarrow H_2O$, water needs a coefficient of __________.
3. According to the law of __________, matter cannot be created or destroyed.
4. __________ did experiments that demonstrated the law in question 3.
5. When you balance a chemical equation, you should change only the __________.
6. Balanced equations show that __________ is conserved in chemical reactions.
7. The scientist called the father of modern chemistry is __________.

Lesson 8.2: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how the law of conservation of mass relates to chemical equations.

8.3 Types of Chemical Reactions

Lesson 8.3: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Water decomposes when an electric current passes through it.

_____ 2. A combustion reaction usually gives off heat and light.

_____ 3. The burning of glucose in cells is called cellular combustion.

_____ 4. Sodium chloride forms in a decomposition reaction.

_____ 5. Methane and oxygen combine in a synthesis reaction.

_____ 6. One product of the reaction in question 5 is carbon dioxide.

_____ 7. There are two types of decomposition reactions.

_____ 8. Carbon dioxide forms only in combustion reactions.

_____ 9. The general equation AB + CD $\rightarrow$ AD + CB represents a replacement reaction.

_____ 10. The chemical reaction $2K + 2H_2O \rightarrow 2KOH + H_2$ is a replacement reaction.

Lesson 8.3: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Combustion Reactions

A combustion reaction occurs when a substance reacts quickly with oxygen (O_2). Combustion is commonly called burning. The substance that burns is usually referred to as fuel. The products of a combustion reaction include carbon dioxide (CO_2) and water (H_2O). The reaction typically gives off heat and light as well. The general equation for a combustion reaction can be represented by:

$$\text{Fuel} + O_2 \rightarrow CO_2 + H_2O$$

The fuel that burns in a combustion reaction is often a substance called a hydrocarbon. A hydrocarbon is a compound that contains only carbon (C) and hydrogen (H). Fossil fuels, such as natural gas, consist of hydrocarbons. Natural gas is a fuel that is commonly used in home furnaces and gas stoves. The main component of natural gas is the hydrocarbon called methane (CH_4). The combustion of methane is represented by the equation:

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Your own body cells burn fuel in combustion reactions. The fuel is glucose ($C_6H_{12}O_6$), a simple sugar. The process in which combustion of glucose occurs in body cells is called cellular respiration. This combustion reaction provides energy for life processes. Cellular respiration can be summed up by the equation:

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

Questions

1. What is a combustion reaction?
2. Identify the reactants and products in any combustion reaction.
3. Compare and contrast methane and glucose as fuels.

Lesson 8.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Which of the following is an example of a synthesis reaction?
   a. $2NO + O_2 \rightarrow 2NO_2$
   b. $2Na + Cl_2 \rightarrow 2NaCl_2$
   c. $H_2O \rightarrow H_2 + O_2$
   d. two of the above
2. A decomposition reaction is represented by the general equation
   a. A + B + C → AB + C.
   b. A + BC → AB + C.
   c. AB → A + B
   d. none of the above
3. Which type of reaction is represented by the following chemical equation? NaCl + AgF → NaF + AgCl
   a. synthesis
   b. decomposition
   c. single replacement
   d. double replacement
4. Which of the following is always a reactant in a combustion reaction?
   a. water
   b. oxygen
   c. carbon dioxide
   d. two of the above
5. Methane is a
   a. hydrocarbon.
   b. component of natural gas.
   c. compound containing only carbon and hydrogen.
   d. all of the above
6. What do living cells use for fuel?
   a. oxygen
   b. water
   c. glucose

d. hydrocarbons

7. The reaction in which carbon dioxide and water combine to form glucose
   a. is a combustion reaction.
   b. is called photosynthesis.
   c. takes place in all living cells.
   d. all of the above

Lesson 8.3: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. one reactant breaking down into two or more products

_____ 2. ions changing places in two compounds

_____ 3. two reactants combining to form a single product

_____ 4. substance reacting quickly with oxygen

_____ 5. one of the reactants in a combustion reaction

_____ 6. one ion taking the place of another in a compound

_____ 7. another term for a combustion reaction

Terms

a. synthesis reaction

b. combustion reaction

c. decomposition reaction

d. single replacement reaction

e. double replacement reaction

f. burning

g. fuel

Lesson 8.3: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. A(n) __________ reaction is represented by the general equation $A + B \rightarrow C$.
2. The reaction $H_2CO_2 \rightarrow H_2O + CO_2$ is a(n) __________ reaction.
3. A(n) __________ reaction is the reverse of a synthesis reaction.
4. The general equation $A + BC \rightarrow B + AC$ represents a(n) __________ reaction.
5. A(n) __________ replacement reaction produces two new compounds.
6. Replacement reactions involve the exchange of one or more __________.

7. The products of a combustion reaction include carbon dioxide and __________.

Lesson 8.3: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare and contrast single and double replacement reactions. Identify ways they are similar as well as how they differ.

8.4 Lesson 8.4: Chemical Reactions and Energy

Lesson 8.4: True or False

Name____________________ Class_______________ Date___________

Determine if the following statements are true or false.

_____ 1. All chemical reactions involve energy.

_____ 2. One of the most important endothermic reactions is photosynthesis.

_____ 3. In an exothermic reaction, it takes more energy to break bonds in reactants than is released when bonds form in products.

_____ 4. Combustion is an example of an endothermic reaction.

_____ 5. There is no overall change in the amount of energy in chemical reactions.

_____ 6. Only endothermic reactions need energy to get started.

_____ 7. Energy is absorbed in exothermic reactions.

_____ 8. An increase in temperature is a sign of an exothermic reaction.

_____ 9. Products have less stored chemical energy than reactants in an endothermic reaction.

_____ 10. Catalysts in living things are called enzymes.

Lesson 8.4: Critical Reading

Name____________________ Class_______________ Date___________

Read this passage from the text and answer the questions that follow.

Conservation of Energy

Whether a reaction absorbs energy or releases energy, there is no overall change in the amount of energy in a chemical reaction. That's because energy cannot be created or destroyed. This is the law of conservation of energy. Energy can change form—for example, from electricity to light—but the same amount of energy always remains.

If energy cannot be destroyed, what happens to the energy that is absorbed in an endothermic reaction? The energy is stored in the chemical bonds of the products. This form of energy is called chemical energy. In an endothermic reaction, the products have more stored chemical energy than the reactants. In an exothermic reaction, the opposite is true. The products have less stored chemical energy than the reactants. The excess energy in the reactants is released to the surroundings when the reaction occurs.

Questions

1. State the law of conservation of energy.
2. Explain what happens to the energy that is absorbed in an endothermic reaction.
3. Compare the energy of reactants and products in an exothermic reaction.

Lesson 8.4: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Which statement describes a role of energy in chemical reactions?
   a. Energy is created in exothermic reactions.
   b. Energy is always released in chemical reactions.
   c. Energy is needed for chemical reactions to start.
   d. Energy is destroyed in endothermic reactions.
2. The energy needed for photosynthesis is in the form of
   a. glucose.
   b. oxygen.
   c. light.
   d. heat.
3. When products have less chemical energy than reactants, a chemical reaction
   a. is endothermic.
   b. is exothermic.
   c. absorbs energy.
   d. two of the above
4. According to the law of conservation of energy, energy
   a. cannot be created.
   b. cannot be destroyed.
   c. cannot change form.
   d. two of the above
5. Factors that affect reaction rates include
   a. temperature.
   b. concentration.
   c. surface area.
   d. all of the above
6. Crushing a solid reactant into a powder will
   a. decrease the reactant's surface area.
   b. increase the rate of the reaction.
   c. decrease the concentration of products.
   d. increase the temperature of reactants.
7. Which statement about catalysts is true?
   a. They change the rate of chemical reactions.
   b. They are reactants in chemical reactions.
   c. They are used up in chemical reactions.
   d. two of the above

Lesson 8.4: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. energy stored in chemical bonds

_____ 2. substance that speeds up chemical reactions

_____ 3. turning out heat

_____ 4. how fast a reaction occurs

_____ 5. energy needed to start a reaction

_____ 6. taking in heat

_____ 7. number of particles of a substance in a given volume

Terms

a. activation energy

b. catalyst

c. concentration

d. endothermic

e. exothermic

f. reaction rate

g. chemical energy

Lesson 8.4: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. In a(n) __________ chemical reaction, less energy is needed to break bonds in reactants than is released when bonds form in products.
2. A constant input of energy is needed to keep a(n) __________ chemical reaction going.
3. The general equation for a(n) __________ chemical reaction is: Reactants $\rightarrow$ Products + Energy
4. A drop in temperature is a sign that a chemical reaction is __________.
5. Chemical reactions occur more __________ when the temperature is higher.
6. A greater concentration of reactants __________ the reaction rate.
7. Catalysts increase reaction rates by decreasing the amount of __________ energy needed.

Lesson 8.4: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why all chemical reactions—even exothermic reactions—require activation energy to begin.

CHAPTER 9 Chemistry of Carbon Worksheets

Chapter Outline

9.1 Properties of Carbon

Lesson 9.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. The chief component of cellulose is carbon.

_____ 2. Carbon forms more compounds than any other element.

_____ 3. Carbon can form bonds with any other element except itself.

_____ 4. The carbon compound with the formula CH_4 is polyethylene.

_____ 5. In a triple bond, two atoms share three valence electrons.

_____ 6. Plastics are examples of synthetic carbon polymers.

_____ 7. All forms of crystalline carbon have the same structure.

_____ 8. Carbon can combine only with hydrogen and oxygen.

_____ 9. Carbon forms ionic bonds with other nonmetals.

_____ 10. There are millions of known carbon compounds.

Lesson 9.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Monomers and Polymers of Carbon

Because of carbon's ability to form so many covalent bonds, it often forms polymers. A polymer is a large molecule that consists of many smaller molecules joined together by covalent bonds. The smaller molecules are called monomers. (The prefix *mono-* means "one" and the prefix *poly-* means "many.") Polymers may consist of just one type of monomer or of more than one type. Polymers are a little like strings of beads. Like monomers making up a polymer, the beads in a string may be all the same or different from one another.

Many polymers occur naturally. Other polymers are synthetic. This means that they are produced in labs or factories. Synthetic polymers are created in synthesis reactions in which monomers bond together to form much larger compounds. Plastics are examples of synthetic polymers. A very common type of plastic is polythene (also called polyethylene). It consists of repeating monomers of ethene (C_2H_4). This plastic is used to make plastic milk jugs and grocery bags, among many other uses.

Questions

1. Relate polymers to monomers.
2. Explain how strings of beads are like polymers.

3. What are plastics? How are they made?

Lesson 9.1: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. How many more valence electrons does carbon need to fill its outer energy level?
    a. 1
    b. 2
    c. 3
    d. 4
2. Which type(s) of bonds can a carbon atom form with other carbon atoms?
    a. single bonds
    b. double bonds
    c. triple bonds
    d. all of the above
3. Forms of pure carbon include
    a. methane.
    b. cellulose.
    c. diamond.
    d. two of the above
4. One of the most common naturally occurring compounds on Earth is
    a. graphite.
    b. fullerene.
    c. cellulose.
    d. polythene.
5. The monomers in a polymer may be
    a. all the same.
    b. different from one another.
    c. joined by metallic bonds.
    d. two of the above
6. All carbon polymers are
    a. naturally occurring.
    b. produced in labs.
    c. found in plastics.
    d. large molecules.

Lesson 9.1: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. large molecule that consists of many smaller molecules joined together by covalent bonds

_____ 2. form of carbon in which carbon atoms are arranged in layers

_____ 3. one of the simplest carbon compounds

_____ 4. form of carbon that it is the hardest natural substance

_____ 5. small molecule joined with other small molecules by covalent bonds to form a much larger molecule

_____ 6. form of carbon in which carbon atoms are arranged in hollow spheres

_____ 7. carbon compound found only in plants

Terms

a. monomer

b. polymer

c. cellulose

d. diamond

e. methane

f. graphite

g. fullerene

Lesson 9.1: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. More than 90 percent of all known compounds contain the element __________.
2. Carbon is an element in the class of elements known as __________.
3. Because carbon is placed in group 14 of the periodic table, you know it has __________ valence electrons.
4. Carbon forms a total of four __________ bonds.
5. In a(n) __________ covalent bond, two atoms share two pairs of electrons.
6. Diamond, graphite, and fullerenes are forms of carbon that exist as __________.
7. A diagram of a molecule in which bonds are represented by dashes is called a(n) __________.

Lesson 9.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare and contrast the three forms of crystalline carbon.

9.2 Hydrocarbons

Lesson 9.2: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. All hydrocarbons are small chemical compounds.

_____ 2. Hydrocarbons are generally nonpolar compounds.

_____ 3. Isomers of a given compound always have the same properties.

_____ 4. Heptane is an unsaturated hydrocarbon.

_____ 5. Butane has branched-chain molecules.

_____ 6. The size of hydrocarbon molecules influences their properties.

_____ 7. Any hydrocarbon ending in *–ane* has only straight-chain molecules.

_____ 8. The physical properties of alkenes are generally similar to those of alkanes.

_____ 9. Alkynes are relatively rare in nature.

_____ 10. Fossil fuels formed over millions of years from dead organisms.

Lesson 9.2: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Classification of Hydrocarbons

Hydrocarbons can be classified in two basic classes. The classes are saturated hydrocarbons and unsaturated hydrocarbons. This classification is based on the number of bonds between carbon atoms.

Saturated hydrocarbons contain only single bonds between carbon atoms. They are the simplest hydrocarbons. They are called saturated because each carbon atom is bonded to as many hydrogen atoms as possible. In other words, the carbon atoms are saturated with hydrogen. They may have straight-chain, branched-chain, or cyclic molecules.

Unsaturated hydrocarbons contain at least one double or triple bond between carbon atoms. As a result, the carbon atoms are unable to bond with as many hydrogen atoms as they could if they were joined only by single bonds. This makes them unsaturated with hydrogen. Unsaturated hydrocarbons are classified on the basis of their bonds as alkenes or alkynes.

- Alkenes are unsaturated hydrocarbons that contain at least one double bond. They may have straight-chain, branched-chain, or cyclic molecules. Cyclic alkenes are called aromatic hydrocarbons because they have a strong aroma. They have alternating single and double bonds between carbon atoms.
- Alkynes are unsaturated hydrocarbons that contain at least one triple bond. They may have straight- or branched-chain molecules but rarely occur as cyclic molecules.

Questions

1. Identify the two basic classes of hydrocarbons.
2. Compare and contrast alkanes, alkenes, and alkynes.
3. What are aromatic hydrocarbons?

Lesson 9.2: Multiple Choice

Name____________________ Class_______________ Date___________

Circle the letter of the correct choice.

1. Which statement about hydrocarbons is true?
   a. They are the most complex type of carbon compounds.
   b. They are all gases at room temperature.
   c. They generally do not dissolve in water.
   d. none of the above
2. The simplest hydrocarbons are
   a. unsaturated hydrocarbons.
   b. saturated hydrocarbons.
   c. aromatic hydrocarbons.
   d. alkenes and alkynes.
3. The first part of the name of a hydrocarbon indicates the number of
   a. bonds between carbon atoms.
   b. branches in the molecule.
   c. hydrogen atoms.
   d. carbon atoms.
4. Alkanes with more carbon atoms generally have
   a. higher boiling points.
   b. lower boiling points.
   c. higher melting points.
   d. two of the above
5. Aromatic hydrocarbons generally have
   a. a strong scent.
   b. rings of four carbon atoms.
   c. alternating double and triple bonds.
   d. all of the above
6. Hydrocarbon compounds that are burned for fuels include
   a. coal.
   b. propane.
   c. kerosene.
   d. all of the above
7. Fossil fuels include
   a. wood.
   b. charcoal.
   c. petroleum.
   d. all of the above

Lesson 9.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. Ring-shaped unsaturated hydrocarbons

_____ 2. all compounds that consist only of carbon and hydrogen

_____ 3. unsaturated hydrocarbons with at least one double bond

_____ 4. ring-shaped saturated hydrocarbons

_____ 5. saturated hydrocarbons such as ethane

_____ 6. molecules with the same atoms but different shapes

_____ 7. unsaturated hydrocarbons with at least one triple bond

Terms

a. alkanes

b. alkenes

c. alkynes

d. hydrocarbons

e. isomers

f. aromatic hydrocarbons

g. cycloalkanes

Lesson 9.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. In a saturated hydrocarbon, each carbon atom is saturated with __________.
2. The name of the smallest alkane is __________.
3. In branched-chain molecules, at least one __________ atom branches off to the side from the backbone.
4. *Iso*-butane is a(n) __________ of butane.
5. The name of the smallest alkene is __________.
6. The most important use of hydrocarbons is as __________.
7. The main source of hydrocarbons is __________.

Lesson 9.2: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Hydrocarbons have been called the "driving force of western civilization." Do you agree? Why or why not?

9.3 Carbon and Living Things

Lesson 9.3: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. All biochemical compounds contain hydrogen.

_____ 2. There are a total of 20 different biochemical compounds.

_____ 3. Some nucleic acids are hormones that regulate life processes.

_____ 4. The simplest sugar is named sucrose.

_____ 5. Bread is a good source of starch in the diet.

_____ 6. We need oils to help move food wastes through the digestive tract.

_____ 7. Hemoglobin is a protein that fights infections in the blood.

_____ 8. Muscle tissues are composed mainly of fatty acids.

_____ 9. Organisms use lipids mainly to store energy.

_____ 10. There are two main types of nucleic acids.

Lesson 9.3: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Structure of Nucleic Acids

Nucleic acids consist of chains of small molecules called nucleotides. Each nucleotide contains a phosphate group, a sugar, and one of four different nitrogen-containing bases. In DNA, the bases are adenine, thymine, guanine, and cytosine. In RNA, the base uracil is substituted for thymine.

DNA consists of two long chains of nucleotides. Sugars and phosphate groups form the "backbone" of each chain, and nitrogen bases stick out to the side from the backbone. Nitrogen bases on the two chains form hydrogen bonds with each other. Adenine always bonds with thymine, and guanine always bonds with cytosine. These bonds hold together the two chains and give DNA its characteristic double helix, or spiral, shape. RNA, in contrast to DNA, consists of just one chain of nucleotides.

DNA stores genetic information in the cells of all living things. It contains the genetic code, which instructs cells how to make proteins. The instructions are encoded in the sequence of nitrogen bases in the nucleotide chains of DNA. RNA "reads" the genetic code in DNA and is involved in the synthesis of proteins based on the code.

Questions

1. Describe the structure of a nucleotide and a nucleotide chain.

2. Explain the role of nitrogen bases in the double helix shape of DNA.
3. Contrast the functions of DNA and RNA.

Lesson 9.3: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Which of the following is one of the four main classes of biochemical compounds?
   a. sugars
   b. starches
   c. cellulose
   d. carbohydrates
2. All biochemical compounds include carbon, hydrogen, and
   a. sulfur.
   b. oxygen.
   c. nitrogen.
   d. phosphorus.
3. Organisms use carbohydrates mainly for
   a. energy.
   b. cell membranes.
   c. hormones.
   d. antibodies.
4. The function of a given protein depends on its
   a. overall shape.
   b. sequence of amino acids.
   c. number of amino acid chains.
   d. all of the above
5. Which statement about saturated fatty acids is true?
   a. They have only single bonds between carbon atoms.
   b. They are used by plants to store energy.
   c. They make up lipids known as oils.
   d. They are always in the liquid state.
6. Nitrogen bases found in both DNA and RNA include
   a. glycine.
   b. adenine.
   c. thymine.
   d. uracil.
7. Which of the following is a function of RNA?
   a. fighting infections
   b. reading the genetic code
   c. carrying substances in the blood
   d. all of the above

Lesson 9.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. long carbon chains found in lipids

_____ 2. class of biochemical compounds that includes oils

_____ 3. general name given to biochemical polymers

_____ 4. class of biochemical compounds that includes DNA

_____ 5. "building blocks" of proteins

_____ 6. class of biochemical compounds that includes cellulose

_____ 7. class of biochemical compounds that includes enzymes

Terms

a. carbohydrates

b. lipids

c. proteins

d. nucleic acids

e. macromolecules

f. fatty acids

g. amino acids

Lesson 9.3: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. A(n) __________ compound is any carbon-based compound found in living things.
2. Complex carbohydrates that plants use to store energy are called __________.
3. Cell membranes consist of two layers of __________.
4. Chains of small molecules called __________ make up nucleic acids.
5. Simple carbohydrates that cells use for energy are called __________.
6. Biochemical compounds that contain sulfur are classified as __________.
7. In __________ fatty acids, there is at least one double bond between carbon atoms.

Lesson 9.3: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Justify the statement that "carbon is the most important element in living things."

9.4 Biochemical Reactions

Lesson 9.4: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. All organisms make food by photosynthesis.

_____ 2. The synthesis of glucose requires carbon dioxide.

_____ 3. Insect-catching plants such as pitcher plants obtain glucose from insects.

_____ 4. Chemical reactions provide living cells with energy.

_____ 5. Photosynthesis is an exothermic, or energy-releasing, process.

_____ 6. The overall chemical reaction for photosynthesis is represented by the equation: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy.

_____ 7. Products of cellular respiration include many small, energy-storing molecules.

_____ 8. Cellular respiration takes place only in organisms that cannot make their own food.

_____ 9. The process of cellular respiration requires carbon dioxide.

_____ 10. One of the products of cellular respiration is oxygen.

Lesson 9.4: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Enzymes and Biochemical Reactions

Human body temperature must remain within a narrow range around 37 °C (98.6 °F). At this temperature, most biochemical reactions would occur too slowly to keep us alive. That's where enzymes come in. Enzymes are biochemical catalysts. They speed up biochemical reactions not only in humans but in virtually all living things. Most enzymes are proteins.

The human body produces many enzymes that help digest food. Two examples are amylase and pepsin.

- Amylase in found in saliva in the mouth. It catalyzes the breakdown of starches to sugars.
- Pepsin is found in fluid in the stomach. It catalyzes the breakdown of proteins to amino acids.

Questions

1. What are enzymes?
2. What is the relationship between body temperature and the need for enzymes in the human body?
3. Describe the human enzymes amylase and pepsin.

Lesson 9.4: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. All living things need
   a. carbon dioxide.
   b. sunlight.
   c. energy.
   d. two of the above
2. Reactants in photosynthesis include
   a. chlorophyll.
   b. oxygen.
   c. glucose.
   d. water.
3. Types of organisms that make their own glucose include
   a. algae.
   b. plants.
   c. cyanobacteria.
   d. all of the above
4. All organisms that undergo photosynthesis contain
   a. pepsin.
   b. amylase.
   c. chlorophyll.
   d. two of the above
5. Cellular respiration releases some energy in the form of
   a. heat.
   b. light.
   c. motion.
   d. electricity.
6. Amylase catalyzes the breakdown of
   a. lipids.
   b. proteins.
   c. nucleic acids.
   d. complex carbohydrates.

Lesson 9.4: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. process in which cells break down glucose and release energy

_____ 2. any chemical reaction that takes place in living things

_____ 3. protein that speeds up biochemical reactions

_____ 4. byproduct of photosynthesis

_____ 5. compound that cells use for energy

_____ 6. pigment that captures light energy

_____ 7. process in which certain organisms make glucose

Terms

a. photosynthesis

b. biochemical reaction

c. oxygen

d. cellular respiration

e. glucose

f. chlorophyll

g. enzyme

Lesson 9.4: Fill in the Blank

Name____________________ Class_______________ Date________

Fill in the blank with the appropriate term.

1. The products of photosynthesis are the reactants of __________.
2. Most of the energy used by living things comes either directly or indirectly from the __________.
3. Photosynthesis changes light energy to __________ energy.
4. Cellular respiration releases energy and produces carbon dioxide and __________.
5. Most biochemical catalysts belong to the __________ class of biochemical compounds.
6. The enzyme amylase is involved in the __________ of food.
7. Pepsin catalyzes the breakdown of __________.

Lesson 9.4: Critical Writing

Name____________________ Class_______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how photosynthesis and cellular respiration are related.

Chapter 10 Chemistry of Solutions Worksheets

Chapter Outline

10.1 Introduction to Solutions

Lesson 10.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Particles of solute eventually settle to the bottom of a solution.

_____ 2. Particles of solute dissolved in a solution are too small to see.

_____ 3. The solvent in a solution is always in the liquid state.

_____ 4. When sugar dissolves in water, it separates into individual ions.

_____ 5. Smaller particles of solute dissolve more quickly than larger particles.

_____ 6. Paint thinner is an example of a nonpolar solvent.

_____ 7. A solute changes the chemical properties of a solvent.

_____ 8. Pure water has a higher boiling point than salty water.

_____ 9. Ionic compounds dissolve in nonpolar solvents.

_____ 10. Water is a solute in moist air.

Lesson 10.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Solutes and Solvents

A solution forms when one substance dissolves in another. The substance that dissolves is called the solute. The substance it dissolves in is called the solvent. For example, ocean water is a solution in which the solute is salt and the solvent is water. In this example, a solid (salt) is dissolved in a liquid (water). However, matter in any state can be the solute or solvent in a solution.

When a solute dissolves in a solvent, it changes to the same state as the solvent. For example, when solid salt dissolves in liquid water, it becomes part of the liquid solution, salt water. If the solute and solvent are already in the same state, the substance present in greater quantity is considered to be the solvent. For example, nitrogen is the solvent in Earth's atmosphere because it makes up 78 percent of air.

Questions

1. Define solute and solvent, and give an example of each.
2. For any given solution, how can you tell which substance is the solute and which is the solvent?

Lesson 10.1: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Which statement about solutions is true?
   a. They are mixtures.
   b. They are compounds.
   c. They are homogenous.
   d. two of the above
2. When a solid solute dissolves in a liquid solvent, the solute changes to
   a. a different chemical than it was.
   b. the same state as the solvent.
   c. a new type of compound.
   d. the gaseous state.
3. When sodium chloride dissolves in water, the oxygen ends of water molecules attract the
   a. sodium ions in the salt crystals.
   b. chloride atoms in the salt molecules.
   c. negative ends of the other water molecules.
   d. negative ions in the salt crystals.
4. Dissolving occurs more quickly if the
   a. solvent has a lower temperature.
   b. solute has less surface area.
   c. solution is stirred or shaken.
   d. all of the above
5. Which substance does not dissolve in water?
   a. salt
   b. sugar
   c. carbon dioxide
   d. oil-based paint
6. Adding antifreeze to water gives the water a
   a. higher freezing point.
   b. higher boiling point.
   c. lower boiling point.
   d. two of the above
7. Any compound will dissolve in the universal solvent if the compound is
   a. hot.
   b. ionic.
   c. nonpolar.
   d. covalent.

Lesson 10.1: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. substance that dissolves another substance to form a solution

_____ 2. having oppositely charged ends

_____ 3. substance called the universal solvent

_____ 4. unable to dissolve in a given solvent

_____ 5. substance that dissolves in another substance to form a solution

_____ 6. homogeneous mixture with dissolved particles

_____ 7. able to dissolve in a given solvent

Terms

a. solution

b. solute

c. solvent

d. water

e. soluble

f. insoluble

g. polar

Lesson 10.1: Fill in the Blank

Name____________________ **Class**_______________ **Date**_________

Fill in the blank with the appropriate term.

1. When a substance such as salt dissolves in water it forms a(n) ___________.
2. Ocean water is a solution in which the solute is ___________.
3. Air is a solution in which the solvent is ___________.
4. When an ionic solute dissolves, it separates into individual ___________.
5. When a covalent solute dissolves, it separates into individual ___________.
6. Water can dissolve many different solutes because it is a(n) ___________ compound.
7. Solutes generally lower the ___________ point of solvents.

Lesson 10.1: Critical Writing

Name____________________ **Class**_______________ **Date**_________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Assume you want to make a solution of sugar and a given amount of water. Explain what you could do to increase the amount of sugar that will dissolve in the water.

10.2 Solubility and Concentration

Lesson 10.2: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Solubility increases if you stir a solute into a solution.

_____ 2. All solutes have the same solubility in a given solvent.

_____ 3. There is a limit on the amount of solute that can dissolve in a given solvent.

_____ 4. You can dissolve additional solute in an unsaturated solution.

_____ 5. Both temperature and pressure affect the solubility of any solute.

_____ 6. Less oxygen can dissolve in warm water than in cold water.

_____ 7. A solute with greater solubility can form a more concentrated solution than a solute with lesser solubility.

_____ 8. The concentration of a solution is the amount of solvent in a given amount of solvent.

_____ 9. The concentration of a solution is usually expressed as a percent.

_____ 10. Heating a liquid solute increases its solubility.

Lesson 10.2: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Solubility and Saturation

Solubility is the amount of solute that can dissolve in a given amount of solvent at a given temperature. For a given solvent, some solutes have greater solubility than others. For example, you can dissolve more table sugar than baking soda in a given amount of water because sugar is more soluble in water than is baking soda.

Because of solubility, there is a limit on the amount of solute that can dissolve in a given solvent. Even sugar, which is very soluble, has an upper limit. The maximum amount of table sugar that will dissolve in 1 L of water at 20 °C is about 2000 g. If you add more sugar than this, the extra sugar won't dissolve.

A solution that contains as much solute as can dissolve at a given temperature is called a saturated solution. A solution that contains less solute than can dissolve at a given temperature is called an unsaturated solution. A solution of 2000 grams of sugar in 1 L of 20 °C water is saturated. Any solution containing less than 2000 g of sugar in 1 L of 20 °C water is unsaturated.

Questions

1. Define solubility.
2. What is a saturated solution? What is an unsaturated solution?

3. How are solubility and saturation related?

Lesson 10.2: Multiple Choice

Name____________________ Class_______________ Date___________

Circle the letter of the correct choice.

1. Which of the following substances is most soluble in water?
   a. table salt.
   b. baking soda.
   c. Epsom salt.
   d. table sugar.
2. Which statement is true of any saturated solution at a given temperature?
   a. No more solute will dissolve in the solution.
   b. You can dissolve more solute if you stir the solution.
   c. One liter of the solution contains 2000 grams of solute.
   d. Adding more solute will increase the saturation of the solution.
3. Factors that affect the solubility of a solid solute in a given liquid solvent include
   a. size of container.
   b. temperature.
   c. pressure.
   d. two of the above
4. Soda fizzes as you open the can because
   a. carbon dioxide evaporates from the soda.
   b. pressure decreases on carbon dioxide in the soda.
   c. the soda suddenly dissolves more carbon dioxide.
   d. the soda gets warmer and releases carbon dioxide.
5. What is the concentration of a 300-gram saltwater solution that contains 6 grams of salt?
   a. 1%
   b. 2%
   c. 5%
   d. 6%
6. The solubility of Epsom salt in water is 250 g per 1 L of water at 20 °C. What mass of Epsom salt will dissolve in 500 mL of 20 °C water?
   a. 115 g
   b. 125 g
   c. 225 g
   d. 255 g
7. Based on the solubility of Epsom salt in question 6, what mass of Epsom salt will dissolve in 1 L of water at 30 °C.
   a. less than 250 g
   b. exactly 250 g
   c. more than 250 g
   d. it depends on the pressure

Lesson 10.2: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. solution with a low concentration of solute

_____ 2. solution that contains less solute than can dissolve at a given temperature

_____ 3. solution with a high concentration of solute

_____ 4. factor that affects the solubility of gases

_____ 5. amount of solute in a given amount of solution

_____ 6. solution that contains as much solute as can dissolve at a given temperature

_____ 7. amount of solute that can dissolve in a given amount of solvent at a given temperature

Terms

a. solubility

b. saturated solution

c. concentration

d. dilute solution

e. unsaturated solution

f. concentrated solution

g. pressure

Lesson 10.2: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. For a liquid solute, increasing the temperature __________ its solubility.
2. For a gaseous solute, increasing the temperature __________ its solubility
3. Increasing the pressure on a gas __________ its solubility.
4. To calculate the concentration of a solution, you divide the mass of the solute by the mass of the __________.
5. A(n) __________ solution has a low concentration of solute.
6. A(n) __________ solution has a high concentration of solute.
7. You can dissolve __________ salt in cold water than in warm water.

Lesson 10.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Sugar is much more soluble in water than is salt. Explain why a sugar-water solution can be more concentrated than a saltwater solution.

10.3 Acids and Bases

Lesson 10.3: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Acids turn blue litmus paper red.

_____ 2. Sodium chloride is an example of a base.

_____ 3. Bases cannot conduct electricity.

_____ 4. All acids are harmful.

_____ 5. A strong acid has a high concentration of hydrogen ions.

_____ 6. The symbol pH represents acidity.

_____ 7. Ammonia is a stronger base than is bleach.

_____ 8. Acids are used to make fertilizer.

_____ 9. Acid rain promotes rapid growth of plants.

_____ 10. Normal (clean) rainwater has a pH of 7.

Lesson 10.3: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Why pH Matters

Acidity is an important factor for living things. For example, many plants grow best in soil that has a pH between 6 and 7. Fish also need a pH close to 7. Some air pollutants form acids when dissolved in water droplets in the air. This results in acid fog and acid rain, which may have a pH of 4 or even lower. Acid fog and rain can kill trees and other plants. It can also lower the pH of surface waters such as ponds and lakes. As a result, the water may become too acidic for fish and many other water organisms to survive.

Even normal rain is slightly acidic. That's because carbon dioxide in the air dissolves in raindrops, producing a weak acid called carbonic acid. When acidic rainwater soaks into the ground, it can slowly dissolve rocks, particularly those containing calcium carbonate. This is how water forms underground caves.

Questions

1. Why is acidity an important factor for living things?
2. What is acid rain? How does it form?
3. How does acid rain affect living things?
4. Why is normal rain slightly acidic? Why does this lead to the formation of caves?

Lesson 10.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Which of the following substances is an acid?
   a. milk.
   b. bleach.
   c. ammonia.
   d. seawater.
2. A very strong base has a pH close to
   a. 1
   b. 5
   c. 7
   d. 14
3. Properties of acids include
   a. a bitter taste.
   b. a slippery feel.
   c. the ability to conduct electricity.
   d. two of the above
4. Which of the following ionic compounds forms an acid when dissolved in water?
   a. KCl
   b. HCl
   c. NaCl
   d. $MgCl_2$
5. Bases are used to make all of the following products except
   a. soap.
   b. concrete.
   c. deodorant.
   d. car batteries.
6. If a solution has a greater concentration of hydrogen ions than does pure water, then the solution
   a. has a pH greater than 7.
   b. is a base.
   c. is an acid.
   d. two of the above
7. Which of the following chemical equations represents a neutralization reaction?
   a. $NaOH + H_2O \rightarrow OH^- + Na^+$
   b. $Na^+ + Cl^- \rightarrow NaCl$
   c. $HCl + NaOH \rightarrow NaCl + H_2O$
   d. $Mg + 2HCl \rightarrow H_2 + MgCl_2$

Lesson 10.3: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. type of chemical reaction in which an acid reacts with a base

_____ 2. ionic compound that produces hydroxide ions when dissolved in water

_____ 3. ionic compound formed when an acid and a base react

_____ 4. concentration of hydrogen ions in a solution

_____ 5. ionic compound that produces hydrogen ions when dissolved in water

_____ 6. measure of the acidity of a solution

_____ 7. compound used to detect acids and bases

Terms

a. acid

b. acidity

c. base

d. pH

e. salt

f. litmus

g. neutralization

Lesson 10.3: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. A sour taste is a property of ionic compounds known as __________.
2. When acids react with metals, they produce __________ gas.
3. __________ turn red litmus paper blue.
4. A stronger base produces a greater concentration of __________ ions when dissolved in water than does a weaker base.
5. Neutral substances have a pH of __________.
6. A substance with a pH of 1 is a very strong __________.
7. Neutralization reactions produce a salt and __________.

Lesson 10.3: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare and contrast acids and bases.

CHAPTER 11 Nuclear Chemistry Worksheets

Chapter Outline

11.1 Radioactivity

Lesson 11.1: True or False

Name____________________ Class_______________ Date___________

Determine if the following statements are true or false.

_____ 1. Some elements naturally change into different elements.

_____ 2. Only unstable nuclei emit radiation.

_____ 3. The radioactive isotope of carbon has fewer neutrons than other isotopes of carbon.

_____ 4. Background radiation is generally considered to be safe for living things.

_____ 5. Radiation can break bonds in biochemical molecules.

_____ 6. Radiation is harmless to nonliving things such as metals.

_____ 7. You cannot see radiation but you can always feel it.

_____ 8. Radiation can be used to generate electricity.

_____ 9. Any exposure to radiation causes burns and destroys blood cells.

_____ 10. A Geiger counter works because radiation changes atoms of a gas to ions.

Lesson 11.1: Critical Reading

Name____________________ Class_______________ Date___________

Read this passage from the text and answer the questions that follow.

Radioisotopes

Isotopes are atoms of the same element that differ from each other because they have different numbers of neutrons. Many elements have one or more isotopes that are radioactive. This means they have unstable nuclei that give off radiation. Radioactive isotopes are called radioisotopes. An example of a radioisotope is carbon-14. All carbon atoms have 6 protons, and most have 6 neutrons. These carbon atoms are called carbon-12, where 12 is the mass number (6 protons + 6 neutrons). A tiny percentage of carbon atoms have 8 neutrons instead of the usual 6. These atoms are called carbon-14 (6 protons + 8 neutrons). The nuclei of carbon-14 atoms are unstable because they have too many neutrons.

To be stable, a small nucleus like carbon, with just 6 protons, should have a 1:1 ratio of neutrons to protons. In other words, it should have the same number of neutrons as protons. In a large nucleus, with many protons, the ratio should be about 2:1 or even 3:1 neutrons to protons for the nucleus to be stable. In elements with more than 83 protons, all the isotopes are radioactive. The force of repulsion among all those protons overcomes the strong force holding them together. This makes the nuclei unstable. Elements with more than 92 protons have such unstable nuclei that these elements do not even exist in nature. They exist only if they are created in labs.

Questions

1. What is a radioisotope?
2. Relate the ratio of neutrons to protons in a nucleus to its stability.

Lesson 11.1: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. For an element to change to a different element, it must change its number of
   a. energy levels.
   b. electrons.
   c. neutrons.
   d. protons.
2. Which statement about radioisotopes is false?
   a. Radioisotopes have unstable nuclei.
   b. Some elements exist only as radioisotopes.
   c. All elements have one or more radioisotopes.
   d. Radioisotopes contribute to background radiation.
3. Radioactive elements include
   a. radium.
   b. uranium.
   c. polonium.
   d. all of the above
4. Elements with more than 92 protons are
   a. a source of radiation in rocks.
   b. too unstable to exist in nature.
   c. the least radioactive elements.
   d. the only radioactive elements.
5. Sources of background radiation include
   a. medical X rays.
   b. cosmic rays.
   c. nuclear power plants.
   d. all of the above
6. Uranium can leave an image on a photographic plate because uranium
   a. gives off X rays.
   b. absorbs sunlight.
   c. emits light rays.
   d. is radioactive.

Lesson 11.1: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. radioactive gas that forms in rocks underground

_____ 2. scientist who discovered radioactivity

_____ 3. ability of an atomic nucleus to give off charged particles and energy

_____ 4. low level of radiation that occurs naturally in the environment

_____ 5. charged particles and energy emitted by an unstable nucleus

_____ 6. scientist who discovered polonium and radium

_____ 7. atom with an unstable nucleus that emits radiation

Terms

a. radiation

b. background radiation

c. radioactivity

d. radon

e. radioisotope

f. Antoine Becquerel

g. Marie Curie

Lesson 11.1: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. A(n) __________ is a substance with a unique number of protons in the nuclei of its atoms.
2. Becquerel was experimenting with the element __________ when he discovered that it is radioactive.
3. Isotopes are atoms of the same element that differ in their numbers of __________.
4. A(n) __________is a device that is used to detect radiation.
5. Radiation is used to diagnose and treat __________.
6. The radioactive isotope of carbon is named __________.
7. In elements with more than __________ protons, all the isotopes are radioactive.

Lesson 11.1: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Radiation can both cause and cure cancer. This statement sounds contradictory. How can it be true?

11.2 Radioactive Decay

Lesson 11.2: True or False

Name__________________ Class_____________ Date_________

Determine if the following statements are true or false.

_____ 1. An alpha particle has the same mass as a helium nucleus.

_____ 2. Nuclear equations do not need to balance.

_____ 3. A beta particle has virtually no mass.

_____ 4. Gamma rays are released only during gamma decay.

_____ 5. Alpha particles can pass through a sheet of aluminum.

_____ 6. Carbon-14 has a half-life of 5.7 million years.

_____ 7. All three types of radioactive decay emit energy.

_____ 8. A beta particle has a charge of +1.

_____ 9. During beta decay, a proton is emitted by a nucleus.

_____ 10. All radioisotopes decay at the same constant rate.

Lesson 11.2: Critical Reading

Name__________________ Class_____________ Date_________

Read this passage from the text and answer the questions that follow.

Radioactive Dating

Radioactive isotopes can be used to estimate the ages of fossils and rocks. The method is called radioactive dating. Carbon-14 dating is an example of radioactive dating. Carbon-14 forms naturally in Earth's atmosphere when cosmic rays strike atoms of nitrogen-14. Living things take in and use carbon-14, just as they do carbon-12. The carbon-14 in living things gradually decays to nitrogen-14. However, it is constantly replaced because living things keep taking in carbon-14. As a result, there is a fixed ratio of carbon-14 to carbon-12 in organisms as long as they are alive.

After organisms die, the carbon-14 they already contain continues to decay, but it is no longer replaced. Therefore, the carbon-14 in a dead organism constantly declines at a fixed rate equal to the half-life of carbon-14. If you measure how much carbon-14 is left in a fossil, you can determine how many half-lives (and how many years) have passed since the organism died.

Questions

1. What is radioactive dating?
2. How does carbon-14 form in Earth's atmosphere? How does carbon-14 end up in living things?
3. Why does the amount of carbon-14 in a living organism remain constant as long as the organism is alive? Why does the amount change after an organisms dies?

4. How can the amount of carbon-14 in a fossil be used to estimate its age?

Lesson 11.2: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Unstable nuclei of radioisotopes may become stable by
   a. undergoing radioactive decay.
   b. changing into other elements.
   c. emitting particles and energy.
   d. all of the above
2. Which of the following equations represents alpha decay?
   a. ${}^{14}_{6}\mathrm{C} \rightarrow {}^{14}_{7}\mathrm{N} + {}^{0}_{-1}e + \mathrm{Energy}$
   b. ${}^{222}_{88}\mathrm{Ra} \rightarrow {}^{218}_{86}\mathrm{Rn} + {}^{4}_{2}\mathrm{He} + \mathrm{Energy}$
   c. ${}^{131}_{53}\mathrm{I} \rightarrow {}^{131}_{54}\mathrm{Xe} + {}^{0}_{-1}e + \mathrm{Energy}$
   d. none of the above
3. Examples of beta decay include
   a. ${}^{238}_{92}\mathrm{U} \rightarrow {}^{234}_{90}\mathrm{Th} + {}^{4}_{2}\mathrm{He} + \mathrm{Energy}$
   b. ${}^{234}_{90}\mathrm{Th} \rightarrow {}^{234}_{91}\mathrm{Pa} + {}^{0}_{-1}e + \mathrm{Energy}$
   c. ${}^{263}_{106}\mathrm{Sg} \rightarrow {}^{259}_{104}\mathrm{Rf} + {}^{4}_{2}\mathrm{He} + \mathrm{Energy}$
   d. two of the above
4. Which of the following radioisotopes has the shortest half-life?
   a. uranium-238
   b. potassium-40
   c. carbon-14
   d. polonium-214
5. Beta particles can travel
   a. only a few centimeters through air.
   b. up to a meter through air.
   c. through several meters of concrete.
   d. for thousands of meters through air.
6. Which type of radiation is most harmful to living things?
   a. alpha particles
   b. beta particles
   c. gamma rays
   d. X rays
7. An alpha particle has a charge of
   a. 0
   b. -1
   c. +1
   d. +2
8. Which of the following nuclear equations is balanced?
   a. ${}^{208}_{84}\mathrm{Po} \rightarrow {}^{204}_{82}\mathrm{Pb} + {}^{4}_{2}\mathrm{He} + \mathrm{Energy}$

b. $^{131}_{53}I \rightarrow {}^{130}_{54}Xe + {}^{0}_{-1}e + Energy$
c. $^{234}_{90}Th \rightarrow {}^{234}_{88}Pa + {}^{0}_{-1}e + Energy$
d. $^{235}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He + Energy$

Lesson 11.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. method of aging fossils that uses radioisotopes

_____ 2. process in which unstable nuclei emit charged particles and energy

_____ 3. process in which a radioactive nucleus emits only energy

_____ 4. form of energy emitted during radioactive decay

_____ 5. particle consisting of two protons and two neutrons

_____ 6. rate at which a radioactive isotope decays

_____ 7. electron emitted by an unstable nucleus

Terms

a. half-life

b. alpha particle

c. radioactive dating

d. beta particle

e. gamma decay

f. radioactive decay

g. gamma ray

Lesson 11.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. Radioactive decay is a(n) __________ reaction.
2. __________ decay occurs when a nucleus emits a helium nucleus and energy.
3. Beta decay starts with a neutron breaking down to form a proton and a(n) __________.
4. If two beta particles combine with one alpha particle, a(n) __________ atom forms.
5. The least-penetrating type of radiation is a(n) __________.
6. The __________ is the length of time it takes for half of a given amount of a radioisotope to decay.
7. __________ decay is the only type of radioactive decay that does not result in a different element.

Lesson 11.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how radioactive decay can result in one element changing into another.

11.3 Nuclear Energy

Lesson 11.3: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. $E = mc^2$ explains why a small amount of mass can produce a great deal of energy.

_____ 2. The letter c in the equation $E = mc^2$ stands for "chain reaction."

_____ 3. The sum of mass and energy is conserved in nuclear reactions.

_____ 4. Nuclear fission happens only in nuclear power plants.

_____ 5. Using nuclear fission for power contributes to global warming.

_____ 6. Nuclear fusion releases less energy than nuclear fission does.

_____ 7. The sun's energy comes from nuclear fusion in its core.

_____ 8. The use of nuclear fusion for energy involves dangerous isotopes.

_____ 9. Matter that undergoes nuclear fusion is in the plasma state.

_____ 10. One product of a nuclear fusion reaction is a proton.

Lesson 11.3: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Nuclear Energy and Einstein's Famous Equation

Probably the most famous equation in the world is $E = mc^2$. You may have heard of it. You may have even seen it on a tee shirt or coffee mug. It's a simple equation that was derived in 1905 by the physicist Albert Einstein. Although the equation is simple, it is incredibly important. It changed how scientists view two of the most basic concepts in science: matter and energy. The equation shows that matter and energy are two forms of the same thing. It also shows how matter and energy are related and why nuclear reactions produce so much energy.

In Einstein's equation, the variable E stands for energy and the variable m stands for mass. The letter c in the equation is a constant. It stands for the speed of light. The speed of light is 300,000 kilometers (186,000 miles) per second, so c^2 is a very big number, no matter what units are used to measure it. Einstein's equation means that the energy in a given amount of matter is equal to its mass times the square of the speed of light. That's a huge amount of energy from even a tiny amount of mass. Suppose, for example, that you have 1 gram of matter. That's about the mass of a paperclip. Multiplying that mass by the square of the speed of light yields enough energy to power 3,600 homes for a year!

When the nucleus of a radioisotope undergoes fission or fusion, it loses a tiny amount of mass. What happens to the lost mass? It isn't really lost at all. It is converted to energy. How much energy? $E = mc^2$. The change in mass is tiny, but it results in a great deal of energy.

Questions

1. What does each letter stand for in Einstein's equation, $E = mc^2$?
2. State in words what Einstein's equation represents.
3. Explain why Einstein's equation is so important.
4. How does Einstein's equation relate to the energy produced in nuclear reactions?

Lesson 11.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Both nuclear fission and nuclear fusion
   a. are used for energy in electric power plants.
   b. release a huge amount of energy.
   c. cannot yet be controlled.
   d. produce three neutrons.
2. Which equation represents a nuclear fission reaction?
   a. ${}^{60}_{27}\text{Co} \rightarrow {}^{60}_{28}\text{Ni} + 1\ \text{Electron} + \text{Energy}$
   b. ${}^{2}_{1}\text{H} + {}^{3}_{1}\text{H} \rightarrow {}^{4}_{2}\text{He} + 1\ \text{Neutron} + \text{Energy}$
   c. ${}^{238}_{92}\text{U} \rightarrow {}^{234}_{90}\text{Th} + {}^{4}_{2}\text{He} + 1\ \text{Proton} + \text{Energy}$
   d. ${}^{235}_{92}\text{U} + 1\ \text{Neutron} \rightarrow {}^{92}_{36}\text{Kr} + {}^{141}_{56}\text{Ba} + 3\ \text{Neutrons} + \text{Energy}$
3. In a nuclear chain reaction, each fission reaction can lead directly to
   a. four more fission reactions.
   b. three more fission reactions.
   c. two more fission reactions.
   d. one more fission reaction.
4. In a nuclear power plant, nuclear reactions are controlled by inserting rods made of a material that
   a. cools down the fuel.
   b. makes the fuel stop burning.
   c. does not undergo fission.
   d. generates electric current.
5. Which of the following is an advantage of nuclear fission over the burning of fossil fuels?
   a. Nuclear fission uses renewable resources.
   b. Nuclear fission produces no air pollution.
   c. Nuclear fission produces no wastes.
   d. Nuclear fission has no risks.
6. When tritium and deuterium fuse together, they form a nucleus of
   a. hydrogen.
   b. uranium.
   c. helium.
   d. barium.
7. Which of the following is a problem in using nuclear fusion for energy?

a. It produces dangerous nuclear wastes.
b. It requires very high temperatures to occur.
c. It depends on a very limited supply of fuel.
d. all of the above

Lesson 11.3: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. process in which one nuclear reaction leads to others

_____ 2. splitting of a nucleus into two smaller nuclei

_____ 3. particle that starts a nuclear fission reaction

_____ 4. form of energy generated by a nuclear power plant

_____ 5. joining of two or more nuclei to form one larger nucleus

_____ 6. reaction such as nuclear fission or nuclear fusion

_____ 7. form of energy released in a nuclear reaction

Terms

a. electrical energy

b. nuclear reaction

c. nuclear chain reaction

d. nuclear fission

e. neutron

f. nuclear energy

g. nuclear fusion

Lesson 11.3: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. A nuclear fission reaction produces three __________, which can start other fission reactions.
2. Nuclear power plants use radiation from __________ reactions to heat water and turn it to steam.
3. The used fuel from a nuclear power plant is called nuclear __________.
4. The main concern over the use of nuclear fission is the accidental release of __________.
5. __________ is the opposite of nuclear fission.
6. Helium in the sun comes from the __________ of hydrogen isotopes.
7. Scientists are still working to develop nuclear __________ power plants.

Lesson 11.3: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare the pros and cons of using nuclear fusion and nuclear fission for energy.

CHAPTER 12 Motion Worksheets

Chapter Outline

12.1 Distance and Direction

Lesson 12.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Direction is as important as distance in describing motion.

_____ 2. Most foot races are measured in meters.

_____ 3. Motion is generally defined as an increase in distance.

_____ 4. Direction is the length of the route between two points.

_____ 5. A vector is any quantity that has no units of measurement.

_____ 6. Motion is a vector when it includes only direction.

_____ 7. You could measure distances with a metric ruler.

_____ 8. Words that describe direction include east, up, and left.

Lesson 12.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Frame of Reference

Assume that a school bus passes by as you stand on the sidewalk. It's obvious to you that the bus is moving. It is moving relative to you and the trees across the street. But what about to the children inside the bus? They aren't moving relative to each other. If they look only at the other children sitting near them, they will not appear to be moving. They may be able to tell that the bus is moving only by looking out the window and seeing you and the trees whizzing by.

This example shows that how we perceive motion depends on our frame of reference. Frame of reference refers to something that is not moving with respect to an observer that can be used to detect motion. For the children on the bus, if they use other children riding the bus as their frame of reference, they do not appear to be moving. But if they use objects outside the bus as their frame of reference, they can tell they are moving.

Questions

1. Define frame of reference.
2. How does a frame of reference help an observer detect motion?
3. If you were standing on a sidewalk and saw a bus go by, how could you tell that the bus was moving? What might be your frame of reference?

Lesson 12.1: Multiple Choice

Name____________________ Class_______________ Date___________

Circle the letter of the correct choice.

1. If you were riding on a moving bus, which frame of reference would allow you to detect the motion?
   a. other people sitting on the bus
   b. trees outside the bus windows
   c. the seats on the bus
   d. the bus driver
2. Which units would most likely be used to measure the distance between two cities?
   a. millimeters
   b. centimeters
   c. meters
   d. kilometers
3. To find the distance of a route that changes direction, you must
   a. consider only the distance traveled in the first direction.
   b. calculate the average distance traveled in one direction.
   c. add up all the distances traveled in different directions.
   d. subtract the starting distance from the ending distance.
4. When both distance and direction are considered, motion
   a. is always measured in meters.
   b. cannot be calculated.
   c. is a force of nature.
   d. is a vector.
5. To determine the distance between two points on a map, you can use a ruler and
   a. a compass.
   b. the compass rose.
   c. a sheet of graph paper.
   d. the scale in the map key.
6. To explain how to get from point A to point B, you must describe both the distance and the
   a. speed.
   b. length.
   c. mileage.
   d. direction.

Lesson 12.1: Matching

Name____________________ Class_______________ Date_________

Match each definition with the correct term.

Definitions

_____ 1. something that is not moving with respect to an observer that can be used to detect motion

_____ 2. quantity that includes both size and direction

_____ 3. location

_____ 4. change in position

_____ 5. line along which something moves

_____ 6. length of the route between two points

_____ 7. SI unit for distance

Terms

a. distance

b. frame of reference

c. motion

d. vector

e. meter

f. direction

g. position

Lesson 12.1: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. The perception of motion depends on a person's __________.
2. A vector can be used to represent both the distance and __________ of motion.
3. A(n) __________ is used to represent a vector.
4. Speed is one way to measure __________.
5. Running events in track and field are named for their __________.
6. The way a vector arrow for motion points represents __________.
7. The length of a vector arrow for motion represents __________.

Lesson 12.1: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why motion is a vector.

12.2 Speed and Velocity

Lesson 12.2: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Speed depends on both distance and direction.

_____ 2. It is easier to calculate average speed than instantaneous speed.

_____ 3. The slope of a distance-time graph represents the direction of motion.

_____ 4. Velocity is the scientific term for speed.

_____ 5. Speed can only be greater than or equal to zero.

_____ 6. Objects moving at the same speed always have the same velocity.

_____ 7. Average speed can be calculated from a distance-time graph.

_____ 8. Speed equals distance multiplied by time.

_____ 9. A change in speed can occur without a change in velocity.

_____ 10. A change in velocity can occur without a change in speed.

Lesson 12.2: Critical Reading

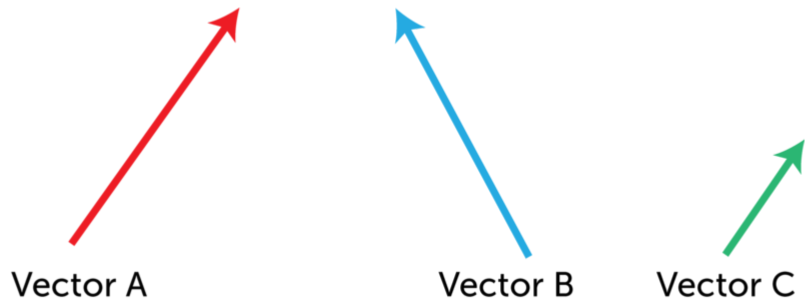
Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Velocity

Speed tells you only how fast an object is moving. It doesn't tell you the direction the object is moving. The measure of both speed and direction is called velocity. Velocity is a vector, or a measure that has both size and direction. In the case of velocity, size refers to speed. Like other vectors, velocity can be represented by an arrow. The length of the arrow represents speed, and the way the arrow points represents direction.

The three arrows shown below represent the velocities of three different objects. Vectors A and B are the same length but point in different directions. They represent objects moving at the same speed but in different directions. Vector C is shorter than vector A or B but points in the same direction as vector A. It represents an object moving at a slower speed than A or B but in the same direction as A.



If two objects are moving at the same speed and in the same direction, they have the same velocity. If two objects are moving at the same speed but in different directions (like A and B above), they have different velocities. If two objects are moving in the same direction but at different speeds (like A and C), they have different velocities.

Questions

1. What is velocity?
2. How does velocity differ from speed?
3. Explain why velocity, but not speed, is a vector.
4. Describe how to use an arrow to represent the velocity of a moving object.

Lesson 12.2: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. When calculating average speed, the symbol δd represents the
   a. change in distance.
   b. change in direction.
   c. instantaneous distance.
   d. division of distance by time.
2. If you run a 100-meter race in 20 seconds, what is your average speed during the race?
   a. 20 m/s
   b. 10 m/s
   c. 5 m/s
   d. 2 m/s
3. Tony ran at a constant speed of 10 m/s for a total of 60 seconds. How far did he run?
   a. 6 m
   b. 60 m
   c. 600 m
   d. 6000 m
4. If you use an arrow to represent velocity, what does the length of the arrow represent?
   a. time
   b. speed
   c. distance
   d. direction
5. Which choice(s) could represent the velocity of a moving car?

a. 80 mi/h
b. 40 km/h
c. 50 km/h north
d. all of the above

6. Which quantity is a vector?
   a. speed
   b. velocity
   c. direction
   d. distance
7. If speed is constant, velocity
   a. must be zero.
   b. must be constant.
   c. can be changing.
   d. none of the above

Lesson 12.2: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. measure of both speed and direction

_____ 2. distance $\div$ speed

_____ 3. speed of a moving object at a given moment

_____ 4. speed $\times$ time

_____ 5. general term for how quickly or slowly something moves

_____ 6. total distance traveled divided by the time it took to travel that distance

_____ 7. steepness of a graph line

Terms

a. speed

b. velocity

c. instantaneous speed

d. average speed

e. slope

f. distance

g. time

Lesson 12.2: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. The SI unit for speed is __________.
2. The slope of a distance-time graph represents the __________ of a moving object.
3. Change in distance divided by change in time equals __________ speed.
4. A straight line on a distance-time graph represents a(n) __________ speed.
5. A horizontal line on a distance-time graph represents a speed of __________.
6. The velocity of a moving object is constant only if the object's speed and __________ are unchanging.
7. Velocity is a vector because it includes both size and __________.

Lesson 12.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

If you know that a moving object has a constant velocity, you can predict correctly where it will be after a given amount of time. However, if you know only that the object has a constant speed, you cannot predict where it will be. Explain why.

12.3 Acceleration

Lesson 12.3: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Acceleration occurs only when there is a change in speed.

_____ 2. It is easier to calculate acceleration when both speed and direction are changing.

_____ 3. The y-axis of a velocity-time graph represents distance traveled.

_____ 4. If a velocity-time graph slopes downward to the right, then acceleration is negative.

_____ 5. If velocity is not changing, then acceleration is zero.

_____ 6. A change in direction with or without a change in speed is velocity.

_____ 7. If the slope of a velocity-time graph is a straight line, then velocity must be constant.

Lesson 12.3: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Defining Acceleration

Acceleration is a measure of the change in velocity of a moving object. It shows how quickly velocity changes. Acceleration may reflect a change in speed, a change in direction, or both. Because acceleration includes both size (speed) and direction, it is a vector.

People commonly think of acceleration as in increase in speed, but a decrease in speed is also acceleration. In this case, acceleration is negative. Negative acceleration is called deceleration. A change in direction without a change in speed is acceleration as well.

Questions

1. Define acceleration.
2. What is deceleration? Give an example.
3. How can acceleration occur when speed is constant?

Lesson 12.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Acceleration shows
   a. how quickly an object travels.
   b. the direction in which an object moves.
   c. how far an object travels in a given time.
   d. how quickly an object's velocity changes.
2. Which of the following is an example of acceleration?
   a. a change in direction
   b. an increase in speed
   c. a decrease in speed
   d. all of the above
3. If you are riding in a car that decelerates suddenly, you will feel your body
   a. pressed backward.
   b. pushed to the side.
   c. thrust forward.
   d. none of the above
4. To calculate acceleration without a change in direction, you should use the formula
   a. acceleration = $\delta v + \delta t$
   b. acceleration = $\delta t / \delta v$
   c. acceleration = $\delta v / \delta t$
   d. acceleration = $\delta v \times \delta t$
5. When Sara ran a race on a straight track, her speed changed from 3 m/s to 6 m/s over a time period of 3 seconds. What was her acceleration during that time?
   a. 3 m/s^2
   b. 1 m/s^2
   c. 2 m/s^2
   d. none of the above
6. What does a velocity-time graph represent?
   a. how velocity changes over time
   b. how distance changes over time
   c. acceleration
   d. two of the above
7. If speed decreases, then acceleration is
   a. zero.
   b. positive.
   c. negative.
   d. between 0 and 1.

Lesson 12.3: Matching

Name____________________ **Class**_______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. speed plus direction of motion

_____ 2. negative acceleration

_____ 3. SI unit for acceleration

_____ 4. symbol for a change in velocity

_____ 5. measure of a change in velocity

_____ 6. symbol for a change in time

_____ 7. how quickly an object changes position

Terms

a. acceleration

b. δt

c. deceleration

d. speed

e. δv

f. velocity

g. m/s^2

Lesson 12.3: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. A change in speed, direction, or both is called __________.
2. Acceleration is a(n) __________ because it includes both size and direction.
3. A decrease in speed is called __________.
4. To calculate acceleration without a change in direction, you divide the change in velocity by the change in __________.
5. Acceleration is represented by the __________ of a velocity-time graph.
6. If the line of a velocity-time graph is horizontal, acceleration is __________.
7. If a car is increasing in speed, its acceleration is __________.

Lesson 12.3: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What is a velocity-time graph, and how does it represent acceleration?

Chapter 13 Forces Worksheets

Chapter Outline

13.1 What is Force?

Lesson 13.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Mass is a measure of the force of gravity on an object.

_____ 2. Most objects have at least two forces acting on them at all times.

_____ 3. If opposing forces are unequal in strength, the net force is less than zero.

_____ 4. The SI unit for weight is the newton.

_____ 5. When two forces act on an object in the same direction, the net force equals zero.

_____ 6. When forces act in opposite directions on an object, they are subtracted to yield the net force.

_____ 7. Every sport involves forces.

_____ 8. Forces are always balanced when they act on an object in the same direction.

_____ 9. Whenever an object is stationary, it has no forces acting on it.

_____ 10. Two forces acting in the same direction always result in a stronger force.

Lesson 13.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Forces Acting in Opposite Directions

When two forces act on an object in opposite directions, the net force is equal to the difference between the two forces. The net force is calculated by subtracting the lesser force from the greater force. How opposing forces affect the motion of an object depends on whether the forces are balanced or unbalanced.

- If opposing forces are balanced, they are equal in strength and the net force is zero. With a net force of zero acting on an object, its motion does not change. If it isn't moving, it remains stationary. If it is moving, its speed and direction do not change.
- If opposing forces are unbalanced, they are not equal in strength and the net force is greater than zero. With a net force greater than zero acting on an object, its motion changes. If it is stationary, it starts moving. If it is already moving, its speed or direction changes.

Questions

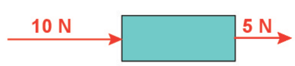
1. How is net force calculated when two forces act on an object in opposite directions?
2. How do opposing forces affect the motion of an object if the forces are balanced?
3. How do unbalanced forces affect an object's motion?

Lesson 13.1: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

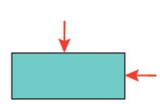
1. Force can cause a
   a. stationary object to start moving.
   b. moving object to change speed.
   c. moving object to change direction.
   d. all of the above
2. Examples of forces include
   a. motion.
   b. friction.
   c. acceleration.
   d. two of the above
3. If gravity pulls you down toward the center of Earth with a force of 500 N, how much upward force does the ground exert on you?
   a. 0 N
   b. 50 N
   c. 500 N
   d. none of the above
4. In the following sketch, what is the net force acting on the box?



   a. 5 N to the right
   b. 5 N to the left
   c. 15 N to the right
   d. 15 N to the left
5. Which diagram represents balanced forces?

a.

b.



c.

d.

6. Which pair of forces in question 5 differ from each other in both strength and direction?
   a. a
   b. b
   c. c
   d. d
7. Which pair of forces in question 5 produces a net force of zero?
   a. a
   b. b
   c. c
   d. d

Lesson 13.1: Matching

Name____________________ Class_______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. combination of all the forces acting on an object

_____ 2. force that a person or thing exerts on to an object

_____ 3. push or pull acting on an object

_____ 4. forces that produce a net force of zero

_____ 5. example of a force

_____ 6. SI unit for force

_____ 7. forces that produce a net force greater than zero

Terms

a. force

b. unbalanced forces

c. net force

d. applied force

e. newton

f. gravity

g. balanced forces

Lesson 13.1: Fill in the Blank

Name____________________ Class_______________ Date________

Fill in the blank with the appropriate term.

1. Whenever the motion of an object changes, ___________ has been applied.
2. Force is a(n) ___________ because it has both size and direction.

3. The amount of force needed to cause a mass of 1 kilogram to accelerate at 1 m/s^2 is __________.
4. How a force affects an object's motion depends on the strength of the force and the __________ of the object.
5. If force is represented by an arrow, the length of the arrow represents the __________ of the force.
6. When unequal and opposite forces act on an object, the forces are said to be __________.
7. When two forces act on an object in the same direction, the net force equals the __________ of the two forces.

Lesson 2.1: Critical Writing

Name__________________ Class_____________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Forces can act on an object in the same direction or in opposite directions. How does each situation affect the motion of the object?

13.2 Friction

Lesson 13.2: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Friction is never useful.

_____ 2. Too much friction can cause parts to wear out.

_____ 3. Friction can cause scrapes on the skin.

_____ 4. Some surfaces are so smooth that they have no friction.

_____ 5. You use friction when you strike and light a match.

_____ 6. It takes more force to slide than to roll a heavy object.

_____ 7. Friction works in the same direction as the force applied to move an object.

_____ 8. When a dolly is stationary, there is rolling friction between the wheels and ground.

_____ 9. Static friction prevents you from sliding out of your chair to the floor.

_____ 10. The brakes on a bike create rolling friction.

Lesson 13.2: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

What Is Friction?

Friction is a force that opposes motion between two surfaces that are touching. Friction can work for or against us. For example, putting sand on an icy sidewalk increases friction so you are less likely to slip. On the other hand, too much friction between moving parts in a car engine can cause the parts to wear out.

Friction occurs because no surface is perfectly smooth. Even surfaces that look smooth to the unaided eye appear rough or bumpy when viewed under a microscope. For example, new metal pipes are so smooth that they are shiny. But if you examine the metal under a high-power microscope, the surface appears to be bumpy. All those mountains and valleys catch and grab the mountains and valleys of any other surface that contacts the metal. This creates friction.

Questions

1. Define friction.
2. Give an example of friction that is useful and friction that is not useful.
3. Explain what causes friction.

Lesson 13.2: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Friction occurs because
   a. all surfaces have some roughness.
   b. surfaces in contact generate heat.
   c. chemical reactions take place when surfaces touch.
   d. none of the above
2. Which factors affect friction?
   a. roughness of the surfaces
   b. area of the surfaces
   c. force of weight pressing on the surfaces
   d. two of the above
3. If you pick up and carry a piece of heavy furniture, which type of friction do you have with the floor?
   a. static friction
   b. lifting friction
   c. sliding friction
   d. rolling friction
4. Why is it easier to slide a heavy box over a floor that it is to start it sliding in the first place?
   a. The box is lighter when it is sliding.
   b. The box has less mass when it is moving.
   c. The box has no friction when it is stationary.
   d. The box has less friction when it is sliding.
5. Which statement about rolling friction is false?
   a. It would be hard to ride a bike without it.
   b. It occurs when ball bearings are used.
   c. It is stronger than sliding friction.
   d. It is weaker than static friction.
6. A skydiver uses a parachute to
   a. increase air resistance.
   b. cushion the landing.
   c. slow the descent.
   d. two of the above
7. Which type of friction occurs between a paddle and the water?
   a. static friction
   b. sliding friction
   c. fluid friction
   d. rolling friction

Lesson 13.2: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. type of friction between ice skates and ice

_____ 2. any substance that can flow and take the shape of its container

_____ 3. force that opposes motion between any two surfaces

_____ 4. type of friction between shoes and pavement

_____ 5. type of friction between a parachute and air

_____ 6. type of friction between roller skates and concrete

_____ 7. type of friction between an object and a gas or liquid

Terms

a. friction

b. static friction

c. air resistance

d. fluid

e. sliding friction

f. fluid friction

g. rolling friction

Lesson 13.2: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. Rough surfaces have __________ friction than smooth surfaces.
2. Heavier objects have __________ friction that lighter objects.
3. __________ friction occurs between a swimmer and the water.
4. __________ friction occurs between objects that are not moving.
5. When you write with a pencil, you use __________.
6. Sliding friction is stronger than __________ friction.
7. Sliding friction is weaker than __________ friction.

Lesson 13.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Choose a sport with which you are familiar, and describe at least two ways that friction occurs in the sport. Is the friction a help or a hindrance to the players? Explain why.

13.3 Gravity

Lesson 13.3: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Satellites orbit Earth because of gravity.

_____ 2. An object has a greater mass on Earth than it does on the moon.

_____ 3. Molecules of gas are attracted toward one another by gravity.

_____ 4. The mass of an object affects its force of gravity.

_____ 5. Objects that are closer together have a weaker force of gravity.

_____ 6. All objects have the same acceleration due to gravity.

_____ 7. The curved path of an arrow is called its orbit.

_____ 8. The moon has both forward velocity and acceleration toward Earth.

_____ 9. Einstein's theory of gravity is better than Newton's law of gravity at predicting how all objects move.

_____ 10. Einstein defined gravity as a force of attraction between objects with mass.

Lesson 13.3: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Newton, Einstein, and Gravity

People have known about gravity for thousands of years. After all, they constantly experienced gravity in their daily lives. They knew that things always fall toward the ground. However, it wasn't until the late 1600s that Sir Isaac Newton developed his law of gravity. Newton was the first one to suggest that gravity is universal, that all objects in the universe are attracted to each other. That's why Newton's law of gravity is called the law of universal gravitation. Newton's law also states that more massive objects and objects that are closer together have a greater force of attraction.

Newton's law of gravity can predict the motion of most but not all objects. In the early 1900s, Albert Einstein came up with a theory of gravity that is better at predicting how all objects move. Einstein showed mathematically that gravity is not really a force in the sense that Newton thought. Instead, gravity is a result of the warping, or curving, of space and time. Imagine a bowling ball pressing down on a trampoline. The surface of the trampoline would curve downward instead of being flat. Einstein theorized that Earth and other massive objects affect space and time around them in a similar way. According to Einstein, objects curve toward one another because of the curves in space and time, not because they are pulling on each other with a force of attraction as Newton thought.

Questions

1. State Newton's law of universal gravitation.
2. How does Einstein's theory of gravity differ from Newton's law of gravity?

Lesson 13.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Gravity always causes objects to
   a. repel each other.
   b. circle each other.
   c. attract each other.
   d. two of the above
2. Unlike friction, gravity
   a. is a force.
   b. acts over a distance.
   c. acts between objects that are not touching.
   d. two of the above
3. What does weight measure?
   a. size
   b. mass
   c. force
   d. volume
4. Jody has a mass of 50 kilograms. What is his weight on Earth?
   a. 5 N
   b. 50 N
   c. 500 N
   d. 5000 N
5. There is gravity between you and
   a. Earth.
   b. the moon.
   c. your desk.
   d. all of the above
6. The moon orbits Earth rather than the sun because
   a. the sun's gravity is weaker than Earth's.
   b. the moon is smaller than Earth.
   c. Earth already orbits the sun.
   d. the moon is closer to Earth.
7. An object with greater mass
   a. has greater acceleration when it falls.
   b. has a weaker force of gravity.
   c. is less affected by gravity.
   d. has greater weight.

Lesson 13.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. SI unit for weight

_____ 2. motion of an object subject to horizontal force and the force of gravity

_____ 3. force of attraction between two masses

_____ 4. scientist who proposed that gravity is due to curves in space and time

_____ 5. measure of the force of gravity

_____ 6. path of one object around another, such as the moon around Earth

_____ 7. scientist who proposed the law of universal gravitation

Terms

a. gravity

b. Isaac Newton

c. orbit

d. weight

e. projectile motion

f. Albert Einstein

g. newton

Lesson 13.3: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. The force that created the solar system is __________.
2. On Earth, a mass of 1 kilogram has weight of about __________.
3. A scale is a device that measures __________.
4. __________ was the first to suggest that gravity affects all objects in the universe.
5. Because of gravity, objects accelerate toward Earth at a rate of __________.
6. An arrow shot straight ahead from a bow has __________ motion.
7. The moon has __________ motion because of its forward velocity and acceleration due to Earth's gravity.

Lesson 13.3: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why you would weigh less on the moon than you do on Earth.

13.4 Elastic Force

Lesson 13.4: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Something that is elastic springs back after being stretched.

_____ 2. An elastic material resists a change in shape.

_____ 3. Elastic force is not very useful.

_____ 4. When you use a resistance band, resistance comes from elastic force.

_____ 5. Glass is an example of an elastic material.

Lesson 13.4: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Elasticity and Elastic Force

Something that is elastic can return to its original shape after being stretched or compressed. This property is called elasticity. As you stretch or compress an elastic material, it resists the change in shape. It exerts a counter force in the opposite direction. This force is called elastic force. Elastic force causes the material to spring back to its original shape as soon as the stretching or compressing force is released.

Questions

1. Define elasticity.
2. What is elastic force?
3. If you stretch a rubber band, in what direction is elastic force exerted?

Lesson 13.4: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Items that are elastic include
   a. metal wires.
   b. concrete blocks.
   c. plastic spring toys.

d. all of the above

2. A rubber band keeps a newspaper tightly rolled because it

a. can be tied tightly.
b. exerts elastic force.
c. is unbreakable.
d. none of the above

3. When you compress a spring, it

a. resists the change in shape.
b. exerts a force in the same direction.
c. permanently changes to a new shape.
d. two of the above

4. Springs are used in

a. beds.
b. cars.
c. scales.
d. all of the above

5. What happens when the stretching force on an elastic material is released?

a. The material breaks.
b. The material remains stretched out.
c. The material starts to exert elastic force.
d. The material snaps back to its original shape.

Lesson 13.4: Matching

Name____________________ Class_______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. force exerted on a material that is pulled apart

_____ 2. structure that returns to its original shape after being stretched or compressed

_____ 3. force exerted on a material that is pushed together

_____ 4. counter force exerted by an elastic material that is stretched or compressed

_____ 5. ability of a material to return to its original shape after being stretched or compressed

Terms

a. elastic force

b. stretching force

c. compressing force

d. elasticity

e. spring

Lesson 13.4: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. A rubber band can stretch without breaking because it is __________.
2. __________ force causes a stretchy material to spring back to its original shape.
3. Elastic force is exerted in the __________ direction as the force applied to an elastic material.
4. Bungee cords are made of __________ material.
5. __________ are used to cushion the ride in a car.

Lesson 13.4: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe three ways that you commonly use elastic force. In each case, identify the job done by elastic force.

CHAPTER 14 Newton's Laws of Motion Worksheets

Chapter Outline

14.1 Newton's First Law

Lesson 14.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Inertia is the tendency of an object to resist motion.

_____ 2. Newton's first law of motion is also called the law of acceleration.

_____ 3. If an object is at rest, inertia will keep it at rest.

_____ 4. The inertia of an object is determined by its speed.

_____ 5. The speed of an object changes only when it is acted on by an unbalanced force.

_____ 6. A stationary object resists movement only because of gravity.

_____ 7. The tendency of an object to resist a change in motion depends on its mass.

_____ 8. If the net force acting on an object is zero, its inertia is also zero.

_____ 9. When you are moving at a high rate of speed, inertia makes is hard to stop.

_____ 10. Newton's first law of motion applies only to objects that are already moving.

Lesson 14.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Inertia

Inertia is the tendency of an object to resist a change in its motion. If an object is already at rest, inertia will keep it at rest. If the object is already moving, inertia will keep it moving. Think about what happens when you are riding in a car that stops suddenly. Your body moves forward on the seat. Why? The brakes stop the car but not your body, so your body keeps moving forward because of inertia. That's why it's important to always wear a seat belt.

The inertia of an object depends on its mass. Objects with greater mass also have greater inertia. Think how hard it would be to push a big cardboard box full of books. Then think how easy it would be to push the box if it was empty. The full box is harder to move because it has greater mass and therefore greater inertia.

Questions

1. What is inertia?
2. Describe how inertia affects motion.
3. What is the relationship between mass and inertia?

Lesson 14.1: Multiple Choice

Name__________________ Class_____________ Date_________

Circle the letter of the correct choice.

1. Newton's first law of motion states than an object's motion will not change unless
   a. the net force acting on it is greater than zero.
   b. a force continues to be applied to the object.
   c. its inertia is stronger than the applied force.
   d. the object has no inertia.
2. Overcoming an object's inertia always requires a(n)
   a. large mass.
   b. massive force.
   c. unbalanced force.
   d. two of the above
3. It is more difficult to start a 50-kg box sliding across the floor than a 5-kg box because the 50-kg box has greater
   a. size.
   b. inertia.
   c. volume.
   d. velocity.
4. Once an object starts moving along a clear path, it would keep moving at the same velocity if it were not for
   a. inertia.
   b. friction.
   c. an unbalanced force.
   d. two of the above
5. An object's velocity will not change unless it is acted on by a(n)
   a. net force.
   b. strong force.
   c. unbalanced force.
   d. opposite but equal force.
6. The direction of a moving object will not change if the net force acting on it is
   a. greater than zero.
   b. less than zero.
   c. zero.
   d. two of the above

Lesson 14.1: Matching

Name__________________ Class_____________ Date________

Match each definition with the correct term.

Definitions

_____ 1. combination of all the forces acting on an object

_____ 2. force that opposes the motion of any object

_____ 3. an object's motion will not change unless an unbalanced force acts on it

_____ 4. factor that determines the inertia of an object

_____ 5. type of force needed to overcome inertia of an object

_____ 6. tendency of an object to resist a change in motion

Terms

a. inertia

b. unbalanced force

c. friction

d. law of inertia

e. mass

f. net force

Lesson 14.1: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. Newton's first law of motion is also called the law of __________.
2. An object at rest will stay at rest unless a(n) __________ force acts on it.
3. When the car you are riding in stops suddenly, you move forward because of __________.
4. Objects with greater mass have __________ inertia.
5. If an object is not moving, __________ will cause it to remain stationary.
6. Once objects start moving, __________ keeps them moving.
7. An object's motion will not change as long as the net force acting on it is __________.

Lesson 14.1: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how Newton's first law of motion is related to the concept of inertia.

14.2 Newton's Second Law

Lesson 14.2: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. The relationship between mass and inertia is described by Newton's second law of motion.

_____ 2. Newton determined that there is a direct relationship between force and mass.

_____ 3. Any change in velocity for any reason is called acceleration.

_____ 4. The greater the net force applied to a given object, the more it will accelerate.

_____ 5. The greater the mass of an object, the more it will accelerate when a given net force is applied to it.

_____ 6. A net force of 1 N applied to a mass of 1 kg results in an acceleration of 0.5 m/s^2.

_____ 7. Your weight equals your mass multiplied by the acceleration due to gravity.

_____ 8. A 10-kg object has greater acceleration due to gravity than a 5-kg object.

_____ 9. The acceleration of an object equals its mass times the net force applied to it.

_____ 10. The acceleration of an object due to gravity depends on the object's initial velocity

Lesson 14.2: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Acceleration and Weight

Newton's second law of motion explains the weight of objects. Weight is a measure of the force of gravity pulling on an object of a given mass. It's the force (F) in the acceleration equation that was introduced above:

$$a = \frac{F}{m}$$

This equation can also be written as:

$$F = m \times a$$

The acceleration due to gravity of an object equals 9.8 m/s^2, so if you know the mass of an object, you can calculate its weight as:

$$F = m \times 9.8 \text{ m/s}^2$$

As this equation shows, weight is directly related to mass. As an object's mass increases, so does its weight. For example, if mass doubles, weight doubles as well.

Questions

1. Define weight.
2. How is the weight of an object related to its mass?
3. If an object has a mass of 50 kg, what is its weight?

Lesson 14.2: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. An object is accelerating when it
   a. speeds up.
   b. slows down.
   c. changes direction.
   d. any of the above
2. Newton's second law of motion relates an object's acceleration to
   a. its mass.
   b. its velocity.
   c. the net force acting on it.
   d. two of the above
3. Doubling the net force acting on an object
   a. doubles its acceleration.
   b. decreases it acceleration.
   c. cuts its acceleration in half.
   d. does not affect its acceleration.
4. If you push a 20-kilogram mass with a force of 40 N, what will be the object's acceleration?
   a. 40 m/s^2
   b. 20 m/s^2
   c. 10 m/s^2
   d. 2 m/s^2
5. Which units can be used to express force?
   a. N
   b. kg/s^2
   c. kg • m/s^2
   d. two of the above
6. If you know the mass of an object, you can calculate its weight with the formula
   a. $F = m \times 9.8$ m
   b. $F = m \times 9.8$ m/s
   c. $F = m \times 9.8$ m/s^2
   d. $F = m \times 0.98$ m/s^2
7. If the mass of an object doubles, its weight

a. doubles.
b. decreases.
c. is not affected.
d. changes by a factor of $\frac{1}{2}$.

Lesson 14.2: Matching

Name____________________ **Class**_______________ **Date**_________

Match each definition with the correct term.

Definitions

_____ 1. acceleration due to gravity

_____ 2. formula for weight

_____ 3. formula for acceleration

_____ 4. measure of the force of gravity pulling on an object

_____ 5. type of relationship between acceleration and mass

_____ 6. measure of the change in velocity of a moving object

_____ 7. type of relationship between acceleration and force

Terms

a. acceleration

b. weight

c. direct relationship

d. $a = \frac{F}{m}$

e. inverse relationship

f. $F = m \times a$

g. 9.8 $\mathrm{m/s^2}$

Lesson 14.2: Fill in the Blank

Name____________________ **Class**_______________ **Date**_________

Fill in the blank with the appropriate term.

1. ___________ occurs whenever an object is acted upon by an unbalanced force.
2. The acceleration of an object is determined by the net force acting on the object and the object's ___________.
3. Newton's second law of motion shows that there is a direct relationship between acceleration and ___________.
4. One newton is the force needed to cause a 1-kilogram mass to accelerate at ___________.
5. There is a(n) ___________ relationship between an object's weight and its mass.
6. To calculate weight from acceleration and mass, mass must be expressed in ___________.
7. An object's acceleration is zero when the net force acting on the object is ___________.

Lesson 14.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how Newton's second law of motion can be used to calculate the acceleration of an object.

14.3 Newton's Third Law

Lesson 14.3: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Forces always act in pairs.

_____ 2. Action and reaction forces always cancel out.

_____ 3. Action and reaction forces always result in motion.

_____ 4. Only moving objects have momentum.

_____ 5. A smaller mass cannot have as much momentum as a larger mass.

_____ 6. Momentum can be transferred from one object to another.

_____ 7. When an action and reaction occur, momentum is usually lost.

_____ 8. Momentum is conserved only in head-on collisions.

_____ 9. Newton's third law of motion is also called the law of conservation of momentum.

_____ 10. Momentum is another term for acceleration.

Lesson 14.3: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Action and Reaction

Newton's third law of motion states that every action has an equal and opposite reaction. This means that forces always act in pairs. First an action occurs, such as two skateboarders pushing together. Then a reaction occurs that is equal in strength to the action but in the opposite direction. In the case of the skateboarders, they move apart, and the distance they move depends on how hard they first pushed together.

You might think that actions and reactions would cancel each other out like balanced forces do. Balanced forces, which are also equal and opposite, cancel out because they act on the same object. Action and reaction forces, in contrast, act on different objects, so they don't cancel out. In fact, they often result in motion.

Questions

1. What is Newton's third law of motion?
2. Describe an example of an action and reaction that result in motion.
3. Compare and contrast action-reaction forces and balanced forces.

Lesson 14.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. When an action force occurs, the reaction force is always
   a. in the same direction as the action force.
   b. equal and opposite to the action force.
   c. applied to the same object as the action force.
   d. two of the above
2. When you stand on the floor, the force of your body pushing down on the floor is
   a. matched by the floor pushing up on your body.
   b. less than the reaction force applied by the floor.
   c. a reaction to the floor pushing up.
   d. none of the above
3. When a kangaroo jumps, the kangaroo's action force acts on the ground and the reaction force
   a. is exerted by the ground.
   b. acts on the kangaroo.
   c. is greater than the action force.
   d. two of the above
4. If the following objects are all moving at the same velocity, which of the objects has the greatest momentum?
   a. pea
   b. marble
   c. volleyball
   d. bowling ball
5. Momentum is directly related to
   a. mass.
   b. velocity.
   c. distance.
   d. two of the above
6. Momentum is a
   a. force of nature.
   b. form of energy.
   c. property of an object.
   d. measure of an object's motion.
7. What is the momentum of a 9-kilogram object that has a velocity of 3 m/s?
   a. 3 kg/m/s
   b. 6 kg/s/m
   c. 12 kg • s/m
   d. 27 kg • m/s

Lesson 14.3: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. how to calculate momentum

_____ 2. SI unit for momentum

_____ 3. equal and opposite forces that act on different objects

_____ 4. combined momentum of objects remains the same when an action-reaction occurs

_____ 5. property of a moving object that makes it hard to stop

_____ 6. equal and opposite forces that act on the same object

_____ 7. every action has an equal and opposite reaction

Terms

a. momentum

b. Newton's third law of motion

c. balanced forces

d. kg • m/s

e. law of conservation of momentum

f. action-reaction forces

g. mass × velocity

Lesson 14.3: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. Two objects with the same mass have the same momentum only if they also have the same __________.
2. If a very massive object is stationary, its momentum is __________.
3. A 20-kg object moving at a velocity of 3 m/s has a momentum of __________.
4. For every action, there is an equal and __________ reaction.
5. Action and reaction forces are not balanced forces because they act on __________ objects.
6. When moving objects collide, their combined __________ is conserved.
7. If you double the mass of a moving object, the object's momentum __________.

Lesson 14.3: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Apply Newton's third law of motion to explain movements of a soccer ball during a game of soccer.

CHAPTER 15 Fluid Forces Worksheets

Chapter Outline

15.1 Pressure of Fluids

Lesson 15.1: True or False

Name____________________ Class_______________ Date___________

Determine if the following statements are true or false.

_____ 1. All fluids exert pressure.

_____ 2. Particles of a fluid always move from an area of lower pressure to an area of higher pressure.

_____ 3. Denser fluids exert greater pressure than less dense fluids.

_____ 4. Air exerts greater pressure than water.

_____ 5. Differences in air pressure allow you to breathe.

_____ 6. Fluids have the ability to transmit pressure.

_____ 7. Air flows faster below than above an airplane wing.

_____ 8. The spoiler on a racecar acts like an upside-down wing.

_____ 9. Air pressure decreases slowly at lower altitudes and then more quickly at higher altitudes.

_____ 10. In a hydraulic car lift, more pressure is applied to the hydraulic fluid than the fluid applies to the car.

Lesson 15.1: Critical Reading

Name____________________ Class_______________ Date___________

Read this passage from the text and answer the questions that follow.

What Is Pressure?

All fluids exert pressure. The particles of fluids are constantly moving in all directions at random. As the particles move, they keep bumping into each other and into anything else in their path. These collisions cause pressure, which is the result of force acting on a given area. Pressure shows how concentrated the force is. The smaller the area to which a given force is applied, the greater the pressure is on that area. When particles of a fluid are crowded together in one place, they quickly spread out to fill whatever space is available. That's because fluid particles always move from a region of higher pressure to a region of lower pressure until the pressure is the same throughout.

Pressure can be calculated using this equation:

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

In this equation, force is expressed in newtons (N) and area is expressed in square meters (m^2). Therefore, pressure is expressed in N/m^2, which is the SI unit for pressure. This unit is also called the pascal (Pa).

Questions

1. If you add air to a flat tire through a single small entry hole, why does the air spread out to fill the tire?

2. When the same amount of force is applied to a smaller area, how is pressure affected?
3. If 20 N of force are exerted on an area of 2 m^2, how much pressure is applied to that area?

Lesson 15.1: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Why do fluids exert pressure?
   a. They are heavier than solids.
   b. Their particles are constantly moving.
   c. Their force is applied to a small area.
   d. They crowd together in the smallest possible space.
2. When the same force is applied to a smaller area, the pressure is
   a. lower.
   b. greater.
   c. reduced.
   d. the same.
3. What is 50 kPa expressed in pascals?
   a. 500 Pa
   b. 5000 Pa
   c. 50,000 Pa
   d. 500,000 Pa
4. If a force of 200 N is applied to an area of 0.5 m^2, the pressure is
   a. 40 Pa.
   b. 100 Pa.
   c. 400 Pa.
   d. 2000 Pa.
5. The pressure of ocean water increases as the water
   a. gets closer to shore.
   b. becomes deeper.
   c. gets shallower.
   d. two of the above
6. When the same amount of pressure acts over a larger area, it exerts
   a. a greater force.
   b. a smaller force.
   c. the same force.
   d. a weaker force.
7. Birds can fly because air pressure is
   a. greater below than above their wings.
   b. greater above than below their wings.
   c. the same on both sides of their wings.
   d. transmitted through their wings.

Lesson 15.1: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. a push or pull

_____ 2. SI unit for pressure

_____ 3. upward force that allows flight

_____ 4. pressure in a moving fluid is less when the fluid is moving faster

_____ 5. change in pressure is transmitted equally throughout a fluid

_____ 6. use of fluid pressure to increase force and do work

_____ 7. liquid or gas

Terms

a. fluid

b. Bernoulli's law

c. force

d. pascal

e. Pascal's law

f. hydraulics

g. lift

Lesson 15.1: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. __________ is the result of force acting on a given area.
2. The unit N/m^2 is also called a(n) __________.
3. Force can be calculated by multiplying area by __________.
4. As you go deeper in the ocean, the pressure exerted by the water __________.
5. Air pressure of the atmosphere is greatest at __________.
6. __________ law explains why toothpaste squirts out of a tube when you squeeze the opposite end.
7. __________ law explains why an airplane can take off from the ground.

Lesson 15.1: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What are the relationships between pressure and force and between pressure and area?

15.2 Buoyancy of Fluids

Lesson 15.2: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Only liquids have buoyancy.

_____ 2. Any object sinks if its weight is greater than its volume

_____ 3. A denser object weighs more than a less dense object of the same size.

_____ 4. Helium balloons float in air because helium is purer than air.

_____ 5. The buoyant force acting on an object in a fluid always equals the object's weight.

_____ 6. Archimedes determined that the mass of fluid displaced by an object equals the mass of the object.

_____ 7. The more fluid an object displaces, the greater the buoyant force acting on the object.

_____ 8. Buoyancy is a property of an object that can float in a fluid.

_____ 9. Fluids exert pressure only in an upward direction.

_____ 10. Buoyant force explains why some objects float in water.

Lesson 15.2: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Archimedes' Law

Did you ever notice that when you get into a bathtub of water the level of the water rises? More than 2200 years ago, a Greek mathematician named Archimedes noticed the same thing. He observed that a body and the water in a tub can't occupy the same space at the same time. As a result, some of the water is displaced, or moved out of the way. How much water is displaced? Archimedes determined that the volume of displaced water equals the volume of the submerged object. So more water is displaced by a bigger body than a smaller one.

What does displacement have to do with buoyant force? Everything! Archimedes discovered that the buoyant force acting on an object equals the weight of the fluid displaced by the object. This is known as Archimedes' law. It explains why some objects float in fluids even though they are very heavy. For example, an extremely heavy ship is able to stay afloat because the design of its hull causes it to displace a lot of water. The weight of the displaced water is greater than the weight of the ship, so the buoyant force is greater than the force of gravity acting on the ship. As a result, the ship floats.

Questions

1. What is displacement? How much water is displaced by a solid object with a volume of 9 cm^3 that is completely submerged in the water?

2. What does displacement have to do with buoyant force?
3. What determines whether an object floats?

Lesson 15.2: Multiple Choice

Name____________________ Class_______________ Date___________

Circle the letter of the correct choice.

1. Which statement explains buoyant force?
   a. Denser fluids exert less pressure.
   b. Fluid pressure is greater at greater depths.
   c. An object weighs less in water.
   d. all of the above
2. What determines whether an object floats or sinks in water?
   a. the buoyant force acting on the object
   b. the force of gravity acting on the object
   c. the object's weight
   d. all of the above
3. Ice cubes float on water because ice is
   a. less dense than water.
   b. colder than water.
   c. heavier than water.
   d. less stable than water.
4. When you sit in a tub of bath water, the water rises because it
   a. becomes less dense.
   b. is displaced.
   c. gets warmer.
   d. floats.
5. Buoyancy is a property of
   a. gases.
   b. liquids.
   c. solids.
   d. two of the above
6. Where is water pressure greatest on an object in the water?
   a. on top of the object
   b. on the sides of the object
   c. on the bottom of the object
   d. two of the above
7. You feel lighter in the water than on land because
   a. gravity is not as strong in the water.
   b. the buoyant force of the water counters some of your weight.
   c. your mass is less in the water than on land.
   d. you are trying to stay afloat.

Lesson 15.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. amount of mass in a given volume

_____ 2. force that causes an object to sink in a fluid

_____ 3. to remain at or near the surface of a fluid

_____ 4. force that causes an object to float on a fluid

_____ 5. act in which an object moves fluid out of its way

_____ 6. ability of a fluid to exert upward force

_____ 7. measure of the force of gravity pulling down on an object

Terms

a. buoyant force

b. displacement

c. buoyancy

d. float

e. weight

f. gravity

g. density

Lesson 15.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. A fluid exerts __________ force on objects placed in the fluid
2. Buoyant force and the force of __________ determine whether an object sinks or floats.
3. If an object's weight is greater than the buoyant force on the object, the object will __________.
4. A less dense substance usually __________ in a fluid with greater density.
5. The amount of fluid displaced by an object equals the __________ of the object.
6. Buoyant force equals the __________ of the displaced fluid.
7. __________ law explains why a heavy ship floats.

Lesson 15.2: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Do you think that it is easier to float if you spread out in the water or if you curl up into a ball? Explain your answer.

CHAPTER 16 Work and Machines Worksheets

Chapter Outline

16.1 Work

Lesson 16.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Whenever you move your body you are doing work.

_____ 2. You do work when you push a heavy object even if the object does not move.

_____ 3. Work can be expressed in the unit N • m.

_____ 4. A more powerful device can do the same work in less time than a less powerful device.

_____ 5. If you move an object that weighs 10 newtons a distance of 2 meters, you do 5 joules of work.

_____ 6. If you move the object in question 5 a distance of 5 meters, you do 2 joules of work.

_____ 7. A device that does 100 joules of work in 3 seconds has 300 watts of power.

_____ 8. The unit called the horsepower was introduced by James Watt.

_____ 9. A 2-horsepower device has almost 1500 watts of power.

_____ 10. The more force you apply to move an object, the more work you do.

Lesson 16.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

What Is Power?

Did you ever rake leaves? It can take a long time to do all that work. But if you use an electric leaf blower instead, you can do the job much more quickly. Both the leaf blower and the rake do the work of removing leaves from the yard, but the leaf blower has more power. That's why it can do the same amount of work in less time. Power is a measure of the amount of work that can be done in a given amount of time.

Power can be represented by the equation:

$$\text{Power} = \frac{\text{Work}}{\text{Time}}$$

In this equation, work is measured in joules and time is measured in seconds, so power is expressed in joules per second (J/s). This is the SI unit for power, also known as the watt (W). A watt equals 1 joule of work per second. You may already be familiar with watts. That's because light bulbs and small appliances such as hair dryers are labeled with the watts of power they provide. For example, a hair dryer might have 2000 watts of power. This amount of power could also be expressed kilowatts. A kilowatt equals 1000 watts, so a 2000-watt hair dryer has 2 kilowatts of power.

Questions

1. What is power?
2. How can power be calculated? What units are used to express power?
3. How does the power of a device affect the amount of work it can do?

Lesson 16.1: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. For work to be done on an object, force must be applied
    a. in an upward direction.
    b. against the force of gravity.
    c. in the same direction as gravity.
    d. in the same direction that the object moves.
2. Work is directly related to the force applied to an object and to the
    a. mass of the object.
    b. distance the object moves.
    c. direction of the applied force.
    d. amount of time the force is applied.
3. If a mover pushes a box weighing 100 newtons a distance of 3 meters, how much work does she do?
    a. 3 J
    b. 33 J
    c. 300 J
    d. 3000 J
4. The power of a device can be expressed in
    a. joules.
    b. joules per meter.
    c. joules per second.
    d. none of the above
5. Work can be calculated as
    a. force $\times$ time.
    b. force $\times$ power.
    c. power $\times$ time.
    d. power $\times$ distance.
6. A device does 2000 joules of work in 10 seconds. What is the power of the device?
    a. 20,000 W
    b. 2000 W
    c. 200 W
    d. 20 W
7. One horsepower is the amount of work a horse can do in one
    a. second.
    b. minute.
    c. hour.
    d. day.

Lesson 16.1: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. unit for power that equals 745 watts

_____ 2. SI unit for work

_____ 3. how to calculate work

_____ 4. use of force to move an object

_____ 5. how to calculate power

_____ 6. SI unit for power

_____ 7. measure of the amount of work that can be done in a given amount of time

Terms

a. joule

b. horsepower

c. power

d. force $\times$ distance

e. watt

f. work $\div$ time

g. work

Lesson 16.1: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. The greater the force that is used to move an object, the __________ work that is done.
2. One __________ equals the amount of work that is done when 1 N of force moves an object a distance of 1 m.
3. The SI unit called the __________ equals 1 joule of work per second.
4. A 2000-watt machine produces __________ kilowatts of power.
5. A more powerful device can do __________ work in the same amount of time than a less powerful device.
6. Work can be calculated by multiplying __________ by time.
7. In the 1770s, __________ invented the first powerful steam engine that began the industrial revolution.

Lesson 16.1: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why the following statement is true, and give examples to illustrate your answer: "Not all force that is used to move an object does work on the object."

16.2 Machines

Lesson 16.2: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. The output distance of a machine is always greater than the input distance.

_____ 2. Using a machine increases the amount of work that is done for a given amount of force.

_____ 3. A machine increases the applied force by increasing the distance over which the force is applied.

_____ 4. The force you apply to a doorknob is less than the force applied by the doorknob to open the door.

_____ 5. All machines that change the strength of the force also change the distance over which the force is applied.

_____ 6. The actual mechanical advantage of a machine is always greater than its ideal mechanical advantage.

_____ 7. If a machine's output distance is greater than the input distance, the ideal mechanical advantage is less than 1.

_____ 8. If a machine changes only the direction of force, its mechanical advantage is equal to 1.

_____ 9. A lever is a machine that changes the direction of the force that is applied to it.

_____ 10. The force applied by a machine is always greater than the force applied to the machine.

Lesson 16.2: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

How Machines Help Us Do Work

A machine is any device that makes work easier by changing a force. When you use a machine, you apply force to the machine. This force is called the input force. The machine, in turn, applies force to an object. This force is called the output force. The force you apply to a machine is applied over a certain distance, called the input distance. The force applied by the machine to the object is also applied over a certain distance, called the output distance.

Machines make work easier by increasing the amount of force that is applied, increasing the distance over which the force is applied, or changing the direction in which the force is applied. Contrary to popular belief, machines do not increase the amount of work that is done. They just change how the work is done. The work done on a machine or by a machine always equals force multiplied by distance. Because a machine doesn't change the amount of work that is done, a machine that increases force must apply the force over a shorter distance. For the same reason, a machine that increases the distance over which the force is applied must apply less force.

Questions

1. Define machine.

2. How do machines make work easier?
3. If a machine increases force, why must the machine apply the force over a shorter distance?

Lesson 16.2: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. A machine can make work easier by
   a. increasing the amount of force that is applied.
   b. increasing the distance over which force is applied.
   c. changing the direction in which force is applied.
   d. any of the above
2. Examples of machines that increase force include
   a. doorknobs.
   b. hammers.
   c. canoe paddles.
   d. two of the above
3. How does a nutcracker change the force applied to it?
   a. It increases the force that is applied.
   b. It increases the distance over which force is applied.
   c. It changes the direction in which force is applied.
   d. two of the above
4. A machine that increases the applied force and also changes its direction is a
   a. hammer.
   b. canoe paddle.
   c. pry bar.
   d. doorknob.
5. Which of the following could be the efficiency of a machine?
   a. 200%
   b. 150%
   c. 100%
   d. 75%
6. What is the mechanical advantage of a machine that increases the distance over which force is applied?
   a. less than 1
   b. equal to 1
   c. greater than 1
   d. greater than 2
7. If the output force of a machine is greater than input force, the mechanical advantage of the machine is
   a. greater than 1.
   b. equal to 1.
   c. less than 1.
   d. any of the above

Lesson 16.2: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. number of times a machine multiplies the input force

_____ 2. distance over which force is applied to a machine

_____ 3. percent of input work that becomes output work

_____ 4. force applied to a machine

_____ 5. any device that makes work easier by changing a force

_____ 6. distance over which a machine applies force

_____ 7. force applied by a machine

Terms

a. efficiency

b. input force

c. output force

d. mechanical advantage

e. input distance

f. output distance

g. machine

Lesson 16.2: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. If the output force is greater than the input force, then the output distance must be __________ than the input distance.
2. All machines must use some of the work put into them to overcome the force of __________.
3. The __________ of a machine is a measure of how well the machine reduces friction.
4. How much a machine multiplies force when it is used in the real world is its __________ mechanical advantage.
5. How much a machine would multiply force if there were no friction is its __________ mechanical advantage.
6. The mechanical advantage of a machine that increases force is always __________ than one.
7. The mechanical advantage of a machine that increases the distance over which force is applied is always __________ than one.

Lesson 16.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What is mechanical advantage? How can a machine with a mechanical advantage of less than one help you do work? Use examples in your answer.

16.3 Simple Machines

Lesson 16.3: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. There are seven different types of simple machines.

_____ 2. The input distance of an inclined plane is always greater than the output distance.

_____ 3. The input force is always applied to the thinner side of a wedge.

_____ 4. The closer together the threads of a screw are, the harder it is to turn the screw.

_____ 5. When you use a hammer to pry a nail out of board, the hammer is a first class lever.

_____ 6. A lever always increases the force applied to the lever.

_____ 7. The wheel of a Ferris wheel turns more quickly than the axle.

_____ 8. A single fixed pulley has an ideal mechanical advantage of 1.

_____ 9. A compound pulley always contains at least two fixed pulleys.

_____ 10. A zip-line pulley is an example of a single moveable pulley.

Lesson 16.3: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Inclined Plane

An inclined plane is a simple machine consisting of a sloping surface that connects lower and higher elevations. An inclined plane makes it easier to move objects uphill against the force of gravity. The sloping surface of the inclined plane supports part of the weight of the object as it moves up the slope. As a result, it takes less force to move the object to a higher elevation. The trade-off is that the object must be moved over a greater distance than if it were moved straight up to the higher elevation. On the other hand, the output force is greater than the input force because it is applied over a shorter distance.

As for other simple machines, the ideal mechanical advantage of an inclined plane is given by:

$$\text{Ideal Mechanical Advantage} = \frac{\text{Input distance}}{\text{Output distance}}$$

The input distance is the length of the sloping surface of the inclined plane, and the output distance is the maximum height of the inclined plane. Because the sloping surface is always greater than the height of the inclined plane, the ideal mechanical advantage of an inclined plane is always greater than 1. An inclined plane with a longer sloping surface relative to its height has a greater mechanical advantage and requires less input force to move an object to a higher elevation.

Questions

1. Describe an inclined plane.
2. How is an inclined plane used?
3. Why is the ideal mechanical advantage of an inclined plane always greater than 1?

Lesson 16.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Which type of simple machine is a chisel?
   a. lever
   b. screw
   c. wedge
   d. none of the above
2. Which of the following is an example of a screw?
   a. spiral staircase
   b. Ferris wheel
   c. seesaw
   d. axe
3. The ideal mechanical advantage of a screw is always
   a. less than 1.
   b. equal to 1.
   c. greater than 1.
   d. greater than 2.
4. Which class of lever does not change the direction of the applied force?
   a. class 1
   b. class 2
   c. class 3
   d. two of the above
5. Which of the following is an example of a third class lever?
   a. seesaw
   b. wheelbarrow
   c. hockey stick
   d. pry bar
6. A wheel and axle increase the applied force when
   a. the input distance is equal to the output distance.
   b. the input distance is less than the output distance.
   c. the input force is applied to the wheel.
   d. the output force is applied by the wheel.
7. How many rope segments pull up on the object in a single moveable pulley?
   a. 1
   b. 2
   c. 3
   d. 4

Lesson 16.3: Matching

Name____________________ Class_______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. simple machine that consists of a rope and grooved wheel

_____ 2. type of lever in which the fulcrum is between the input and output forces

_____ 3. simple machine consisting of two connected rings or cylinders that both turn around a single center point

_____ 4. simple machine that consists of an inclined plane wrapped around a cylinder or cone

_____ 5. fixed point of a lever around which the bar rotates

_____ 6. simple machine consisting of a sloping surface that connects lower and higher elevations

_____ 7. type of lever in which input and output forces are on the same side of the fulcrum

Terms

a. inclined plane

b. class 2 lever

c. pulley

d. screw

e. class 1 lever

f. wheel and axle

g. fulcrum

Lesson 16.3: Fill in the Blank

Name____________________ Class_______________ Date________

Fill in the blank with the appropriate term.

1. A simple machine that consists of two inclined planes is a(n) ___________.
2. A(n) ___________ is a simple machine consisting of a bar that rotates around a fixed point.
3. A ramp is an example of the simple machine called a(n) ___________.
4. Unlike an inclined plane, a wedge works only when it ___________.
5. The ideal mechanical advantage of a third class lever is always ___________ than 1.
6. A single fixed pulley changes the ___________ of the force applied to the pulley.
7. A single moveable pulley has an ideal mechanical advantage of ___________.

Lesson 16.3: Critical Writing

Name____________________ Class_______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare and contrast single fixed pulleys and single moveable pulleys.

16.4 Compound Machines

Lesson 16.4: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Some compound machines consist of thousands of simple machines.

_____ 2. The output force is exerted by the handle ends of the levers in scissors.

_____ 3. Scissors change the direction of the input force.

_____ 4. The fulcrum in a fishing rod is at the center of the rod.

_____ 5. Compound machines have more moving parts than simple machines.

_____ 6. The fewer simple machines a compound machine contains, the greater its mechanical advantage.

_____ 7. Compound machines have more friction to overcome than do simple machines.

Lesson 16.4: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Efficiency and Mechanical Advantage of Compound Machines

Because compound machines have more moving parts than simple machines, they generally have more friction to overcome. As a result, compound machines tend to have lower efficiency than simple machines. When a compound machine consists of a large number of simple machines, friction may become a serious problem, and it may produce a lot of heat. Lubricants such as oil or grease may be used to coat the moving parts so they slide over each other more easily. This is how a car's friction is reduced.

Compound machines have a greater mechanical advantage than simple machines. That's because the mechanical advantage of a compound machine equals the product of the mechanical advantages of all its component simple machines. The greater the number of simple machines it contains, the greater is its mechanical advantage.

Questions

1. Why do compound machines tend to have lower efficiency than simple machines?
2. Which will have a greater mechanical advantage: a compound machine that consists of 200 simple machines or a compound machine that consists of 2 simple machines? Explain your answer.

Lesson 16.4: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Simple machines in a bicycle include
   a. wheels and axles.
   b. pulleys.
   c. levers.
   d. all of the above
2. Which of the following is a compound machine?
   a. wheel and axle
   b. scissors
   c. pulley
   d. lever
3. Which of the following machines contains one or more levers?
   a. wheelbarrow
   b. scissors
   c. fishing rod
   d. all of the above
4. The fulcrum in a pair of scissors is always located
   a. between the input and output points.
   b. closer to the input point.
   c. closer to the output point.
   d. two of the above
5. The mechanical advantage of a compound machine equals the
   a. sum of the mechanical advantages of all its simple machines.
   b. product of the mechanical advantages of all its simple machines.
   c. highest mechanical advantage of all its simple machines.
   d. average mechanical advantage of all of its simple machines.
6. The way friction is reduced in a compound machine such as a car is with
   a. fans.
   b. heaters.
   c. lubricants.
   d. none of the above

Lesson 16.4: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. how greatly a machine increases the applied force

_____ 2. how well a machine deals with friction

_____ 3. example of a third class lever

_____ 4. any machine that consists of more than one simple machine

_____ 5. example of a wheel and axle that works as a pulley

_____ 6. machine consisting of a wheel and axle and a lever

_____ 7. machine consisting of two levers and two wedges

Terms

a. compound machine

b. mechanical advantage

c. fishing rod

d. wheelbarrow

e. fishing reel

f. efficiency

g. scissors

Lesson 16.4: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. A bicycle is an example of a(n) __________ machine.
2. The point around which a lever rotates is called the __________.
3. Scissors contain two-__________ class lever.
4. The blades of scissors are simple machines known as __________.
5. A wheelbarrow contains a __________ class lever.
6. Compound machines tend to have __________ efficiency than simple machines.
7. The mechanical advantage of compound machines is generally __________ than the mechanical advantage of simple machines.

Lesson 16.4: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Name a compound machine and identify at least two simple machines that it contains. Explain how each simple machine contributes to the job done by the compound machine.

CHAPTER 17 Introduction to Energy Worksheets

Chapter Outline

17.1 Types of Energy

Lesson 17.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Most forms of energy can also be classified as kinetic or potential energy.

_____ 2. If the mass of an object doubles, its kinetic energy is only half as great.

_____ 3. Kinetic energy and velocity have an inverse relationship.

_____ 4. Clothes hanging motionless on a clothesline do not have any energy.

_____ 5. Changing the shape of an elastic material gives it potential energy.

_____ 6. If you double the weight of an object, its gravitational potential energy also doubles.

_____ 7. The higher above the ground you are, the less gravitational potential energy you have.

_____ 8. The energy of a child on a swing changes back and forth between kinetic and potential energy.

_____ 9. Some of the kinetic energy of the child in question 8 is given off as heat.

_____ 10. Energy conversions are always permanent changes in energy.

Lesson 17.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Energy Conversion

When you stand on a diving board high above a swimming pool, you have gravitational potential energy. That's because you have the potential to fall toward Earth due to gravity. What happens when you jump off the diving board? Your gravitational potential energy changes to kinetic energy as you fall toward the water. However, you can regain your potential energy by getting out of the water and climbing back up to the diving board. This requires an input of kinetic energy. These changes in energy are examples of energy conversion, the process in which energy changes from one type or form to another. Energy conversion between potential and kinetic energy also occurs when you swing on a playground swing or jump on a trampoline.

The law of conservation of energy applies to energy conversions. Energy is not used up when it changes form. However, some energy may be used to overcome friction, and this energy is usually given off as heat. For example, your kinetic energy at the bottom of a dive is the same as your potential energy when you were on the diving board, except for a small amount of heat resulting from friction with the air as you fell.

Questions

1. What is energy conversion?

2. Describe how kinetic and potential energy change as a diver climbs up to a diving board and then dives into the water below.
3. How does the law of conservation of energy apply to these energy conversions?

Lesson 17.1: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. The ability to cause a change in matter is one definition of
   a. work.
   b. force.
   c. energy.
   d. motion.
2. Forms of energy include
   a. mechanical energy.
   b. electrical energy.
   c. chemical energy.
   d. all of the above
3. What is the kinetic energy of an object that has a mass of 10 kg and a velocity of 1 m/s?
   a. 100 J
   b. 10 J
   c. 5 J
   d. 1 J
4. What is the gravitational potential energy of an object that has a weight of 12 N and is 3 m above the ground?
   a. 108 J
   b. 36 J
   c. 15 J
   d. 4 J
5. Which statement is false about objects with kinetic energy?
   a. They are in motion.
   b. They are doing work.
   c. They are moving matter over a distance.
   d. They are using up their energy by moving.
6. The SI unit for energy is the
   a. joule.
   b. newton.
   c. newton • meter.
   d. two of the above
7. Which type(s) of energy does a person have when jumping on a trampoline?
   a. kinetic energy
   b. elastic potential energy
   c. gravitational potential energy
   d. all of the above

Lesson 17.1: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. energy stored in an object because of its position or shape

_____ 2. stored energy due to an object's shape

_____ 3. use of force to move matter

_____ 4. energy of moving matter

_____ 5. stored energy due to an object's position

_____ 6. ability to do work

_____ 7. process in which energy changes from one type or form to another

Terms

a. energy

b. kinetic energy

c. energy conversion

d. work

e. gravitational potential energy

f. elastic potential energy

g. potential energy

Lesson 17.1: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. When work is done, __________ is transferred from one object to another.
2. The two basic types of energy are kinetic energy and __________ energy.
3. Anything that is moving has __________ energy.
4. The amount of kinetic energy in an object depends on its mass and __________.
5. Gravitational potential energy depends on an object's height above the ground and its __________.
6. When energy changes form, the total amount of energy is always __________.
7. Stretching a rubber band gives it __________ potential energy.

Lesson 17.1: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why an object with kinetic energy always does work.

17.2 Forms of Energy

Lesson 17.2: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Kinetic and potential energy add up to mechanical energy.

_____ 2. There is stored chemical energy in food.

_____ 3. A lightning bolt is a powerful discharge of light energy.

_____ 4. Most of the electrical energy we use is produced in power plants.

_____ 5. The sun produces nuclear energy when hydrogen nuclei undergo fusion.

_____ 6. Some of the sun's energy travels through space to heat and light Earth.

_____ 7. The atoms that make up matter are in constant motion.

_____ 8. Radio waves are a type of sound waves.

_____ 9. Energy rarely changes from one form to another.

_____ 10. One form of energy cannot change into two or more different forms of energy.

Lesson 17.2: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

How Energy Changes Form

Energy often changes from one form to another. For example, the mechanical energy of a moving drumstick changes to sound energy when it strikes the drumhead and causes it to vibrate. Any form of energy can change into any other form. Frequently, one form of energy changes into two or more different forms. For example, when wood burns, the wood's chemical energy changes to both thermal energy and light energy. Whenever energy changes form, energy is conserved. No energy is lost, although some may be released as thermal energy due to friction.

Many machines change energy from one form to another. For example, a turbine changes mechanical energy to electrical energy. Some of the mechanical energy of the moving parts is used to overcome friction. The more efficient a device is, the less energy it uses to overcome friction and the greater the percentage of usable energy it produces. The U.S. government's Energy Star program certifies the energy efficiency of appliances. Appliances with an "Energy Star" label use energy efficiently and thereby reduce energy use.

Questions

1. Describe how a drumstick changes energy when it strikes the drumhead.
2. How does energy change when wood burns?

3. What is the Energy Star program? What does an "Energy Star" label represent?

Lesson 17.2: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Which form of energy does your body use to stay warm?
   a. light energy
   b. sound energy
   c. chemical energy
   d. none of the above
2. Which type of energy is stored in wood?
   a. thermal energy
   b. light energy
   c. chemical energy
   d. two of the above
3. Sources of electrical energy include
   a. the sun.
   b. lightning.
   c. batteries.
   d. two of the above
4. Nuclear power plants produce energy by
   a. burning fossil fuels.
   b. splitting atomic nuclei.
   c. causing chemical reactions.
   d. capturing kinetic energy of atoms.
5. The thermal energy of an object depends on
   a. how quickly its atoms are moving.
   b. how much light it gives off.
   c. how many atoms it has.
   d. two of the above
6. Electromagnetic waves include all of the following except
   a. light.
   b. sound.
   c. X rays.
   d. microwaves.
7. Sound waves can travel through all of the following except
   a. air.
   b. space.
   c. water.
   d. glass.

Lesson 17.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. energy released when atomic nuclei split apart

_____ 2. total kinetic energy of all the atoms in an object

_____ 3. energy stored in chemical bonds

_____ 4. energy of an object that is moving or has the potential to move

_____ 5. energy that travels in waves through matter from a vibrating object

_____ 6. kinetic energy of moving electrons

_____ 7. energy that travels in electrical and magnetic waves

Terms

a. chemical energy

b. electrical energy

c. nuclear energy

d. thermal energy

e. electromagnetic energy

f. mechanical energy

g. sound energy

Lesson 17.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. __________ energy is the sum of an object's kinetic and potential energy.

2. Chemical energy is a form of __________ energy.

3. A battery converts chemical energy to __________ energy.

4. In nuclear power plants, nuclei split apart, or __________.

5. __________ energy comes from moving atoms in matter.

6. The form of energy that travels from the sun through space is __________ energy.

7. The process in which energy changes form is called energy __________.

Lesson 17.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Think of a device you commonly use that changes energy from one form to two or more different forms. Describe the energy conversions that take place when you use the device.

17.3 Energy Resources

Lesson 17.3: True or False

Name____________________ Class_______________ Date___________

Determine if the following statements are true or false.

Write true if the statement is true or false if the statement is false.

_____ 1. It takes millions of years for fossil fuels to form.

_____ 2. Most of the electric power in the U.S. is generated from running water.

_____ 3. The burning of fossil fuels leads to the formation of acid rain.

_____ 4. It takes a large amount of uranium to produce a small amount of nuclear energy.

_____ 5. Renewable energy resources produce air pollution.

_____ 6. Fossil fuels provide most of the world's energy.

_____ 7. Coal and petroleum are often found together.

_____ 8. Smog comes from the burning of fossil fuels.

_____ 9. Using moving water to generate electricity never harms the environment.

_____ 10. Wind turbines change the kinetic energy of wind to electrical energy.

Lesson 17.3: Critical Reading

Name____________________ Class_______________ Date___________

Read this passage from the text and answer the questions that follow.

Renewable Energy Resources

Renewable energy resources are natural resources that can be replaced in a relatively short period of time or are virtually limitless in supply. Besides their availability, renewable energy resources also have the advantage of producing little if any pollution and not contributing to global warming. The technology needed to gather energy from renewable resources may be expensive to install, but most of the resources themselves are free for the taking.

Renewable energy resources include sunlight, moving water, wind, biomass, and geothermal energy.

- The energy in sunlight is called solar energy. It can be used to heat homes and to produce electricity in solar cells. It may not be practical in areas that are often cloudy.
- Water moving downhill through a dam can turn a turbine and generate electricity. Dams generally flood land upstream and reduce water flow downstream. Either effect may harm ecosystems.
- Wind is moving air, so it has kinetic energy that can do work. Wind turbines change the kinetic energy of the wind to electrical energy. Only certain areas of the world get enough steady wind to provide a reliable source of electricity.

- Biomass energy is the stored chemical energy in plants. When plant material is burned, it produces thermal energy that can be used for heating, cooking, or generating electricity. Growing plants for biomass fuels reduces the land available for growing food crops. Burning biofuels produces carbon dioxide and air pollution.
- Heat below Earth's surface—called geothermal energy—can be used to heat homes or generate electricity. Installing a geothermal system by drilling through underground rocks can be very costly.

Questions

1. What are renewable resources?
2. In general, what are the advantages of using renewable, rather than nonrenewable, energy resources?
3. Identify three renewable energy resources and give at least one potential drawback of each.

Lesson 17.3: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Nonrenewable energy resources include
   a. fossil fuels.
   b. running water.
   c. radioactive elements.
   d. two of the above
2. Natural gas is used for energy in
   a. motor vehicles.
   b. water heaters.
   c. furnaces.
   d. all of the above
3. All fossil fuels contain stored chemical energy that came originally from
   a. rocks below Earth's surface.
   b. marine organisms.
   c. giant tree ferns.
   d. the sun.
4. The fossil fuel that produces the most carbon dioxide when burned is
   a. oil.
   b. coal.
   c. biomass.
   d. natural gas.
5. A major drawback of nuclear energy is the production of
   a. air pollution.
   b. carbon dioxide.
   c. carbon monoxide.
   d. radioactive wastes.
6. Renewable energy resources include
   a. wind.
   b. biomass.

c. moving water.
d. all of the above

7. Solar cells convert solar energy to

a. heat.
b. steam.
c. thermal energy.
d. electrical energy.

Lesson 17.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. saving resources by using them more efficiently

_____ 2. resource that is limited in supply and cannot be replaced

_____ 3. energy from plant materials

_____ 4. mixture of hydrocarbons that formed from the remains of dead organisms

_____ 5. heat from below Earth's surface that can be used for energy

_____ 6. anything people use that comes from nature

_____ 7. resource that is virtually limitless in supply or can be replaced quickly

Terms

a. conservation

b. natural resource

c. fossil fuel

d. biomass energy

e. renewable resource

f. geothermal energy

g. nonrenewable resource

Lesson 17.3: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. Coal and natural gas are examples of energy resources called __________.
2. Uranium is used to produce energy in power plants by the process of nuclear __________.
3. Sunlight is an example of a(n) __________ energy resource.
4. The fossil fuel called __________ is used more than any other fossil fuel.
5. The country that uses the most petroleum is __________.

6. Gasoline and kerosene are made from the fossil fuel __________.
7. The fossil fuel that releases the least pollution is __________.

Lesson 17.3: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

If you had to choose between using fossil fuels or nuclear energy to generate electricity, which would you choose? Make a choice and then argue to support it.

CHAPTER 18 Thermal Energy Worksheets

Chapter Outline

18.1 Temperature and Heat

Lesson 18.1: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Only warm or hot objects have thermal energy.

_____ 2. If particles of an object start to move more quickly, the object's temperature rises.

_____ 3. Temperature is the same thing as thermal energy.

_____ 4. An object with a higher temperature always has greater thermal energy than an object with a lower temperature.

_____ 5. On the Celsius scale, the boiling point of water is 32 °C.

_____ 6. Most types of matter expand to some degree when they get warmer.

_____ 7. Temperature is a physical property of matter.

_____ 8. Thermal energy always moves from an object with a higher temperature to an object with a lower temperature.

_____ 9. Specific heat is a property that is specific to a given type of matter.

_____ 10. Most metals have a very high specific heat.

Lesson 18.1: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Heat

Heat is the transfer of thermal energy between objects that have different temperatures. Thermal energy always moves from an object with a higher temperature to an object with a lower temperature. When thermal energy is transferred in this way, the warm object becomes cooler and the cool object becomes warmer. Sooner or later, both objects will have the same temperature. Only then does the transfer of thermal energy end.

Assume that a cool spoon is placed in a cup of steaming hot coffee. Once in the coffee, the spoon quickly heats up. The fast-moving particles of the coffee transfer some of their energy to the slower-moving particles of the spoon. The spoon particles start moving faster and become warmer, causing the temperature of the spoon to rise. Because the coffee particles lose some of their kinetic energy to the spoon particles, the coffee particles start to move more slowly. This causes the temperature of the coffee to fall. Before long, the coffee and spoon have the same temperature.

Questions

1. How is heat defined in physical science?

2. Describe how thermal energy is transferred.
3. When does the transfer of thermal energy end?

Lesson 18.1: Multiple Choice

Name____________________ Class_______________ Date___________

Circle the letter of the correct choice.

1. If two objects have the same mass, the object with the higher temperature always
   a. has greater thermal energy.
   b. has higher specific heat.
   c. feels warmer.
   d. two of the above
2. Which of the following statements about temperature is true?
   a. Temperature measures heat.
   b. Temperature measures kinetic energy.
   c. Temperature is the same thing as heat.
   d. Temperature is the same thing as thermal energy.
3. If a bucket full of water and a cup full of water have the same temperature, then the water in the
   a. bucket and cup have the same thermal energy.
   b. bucket has greater thermal energy.
   c. cup has lower average kinetic energy.
   d. cup has lower specific heat.
4. The thermal energy of an object depends on its
   a. mass.
   b. temperature.
   c. specific heat.
   d. two of the above
5. If you put a cool spoon into a cup of hot coffee, the temperature of the spoon rises because
   a. thermal energy is transferred from the coffee to the spoon.
   b. specific heat is transferred from the coffee to the spoon.
   c. particles of the spoon gain kinetic energy.
   d. two of the above
6. Which of the following materials has the greatest specific heat?
   a. iron
   b. sand
   c. wood
   d. water
7. A material with greater specific heat
   a. warms up more quickly.
   b. requires less energy to get hot.
   c. always has a higher temperature.
   d. none of the above

Lesson 18.1: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. device for measuring temperature

_____ 2. total kinetic energy of particles of matter

_____ 3. amount of energy needed to raise the temperature of 1 gram of a substance by 1 °C

_____ 4. average kinetic energy of particles of matter

_____ 5. scale for measuring temperature

_____ 6. transfer of thermal energy between objects with different temperatures

_____ 7. measure that affects the thermal energy of matter but not its temperature

Terms

a. thermal energy

b. heat

c. temperature

d. thermometer

e. mass

f. Celsius

g. specific heat

Lesson 18.1: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. The freezing point of water on the Celsius scale is __________.
2. All substances have thermal energy because their particles are always __________.
3. The specific heat of a substance is measured in the SI unit called the __________.
4. A(n) __________ shows how hot or cold something is relative to two reference temperatures.
5. Substances in the __________ state of matter usually expand the most when heated.
6. Water takes up __________ space as a liquid than it does as a solid.
7. Thermal energy is transferred between objects only when they have different __________.

Lesson 18.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how kinetic energy, thermal energy, temperature, and heat are related.

18.2 Transfer of Thermal Energy

Lesson 18.2: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Conduction occurs only between particles that collide.

_____ 2. Wood is an example of a good thermal conductor.

_____ 3. Home insulation prevents the transfer of cold into the house.

_____ 4. Warmer air rises because it is less dense than cooler air.

_____ 5. All objects radiate thermal energy.

_____ 6. Convection currents carry thermal energy from the sun to Earth.

_____ 7. Fluid particles with more energy have greater density.

_____ 8. Metals are excellent thermal conductors because they have freely moving electrons.

_____ 9. A land breeze is an example of a convection current.

_____ 10. Thermal energy is transferred from a space heater to a person in front of it by conduction.

Lesson 18.2: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Convection

Convection is the transfer of thermal energy by particles moving through a fluid. Particles transfer energy by moving from warmer to cooler areas. That's how energy is transferred through soup in a pot on a hot stove. Particles of soup near the bottom of the pot get hot first. They have more energy so they spread out and become less dense. With lower density, these particles rise to the top of the pot. By the time they reach the top of the pot, they have transferred their thermal energy and cooled. They have less energy to move apart, so they become denser. With greater density, the particles sink to the bottom of the pot, and the cycle repeats. This loop of moving particles is called a convection current. Convection currents move thermal energy through many fluids, including molten rock inside Earth, water in the oceans, and air in the atmosphere.

Questions

1. What is convection?
2. Describe how convection currents transfer thermal energy throughout a pot of soup on a stovetop.
3. Give other examples of fluids in which thermal energy is transferred by convection currents.

Lesson 18.2: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. A pot resting on a hot stovetop heats up because of
   a. convection.
   b. conduction.
   c. radiation.
   d. all of the above
2. Your hand feels cold when you hold an ice cube because
   a. the ice radiates cold to your hand.
   b. the ice conducts cold to your hand.
   c. your hand cools down by convection.
   d. your hand transfers thermal energy to the ice.
3. In which of the following materials does conduction occur most quickly?
   a. iron
   b. wood
   c. plastic
   d. oxygen
4. Examples of thermal insulators include
   a. down feathers.
   b. Styrofoam.
   c. air.
   d. all of the above
5. The transfer of thermal energy by convection occurs only in
   a. gases.
   b. solids.
   c. fluids.
   d. liquids.
6. Thermal energy is transferred throughout the ocean by
   a. radiation.
   b. conduction.
   c. thermal conductors.
   d. convection currents.
7. A sea breeze blows
   a. toward the land.
   b. toward the sea.
   c. only at night.
   d. during both day and night.

Lesson 18.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. material that allows little if any conduction of thermal energy

_____ 2. transfer of thermal energy by waves that can travel through space

_____ 3. flow of particles in a fluid due to differences in temperature and density

_____ 4. material that is good at transferring thermal energy by conduction

_____ 5. amount of mass in a given volume of matter

_____ 6. transfer of thermal energy between particles of matter that are touching

_____ 7. transfer of thermal energy by particles moving through a fluid

Terms

a. conduction

b. thermal conductor

c. convection

d. thermal insulator

e. radiation

f. convection current

g. density

Lesson 18.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. When you hold a hot object, thermal energy is transferred from the object to your hands by __________.
2. Cooking pots are made of metals because metals are excellent thermal __________.
3. Cooking pot handles are often made of plastic because plastic is a good thermal __________.
4. Particles of a fluid that have the greatest kinetic energy have the __________ density.
5. Convection currents in Earth's atmosphere create __________.
6. Thermal energy is transferred from a campfire to nearby people by __________.
7. __________ is the only way of transferring thermal energy that doesn't require matter.

Lesson 18.2: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Why does conduction work better in solids whereas convection works only in gases and liquids?

18.3 Using Thermal Energy

Lesson 18.3: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. The function of a thermostat is to transfer thermal energy.

_____ 2. The water in a hot-water heating system is heated by a furnace.

_____ 3. In a warm-air heating system, pipes carry thermal energy throughout the house.

_____ 4. Thermal energy from inside a refrigerator changes the refrigerant to a gas.

_____ 5. A combustion engine burns fuel to produce thermal energy.

_____ 6. In any combustion engine, the engine does the work of moving a piston.

_____ 7. In a warm-air heating system, warm-air vents are always placed near the ceiling.

_____ 8. An air conditioner is an example of a cooling system.

_____ 9. Refrigerant changes to a liquid in the condenser of a refrigerator.

_____ 10. Steam ships have internal combustion engines.

Lesson 18.3: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Cooling Systems

Cooling systems, such as air conditioners and refrigerators, transfer thermal energy in order to keep homes and cars cool or to keep food cold. In a refrigerator, for example, thermal energy is transferred from the cool air inside the refrigerator to the warmer air in the kitchen. Thermal energy naturally moves from a warmer area to a cooler area, so how can it move from the cooler refrigerator to the warmer room? The answer is work. The refrigerator does work to transfer thermal energy in this way. Doing this work takes energy, which is usually provided by electricity.

The key to how a refrigerator (or other cooling system) works is the refrigerant. A refrigerant is a substance, such as Freon^{TM}, that has a low boiling point and changes back and forth between liquid and gaseous states as it cycles through the refrigerator. As a liquid, the refrigerant absorbs thermal energy from the cool air inside the refrigerator. The thermal energy causes the refrigerant to change to a gas. As a gas, the refrigerant releases thermal energy to the warm air outside the refrigerator. This causes the refrigerant to change back to a liquid, and the cycle repeats.

Questions

1. What is a cooling system?
2. What work must a cooling system do?

3. What is the role of the refrigerant in a cooling system?

Lesson 18.3: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Types of home heating systems include
   a. warm-air heating systems.
   b. hot-water heating systems.
   c. solar heating systems.
   d. all of the above
2. How is thermal energy transferred in a refrigerator?
   a. from the warm kitchen to the cool refrigerator
   b. from the cool refrigerator to the warm kitchen
   c. from the cool refrigerator to the cold outdoors
   d. two of the above
3. Why must a cooling system do work to keep things cool?
   a. It transfers thermal energy from a cooler to a warmer place.
   b. It takes energy to reverse the normal direction of heat flow.
   c. It takes energy to maintain the normal direction of heat flow.
   d. two of the above
4. What happens to the refrigerant as it passes through a cooling system?
   a. It freezes and lowers the temperature of the system.
   b. It changes between liquid and gaseous states.
   c. It releases thermal energy into the refrigerator.
   d. It keeps evaporating and has to be replaced.
5. In an external combustion engine, thermal energy is used directly to
   a. move the piston back and forth.
   b. move the piston up and down.
   c. turn water into steam.
   d. all of the above
6. What happens first in an internal combustion engine?
   a. Exhaust gases exit the cylinder.
   b. The piston moves up or down.
   c. A fuel-air mixture enters the cylinder.
   d. The piston rod turns the crankshaft.
7. Thermal energy from a radiator travels throughout the air in a room by
   a. conduction.
   b. convection.
   c. radiation.
   d. all of the above

Lesson 18.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. substance that absorbs and releases thermal energy in a cooling system

_____ 2. device in a heating system that controls the furnace or boiler

_____ 3. complex machine that produces thermal energy outside the machine and uses the thermal energy to do work

_____ 4. heating system that includes a boiler, pipes, and radiators

_____ 5. complex machine that produces thermal energy inside the machine and uses the thermal energy to do work

_____ 6. refrigerator or air conditioner

_____ 7. heating system that includes a furnace, ducts, and vents

Terms

a. internal combustion engine

b. cooling system

c. refrigerant

d. warm-air heating system

e. external combustion engine

f. hot-water heating system

g. thermostat

Lesson 18.3: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. As hot water flows through the pipes and radiators of a hot-water heating system, the water becomes ___________.
2. Vents are placed near the floor in a warm-air heating system because warm air is low in density and ___________.
3. A cooling system transfers thermal energy from a cooler area to a warmer area by doing ___________.
4. The key to how a cooling system works is a substance with a low boiling point called a(n) ___________.
5. Any complex machine that burns fuel to produce thermal energy and then uses the energy to do work is a(n) ___________.
6. The type of engine that is found in most motor vehicles is a(n) __________ combustion engine.
7. A steam engine is a type of engine called a(n) __________ combustion engine.

Lesson 18.3: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how an external combustion engine produces thermal energy and uses it to do work.

CHAPTER 19 Waves Worksheets

Chapter Outline

19.1 Characteristics of Waves

Lesson 19.1: True or False

Name____________________ Class_______________ Date___________

Determine if the following statements are true or false.

_____ 1. A mechanical wave starts with a disturbance in matter.

_____ 2. Particles of matter actually travel along with a mechanical wave.

_____ 3. Transverse waves travel only through solid matter.

_____ 4. Earthquakes cause longitudinal waves.

_____ 5. In a surface wave, particles of the medium move only up and down.

_____ 6. Ocean waves crash on shore when the bottoms of the waves slow down due to friction.

_____ 7. All waves transfer energy from one place to another.

_____ 8. All mechanical waves are either transverse or longitudinal waves.

_____ 9. Some waves do not require a medium.

_____ 10. A source of energy is needed to start a mechanical wave.

Lesson 19.1: Critical Reading

Name____________________ Class_______________ Date___________

Read this passage from the text and answer the questions that follow.

Mechanical Waves

A mechanical wave is a disturbance in matter that transfers energy from place to place. A mechanical wave starts when matter is disturbed. Consider what happens when a drop of water falls into a pond. This disturbs the water in the pond. Then the disturbance travels outward from the drop in all directions. This is the wave. A source of energy is needed to start a mechanical wave. In this case, the energy comes from the falling drop of water.

The energy of a mechanical wave can travel only through matter. This matter is called the medium (*plural*, media). The medium in the example just described is a liquid—the water in the pond. But the medium of a mechanical wave can be any state of matter, including a solid or a gas. It's important to note that particles of matter in the medium don't actually travel along with the wave. Only the energy travels. The particles of the medium just vibrate, or move back-and-forth or up-and-down in one spot, always returning to their original positions. As the particles vibrate, they pass the energy of the disturbance to the particles next to them, which pass the energy to the particles next to them, and so on.

Questions

1. Define mechanical wave.

2. How does a mechanical wave begin?
3. What is the medium of a mechanical wave?
4. Describe how particles of the medium move when a mechanical wave passes through them.

Lesson 19.1: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Types of mechanical waves include
   a. longitudinal waves.
   b. transverse waves.
   c. surface waves.
   d. all of the above
2. The medium of a mechanical wave can be a
   a. gas.
   b. solid.
   c. liquid.
   d. any of the above
3. The crests of a transverse wave are like the
   a. crests of a primary wave.
   b. troughs of a longitudinal wave.
   c. rarefactions of a secondary wave.
   d. compressions of a longitudinal wave.
4. Examples of mechanical waves include all of the following except
   a. ocean waves.
   b. sound waves.
   c. waves in a rope.
   d. electromagnetic waves.
5. Waves that an earthquake sends through rocks underground include
   a. tsunami waves.
   b. transverse waves.
   c. longitudinal waves.
   d. two of the above
6. Which of the following statements about ocean waves is true?
   a. They travel on the surface of the water.
   b. They travel deep underwater.
   c. They are secondary waves.
   d. They are primary waves.
7. You generate a longitudinal wave when you
   a. shake a spring up and down.
   b. shake a rope up and down.
   c. push and pull a spring.
   d. two of the above

Lesson 19.1: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. disturbance in matter that transfers energy from place to place

_____ 2. part of a longitudinal wave where particles of the medium are spread farthest apart

_____ 3. wave in which particles of the medium vibrate at right angles to the direction that the wave travels

_____ 4. combined transverse and longitudinal wave

_____ 5. part of a transverse wave where particles of the medium are lowest

_____ 6. wave in which particles of the medium vibrate in the same direction that the wave travels

_____ 7. matter through which a mechanical wave travels

Terms

a. longitudinal wave

b. trough

c. mechanical wave

d. medium

e. surface wave

f. rarefaction

g. transverse wave

Lesson 19.1: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. A wave in a rope is an example of a(n) __________ wave.
2. The highest parts of a transverse wave are called __________.
3. A(n) __________ wave is a transverse wave that occurs with earthquakes.
4. The parts of a longitudinal wave where particles of the medium are closest together are called __________.
5. A(n) __________ wave is a longitudinal wave that occurs with earthquakes.
6. Ocean waves are __________ waves.
7. In a(n) __________ wave, particles of the medium move in a circular motion.

Lesson 19.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how the medium transfers the energy of a mechanical wave.

19.2 Measuring Waves

Lesson 19.2: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. The less compressed particles of matter become in a longitudinal wave, the greater the wave's amplitude.

_____ 2. The distance between two adjacent compressions of a longitudinal wave is its wavelength.

_____ 3. The frequency of a wave is the same as the frequency of the vibrations that caused the wave.

_____ 4. Wave speed measures the same thing as wave frequency.

_____ 5. Wavelength equals wave speed multiplied by wave frequency.

_____ 6. The resting position of particles in a longitudinal wave is where the particles are most spread out.

_____ 7. A wave caused by a disturbance with greater energy has greater amplitude.

_____ 8. If you know the speed and wavelength of a wave, you can calculate its frequency.

_____ 9. Waves generally travel most slowly in gases.

_____ 10. A wave with a higher frequency always has a greater speed than a wave with a lower frequency.

Lesson 19.2: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Wave Frequency

Imagine making transverse waves in a rope. You tie one end of the rope to a doorknob and move the other end of the rope up and down with your hand. You can move the rope up and down slowly or quickly. How quickly you move the rope determines the frequency of the waves.

Wave frequency is the number of waves that pass a fixed point in a given amount of time, such as one second. Wave frequency can be measured by counting the number of crests or compressions that pass the point in the given time. The higher the number is, the greater is the frequency of the wave. The SI unit for wave frequency is the hertz (Hz), where 1 hertz equals 1 wave passing a fixed point in 1 second.

The frequency of a wave is the same as the frequency of the vibrations that caused the wave. For example, to generate a higher-frequency wave in a rope, you must move the rope up and down more quickly. This takes more energy, so a higher-frequency wave has more energy than a lower-frequency wave with the same amplitude.

Questions

1. What is wave frequency? What is the SI unit for wave frequency?
2. What determines the frequency of a wave?

3. Why does a higher-frequency wave have more energy?

Lesson 19.2: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Measures of wave size include
   a. wavelength.
   b. wave amplitude.
   c. wave frequency.
   d. two of the above
2. The amplitude of a transverse wave is the distance between
   a. two adjacent crests.
   b. two adjacent troughs.
   c. a crest and a trough.
   d. a crest and the resting position.
3. What is the speed of a wave that has a wavelength of 0.5 meters and a frequency of 2 waves per second?
   a. $\frac{1}{4}$ m/s
   b. 1 m/s
   c. 4 m/s
   d. 10 m/s
4. Wave amplitude depends on
   a. wavelength.
   b. wave speed.
   c. wave energy.
   d. wave frequency.
   e. wave energy of the original disturbance.
5. When one wave passes a fixed point every second, the frequency of the waves is
   a. 0.1 Hz.
   b. 1 Hz.
   c. 10 Hz.
   d. none of the above
6. Assume that a wave has a fixed speed. If the frequency of the wave increases, its wavelength
   a. increases.
   b. decreases.
   c. does not change.
   d. may or may not change.
7. The speed of waves depends on their
   a. wavelength.
   b. frequency.
   c. medium.
   d. all of the above

Lesson 19.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. maximum distance the particles of a medium move from their resting position

_____ 2. number of waves that pass a fixed point in a given amount of time

_____ 3. how far a wave travels in a given amount of time

_____ 4. highest point reached by particles of the medium in a transverse wave

_____ 5. distance between two corresponding points on adjacent waves

_____ 6. location of particles of the medium in the absence of a wave

_____ 7. SI unit for wave frequency

Terms

a. hertz

b. wavelength

c. wave amplitude

d. resting position

e. wave frequency

f. crest

g. wave speed

Lesson 19.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. In a longitudinal wave, wave __________ is a measure of how compressed particles of the medium become.
2. Wave amplitude is determined by the __________ of the disturbance that causes the wave.
3. Short-wavelength waves have __________ energy than long-wavelength waves.
4. High-frequency waves have __________ energy than low-frequency waves.
5. Wave __________ is equal to wavelength multiplied by wave frequency.
6. Wavelength and wave frequency have a(n) __________ relationship.
7. Waves usually travel most rapidly through matter in the __________ state.

Lesson 19.2: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how to measure the amplitude, wavelength, and frequency of a longitudinal wave.

19.3 Wave Interactions and Interference

Lesson 19.3: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Reflection occurs only with sound waves.

_____ 2. All reflected waves appear to be standing still.

_____ 3. The angle of incidence is always greater than the angle of reflection.

_____ 4. Diffraction is more pronounced with sound waves than light waves.

_____ 5. Wave interference occurs whenever waves enter a new medium.

_____ 6. Wave interference occurs only when a wave is reflected.

_____ 7. Light waves refract when they pass from air to water.

_____ 8. Interference occurs only when the crests of one wave overlap with the troughs of another wave.

_____ 9. A standing wave occurs when a wave is reflected straight back from an obstacle.

_____ 10. Wave interference always changes the speed of a wave.

Lesson 19.3: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Diffraction

Did you ever notice that when you're walking down a street, you can hear sounds around the corners of buildings? The reason you can hear sounds around corners is that sound waves spread out and travel around obstacles. This is called diffraction. It also occurs when waves pass through an opening in an obstacle. All waves may be diffracted, but it is more pronounced with some types of waves than others. For example, sound waves spread out around corners much more than light does. That's why you can hear but not see around corners.

For a given type of waves, such as sound waves, how much the waves diffract depends on two factors: the size of the obstacle or opening in the obstacle and the wavelength of the waves.

- Diffraction is minor if the length of the obstacle or opening is greater than the wavelength.
- Diffraction is major if the length of the obstacle or opening is less than the wavelength.

Questions

1. What is diffraction?
2. When does diffraction occur?

3. What factors determine how greatly a wave is diffracted?

Lesson 19.3: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Ways that waves may interact with matter include
   a. diffraction.
   b. destructive interference.
   c. constructive interference.
   d. all of the above
2. Reflected waves differ from the original waves before they were reflected in their
   a. speed.
   b. direction.
   c. frequency.
   d. wavelength.
3. Refraction occurs because waves
   a. cannot travel through an obstacle such as a wall.
   b. travel at different speeds in different media.
   c. interfere with their reflected waves.
   d. none of the above
4. If the length of an obstacle is greater than the wavelength of a wave, you would expect to see
   a. no diffraction.
   b. very little diffraction.
   c. a lot of diffraction.
   d. wave interference.
5. A standing wave is a wave that
   a. is not moving.
   b. has an upright direction.
   c. is taller than other waves.
   d. appears to be standing still.
6. A standing wave occurs because of a combination of
   a. incidence and reflection.
   b. refraction and diffraction.
   c. refraction and interference.
   d. constructive and destructive interference.
7. Which statement about destructive interference is true?
   a. It occurs when waves pass through each other.
   b. It results in a wave with a higher frequency.
   c. It occurs when waves interact with matter.
   d. It always produces a standing wave.

Lesson 19.3: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. change in direction of waves as they enter a new medium at an angle

_____ 2. bouncing back of waves from a barrier

_____ 3. any interaction of waves with other waves

_____ 4. situation in which crests of one wave overlap crests of another wave

_____ 5. any interaction of waves with matter

_____ 6. spreading out of waves as they pass around a barrier

_____ 7. situation in which crests of one wave overlap troughs of another wave

Terms

a. diffraction

b. wave interaction

c. reflection

d. constructive interference

e. refraction

f. destructive interference

g. wave interference

Lesson 19.3: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. An echo is an example of wave __________.
2. We can see objects because they __________ waves of light.
3. You can hear sounds around the corner of a building because of wave __________.
4. How much a wave is diffracted depends on the length of the obstacle and the __________ of the wave.
5. __________ interference increases wave amplitude.
6. A straight straw in a glass of water appears to be bent because of wave __________.
7. The angle with which waves strike a barrier is called the angle of __________.

Lesson 19.3: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare and contrast the reflection, refraction, and diffraction of waves. Include an example of each.

CHAPTER 20 Sound Worksheets

Chapter Outline

20.1 Characteristics of Sound

Lesson 20.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. All sounds begin with vibrations in matter.

_____ 2. Sound waves generally travel most quickly through gases.

_____ 3. Sounds can travel through air and water but not through solids.

_____ 4. Sound waves travel more quickly in warm air than cold air.

_____ 5. The amount of water vapor in the air affects the speed of sound through air.

_____ 6. Sounds that are too high in frequency for humans to hear are called infrasound.

_____ 7. As distance from a sound source increases, the area covered by the sound waves decreases.

_____ 8. As the decibel level of sounds gets higher, the pitch of the sounds always gets higher.

_____ 9. The intensity of sound waves is the same regardless of distance from the sound source.

_____ 10. Some animals can hear sounds with frequencies as high as 100,000 Hz.

Lesson 20.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Sound Waves

All sounds begin with vibrating matter. For example, a guitar string vibrates when it is plucked. The vibrating string repeatedly pushes against the air particles next to it. The pressure of the vibrating string causes these air particles to vibrate. The air particles alternately push together and spread apart. This starts waves of vibrations that travel through the air in all directions away from the strings. The vibrations pass through the air as longitudinal waves, with individual air particles vibrating back and forth in the same direction that the sound waves travel.

Sound waves are mechanical waves, so they can travel only though matter and not through empty space. This was demonstrated in the 1600s by a scientist named Robert Boyle. Boyle placed a ticking clock in a sealed glass jar. The clock could be heard ticking through the air and glass of the jar. Then Boyle pumped the air out of the jar. The clock was still running, but the ticking could no longer be heard. That's because the sound couldn't travel away from the clock without particles of matter to pass the sound energy along.

Sound waves can travel through many different kinds of matter. Most of the sounds we hear travel through air, but sounds can also travel through liquids such as water and solids such as glass and metal. If you swim underwater—or even submerge your ears in bathwater—any sounds you hear have traveled to your ears through water. You can tell that sounds travel through glass and other solids because you can hear loud outdoor sounds such as sirens through closed windows and doors.

Questions

1. How do sound waves begin and how do they travel?
2. How did Robert Boyle demonstrate that sound waves cannot travel through empty space?
3. Most sounds we hear travel through air. From your own experience, what evidence do you have that sounds can also travel through liquids and solids?

Lesson 20.1: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Through which medium do sounds waves travel most slowly?
   a. air
   b. wood
   c. glass
   d. aluminum
2. Assume that sound A has a decibel level of 10 and sound B has a decibel level of 30. How many times louder is sound B than sound A?
   a. 3
   b. 10
   c. 20
   d. 100
3. What determines the intensity of sound?
   a. amplitude of sound waves
   b. frequency of sound waves
   c. distance from the sound source
   d. two of the above
4. Compared with a low-pitched sound, a high-pitched sound has sound waves with
   a. greater intensity.
   b. higher frequency.
   c. greater amplitude.
   d. longer wavelength.
5. Human beings can normally hear sounds with a frequency between about
   a. 10 and 10,000 Hz.
   b. 20 and 20,000 Hz.
   c. 20 and 140 Hz.
   d. 10 and 120 Hz.
6. The speed of sound in air at 20 °C is
   a. 343 m/s.
   b. 1437 m/s.
   c. 3850 m/s.
   d. 4540 m/s
7. The Doppler effect occurs when the sound source

a. is moving relative to the listener.
b. produces sound waves with a frequency above 10,000 Hz.
c. starts producing lower frequency sound waves.
d. starts producing greater amplitude sound waves.

Lesson 20.1: Matching

Name____________________ Class_______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. how loud or soft a sound seems to a listener

_____ 2. sounds with frequencies above 20,000 hertz

_____ 3. unit of sound intensity

_____ 4. how high or low a sound seems to a listener

_____ 5. transfer of energy from a vibrating object in waves that travel through matter

_____ 6. sounds with frequencies below 20 hertz

_____ 7. measure of the amount of energy in sound waves

Terms

a. loudness

b. infrasound

c. sound

d. decibel

e. intensity

f. ultrasound

g. pitch

Lesson 20.1: Fill in the Blank

Name____________________ Class_______________ Date________

Fill in the blank with the appropriate term.

1. Sound waves are the type of mechanical waves called ___________ waves.
2. ___________ of sound is the distance sound waves travel in a given amount of time.
3. Sound waves travel __________ quickly in water than in air.
4. The loudness of sound is determined by the ___________ of sound waves.
5. The pitch of sound is determined by the ___________ of sound waves.
6. The frequency of sound waves is measured in the SI unit called the ___________.
7. Changes in pitch of a police car siren as the car speeds past you are called the ___________.

Lesson 20.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why a sound becomes louder as you move closer to the source of the sound.

20.2 Hearing Sound

Lesson 20.2: True or False

Name____________________ Class_______________ Date___________

Determine if the following statements are true or false.

_____ 1. Bones in the ear canal transmit sound waves to the middle ear.

_____ 2. The stirrup passes amplified sound waves to the oval window.

_____ 3. We hear sound as soon as sound waves reach the middle ear.

_____ 4. Most adults experience at least some hearing loss as they get older.

_____ 5. The most common cause of hearing loss is exposure to loud sounds.

_____ 6. Long-term exposure to loud sounds is needed to damage hearing.

_____ 7. Many home and yard chores are loud enough to cause hearing loss.

_____ 8. Electronic hearing protectors reduce the amplitude of high-amplitude sound waves.

_____ 9. The brain interprets nerve impulses from the ears as sounds.

_____ 10. Materials used for earplugs include silicon and polyurethane foam.

Lesson 20.2: Critical Reading

Name____________________ Class_______________ Date___________

Read this passage from the text and answer the questions that follow.

Outer, Middle, and Inner Ear

The outer ear includes the pinna, ear canal, and eardrum. The pinna is the only part of the ear that extends outward from the head. Its position and shape make it good at catching sound waves and funneling them into the ear canal. The ear canal is a tube that carries sound waves into the ear. The sound waves travel through the air inside the ear canal to the eardrum. The eardrum is like the head of a drum. It's a thin membrane stretched tight across the end of the ear canal. The eardrum vibrates when sound waves strike it, and it sends the vibrations on to the middle ear.

The middle ear contains three tiny bones (ossicles) called the hammer, anvil, and stirrup. The bones resemble the objects for which they are named. The three bones transmit vibrations from the eardrum to the inner ear. The arrangement of the three bones allows them to work together as a lever that increases the amplitude of the waves as they pass to the inner ear.

The stirrup passes the amplified sound waves to the inner ear through the oval window. When the oval window vibrates, it causes the cochlea to vibrate as well. The cochlea is a shell-like structure that is full of fluid and lined with nerve cells called hair cells. Each hair cell has tiny hair-like projections. When the cochlea vibrates, it causes waves in the cochlear fluid. The waves bend the "hairs" on the hair cells, and this triggers electrical impulses. The electrical impulses travel to the brain through nerves. Only after the nerve impulses reach the brain do we hear the sound.

Questions

1. Identify the structures of the outer ear, and describe the role that each structure plays in hearing.
2. What happens to sound waves when they are transmitted through the middle ear?
3. Describe the cochlea. How are sound waves converted to electrical impulses in the cochlea?

Lesson 20.2: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. The arrangement of the ossicles in the middle ear allows them to work together as a(n)
   a. inclined plane.
   b. wedge.
   c. screw.
   d. lever.
2. When the oval window in the ear vibrates, it causes vibrations in the
   a. anvil.
   b. cochlea.
   c. hammer.
   d. eardrum.
3. Which of the following ear structures is damaged by excessive exposure to loud sounds?
   a. pinna
   b. ossicle
   c. hair cell
   d. ear canal
4. When the cochlea vibrates, it causes
   a. waves to pass through the cochlear fluid.
   b. sound waves to increase in frequency.
   c. the ossicles to start vibrating faster.
   d. two of the above
5. Hearing loss due to exposure to loud sounds is
   a. common.
   b. permanent.
   c. preventable.
   d. all of the above
6. Activities that may expose people to dangerously loud sounds include
   a. lawn mowing.
   b. snowmobile riding.
   c. construction work.
   d. all of the above
7. Which statement about electronic hearing protectors is true?
   a. They muffle all sounds.

b. They generate anti-noise sound waves.
c. They send electronic signals to the brain.
d. They use insulation to block sound waves.

Lesson 20.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. part of the ear that extends outward from the head

_____ 2. any of three tiny bones in the middle ear

_____ 3. fluid-filled structure in the inner ear that is lined with hair cells

_____ 4. tube that carries sound waves into the ear

_____ 5. membrane in the outer ear that vibrates when sound waves strike it

_____ 6. tiny structure in the inner ear that changes vibrations to nerve impulses

_____ 7. part of the ear that transmits and amplifies vibrations from the eardrum

Terms

a. middle ear

b. ear canal

c. cochlea

d. pinna

e. eardrum

f. hair cell

g. ossicle

Lesson 20.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. The organ we use to hear sound is the __________.
2. Total hearing loss is called __________.
3. __________ are simple hearing protectors that muffle sounds by blocking sound waves.
4. Electronic hearing protectors use __________ interference to reduce the amplitude of sound waves.
5. The ear canal extends from the pinna to the __________.
6. The stirrup passes amplified sound waves to the inner ear through the __________.
7. The function of the __________ is to catch sound waves and funnel them into the ear canal.

Lesson 20.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Argue for the use of hearing protectors when exposed to loud sounds.

20.3 Using Sound

Lesson 20.3: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. The earliest musical instruments date back to about 1900.

_____ 2. All musical instruments make sound in the same general way.

_____ 3. Instruments use resonance to make sounds higher in pitch.

_____ 4. A saxophone makes sound when the musician blows across a thin piece of wood.

_____ 5. Some animals use reflected sound waves to locate prey.

_____ 6. Sonar works on the same principle as echolocation.

_____ 7. The only use of ultrasonography is to create images of unborn babies.

Lesson 20.3: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Musical Instruments

People have been using sound to make music for thousands of years. They have invented many different kinds of musical instruments for this purpose. Despite their diversity, however, musical instruments share certain similarities.

- All musical instruments create sound by causing matter to vibrate. The vibrations start sound waves moving through the air.
- Most musical instruments use resonance to amplify the sound waves and make the sounds louder. Resonance occurs when an object vibrates in response to sound waves of a certain frequency. In a musical instrument such as a guitar, the whole instrument and the air inside it may vibrate when a single string is plucked. This causes constructive interference with the sound waves, which increases their amplitude.
- Most musical instruments have a way of changing the frequency of the sound waves they produce. This changes the pitch of the sounds.

Questions

1. How do all musical instruments create sound?
2. What is resonance? How does a musical instrument use resonance?
3. When an instrument changes the frequency of sound waves, how is the sound affected?

Lesson 20.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Basic categories of musical instruments include
    a. wind instruments.
    b. string instruments.
    c. percussion instruments.
    d. all of the above
2. You can change the pitch of a saxophone by
    a. playing the instrument without a reed on the mouthpiece.
    b. opening or closing holes on the sides of the instrument.
    c. blowing harder through the instrument's mouthpiece.
    d. none of the above
3. The sound of a drum is amplified when the
    a. air inside the drum vibrates.
    b. skin of the drum is loosened.
    c. sticks of the drum start to vibrate.
    d. size of the drum is reduced.
4. All of the following instruments are wind instruments except
    a. flutes.
    b. violins.
    c. trumpets.
    d. saxophones.
5. You play a xylophone by hitting wooden bars with rubber mallets. Which type of musical instrument is a xylophone?
    a. wind instrument
    b. string instrument
    c. percussion instrument
    d. none of the above
6. Uses of ultrasound include
    a. sonar.
    b. echolocation.
    c. ultrasonography.
    d. all of the above
7. Animals that use echolocation include
    a. bats.
    b. whales.
    c. dolphins.
    d. all of the above

Lesson 20.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. use of ultrasound to locate underwater objects

_____ 2. use of ultrasound to examine structures inside the body

_____ 3. sound with a frequency higher than 20,000 hertz

_____ 4. use of ultrasound by animals to locate objects they cannot see

_____ 5. vibration of an object in response to sound waves of a certain frequency

_____ 6. how high or low a sound seems to a listener

Terms

a. resonance

b. sonar

c. echolocation

d. ultrasound

e. pitch

f. ultrasonography

Lesson 20.3: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. Most musical instruments use resonance to __________ sound waves.
2. Tightening the skin of a drum raises the __________ of the sound it produces.
3. Bats send out ultrasound waves and use the __________ sound waves to locate prey.
4. Sonar stands for sound navigation and __________.
5. All musical instruments make sound by causing matter to __________.
6. Resonance causes __________ interference of sound waves.
7. Changing the __________ of sound waves changes the pitch of the sound.

Lesson 20.3: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how sonar data can be used to calculate the distance to an underwater object.

CHAPTER 21 Electromagnetic Radiation Worksheets

Chapter Outline

21.1 Electromagnetic Waves

Lesson 21.1: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. When a charged particle vibrates, it causes the electric field around it to vibrate.

_____ 2. The two fields of an electromagnetic wave occur at right angles to each other.

_____ 3. Both fields of an electromagnetic wave vibrate in the same direction that the wave travels.

_____ 4. Electromagnetic waves cannot travel through matter.

_____ 5. Electromagnetic waves may spread out and travel around obstacles.

_____ 6. When electrons return to lower energy levels, they give off particles of matter.

_____ 7. Electromagnetic waves are used for communications, cooking, and medicine.

_____ 8. The human eye can detect all frequencies of electromagnetic waves.

_____ 9. All of the sun's electromagnetic radiation travels to Earth.

_____ 10. Einstein explained how light can behave both as a wave and as a particle.

Lesson 21.1: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Wave or Particle?

Electromagnetic radiation behaves like waves of energy most of the time, but sometimes it behaves like particles. As evidence accumulated for this dual nature of electromagnetic radiation, the famous physicist Albert Einstein developed a new theory about electromagnetic radiation, called the wave-particle theory. This theory explains how electromagnetic radiation can behave as both a wave and as a particle. In brief, when an electron returns to a lower energy level, it is thought to give off a tiny "packet" of energy called a photon. The amount of energy in a photon may vary. It depends on the frequency of electromagnetic radiation. The higher the frequency is, the more energy a photon has.

Questions

1. Describe the dual nature of electromagnetic radiation.
2. What is the wave-particle theory of electromagnetic radiation?
3. Define photon. What determines how much energy a photon has?

Lesson 21.1: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Examples of electromagnetic waves include
    a. radio waves.
    b. light.
    c. X rays.
    d. all of the above
2. A vibrating electric field creates a
    a. mechanical wave.
    b. charged particle.
    c. magnetic field.
    d. photon.
3. As an electromagnetic wave travels through space, it
    a. becomes stronger.
    b. keeps changing direction.
    c. loses energy to the medium.
    d. spreads out over a larger area.
4. When electromagnetic waves strike matter, they may
    a. reflect.
    b. refract.
    c. diffract.
    d. all of the above
5. Which of the following statements about electromagnetic radiation is false?
    a. It provides virtually all the energy for life on Earth.
    b. It behaves like a wave most of the time.
    c. Sometimes it behaves like a particle.
    d. All of its wavelengths are harmful.
6. What do radio waves and sound waves have in common?
    a. Both waves are transverse waves.
    b. Both waves are mechanical waves.
    c. Both waves transfer energy.
    d. Both waves need a medium.
7. An electromagnetic wave consists of a vibrating
    a. magnetic field.
    b. electric field.
    c. particle of matter.
    d. two of the above

Lesson 21.1: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. transfer of energy by waves such as radio waves and light

_____ 2. explanation for how light can behave as both a wave and a particle

_____ 3. invisible area of force surrounding a charged particle

_____ 4. wave in which vibrations occur at right angles to the direction the wave travels

_____ 5. packet of electromagnetic energy

_____ 6. wave that consists of vibrating electric and magnetic fields

_____ 7. invisible area of force surrounding a magnet

Terms

a. photon

b. electromagnetic wave

c. magnetic field

d. transverse wave

e. electromagnetic radiation

f. wave-particle theory

g. electric field

Lesson 21.1: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. Waves in a rope and electromagnetic waves are both __________ waves.
2. Unlike mechanical waves, electromagnetic waves can travel across __________.
3. An electromagnetic wave begins when a(n) __________ particle vibrates.
4. When microwaves strike food in a microwave oven, the waves are converted to __________ energy.
5. The wave-particle theory of light was developed by __________.
6. The amount of energy in a photon depends on the __________ of electromagnetic radiation.
7. The most important source of electromagnetic radiation on Earth is the __________.

Lesson 21.1: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how an electromagnetic wave begins and how it travels.

21.2 Properties of Electromagnetic Waves

Lesson 21.2: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Some electromagnetic waves are extremely harmful.

_____ 2. All electromagnetic waves travel at the same speed across space.

_____ 3. It takes electromagnetic radiation 93 minutes to reach Earth from the sun.

_____ 4. All electromagnetic waves have the same wavelength.

_____ 5. The frequencies of electromagnetic waves range from 1 to 100 hertz.

_____ 6. The frequency of an electromagnetic wave is inversely related to its wavelength.

_____ 7. Electromagnetic waves travel at the same speed in all media.

Lesson 21.2: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Speed of Electromagnetic Waves

All electromagnetic waves travel at the same speed across space. That speed, called the speed of light, is 300 million meters per second (3.0×10^8 m/s). Nothing else in the universe is known to travel this fast. If you could move that fast, you would be able to travel around Earth 7.5 times in just 1 second! The sun is about 150 million kilometers (93 million miles) from Earth, but it takes electromagnetic radiation only 8 minutes to reach Earth from the sun. Electromagnetic waves travel more slowly through a medium, and their speed may vary from one medium to another. For example, light travels more slowly through water than it does through air. If light passes from air to water at an angle, the light refracts, or changes direction, making it appear to bend.

Questions

1. What is the speed of light?
2. Contrast the speed of electromagnetic waves through matter with their speed across space.

Lesson 21.2: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Properties of electromagnetic waves include
   a. speed.
   b. wavelength.
   c. frequency.
   d. all of the above
2. Light slows down when it
   a. travels across space.
   b. passes from air to water.
   c. passes from water to air.
   d. two of the above
3. Electromagnetic waves may vary in their
   a. speed across space.
   b. energy level.
   c. frequency.
   d. two of the above
4. Wavelengths of electromagnetic waves range from
   a. many kilometers to a tiny fraction of a millimeter.
   b. millions of kilometers to several meters.
   c. several meters to a few millimeters.
   d. one kilometer to one millimeter.
5. The highest-frequency electromagnetic waves have a frequency of
   a. hundreds of waves per second.
   b. thousands of waves per second.
   c. millions of waves per second.
   d. trillions of waves per second.
6. If the wavelength of an electromagnetic wave is 3.0 m, what is its frequency?
   a. 9.0×10^2 hertz
   b. 6.0×10^4 hertz
   c. 3.0×10^6 hertz
   d. 1.0×10^8 hertz
7. If the frequency of an electromagnetic wave is 3.0×10^8 hertz, what is its wavelength?
   a. 1 mm
   b. 1 cm
   c. 1 m
   d. 1 km

Lesson 21.2: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. distance between corresponding points of adjacent waves

_____ 2. fastest known speed in the universe

_____ 3. matter through which an electromagnetic wave may travel

_____ 4. number of waves that pass a fixed point in a given amount of time

_____ 5. example of electromagnetic radiation

_____ 6. value that equals wavelength multiplied by wave frequency

Terms

a. speed of light

b. wavelength

c. wave frequency

d. wave speed

e. light

f. medium

Lesson 21.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. The speed of light through space is __________ m/s.
2. Electromagnetic waves travel __________ slowly through water than through air.
3. If light passes from air to water at an angle, the light __________.
4. The frequency of an electromagnetic wave can be calculated by dividing its speed by its __________.
5. An electromagnetic wave with a higher frequency has __________ energy.
6. An electromagnetic wave with a shorter wavelength has a(n) __________ frequency.
7. Electromagnetic waves travel __________ quickly through a medium than across space.

Lesson 21.2: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What is the relationship between the frequency, energy, and potential danger of electromagnetic waves?

21.3 The Electromagnetic Spectrum

Lesson 21.3: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Radio waves have the least amount of energy of all electromagnetic waves.

_____ 2. Visible light has higher-frequency waves than ultraviolet light.

_____ 3. Cell phone transmissions are carried by microwaves.

_____ 4. Radar stands for radio detection and recovery.

_____ 5. Visible light consists of a very wide range of wavelengths.

_____ 6. You should protect your skin from ultraviolet light even on cloudy days.

_____ 7. The only use of X rays is to make images of bones and teeth inside the body.

_____ 8. Gamma rays cannot pass through bones and teeth.

_____ 9. Gamma rays can be used to destroy cancer cells.

_____ 10. Radar is used for tracking storms.

Lesson 21.3: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

X Rays and Gamma Rays

The shortest-wavelength, highest-frequency electromagnetic waves are X rays and gamma rays. These waves have so much energy that they can pass through many materials. This makes them potentially very harmful, but it also makes them useful for certain purposes.

X rays have enough energy to pass through soft tissues such as skin but not enough to pass through bones and teeth, which are very dense. The bright areas on an X ray film show where X rays were absorbed by the bones or teeth. X rays are used not only for dental and medical purposes but also to screen luggage at airports. Too much X ray exposure may cause cancer. If you've had dental X rays, you may have noticed that a heavy apron was placed over your body to protect it from stray X rays. The apron is made of lead, which X rays cannot pass through.

Gamma rays are the most energetic of all electromagnetic waves. They can pass through most materials, including bones and teeth. Nonetheless, even these waves are useful. For example, they can be used to treat cancer. A medical device sends gamma rays to the site of the cancer, and the rays destroy the cancerous cells.

Questions

1. What are the wave properties of X rays and gamma rays?

2. Explain how X rays can be used to "take pictures" of bones and teeth.
3. Why are gamma rays the most dangerous form of electromagnetic radiation? How can they be used?

Lesson 21.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Which of the following choices lists electromagnetic waves from lower to higher frequencies?
   a. radio waves, infrared light, microwaves
   b. ultraviolet light, infrared light, X rays
   c. infrared light, ultraviolet light, gamma rays
   d. visible light, microwaves, ultraviolet light
2. Which electromagnetic waves have a wavelength about as wide as the nucleus of an atom?
   a. radio waves
   b. infrared light
   c. ultraviolet light
   d. gamma rays
3. Compared with FM radio broadcasts, AM radio broadcasts can
   a. carry more information.
   b. be heard more clearly.
   c. pass through the ionosphere.
   d. travel to more distant receivers.
4. Television broadcasts encode pictures by changing the
   a. frequency of radio waves.
   b. amplitude of radio waves.
   c. wavelength of radio waves.
   d. speed of radio waves.
5. Which type of electromagnetic waves are used for radar?
   a. ultraviolet waves
   b. radar waves
   c. microwaves
   d. X rays
6. Visible light with the longest wavelength appears to be
   a. violet.
   b. green.
   c. blue.
   d. red.
7. Uses of ultraviolet light include
   a. killing bacteria.
   b. sterilizing surgical instruments.
   c. making vitamin D by the skin.
   d. all of the above

Lesson 21.3: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. electromagnetic waves with the greatest energy

_____ 2. full range of wavelengths of electromagnetic radiation

_____ 3. electromagnetic waves with wavelengths between infrared and ultraviolet light

_____ 4. light with the shortest wavelengths

_____ 5. electromagnetic waves with the longest wavelengths

_____ 6. light with the longest wavelengths

_____ 7. radio waves with the highest frequencies

Terms

a. radio waves

b. infrared light

c. ultraviolet light

d. microwaves

e. electromagnetic spectrum

f. visible light

g. gamma rays

Lesson 21.3: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. Electromagnetic waves with the highest frequencies are called __________.
2. In AM radio broadcasts, sounds are encoded by changing the __________ of radio waves.
3. Cell phone transmissions use radio waves called __________.
4. The colors of visible light depend on the __________ of light waves.
5. Night-vision goggles detect __________ light waves.
6. Too much exposure to __________ light waves causes sunburn and skin cancer.
7. The bright white areas on an X ray film show where the rays were ________ by bones or teeth.

Lesson 21.3: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how radio waves are used for radio and television broadcasts.

Chapter 22 Visible Light Worksheets

Chapter Outline

22.1 The Light We See

Lesson 22.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. All plants use visible light to make food by photosynthesis.

_____ 2. The moon is an example of a luminescent object.

_____ 3. The filament of an incandescent light bulb glows because it gets extremely hot.

_____ 4. An LED light produces visible light by fluorescence.

_____ 5. You can see clearly through an object that is translucent.

_____ 6. A rainbow occurs because raindrops separate light into its different wavelengths.

_____ 7. An apple appears red because it absorbs only red light.

_____ 8. The bluish green color called cyan is a secondary color of light.

_____ 9. Combining red, green, and blue light produces light that appears to be black.

_____ 10. The primary colors of pigments are the same as the primary colors of light.

Lesson 22.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

How Visible Light Is Produced

The sun and other stars produce light because they are so hot. They glow with visible light due to their extremely high temperatures. This way of producing light is called incandescence. Some objects produce visible light without becoming very hot. They generate light through chemical reactions or other processes. Producing light without heat is called luminescence. Objects that produce light by luminescence are said to be luminous. Luminescence, in turn, can occur in different ways:

- One type of luminescence is called fluorescence. In this process, a substance absorbs ultraviolet light and then gives off the energy as visible light. Certain minerals produce light in this way.
- Another type of luminescence is called electroluminescence. In this process, a substance gives off light when an electric current runs through it. Some gases produce light in this way.
- A third type of luminescence is called bioluminescence. This is the production of light by living things as a result of chemical reactions. Examples of bioluminescent organisms include jellyfish and fireflies.

Questions

1. Compare and contrast incandescence and luminescence.

2. List and define three types of luminescence.

Lesson 22.1: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. The sun and other stars produce visible light by
   a. fluorescence.
   b. luminescence.
   c. incandescence.
   d. electroluminescence.
2. Jellyfish and fireflies produce light as a result of
   a. high temperatures.
   b. chemical reactions.
   c. absorption of ultraviolet light.
   d. reflection of light from other sources.
3. Which type of light bulb produces visible light by electroluminescence?
   a. incandescent light bulb
   b. vapor light bulb
   c. neon light bulb
   d. two of the above
4. An example of opaque matter is a
   a. clear glass window.
   b. wooden door.
   c. mirror.
   d. two of the above
5. Light with the longest wavelength appears
   a. red.
   b. blue.
   c. green.
   d. violet.
6. A prism separates light into different colors by
   a. reflection.
   b. refraction.
   c. scattering.
   d. transmission.
7. If only green light strikes a blue object, the object appears
   a. green.
   b. blue.
   c. black.
   d. white.

Lesson 22.1: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. referring to matter that allows all visible light to pass through

_____ 2. production of visible light in a way that does not require high temperatures

_____ 3. referring to matter that does not allow visible light to pass through it

_____ 4. production of visible light by an object that is so hot it glows

_____ 5. passage of light through matter

_____ 6. referring to matter that transmits but scatters visible light

_____ 7. substance that colors materials by reflecting light of certain wavelengths and absorbing light of other wavelengths

Terms

a. incandescence

b. translucent

c. pigment

d. luminescence

e. transmission

f. transparent

g. opaque

Lesson 22.1: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. __________ occurs when a substance absorbs ultraviolet light and gives off visible light.
2. The production of light by living things is called __________.
3. A neon light produces visible light by the process of __________.
4. __________ occurs when transmitted light is spread out by particles of matter.
5. The color that visible light appears depends on the __________ of the light.
6. The colors red, green, and blue are referred to as the __________ colors of light.
7. The colors cyan, magenta, and yellow are the primary colors of __________.

Lesson 22.1: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

The human eye can sense only three colors of light: red, green, and blue. Explain how we can see objects of other colors.

22.2 Optics

Lesson 22.2: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. Only mirrors reflect light and form images.

_____ 2. All mirrors can form virtual images.

_____ 3. The image formed by a plane mirror looks exactly like the object in every way.

_____ 4. The focal point of a concave mirror is the point in front of the mirror where reflected rays intersect.

_____ 5. A concave mirror can form only virtual images.

_____ 6. The image formed by a convex mirror is always upright and reduced in size.

_____ 7. Light travels more quickly through glass than through air.

_____ 8. The more curved the surface of a lens is, the more it refracts light.

_____ 9. The lens in a camera is a convex lens.

_____ 10. A refracting telescope uses a convex lens to collect and focus light.

Lesson 22.2: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Lasers

A laser is a device that produces a very focused beam of light of just one wavelength and color. Laser light is produced in a tube. Electrons in a material such as a ruby crystal are stimulated to radiate photons of light of one wavelength. There are mirrors at the ends of the tube, and the photons of light bounce back and forth off the mirrors. This focuses the light, causing the crests and troughs of the waves to line up. The mirror at one end of the tube is partly transparent. A constant stream of photons passes through the transparent part, forming the laser beam.

Laser light has many uses. For example, it is used to scan bar codes and to carry communication signals in optical fibers. Optical fibers are extremely thin glass tubes that are used to guide laser light. Sounds or pictures are encoded in pulses of laser light, which are then sent through an optical fiber. Optical fibers are used to carry telephone, cable TV, and Internet signals.

Questions

1. What is laser light?
2. Describe how laser light is produced.
3. What are two uses of laser light?

Lesson 22.2: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. The image of an object that is formed by a concave mirror is always
   a. real.
   b. virtual.
   c. upright.
   d. none of the above
2. Which statement about concave lenses is true?
   a. They are thicker in the middle than at the edges.
   b. They cause rays of light to diverge.
   c. They form upside-down images.
   d. They form enlarged images.
3. Whether a convex lens forms a real or virtual image depends on
   a. where the object is located relative to the focus.
   b. whether the object is placed right-side up.
   c. how large the object is.
   d. how curved the lens is.
4. Optical instruments include
   a. microscopes.
   b. telescopes.
   c. cameras.
   d. all of the above
5. Both microscopes and telescopes use
   a. concave lenses.
   b. convex lenses.
   c. convex mirrors.
   d. all of the above
6. The image produced by a camera is
   a. virtual.
   b. enlarged.
   c. reduced.
   d. two of the above
7. A laser device produces a very focused beam of light by
   a. lining up the crests and troughs of light waves.
   b. using only very high frequencies of light waves.
   c. using convex lenses to enlarge light waves.
   d. shining light waves through an optical fiber.

Lesson 22.2: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. formation of a clear image by light reflected from a very smooth surface

_____ 2. device that produces a very focused beam of light of just one wavelength

_____ 3. curving outward like the outside of a bowl

_____ 4. copy of an object that is formed by reflected or refracted light

_____ 5. formation of a blurry image by light reflected from a rough surface

_____ 6. curving inward like the inside of a bowl

_____ 7. study of visible light and the ways it can be used

Terms

a. convex

b. laser

c. concave

d. regular reflection

e. optics

f. image

g. diffuse reflection

Lesson 22.2: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. According to the law of __________, the angle of reflection of light equals the angle of incidence.
2. A mirror with a flat reflective surface is called a(n) __________ mirror.
3. An image that forms where reflected or refracted light rays actually meet is called a(n) __________ image.
4. A(n) __________ mirror forms only virtual images.
5. A(n) __________ lens forms only virtual images.
6. A(n) __________ telescope uses a concave mirror to collect and focus light.
7. A camera uses a(n) __________ lens to form an image on film or a sensor.

Lesson 22.2: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Compare and contrast mirrors and lenses.

22.3 Vision

Lesson 22.3: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. The eyes and brain work together to enable vision.

_____ 2. The pupil helps to focus light that enters the eye.

_____ 3. The lens changes shape to focus images of close or distant objects.

_____ 4. There are two different types of rods in the retina.

_____ 5. The brain interprets signals from the retina as shape, color, and brightness.

_____ 6. The brain interprets images on the retina as though they were upright.

_____ 7. Laser surgery corrects vision problems by changing the shape of the lens.

_____ 8. The role of the iris is to control the size of the pupil.

_____ 9. The lens normally focuses images on the optic nerve.

_____ 10. Hyperopia is also called nearsightedness.

Lesson 22.3: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

How We See

The eyes and brain work together to enable human vision. The eyes collect and focus visible light. The lens and other structures of the eye work together to focus a real image on the retina. The image is upside-down and reduced in size. Rods and cones in the retina send electrical signals about the image to the brain through the optic nerve. The brain interprets the signals as shape, color, and brightness. It also interprets the image as though it were right-side up. The brain does this automatically, so what we see is always right-side up. The brain also "tells" us what we are seeing.

Questions

1. What is the role of the eyes in vision?
2. How does information about an image on the retina reach the brain?
3. What is the role of the brain in vision?

Lesson 22.3: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Structures of the eye that help to focus light include the
    a. iris.
    b. cornea.
    c. retina.
    d. two of the above
2. Which choice shows the correct order in which light passes through structures of the eye?
    a. lens, pupil, cornea
    b. pupil, cornea, lens
    c. cornea, pupil, lens
    d. cornea, lens, pupil
3. Why does the pupil of the eye look black?
    a. It reflects only black light.
    b. It does not reflect any light.
    c. It consists of a black membrane.
    d. It absorbs all the light that strikes it.
4. Functions of the cornea of the eye include
    a. protecting the eye from injury.
    b. adjusting the position of the lens.
    c. controlling how much light enters the eye.
    d. two of the above
5. The image formed on the retina by the lens of the eye is
    a. virtual.
    b. enlarged.
    c. upside-down.
    d. two of the above
6. Which statement about myopia is true?
    a. It is also called farsightedness.
    b. It can be corrected with convex lenses.
    c. It occurs when the eyeball is longer than normal.
    d. It causes both near and distant objects to appear blurry.
7. What happens when the eyeball is shorter than normal?
    a. Images are focused in back of the retina.
    b. Distant objects are seen clearly.
    c. Nearby objects appear blurry.
    d. all of the above

Lesson 22.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. nerve cell in the retina that senses dim light

_____ 2. colored part of the eye

_____ 3. opening at the front of the eye that lets in light

_____ 4. nerve cell in the retina that senses colors of light

_____ 5. organ specialized to collect light and focus images

_____ 6. transparent outer covering of the eye

_____ 7. membrane lining the back of the eye

Terms

a. eye

b. rod

c. cornea

d. cone

e. iris

f. retina

g. pupil

Lesson 22.3: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. The lens of the eye is a(n) __________ lens.
2. Rods and cones change images to __________ signals.
3. The shape of the eye's lens is controlled by tiny __________.
4. Electrical signals from the eye travel to the brain through the __________.
5. The vision problem in which nearby objects are seen clearly but distant objects appear blurry is __________.
6. The vision problem in which distant objects are seen clearly but nearby objects appear blurry is __________.
7. The vision problem in question 6 can be corrected with __________ lenses.

Lesson 22.3: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how the structures of the eye collect and focus light to form images.

CHAPTER 23 Electricity Worksheets

Chapter Outline

23.1 Electric Charge

Lesson 23.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. If you get a shock when you touch a metal doorknob, static discharge has occurred.

_____ 2. All electric charge is based on the protons and electrons in atoms.

_____ 3. Positive and negative particles always repel each other.

_____ 4. Charged particles must be in contact in order to exert electric force over each other.

_____ 5. When charged particles exert force on each other, their electric fields interact.

_____ 6. When electrons move from one object to another, the total charge remains the same.

_____ 7. Rubber attracts electrons less strongly than wool does.

_____ 8. Electrons can be transferred between objects only when the objects are touching.

_____ 9. Electric charges cannot travel easily through the air, especially if the air is dry.

_____ 10. During a thunderstorm, negative charges become concentrated at the tops of clouds.

Lesson 23.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

How Lightning Occurs

Lighting is static discharge on a large scale. It occurs when there is a sudden discharge of static electricity between a cloud and the ground (or between two clouds). It occurs in this sequence of events in cloud-to-ground lightning:

1. The movement of air molecules, water drops, and ice particles in a cloud causes the cloud to develop regions of positive and negative charge. The negative charges are concentrated at the bottom of the cloud, and the positive charges are concentrated at the top.
2. Through polarization, the ground below the cloud becomes positively charged. However, the atmosphere prevents electrons from flowing to the ground until a huge amount of charge has built up.
3. Charges keep building up in the cloud and on the ground. Eventually, a channel of charged particles starts to form in the air between the cloud and the ground.
4. When the channel of charges is complete, electricity is suddenly discharged as a bolt of lightning.

Questions

1. What is lightning?

2. Why do charges build up in a cloud?
3. How does the ground below the cloud become positively charged?
4. When does a lightning bolt occur?

Lesson 23.1: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Moving electric charges create
   a. lightning bolts.
   b. electric current.
   c. friction.
   d. two of the above
2. Electric field lines around a negatively charged particle
   a. point away from the particle.
   b. circle around the particle.
   c. point toward the particle.
   d. repel the particle.
3. The strength of electric force is determined by the
   a. amount of electric charge.
   b. conservation of electric charge.
   c. distance between charged particles.
   d. two of the above
4. The formation of charged matter depends on the
   a. transfer of electrons.
   b. loss of protons.
   c. discharge of current.
   d. buildup of neutrons.
5. Ways that charges can be transferred include
   a. friction.
   b. conduction.
   c. polarization.
   d. all of the above
6. If you rub a balloon on your hair, the balloon and hair attract each other because
   a. electrons are transferred from the hair to the balloon.
   b. hair is negatively charged and the balloon is positively charged.
   c. the hair attracts electrons more strongly than the balloon does.
   d. two of the above
7. A buildup of electric charges on an object occurs because of
   a. static electricity.
   b. static discharge.
   c. electric current.
   d. polarization.

Lesson 23.1: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. buildup of electric charges on an object

_____ 2. transfer of electrons within an object

_____ 3. force of attraction or repulsion between charged particles

_____ 4. transfer of electrons through direct contact between objects

_____ 5. space around a charged particle where the particle exerts electric force

_____ 6. physical property that causes particles to attract or repel each other without touching

_____ 7. sudden flow of electrons from an object that has a buildup of charges

Terms

a. electric charge

b. conduction

c. electric field

d. polarization

e. electric force

f. static electricity

g. static discharge

Lesson 23.1: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. Objects become charged when they transfer __________.
2. Particles with opposite charges __________ each other.
3. Particles with the same charge __________ each other.
4. When atoms give up electrons they become positively charged ions called __________.
5. When atoms gain electrons, they become negatively charged ions called __________.
6. A van de Graaff generator transfers electrons to a person touching it by the process of __________.
7. A lightning bolt is an example of __________.

Lesson 23.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What is electric charge, and how do objects become electrically charged?

23.2 Electric Current

Lesson 23.2: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Current flowing through a battery-powered flashlight is alternating current.

_____ 2. An electric charge has potential energy because of its position.

_____ 3. Electric charges always move from lower to higher potential energy.

_____ 4. Car batteries contain wet cells.

_____ 5. Both dry cells and wet cells work the same basic way.

_____ 6. Solar cells contain a material that absorbs electrons and gives off light.

_____ 7. A wider wire has more resistance than a narrower wire.

_____ 8. Current always travels through the material with the greatest resistance.

_____ 9. Greater voltage results in more current.

_____ 10. Ohm's law states the relationships among current, voltage, and resistance.

Lesson 23.2: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Ohm's Law

Voltage is needed for electric current to flow, and greater voltage results in more current. Resistance opposes the flow of electric current, and greater resistance results in less current. These relationships among voltage, resistance, and current were first demonstrated by a German scientist named Georg Ohm in the early 1800s, so they are referred to as Ohm's law. Ohm's law can be represented by the equation:

$$\text{Current (amps)} = \frac{\text{Voltage (volts)}}{\text{Resistance (ohms)}}$$

You can use this equation to calculate the amount of current flowing through a material when voltage and resistance are known. Consider an electric wire that is connected to a 12-volt battery. If the wire has a resistance of 3 ohms, how much current is flowing through the wire?

$$\text{Current} = \frac{12 \text{ volts}}{3 \text{ ohms}} = 4 \text{ amps}$$

You may have a better understanding of Ohm's law if you compare current flowing through a wire from a battery to water flowing through a garden hose from a tap. Opening the tap wider allows more water to flow through the hose.

This is like increasing the voltage of the battery, which allows more current to flow through the wire. Stepping on the hose allows less water to flow through it. This is like increasing resistance in the wire, which allows less current to flow through it.

Questions

1. State Ohm's law in your own words.
2. If an electric wire is connected to a 9-volt battery that has 3 ohms of resistance, how much current is flowing through the wire?
3. Compare current flowing through a wire from a battery to water flowing through a hose from a tap.

Lesson 23.2: Multiple Choice

Name____________________ Class_______________ Date___________

Circle the letter of the correct choice.

1. For an electric charge to move from one position to another, there must be a difference between the two positions in
   a. electrical conductivity.
   b. electric potential energy.
   c. kinetic energy of particles.
   d. resistance to electric charges.
2. Sources of voltage include
   a. generators.
   b. solar cells.
   c. chemical cells.
   d. all of the above
3. Batteries produce electrical energy by
   a. moving electrodes.
   b. chemical reactions.
   c. thermal transfer.
   d. nuclear fusion.
4. Which of the following materials is an electric conductor?
   a. copper
   b. rubber
   c. plastic
   d. wood
5. An example of an electric insulator is
   a. steel.
   b. water.
   c. dry air.
   d. aluminum.
6. Properties that affect the resistance of a material include its
   a. width.
   b. length.
   c. temperature.

   d. all of the above

7. If a wire with a resistance of 4 ohms is connected to a 12-volt battery, how much current is flowing through the wire?
   a. 48 amps
   b. 16 amps
   c. 4 amps
   d. 3 amps

Lesson 23.2: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. material that has low resistance to the flow of electric current

_____ 2. electric current that flows in only one direction

_____ 3. opposition to the flow of electric current

_____ 4. material that has high resistance to the flow of electric current

_____ 5. any continuous flow of electric charges due to a difference in voltage

_____ 6. electric current that keeps reversing the direction in which the current flows

_____ 7. difference in electric potential energy between two positions

Terms

a. alternating current

b. electric insulator

c. electric current

d. direct current

e. electric conductor

f. voltage

g. resistance

Lesson 23.2: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. __________ is measured as the amount of charge that flows past a given point in a certain amount of time.
2. The SI unit for electric current is the __________.
3. The SI unit for voltage is the __________.
4. A battery in which the electrolyte is a paste is called a __________.
5. The __________ electrode of a battery gives up electrons.

6. A photovoltaic cell uses __________ to produce voltage.
7. The SI unit for resistance is the __________.

Lesson 23.2: Critical Writing

Name__________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

What is voltage, and why is voltage required for an electric current?

23.3 Electric Circuits

Lesson 23.3: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Electric current can flow through a circuit only if it forms a closed loop.

_____ 2. Most home circuits can safely carry 120 amps of current.

_____ 3. A more powerful electric device changes electric current to another form of energy in less time.

_____ 4. All electric circuits must have at least four parts.

_____ 5. When a circuit is closed, current cannot flow through it.

_____ 6. A circuit diagram uses standard symbols to represent the parts of a circuit.

_____ 7. The wiring in a house consists of parallel circuits.

_____ 8. The power of an electric device is a product of voltage and time.

_____ 9. A less powerful electric device uses less energy in the same amount of time as a more powerful device.

_____ 10. Dangers of electricity include burns and fires.

Lesson 23.3: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Series and Parallel Circuits

There are two basic types of electric circuits, called series and parallel circuits. They differ in the number of loops through which current can flow.

- A series circuit has only one loop through which current can flow. If the circuit is interrupted at any point in the loop, no current can flow through the circuit and no devices in the circuit will work. Series circuits are commonly used in devices such as flashlights.
- A parallel circuit has two (or more) loops through which current can flow. If the circuit is interrupted in one of the loops, current can still flow through the other loop(s). The wiring in a house consists of parallel circuits.

Questions

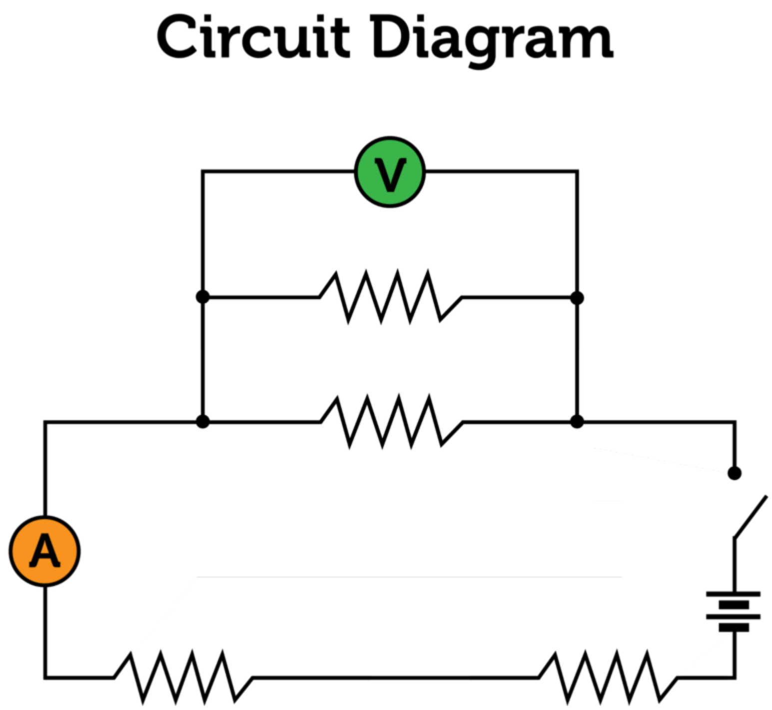
1. How does a parallel circuit differ from a series circuit?
2. Where are series circuits used? Where are parallel circuits used?
3. What is a drawback of series circuits?

Lesson 23.3: Multiple Choice

Name____________________ **Class**_______________ **Date**___________

Circle the letter of the correct choice.

1. Most home circuits have a voltage of
   a. 20 volts.
   b. 30 volts.
   c. 60 volts.
   d. 120 volts.
2. How many resistors are there in the circuit represented by this circuit diagram?



   a. 1
   b. 2
   c. 3
   d. 4
3. Electric power is expressed in the SI unit called the
   a. watt.
   b. ohm.
   c. amp.
   d. volt.
4. The power of an electric device can be calculated if you know the circuit's
   a. resistance.
   b. voltage.
   c. current.
   d. two of the above
5. The electrical energy used by a 1000-watt microwave that runs for 30 minutes is

a. 0.5 kilowatt-hours.
b. 3.0 kilowatt-hours.
c. 15 kilowatt-hours.
d. 500 kilowatt-hours.

6. A ground-fault circuit interrupter is found in

a. almost all electrical devices.
b. the main breaker box in a house.
c. some electrical outlets.
d. all of the above

7. Which of the following is an electric safety rule?

a. Never go near fallen electric lines.
b. Do not plug too many devices into one outlet.
c. Never plug in electric devices when your hands are wet.
d. all of the above

Lesson 23.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. any device that converts some of the electricity in a circuit to another form of energy

_____ 2. any closed loop through which electric current can flow

_____ 3. rate at which a device changes electric current to another form of energy

_____ 4. circuit with two (or more) loops through which current can flow

_____ 5. device that measures the flow of current through a circuit

_____ 6. device used to control the flow of current in a circuit

_____ 7. circuit with one loop through which current can flow

Terms

a. ammeter

b. series circuit

c. electric circuit

d. electric power

e. switch

f. parallel circuit

g. resistor

Lesson 23.3: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. A(n) __________ occurs when electric current follows a shorter path than the intended loop of the circuit.
2. A switch that automatically opens a circuit if too much current flows through it is called a(n) __________.
3. A(n) __________ outlet contains a tiny device that monitors the amount of current leaving and returning to the outlet.
4. The round prong on a three-prong plug safely carries any stray current to the __________.
5. All electric circuits must have a voltage source and a(n) __________.
6. The voltage in a circuit can be measured with a device called a(n) __________.
7. The type of circuit commonly found in a flashlight is a(n) __________ circuit.

Lesson 23.3: Critical Writing

Name__________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

How is the electrical energy used by a device related to the device's power?

23.4 Electronics

Lesson 23.4: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Electronic devices change electric current to other forms of energy.

_____ 2. Microphones encode sounds as digital signals.

_____ 3. DVDs encode sounds and pictures as analog signals.

_____ 4. Electronic components are the parts used in electronic devices.

_____ 5. A crystal of pure silicon cannot conduct electricity.

_____ 6. Types of semiconductors include diodes and transistors.

_____ 7. A microchip may contain millions of electronic components.

_____ 8. In a diode, electrons can flow only from the p-type to the n-type semiconductor.

_____ 9. TV remotes and CD players are examples of electronic devices.

_____ 10. In computers, a byte refers to a single digit (either 0 or 1) of information.

Lesson 23.4: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Electronic Signals

Did you ever make a secret code? One way to make a code is to represent each letter of the alphabet by a different number. Then you can send a coded message by writing words as strings of digits. This is similar to how information is encoded using an electric current. The voltage of the current is changed rapidly and repeatedly to encode a message, called an electronic signal. There are two different types of electronic signals: digital signals and analog signals.

- A digital signal consists of pulses of voltage in a circuit, created by repeatedly switching the current off and on. This type of signal encodes information as a string of 0's (current off) and 1's (current on). This is called a binary ("two-digit") code. DVDs, for example, encode sounds and pictures as digital signals.
- An analog signal consists of continuously changing voltage in a circuit. For example, microphones encode sounds as analog signals.

Questions

1. What is an electronic signal?
2. Compare and contrast digital and analog signals.

Lesson 23.4: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. Examples of electronic devices include
   a. computers.
   b. cell phones.
   c. microphones.
   d. all of the above
2. Electronic signals are encoded in electric current by changing the
   a. resistance.
   b. amperage.
   c. voltage.
   d. power.
3. Silicon can conduct current when it contains very small amounts of
   a. boron or phosphorus.
   b. copper or aluminum.
   c. carbon or oxygen.
   d. plastic or rubber.
4. The type of electronic component that can be used to increase the amount of current flowing through a circuit is a
   a. diode.
   b. transistor.
   c. microchip.
   d. semiconductor.
5. Current flows very rapidly through an integrated circuit because the circuit
   a. is extremely small.
   b. is part of a transistor.
   c. contains just one electronic component.
   d. is made from an electric conductor such as copper.
6. The computer microchip that provides temporary storage for programs and data that are currently in use is called
   a. RAM.
   b. ROM.
   c. CPU.
   d. none of the above
7. The role of the motherboard in a computer is to
   a. store important information such as start-up instructions.
   b. allow other parts of the computer to communicate.
   c. provide long-term storage for programs and data.
   d. carry out program instructions.

Lesson 23.4: Matching

Name____________________ Class_______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. electronic signal created by repeated pulses of voltage

_____ 2. tiny flat piece of silicon that contains layers of many electronic components

_____ 3. electronic component consisting two semiconductors

_____ 4. electronic signal created by continuous changes in voltage

_____ 5. use of electric current to encode information

_____ 6. electronic component consisting of three semiconductors

_____ 7. material that conducts current better than an insulator but not as well as a conductor

Terms

a. electronics

b. analog signal

c. digital signal

d. integrated circuit

e. semiconductor

f. diode

g. transistor

Lesson 23.4: Fill in the Blank

Name____________________ Class_______________ Date________

Fill in the blank with the appropriate term.

1. An electronic code that consists only of 0's and 1's is called a(n) ___________ code.
2. Semiconductors are made mainly of the element ___________.
3. A(n) ___________ semiconductor is like the negative terminal of a chemical cell.
4. A(n) ___________ semiconductor is like the positive terminal of a chemical cell.
5. The type of electronic component that can change alternating current to direct current is a(n) ___________.
6. The type of electronic component that can be used as a switch is a(n) ___________.
7. The microchip that provides permanent storage in a computer is called ___________.

Lesson 23.4: Critical Writing

Name____________________ Class_______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why integrated circuits allow computers to be extremely fast without being very large.

CHAPTER 24 Magnetism Worksheets

Chapter Outline

24.1 Magnets and Magnetism

Lesson 24.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Some magnets have just one magnetic pole.

_____ 2. Bringing together the north poles of two magnets demagnetizes them.

_____ 3. A magnet will attract any material that contains iron.

_____ 4. Only ferromagnetic materials are affected by magnetic force.

_____ 5. For a ferromagnetic material to become magnetic its magnetic domains must be aligned.

_____ 6. Iron is the only ferromagnetic material.

_____ 7. While paper clips are clinging to a bar magnet, they are temporary magnets.

_____ 8. Permanent magnets can never be demagnetized.

_____ 9. Magnetite is a naturally occurring permanent magnet.

_____ 10. The magnetic properties of lodestone were discovered only recently.

Lesson 24.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

What Makes a Material Magnetic?

Magnetism is due to the movement of electrons within atoms of matter. When electrons spin around the nucleus of an atom, they cause the atom to become a tiny magnet, with north and south poles and a magnetic field. In most materials, the north and south poles of atoms point in all different directions, so the matter is not magnetic. Examples of nonmagnetic materials include wood, glass, plastic, paper, copper, and aluminum. These materials are not attracted to magnets and cannot become magnets.

In other materials, there are large areas where the north and south poles of atoms are all lined up in the same direction. These areas are called magnetic domains. Generally, the magnetic domains point in different directions, so the material is still not magnetic. However, the material can be magnetized by placing it in a magnetic field. When this happens, all the magnetic domains become aligned, and the material becomes a magnet. Materials that can be magnetized in this way are called ferromagnetic materials. They include iron, cobalt, and nickel.

Questions

1. What are some examples of nonmagnetic materials? Why are these materials nonmagnetic?
2. What are ferromagnetic materials? Which elements are ferromagnetic?

3. Explain why ferromagnetic materials can become magnets.

Lesson 24.1: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Why are the poles of a magnet called north and south poles?
    a. One pole is positive and one pole is negative.
    b. The poles are at opposite ends of the magnet.
    c. The poles are the coldest parts of the magnet.
    d. The poles line up with Earth's north-south axis.
2. What happens if you cut a bar magnet in half between the north and south poles?
    a. One half has a north pole and one half has a south pole.
    b. Each half is a stronger magnet than the original magnet.
    c. Each half has both a north pole and a south pole.
    d. The two halves are no longer magnetic.
3. Which statement about magnetic force is false?
    a. It is exerted over a distance.
    b. It affects only certain types of matter.
    c. It includes forces of attraction and repulsion.
    d. It acts only on materials that are touching a magnet.
4. Which of the following materials is attracted to a magnet?
    a. aluminum
    b. copper
    c. glass
    d. steel
5. A material that can be magnetized
    a. has magnetic domains.
    b. is called ferromagnetic.
    c. must contain iron.
    d. two of the above
6. If you place a paper clip very close to a magnet, the paper clip
    a. is attracted to the magnet.
    b. moves toward the magnet.
    c. becomes a temporary magnet.
    d. all of the above
7. Magnetism is caused by the
    a. attraction between protons and neutrons of atoms.
    b. attraction between positive and negative ions.
    c. movement of electrons within atoms.
    d. none of the above

Lesson 24.1: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. force of attraction or repulsion exerted by a magnet

_____ 2. object that attracts ferromagnetic materials

_____ 3. iron, nickel, or cobalt

_____ 4. north or south end of a magnet

_____ 5. area around a magnet where it exerts force

_____ 6. ability of a material to respond to and exert magnetic force

_____ 7. area of a ferromagnetic material where the poles of atoms are aligned in the same direction

Terms

a. ferromagnetic material

b. magnet

c. magnetic domain

d. magnetic field

e. magnetic force

f. magnetic pole

g. magnetism

Lesson 24.1: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. A magnet is strongest at its __________.
2. The north and south poles of two magnets __________ each other.
3. When electrons spin around the nucleus of an atom, it causes the atom to become a tiny __________.
4. A ferromagnetic material can be magnetized by placing it in a(n) __________.
5. The most magnetic material in nature is the mineral __________.
6. When two magnets are brought close together, their magnetic fields __________.
7. If you stroke an iron nail with a bar magnet, the nail becomes a(n) __________ magnet.

Lesson 24.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how and why a so-called permanent magnet can be demagnetized.

24.2 Earth as a Magnet

Lesson 24.2: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. The north end of a compass needle always points to 90° north latitude.

_____ 2. Earth's magnetic field extends outward from the planet in all directions.

_____ 3. Earth's magnetic poles have switched places many times over the past hundred years.

_____ 4. Once molten rocks harden, their magnetic domains are frozen in place forever.

_____ 5. Earth's outer core is made up mainly of iron and nickel.

_____ 6. Charged particles move inside Earth when it spins on its axis.

_____ 7. Harmful particles from the sun are repelled by Earth's magnetic poles.

_____ 8. Magnetic reversals were discovered by William Gilbert in 1600.

_____ 9. Earth's south magnetic pole is the same as Earth's south geographic pole.

_____ 10. Migrating birds may detect Earth's magnetic field with structures in their eyes.

Lesson 24.2: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Magnetic Field Reversals

Earth's magnetic poles have switched places repeatedly over the past hundreds of millions of years, each time reversing Earth's magnetic field. Scientists don't know for certain why magnetic reversals occur, but there is hard evidence showing that they have occurred. The evidence comes from rocks on the ocean floor. At the center of ridges on the ocean floor, hot magma pushes up through the crust and hardens into rock. Once the magma hardens, the alignment of magnetic domains in the rock is frozen in place forever. The newly hardened rock is then gradually pushed away from the ridge in both directions as more magma erupts and newer rock forms. Rock samples from many places on the ocean floor reveal that magnetic domains of rocks from different time periods are aligned in opposite directions. The evidence shows that Earth's magnetic field reversed hundreds of times over the past 330 million years. The last reversal was less than a million years ago.

Questions

1. What is a magnetic field reversal?
2. What evidence shows that magnetic field reversals have occurred?

Lesson 24.2: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Like a bar magnet, planet Earth
   a. exerts magnetic force.
   b. has a magnetic field.
   c. has magnetic poles.
   d. all of the above
2. Earth's true north magnetic pole is actually located near Earth's
   a. equator.
   b. south magnetic pole.
   c. south geographic pole.
   d. none of the above
3. Earth's magnetic field extends outward from Earth for
   a. a few kilometers.
   b. about 100 kilometers.
   c. about 330 kilometers.
   d. several thousand kilometers.
4. The magnetosphere
   a. completely surrounds Earth.
   b. is found only near Earth's poles.
   c. exists over a region larger than Earth.
   d. two of the above
5. Which statement about magnetic reversals is false?
   a. Magnetic reversals have occurred hundreds of times.
   b. The most recent magnetic reversal occurred 330 million years ago.
   c. There is hard evidence showing that magnetic reversals have occurred.
   d. Scientists do not know for certain why magnetic reversals have occurred.
6. The idea that Earth is a magnet was first proposed
   a. by William Gilbert in 1800.
   b. after seismographs were developed.
   c. before scientists learned about Earth's inner structure.
   d. around the same time that Earth's outer core was discovered.
7. Many migrating birds
   a. navigate using Earth's magnetic field.
   b. may be able to see Earth's magnetic field.
   c. have natural "compasses" that they use for migration.
   d. all of the above

Lesson 24.2: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. about 80° north latitude

_____ 2. solid sphere that makes up Earth's center

_____ 3. exactly 90° north latitude

_____ 4. region deep inside Earth that consists of liquid metals

_____ 5. Earth's magnetic field

_____ 6. switching of Earth's north and south magnetic poles

_____ 7. navigation device that always points north

Terms

a. magnetosphere

b. north geographic pole

c. outer core

d. north magnetic pole

e. magnetic reversal

f. compass

g. inner core

Lesson 24.2: Fill in the Blank

Name___________________ **Class**______________ **Date**________

Fill in the blank with the appropriate term.

1. A compass needle always points to Earth's north __________ pole.
2. What we call Earth's north magnetic pole is actually the __________ pole of magnet Earth.
3. Earth's magnetic field is strongest at the __________.
4. The alignment of magnetic domains in rocks on the ocean floor provides evidence for magnetic __________.
5. Earth is a magnet because of the movement of charged particles in Earth's __________.
6. Earth's magnetic field protects living things from harmful particles given off by the __________.
7. A(n) __________ is a device that detects and measures earthquake waves.

Lesson 24.2: Critical Writing

Name___________________ **Class**______________ **Date**________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Describe Earth's magnetic field, and explain how it benefits living things.

CHAPTER 25 Electromagnetism Worksheets

Chapter Outline

25.1 Electricity and Magnetism

Lesson 25.1: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Oersted's discovery of the connection between electric currents and magnetic fields was a lucky accident.

_____ 2. Oersted discovered electromagnetism when he placed a compass near a battery.

_____ 3. The direction of the magnetic field around a wire is parallel to the direction of the current through the wire.

_____ 4. The magnetic field around a wire is stronger when more current is flowing through the wire.

_____ 5. The magnetic field Oersted created around a wire was too weak to affect a nearby compass.

_____ 6. A compass always points to Earth's north magnetic pole even when placed near a magnet.

_____ 7. The right hand rule states that you should always hold a compass in your right hand.

Lesson 25.1: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Electric Currents and Magnetic Fields

The magnetic field created by a current flowing through a wire surrounds the wire in concentric circles. The magnetic field is stronger if more current is flowing through the wire. The direction of the magnetic field depends on the direction that the current is flowing through the wire. A simple rule, called the right hand rule, makes it easy to find the direction of the magnetic field if the direction of the current is known. When the thumb of the right hand is pointing in the same direction as the current, the fingers of the right hand curl around the wire in the direction of the magnetic field.

Questions

1. Describe the magnetic field around a wire that is carrying current.
2. Explain how to find the direction of the magnetic field around a wire if the direction of the current is known.

Lesson 25.1: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Oersted discovered that electric currents generate magnetic fields in

a. 1600.
b. 1820.
c. 1980.
d. 2000.

2. When Oersted made the discovery in question 1, he was trying to demonstrate that

a. electricity and magnetism are not related.
b. electric currents create magnetic fields.
c. compasses can detect magnetic fields.
d. magnetic fields create electric currents.

3. The magnetic field created by current flowing through a wire

a. surrounds the wire in concentric circles.
b. is just like the magnetic field of a bar magnet.
c. has the same direction as the current.
d. has the opposite direction to the current.

4. According to the right hand rule, the fingers of the right hand curl around the wire in the same direction as the

a. current.
b. compass.
c. conductor.
d. magnetic field.

5. Factors that affect the magnetic field around a wire that is carrying current include

a. amount of current.
b. direction of current.
c. position of compass.
d. two of the above

Lesson 25.1: Matching

Name___________________ **Class**______________ **Date**________

Match each definition with the correct term.

Definitions

_____ 1. material through which electric current can flow

_____ 2. continuous flow of electric charges

_____ 3. device that points toward a north magnetic pole

_____ 4. way to find the direction of the magnetic field around a wire carrying electric current

_____ 5. magnetism produced by electric current

Terms

a. electromagnetism

b. compass

c. right hand rule

d. electric current

e. electric conductor

Lesson 25.1: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. The scientist who discovered how electricity and magnetism are related was __________.
2. The direction of the magnetic field around a wire depends on the direction of the __________.
3. A crane magnet is a type of magnet called a(n) __________.
4. Oersted investigated the magnetic field around a wire by placing a(n) __________ at different locations around the wire.
5. To apply the right hand rule, your thumb should point in the same direction as the __________.

Lesson 25.1: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how you could use a wire and a battery to create a magnetic field.

25.2 Using Electromagnetism

Lesson 25.2: True or False

Name___________________ **Class**______________ **Date**__________

Determine if the following statements are true or false.

_____ 1. The magnetic field of a solenoid has north and south poles.

_____ 2. An electric motor contains two electromagnets.

_____ 3. An electromagnet contains a solenoid.

_____ 4. A solenoid has a magnetic field only when current flows through it.

_____ 5. Very few devices contain electromagnetics.

_____ 6. The clapper of an electric doorbell is an electromagnet.

_____ 7. When the clapper of a doorbell strikes the bell, it opens an electric circuit.

_____ 8. The electromagnet of an electric motor is connected to a permanent magnet.

_____ 9. Only the shaft of an electric motor turns when current flows through the motor.

_____ 10. The poles of the electromagnet in an electric motor keep reversing.

Lesson 25.2: Critical Reading

Name___________________ **Class**______________ **Date**__________

Read this passage from the text and answer the questions that follow.

Electromagnets

An electromagnet consists of a solenoid (soil of wire) wrapped around a bar of iron or other ferromagnetic material. When current flows through the solenoid, it gives it a magnetic field like a bar magnet. The magnetic field of the solenoid magnetizes the ferromagnetic bar by aligning its magnetic domains. The combined magnetic force of the magnetized iron bar and the wire coil makes an electromagnet very strong. In fact, electromagnets are the strongest magnets made. Some of them are strong enough to lift a train. A maglev train contains permanent magnets that are repelled by strong electromagnets in the track. The force of repulsion causes the train to levitate above the track.

An electromagnet is stronger if there are more turns in the coil of wire or more current is flowing through it. A bigger bar or one made of a material that is easier to magnetize also increases an electromagnet's strength.

Questions

1. What is an electromagnet?
2. Why does an electromagnet have a stronger magnetic field than the solenoid it contains?
3. Identify four factors that affect the strength of an electromagnet.

Lesson 25.2: Multiple Choice

Name___________________ Class______________ Date__________

Circle the letter of the correct choice.

1. Each turn of the wire coil of a solenoid has
   a. current that flows in a different direction.
   b. a bar of iron inside of it.
   c. its own magnetic field.
   d. two of the above
2. You can increase the magnetic strength of a solenoid by
   a. decreasing the amount of current flowing through it.
   b. increasing the number of turns of wire in the coil.
   c. attaching a compass to it.
   d. two of the above
3. An electromagnet is stronger if it uses
   a. less current.
   b. a straight wire instead of a coil.
   c. a smaller bar of ferromagnetic material.
   d. a ferromagnetic material that is easier to magnetize.
4. Devices that contain electromagnets include
   a. fans.
   b. telephones.
   c. CD players.
   d. all of the above
5. Pressing the button of an electric doorbell causes two electric contacts to come together and
   a. turn off an electromagnet.
   b. push against a bell.
   c. complete an electric circuit.
   d. turn a shaft.
6. The electromagnet in an electric motor is located between
   a. opposite poles of permanent magnets.
   b. the commutator and shaft.
   c. the voltage source and coil.
   d. none of the above
7. In an electric motor, the shaft and the electromagnet both have
   a. electrical energy.
   b. kinetic energy.
   c. a magnetic field.
   d. a source of current.

Lesson 25.2: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. device that uses an electromagnet to change electrical energy to kinetic energy

_____ 2. material such as iron that can be magnetized

_____ 3. part of an electric motor that changes the direction of the current

_____ 4. part of an electric motor that is turned by the rotating electromagnet

_____ 5. solenoid wrapped around a bar of ferromagnetic material

_____ 6. type of magnet that a solenoid resembles

_____ 7. coil of wire with electric current flowing through it, giving it a magnetic field

Terms

a. solenoid

b. ferromagnetic material

c. electromagnet

d. bar magnet

e. electric motor

f. shaft

g. commutator

Lesson 25.2: Fill in the Blank

Name____________________ **Class**_______________ **Date**_________

Fill in the blank with the appropriate term.

1. The magnetic field of a coiled wire is __________ than the magnetic field around a straight wire.
2. The magnetic field of an electromagnetic magnetizes the iron bar inside it by aligning its __________.
3. The strongest magnets that are made are __________.
4. A solenoid with more turns of wire has a(n) __________ magnetic field.
5. Most electric devices that have moving parts contain __________.
6. The __________ inside a doorbell attracts the clapper and causes it to hit the bell.
7. The electromagnet inside an electric motor rotates because it is repelled by a(n) __________.

Lesson 25.2: Critical Writing

Name____________________ **Class**_______________ **Date**_________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain how an electric motor changes electrical energy to kinetic energy.

25.3 Generating and Using Electricity

Lesson 25.3: True or False

Name___________________ Class______________ Date__________

Determine if the following statements are true or false.

_____ 1. Current will flow through a wire in a closed circuit whenever the wire crosses magnetic field lines.

_____ 2. Electromagnetic induction occurs when an electromagnet creates a magnetic field.

_____ 3. If you were to mechanically turn the shaft of an electric motor, the motor would generate electricity.

_____ 4. An electric generator contains a magnet and a rotating coil of wire.

_____ 5. An electric generator can produce only direct current.

_____ 6. A car generator uses the kinetic energy of a turning crankshaft.

_____ 7. A hydroelectric power plant uses the kinetic energy of steam under pressure.

_____ 8. An electric transformer works only with alternating current.

_____ 9. The iron core of an electric transformer becomes an electromagnet when current passes through the P coil.

_____ 10. The P and S coils of an electric transformer always have the same number of turns of wire.

Lesson 25.3: Critical Reading

Name___________________ Class______________ Date__________

Read this passage from the text and answer the questions that follow.

Electrifying the Home

Power plant generators produce high-voltage electric current. Many power plants also use step-up transformers to increase the voltage of the current even more. By increasing the voltage, the amount of current traveling through power lines is decreased. This results in less loss of electrical energy as the current travels from power plants to homes. However, the voltage in power lines is too high to be safe for home circuits. The voltage in power lines may be as great as 750,000 volts, whereas the voltage of most home circuits is 240 volts or less. One or more step-down transformers decrease the voltage of current before it enters a house. Other step-down transformers within the house lower the voltage of some of the home's circuits.

Questions

1. Why is a step-up transformer used as electric current leaves a power plant?
2. Why is a step-down transformer needed before electric current enters a home?

Lesson 25.3: Multiple Choice

Name___________________ **Class**______________ **Date**__________

Circle the letter of the correct choice.

1. What happens if a magnetic field and an electric conductor move relative to one another?
   a. The magnetic field becomes stronger.
   b. The conductor becomes an electromagnet.
   c. The conductor becomes an electric insulator.
   d. Electric current flows through the conductor.
2. Assume that a bar magnet is placed inside a coil of wire that is part of a closed circuit. Which situation produces an alternating current in the wire?
   a. The magnet is moved back and forth inside the coil.
   b. The coil is moved back and forth over the magnet.
   c. The magnet is connected to the closed circuit.
   d. two of the above
3. You can create more current by moving the coil or magnet in question 2
   a. slower.
   b. faster.
   c. farther.
   d. none of the above
4. Devices that use electromagnetic induction include
   a. electric motors.
   b. electric generators.
   c. electric transformers.
   d. two of the above.
5. An electric generator uses kinetic energy to
   a. rotate a coil of wire.
   b. create a magnetic field.
   c. reverse the poles of an electromagnet.
   d. change the voltage of electric current.
6. When alternating current flows through coil P of an electric transformer, it
   a. changes to direct current.
   b. magnetizes an iron core.
   c. repels a magnetic field.
   d. charges a battery.
7. Increasing the voltage of current leaving a power plant causes the
   a. amount of current to increase.
   b. amount of current to decrease.
   c. direction of current to change.
   d. two of the above

Lesson 25.3: Matching

Name___________________ Class______________ Date________

Match each definition with the correct term.

Definitions

_____ 1. process of generating electric current with a changing magnetic field

_____ 2. device that uses electromagnetic induction to increase the voltage of electric current

_____ 3. device in a power plant that provides kinetic energy to the electric generator

_____ 4. idea that a changing magnetic field produces an electric current

_____ 5. device that changes kinetic energy to electrical energy through electromagnetic induction

_____ 6. device that uses electromagnetic induction to decrease the voltage of electric current

_____ 7. device that measures the amount of current flowing through a wire

Terms

a. electric generator

b. ammeter

c. step-up transformer

d. turbine

e. electromagnetic induction

f. step-down transformer

g. Faraday's law

Lesson 25.3: Fill in the Blank

Name___________________ Class______________ Date________

Fill in the blank with the appropriate term.

1. If a magnet moves inside a coil of wire that is part of a circuit, it produces __________.
2. An electric generator is a(n) __________ in reverse.
3. The electric generator in a car produces __________ electric current.
4. A(n) __________ consists of two wire coils wrapped around an iron core.
5. In a step-down transformer, coil P has __________ turns of wire than coil S.
6. A power plant may use a(n) __________ to change the voltage of current before it travels to homes.
7. A(n) __________ is used to change the voltage of current from a power plant before it enters a home.

Lesson 25.3: Critical Writing

Name___________________ Class______________ Date________

Thoroughly answer the question below. Use appropriate academic vocabulary and clear and complete sentences.

Explain why an electric transformer does not work with direct current.

CHAPTER 26 CK-12 Physical Science for Middle School Workbook Answers

Chapter Outline

26.1 Chapter 1: The World of Science

Lesson 1.1: What is Science?

True or False

1. false
2. false
3. false
4. true
5. false
6. false
7. false
8. true
9. false
10. true

Critical Reading

1. A scientific theory is a broad explanation for why things happen in the natural world, whereas a scientific law just describes how things happen the natural world.
2. *Sample answer*: I disagree. A theory never becomes a law, no matter how much evidence is found to support it, because a theory is an explanation, whereas a law is just a description. A theory answers "why" questions. A law answers "how" questions.
3. The statement is a scientific law because it describes how matter behaves. It isn't a theory because it doesn't explain why matter behaves that way.

Multiple Choice

1. d
2. d
3. a
4. b
5. a
6. b
7. c

Matching

1. g
2. f
3. e
4. b

5. c
6. d
7. a

Fill in the Blank

1. science
2. induction
3. theory
4. law
5. Thales
6. Copernicus
7. evidence

Critical Writing

Sample answer: To "think like a scientist" means to be curious about the world. A scientist wonders why things happen and how things work. To think like a scientist also means answering questions on the basis of evidence and logic.

Lesson 1.2: The Scope of Physical Science

True or False

1. true
2. false
3. true
4. true
5. false
6. false
7. true
8. false
9. true
10. true

Critical Reading

1. Answers may vary. Sample answer: Physical science is the study of what things are made of and how things move and change. For example, physical science explains why fireworks explode.
2. *Sample answer*: I think an expert in chemistry would study problem A (create a fuel that produces less pollution when it burns), because chemistry includes the structure and properties of matter and chemical reactions such as burning. I think an expert in physics would study problem B (design a car with a shape that has less air resistance), because physics includes motion and forces.

Multiple Choice

1. d

2. a
3. a
4. d
5. d
6. c

Matching

1. c
2. g
3. d
4. a
5. e
6. b
7. f

Fill in the Blank

1. energy
2. energy
3. Chemistry
4. forces
5. energy
6. physics
7. physical

Critical Writing

Answers may vary. *Sample answer*: I agree that physical science underlies all science, including life science. Physical science is the study of matter and energy, and all things in the universe, including living things, consist of matter and have energy.

26.2 Chapter 2: Scientific Research and Technology

Lesson 2.1: Scientific Investigation

True or False

1. false
2. true
3. false
4. true
5. true
6. false
7. false
8. false
9. true
10. true

Critical Reading

1. To be used as a scientific hypothesis, a statement must be testable. It must be possible to gather information to show whether the statement is false if it really is false.
2. Examples will vary. *Sample answer*: An example of a statement that could be a scientific hypothesis is: "Spaghetti cooks more quickly in salt water than in pure water." If it is not true, it should be possible to gather evidence showing that it is not true.

Multiple Choice

1. c
2. a
3. d
4. b
5. c
6. d
7. c

Matching

1. c
2. d
3. f
4. e
5. a
6. g

7. b

Fill in the Blank

1. hypothesis
2. observation
3. dependent
4. replication
5. communicate
6. variable
7. prediction

Critical Writing

Sample answer: Ethical rules are rules for deciding between right and wrong behavior. Scientific research must be guided by ethical rules to ensure that the results are reliable and the research is done safely. Examples of ethical rules for scientific research include reporting research results honestly and telling human subjects about any potential risks of the research. Following the rules furthers both science and society.

Lesson 2.2: Science Skills

True or False

1. false
2. false
3. true
4. false
5. true
6. false
7. true
8. true
9. false
10. false

Critical Reading

1. *Sample answer*: Based on the model, I can infer that a water molecule consists of an atom of oxygen and two atoms of hydrogen. I can also infer that each hydrogen atom shares two electrons with the oxygen atom.
2. Answers may vary. *Sample answer*: Yes, I think the water molecule model meets the criteria of a useful model in science. It represents a real water molecule in important ways. For example, it shows the components of the molecule and how they are arranged. The model is also easier to manipulate than the real thing because an actual water molecule is extremely small.

Multiple Choice

1. d
2. a

3. d
4. d
5. d
6. a
7. a

Matching

1. c
2. d
3. e
4. g
5. b
6. a
7. f

Fill in the Blank

1. kilogram
2. 0
3. 373 K
4. meniscus
5. length
6. 5.3×10^4
7. 6

Critical Writing

Sample answer: In a scientific investigation, a researcher may make and record many measurements. When data are recorded in a spreadsheet or data table, it can be hard to see patterns or trends. Descriptive statistics and graphs help organize the data so patterns and trends are easier to see. Descriptive statistics include the mean and range. The mean is the average value. It gives you an idea of the typical measurement. The range is the total spread of values. It gives you an idea of the variation in the measurements. Graphs can help you visualize a set of data. Bar graphs are especially useful for comparing values for different types of things. Circle graphs are especially useful for showing percents of a whole. Line graphs are especially useful for showing changes over time.

Lesson 2.3: Technology

True or False

1. true
2. true
3. true
4. false
5. false
6. false
7. true

8. true
9. false
10. true

Critical Reading

1. Both technological design and scientific investigation use evidence and logic to solve problems, using a similar process with some of the same steps.
2. Ethical concerns are constraints on many technological designs, and engineers must follow ethical rules. For example, their technological designs must be as safe as possible for people and the environment.
3. *Sample answer*: An ethical constraint on the design of a solar-powered car might be the safety of the car for drivers and passengers.

Multiple Choice

1. d
2. b
3. a
4. b
5. c
6. b
7. c

Matching

1. c
2. g
3. f
4. b
5. a
6. e
7. d

Fill in the Blank

1. technology
2. model
3. science
4. technology
5. nanotechnology
6. fiber optics
7. problem

Critical Writing

Answers may vary. *Sample answer*: I agree with the quotation that "the science of today is the technology of tomorrow" because scientific knowledge is needed to create new technologies. For example, scientific knowledge of light was needed for the invention of the microscope, and scientific knowledge of sound was needed for the invention of sonar.

26.3 Chapter 3: Introduction to Matter

Lesson 3.1: Properties of Matter

True or False

1. false
2. false
3. false
4. true
5. true
6. true
7. false
8. true
9. true
10. false

Critical Reading

1. *Sample **Table** 26.1*:

TABLE 26.1: Mass and Weight

Measure	What It Measures	Instrument Used to Measure It	SI Unit
Mass	amount of matter in an object	balance	kilogram (kg)
Weight	how strongly the force of gravity pulls on an object	scale	newton (N)

2. Gravity does not affect an object's mass, so his mass would have been the same on the moon as on Earth—80 kg.

Multiple Choice

1. a
2. b
3. d
4. c
5. a
6. a
7. d

Matching

1. b
2. g
3. d
4. a
5. e
6. f
7. c

Fill in the Blank

1. energy
2. Weight
3. newton (N)
4. displacement
5. density
6. burn

Critical Writing

Sample answer: Both the tiny speck of dust and I are made of matter. As matter, we both have mass and volume. This means that we are made of particles that take up space.

Lesson 3.2: Types of Matter

True or False

1. true
2. false
3. true
4. false
5. true
6. false
7. true
8. false
9. true
10. false

Critical Reading

1. Elements can be identified by their properties because each element has a unique set of properties that make it different from all other elements. The property of being attracted to a magnet could help you identify the element iron.
2. The idea of elements goes back at least 2500 years, when the Greek philosopher Aristotle proposed that all matter consists of just four elements, which he identified as earth, air, water, and fire. His ideas about elements were accepted for the next 2000 years. Then, scientists started discovering the unique substances such as gold and oxygen that we call elements today. Presently, 92 naturally occurring elements are known.

3. An atom is the smallest particle of an element that still has the element's properties. All the atoms of an element are alike, and they are different from the atoms of all other elements."

Multiple Choice

1. d
2. d
3. b
4. d
5. d
6. d
7. a

Matching

1. e
2. d
3. a
4. f
5. b
6. g
7. c

Fill in the Blank

1. hydrogen
2. atom
3. 92
4. molecule
5. homogeneous
6. sodium chloride (table salt)
7. crystals

Critical Writing

Sample answer: If you combine two different elements, the outcome is a chemical compound if the elements combine chemically and become entirely different substances. If the two elements do not combine chemically and retain their original chemical properties, the outcome is a mixture.

Lesson 3.3: Changes in Matter

True or False

1. false
2. true
3. true
4. false

5. false
6. true
7. true
8. false
9. false
10. false

Critical Reading

1. *Sample answer*: After a physical change has occurred, matter may have a different size, shape, or arrangement.
2. *Sample answer*: You know that the smaller pieces of the log still have the same chemical properties as the original log before it was cut because the smaller pieces can burn just as the larger log does, and the ability to burn (flammability) is a chemical property of matter.
3. *Sample answer*: I could reverse dissolving salt in water by heating the salt water so the water evaporates. After all the water evaporates, the salt would be left behind.

Multiple Choice

1. d
2. c
3. a
4. c
5. a
6. a
7. d

Matching

1. b
2. g
3. d
4. f
5. a
6. e
7. c

Fill in the Blank

1. physical
2. chemical
3. chemical
4. chemical
5. mass
6. physical
7. chemical

Critical Writing

Sample answer: An example of a physical change in matter is tying a knot in a piece of string. The string has a different shape, but it is still string and has the same chemical properties. For example, it would burn if you threw it in a fire. The knot can also be untied to reverse the change. This is another indication that it is a physical change. An example of a chemical change in matter is food spoiling. Spoiled food has a different color and an odor, both of which are signs that a chemical change has occurred. The spoiled food also cannot be changed back to its original form, and this is typical of chemical changes.

26.4 Chapter 4: States of Matter

Lesson 4.1: Solids, Liquids, Gases, and Plasmas

True or False

1. false
2. true
3. false
4. false
5. false
6. false
7. false
8. true
9. false
10. true

Critical Reading

1. *Sample **Table** below*:

TABLE 26.2: States of Matter

State	Particle Movement	Kinetic Energy	Volume	Shape
Solid	least	least	fixed	fixed
Liquid	intermediate	intermediate	fixed	changeable
Gas	greatest	greatest	changeable	changeable

2. According to the kinetic theory of matter, the particles that make up matter have kinetic energy and are constantly moving. At the same time, the particles are attracted to each other. They need a lot of kinetic energy to overcome the force of attraction and move apart. Particles of solids do not have enough energy to move apart. Particles of liquids have enough energy to slide over each other but not move apart. Particles of gases have enough energy to completely overcome the force of attraction and move apart.

Multiple Choice

1. b
2. c
3. a
4. d
5. c
6. d
7. c

Matching

1. c
2. a
3. e
4. g
5. b
6. d
7. f

Fill in the Blank

1. physical
2. water vapor
3. ice
4. surface tension
5. viscosity
6. plasma
7. crystalline

Critical Writing

Sample answer: Matter is anything that has mass and volume. Energy is the ability of matter to change. All matter has energy. Kinetic energy gives matter the ability to move. The atoms and molecules that make up matter have kinetic energy and are constantly moving. Matter with more kinetic energy has particles that move faster. They are better able to pull apart from one another. Differences in the kinetic energy of atoms and molecules explain different states of matter and their properties.

Lesson 4.2: Behavior of Gases

True or False

1. false
2. false
3. true
4. true
5. false
6. true
7. false
8. true
9. false
10. true

Critical Reading

1. Gases exert pressure because their particles are constantly moving and bumping into things. The force of the particles against whatever they bump into creates pressure, which is the amount of force pushing against a given area.

2. As altitude increases, the pressure exerted by Earth's atmosphere decreases. This occurs because there is less air pushing down from above you as you go higher above Earth's surface.

Multiple Choice

1. d
2. d
3. a
4. c
5. b
6. b
7. c

Matching

1. a
2. d
3. g
4. b
5. f
6. e
7. c

Fill in the Blank

1. pressure
2. sea level
3. inverse
4. temperature
5. increases
6. increases
7. decreases

Critical Writing

Sample answer: For a given amount of gas, the gas's pressure, volume, and temperature are related in certain ways. These relationships always hold, so they are called laws. If the temperature of a gas is held constant, increasing the volume of the gas decreases its pressure. This is Boyle's law. If the pressure of a gas is held constant, increasing the temperature of the gas increases its volume. This is Charles's law. If the volume of a gas is held constant, increasing the temperature of the gas increases its pressure. This is Amontons's law.

Lesson 4.3: Changes of State

True or False

1. false
2. false

3. true
4. false
5. true
6. true
7. false
8. true
9. false
10. false

Critical Reading

1. Condensation is the process that changes a gas to a liquid. During this process, particles of a gas lose energy. In the liquid state, the particles move more slowly than they did as a gas.
2. *Sample* ***Table*** *26.3*:

TABLE 26.3: **Energy and Changes of State**

Process	How Energy Changes
Melting	increases
Freezing	decreases
Evaporation	increases
Condensation	decreases
Sublimation	increases
Deposition	decreases

Multiple Choice

1. c
2. a
3. a
4. b
5. d
6. d
7. c

Matching

1. c
2. d
3. a
4. e
5. g
6. b
7. f

Fill in the Blank

1. energy

2. Temperature
3. freezing point
4. 0 (zero)
5. boiling point
6. physical
7. deposition

Critical Writing

Sample answer: All changes of state involve changes in the kinetic energy of particles of matter. During each change of state, matter either loses or gains energy. Temperature is the average kinetic energy of particles of matter, so the temperature of matter always changes with changes of state.

26.5 Chapter 5: Atoms

Lesson 5.1: Inside the Atom

True or False

1. false
2. false
3. true
4. true
5. false
6. true
7. true
8. false
9. true
10. true

Critical Reading

1. Unlike atoms, which are always neutral in charge, ions are always positive or negative in charge because they do not have the same number of electrons as protons. Ions form when atoms gain or lose electrons.
2. Isotopes are atoms of the same element that differ in their number of neutrons. Different isotopes of the same element usually have the same properties because they have the same number of protons.
3. An isotope of carbon with eight neutrons has a mass number of 14 (6 protons + 8 neutrons), so it is called carbon-1#

Multiple Choice

1. c
2. b
3. d
4. c
5. c
6. b
7. a

Matching

1. d
2. c
3. a
4. f
5. g

6. b
7. e

Fill in the Blank

1. atom
2. nucleus
3. protons
4. strong
5. atomic mass unit (amu)
6. atomic
7. mass

Critical Writing

Sample answer: Atomic number is the number of protons in an atom. Atomic number is the same for all atoms of an element because they all have the same number of protons. Atoms often have the same number of neutrons as protons, but not always. Even atoms of the same element may have a different number of neutrons. Having different numbers of neutrons gives them different mass numbers because mass number is the sum of protons and neutrons in an atom.

Lesson 5.2: History of the Atom

True or False

1. true
2. false
3. false
4. false
5. true
6. true
7. false
8. false
9. false
10. true

Critical Reading

1. Rutherford tested the hypothesis that positive charge is spread evenly throughout an atom (Thomson's plum pudding model).
2. His results did not support the hypothesis. If the hypothesis were true, alpha particles should have changed course slightly as they passed through the gold foil. Instead, most of the alpha particles passed straight through the foil and a few bounced back as though they had struck a wall.
3. From the results of his experiments, Rutherford concluded that all the positive charge of an atom is concentrated in a small central area of the atom, which he called the nucleus.

Multiple Choice

1. a
2. d
3. a
4. a
5. b
6. d
7. c

Matching

1. d
2. b
3. f
4. a
5. g
6. c
7. e

Fill in the Blank

1. Dalton
2. atoms
3. electron
4. Rutherford
5. neutrons
6. uncuttable
7. compounds

Critical Writing

Sample answer: Rutherford sent beams of positive alpha particles toward a very thin sheet of gold foil and observed how the alpha particles moved after they struck the foil. A few of the alpha particles bounced back from the foil but most passed straight through. This provided indirect evidence that all the positive charge of an atom is concentrated in one tiny area. Rutherford named this area the nucleus.

Lesson 5.3: Modern Atomic Theory

True or False

1. false
2. true
3. false
4. false
5. true
6. false
7. false

8. false
9. true
10. false

Critical Reading

1. Energy levels are areas located at fixed distances from the nucleus of an atom. Electrons can occupy one energy level or another but not the space in between energy levels. Energy levels are like the rungs of a ladder because you can stand on one rung or another but not in between rungs.
2. In the model atom, energy level 6 has the most energy because it is the energy level farthest from the nucleus.
3. When chemicals in fireworks explode, their atoms absorb energy and some of their electrons jump to higher energy levels. When the electrons move back to their original energy levels, they give off the energy as light.

Multiple Choice

1. a
2. d
3. b
4. d
5. c
6. d
7. d

Matching

1. g
2. a
3. c
4. f
5. b
6. e
7. d

Fill in the Blank

1. Bohr's
2. nucleus
3. energy
4. waves
5. Orbitals
6. eight
7. lower

Critical Writing

Sample answer: Because of the wave nature of electrons, electrons only have a certain chance of being in any particular place. They do not travel in fixed paths, so their exact locations cannot be determined. The electron cloud model is a way of representing the possible locations of electrons in an atom. The electron cloud is an area around the nucleus where electrons are likely to be. Some areas of the electron cloud are denser than others. These denser areas, called orbitals, are where electrons are most likely to be.

26.6 Chapter 6: Periodic Table

Lesson 6.1: How Elements Are Organized

True or False

1. true
2. false
3. false
4. false
5. true
6. false
7. false
8. true
9. false
10. true

Critical Reading

1. In the most periods of the modern periodic table, 18 elements are placed in a period (row) before the pattern repeats.
2. Within each period of the periodic table, the elements range from metals on the left to metalloids and then to nonmetals on the right.
3. Within each group of the periodic table, the number of protons (atomic number) increases from the top to the bottom of the table.

Multiple Choice

1. a
2. d
3. d
4. d
5. c
6. c
7. c

Matching

1. c
2. b
3. g
4. e
5. f

6. a
7. d

Fill in the Blank

1. Mendeleev
2. increases
3. increases
4. families
5. metals
6. 1
7. 18

Critical Writing

Sample answer: Both periodic tables have a repeating pattern, but the pattern is based on atomic mass in Mendeleev's table and on atomic number in the modern table. In each table, atomic mass or atomic number increases from left to right across each period and from top to bottom within each group. Because fewer elements had been discovered when Mendeleev created his table, his table contains fewer elements than the modern periodic table.

Lesson 6.2: Classes of Atoms

True or False

1. true
2. false
3. false
4. false
5. true
6. true
7. true
8. false
9. false
10. false

Critical Reading

1. Valence electrons are electrons in the outer energy level of an atom.
2. The number of valence electrons determines an element's reactivity, or how likely the element is to react with other elements.
3. Some nonmetals, such as fluorine, have an outer energy level that is almost full. They "want" to gain electrons so they will have a full outer energy level. As a result, these nonmetals are very reactive. Other nonmetals, such as neon, have a completely full outer energy level. Their electrons are already in the most stable arrangement possible, so they are unreactive.

Multiple Choice

1. d
2. b
3. c
4. d
5. a
6. d
7. d

Matching

1. c
2. g
3. b
4. f
5. e
6. d
7. a

Fill in the Blank

1. metals
2. malleable
3. nonmetals
4. metalloids
5. valence
6. solid
7. metals

Critical Writing

Sample answer: The number of valence electrons determines whether an element can conduct electric current, which is the flow of electrons. Metals have few valence electrons, so they "want" to give up their few valence electrons to have a full outer energy level. As a result, metals are very good conductors of electricity. Some nonmetals have an outer energy level that is almost full. They "want" to gain electrons so they will have a full outer energy level. Because they only accept electrons and do not give them up, they cannot conduct electricity. Other nonmetals have a completely full outer energy level. Their electrons are already in the most stable arrangement possible, so they do not give up electrons or conduct electricity.

Lesson 6.3: Groups of Elements

True or False

1. false
2. true
3. true
4. false

5. false
6. true
7. false
8. false
9. false
10. false

Critical Reading

1. Groups 13–16 all contain one or more metalloids.
2. *Sample **Table** 26.4*:

TABLE 26.4: Groups 13–16

Group Number & Name	Number of Elements by Class	Number of Valence Electrons	Reactivity	State(s) at Room Temperature
Group 13 Boron group	4 metals 1 metalloid 0 nonmetals	3	fairly reactive	0 gases 5 solids
Group 14 Carbon group	2 metals 2 metalloids 1 nonmetal	4	not very reactive	0 gases 5 solids
Group 15 Nitrogen group	1 metal 2 metalloids 2 nonmetals	5	differ in reactivity	1 gas 4 solids
Group 16 Oxygen group	1 metal 1 metalloid 3 nonmetals	6	very reactive	1 gas 4 solids

Multiple Choice

1. d
2. a
3. b
4. a
5. c
6. a
7. d

Matching

1. f
2. d
3. a
4. g
5. b
6. e
7. c

Fill in the Blank

1. group
2. alkali
3. two
4. transition
5. metalloids
6. halogens
7. noble gases

Critical Writing

Sample answer: The most reactive of all elements are those that need to either gain or lose just one valence electron in order to have a filled outer energy and the most stable arrangement of electrons. These elements are the alkali metals (1 valance electron) and the halogens (7 valence electrons). Elements that need to either gain or lose two valence electrons are also very reactive. These elements are the alkaline Earth metals (2 valence electrons) and the elements in the oxygen group (6 valence electrons). Elements that have 4 or 5 valence electrons are less likely to gain or lose valence electrons, so they are not very reactive. Elements that have 8 valence electrons already have a filled outer energy level, so these elements (the noble gases)

26.7 Chapter 7: Chemical Bonding

Lesson 7.1: Introduction to Chemical Bonds

True or False

1. false
2. false
3. true
4. false
5. false
6. true
7. true
8. true
9. false
10. false

Critical Reading

1. In a water molecule, each hydrogen atom shares a pair of valence electrons with the oxygen atom—its own valence electron and one of the six valence electrons of oxygen.
2. Atoms share electrons because it gives each atom a full outer energy level. This is more stable arrangement of electrons that takes less energy to maintain.

Multiple Choice

1. b
2. c
3. a
4. a
5. c
6. d
7. d

Matching

1. e
2. c
3. f
4. g
5. b
6. d
7. a

Fill in the Blank

1. water
2. H_2O
3. two
4. CO_2
5. carbon monoxide
6. bonds
7. metallic

Critical Writing

Sample answer: Elements can combine chemically in many different ways. When they do, they form new unique substances called compounds. Therefore, although there are fewer than 100 naturally occurring elements, they can form millions of different compounds.

Lesson 7.2: Ionic Bonds

True or False

1. false
2. true
3. false
4. false
5. true
6. false
7. false
8. true
9. false
10. false

Critical Reading

1. The crystal structure of ionic compounds is strong and rigid because it consists of many oppositely charged ions held together by strong ionic bonds.
2. Ionic compounds have high melting and boiling points, are brittle, and are poor conductors of electricity except as liquids or when dissolved in water.
3. Ionic compounds are solids at room temperature because of their high melting points. They cannot conduct electricity in the solid state because their strong ionic bonds lock the ions into place in the crystal. Therefore, they do not have freely moving electrons that could carry electric current.

Multiple Choice

1. b
2. c
3. c
4. c
5. d

6. b
7. d

Matching

1. e
2. c
3. f
4. b
5. g
6. a
7. d

Fill in the Blank

1. ionic
2. positive
3. loses
4. one
5. gains
6. positive (or metallic)
7. bromide

Critical Writing

Sample answer: The crystal structure of ionic compounds is very strong. It takes a lot of energy to break all those ionic bonds. As a result, ionic compounds are solids with high melting and boiling points. Ionic crystals are also rigid. This makes ionic compounds brittle and likely to shatter when struck. Ionic bonds are strong, so ions in a crystal are locked into place in the solid state. They cannot move freely and carry electric current, so ionic compounds are poor conductors of electricity as solids.

Lesson 7.3: Covalent Bonds

True or False

1. false
2. false
3. true
4. false
5. true
6. false
7. false
8. true
9. true
10. false

Critical Reading

1. A covalent bond is a bond that forms when two atoms share a pair of valence electrons. A covalent compound is a compound in which atoms of different nonmetal elements are joined together by covalent bonds.
2. Properties of covalent compounds include relatively low melting and boiling points. Covalent compounds are also poor conductors of electricity, and many are unable to dissolve in water.
3. Covalent compounds are poor conductors of electricity because their shared valence electrons are not free to move and carry electric current.

Multiple Choice

1. d
2. d
3. a
4. b
5. a
6. b
7. a

Matching

1. g
2. d
3. e
4. a
5. b
6. c
7. f

Fill in the Blank

1. share
2. nonmetals
3. electrons
4. two
5. oxygen
6. solid
7. hydrogen

Critical Writing

Sample answer: Water has a relatively high boiling point for a covalent compound because water molecules are polar. The oxygen atom in each water molecule attracts electrons more strongly than the two hydrogen atoms do. As a result, a water molecule is slightly negative on one end and slightly positive on the other end. The oppositely charged ends of nearby water molecules form hydrogen bonds that hold the molecules together. These hydrogen bonds must be broken in order for water molecules to separate and for liquid water to change to gaseous water vapor. This takes extra energy and gives water a relatively high boiling point.

Lesson 7.4: Metallic Bonds

True or False

1. true
2. false
3. true
4. true
5. false
6. false
7. false
8. true
9. false
10. false

Critical Reading

1. Metallic bonding is the force of attraction between positive metal ions and valence electrons, both their own valence electrons and those of other metal ions around them. Metallic bonding occurs because metals "want" to give up their valence electrons. This means that their valence electrons move freely, forming a "sea" of negative charge surrounding the positive ions.
2. A metallic lattice is a lattice-like structure that consists of many positive metal ions within a "sea" of electrons, all held together by metallic bonding.
3. Metals can change shape without breaking because a metallic lattice is flexible. The ions of the metal can move closer together or farther apart within the "sea" of valence electrons without breaking the metallic bonds that hold them together.

Multiple Choice

1. c
2. b
3. d
4. c
5. a
6. a

Matching

1. d
2. g
3. f
4. c
5. e
6. a
7. b

Fill in the Blank

1. positive
2. electrons
3. ductile
4. malleable
5. carbon
6. bronze
7. copper

Critical Writing

Sample answer: Metallic bonds form between positive metal ions and the "sea" of valence electrons surrounding them. The electrons are freely moving, which makes metals good conductors of electricity. Because metallic bonds form a flexible lattice structure, metal ions can move within the lattice without breaking the bonds. As a result, metals can change shape without breaking. For example, they are both ductile and malleable.

26.8 Chapter 8: Chemical Reactions

Lesson 8.1: Introduction to Chemical Reactions

True or False

1. false
2. false
3. false
4. true
5. true
6. true
7. false
8. false
9. true
10. false

Critical Reading

1. A chemical reaction is a process in which some substances change into different substances.
2. Reactants are substances that start a chemical reaction. Products are substances that are produced in the reaction. Both reactants and products can be elements or compounds. In a chemical reaction, bonds break in reactants and new bonds form in products. Reactants and products contain the same atoms, but they are rearranged during the reaction. As a result, products have different combinations of atoms than reactants do, so they are different substances.

Multiple Choice

1. b
2. a
3. a
4. c
5. d
6. b

Matching

1. e
2. d
3. g
4. f
5. c
6. a

7. b

Fill in the Blank

1. break
2. equilibrium
3. chemical reaction
4. products
5. arrow
6. atoms
7. precipitate

Critical Writing

Sample answer: Chemical reactions are processes that change substances called reactants into different substances called products. Matter changes in chemical reactions when chemical bonds break in reactants and new bonds form in products. Both reactants and products have the same atoms but they are arranged differently. This gives the products different chemical compositions and different chemical properties than the reactants.

Lesson 8.2: Chemical Equations

True or False

1. false
2. false
3. false
4. true
5. false
6. false
7. false
8. true
9. true
10. true

Critical Reading

1. The law of conservation of mass states that matter cannot be created or destroyed in chemical reactions.
2. Lavoisier measured the mass of reactants and products in many different chemical reactions. He carried out the reactions inside a sealed glass jar so none of the products escaped. In every case, the total mass of the jar and its contents was the same after the reaction as it was before the reaction occurred. This showed that matter was neither created nor destroyed.

Multiple Choice

1. c
2. c
3. c

4. d
5. a
6. c

Matching

1. d
2. e
3. g
4. c
5. b
6. a
7. f

Fill in the Blank

1. CO_2
2. 2
3. conservation of mass
4. Lavoisier
5. coefficients
6. mass
7. Lavoisier

Critical Writing

Sample answer: According to the law of conservation of mass, matter can be neither created nor destroyed in chemical reactions. Chemical equations are a shorthand way to represent chemical reactions. To show that mass is conserved in chemical reactions, chemical equations must be balanced. This means that there must be the same number of each type of atom in the products as there are in the reactants.

Lesson 8.3: Types of Chemical Reactions

True or False

1. true
2. true
3. false
4. false
5. false
6. true
7. false
8. false
9. true
10. true

Critical Reading

1. A combustion reaction is a chemical reaction in which a substance reacts quickly with oxygen.
2. The reactants in any combustion reaction are a fuel and oxygen. The products in any combustion reaction are carbon dioxide and water.
3. Both methane and glucose are substances that are used as fuels. Methane is a hydrocarbon, or a compound that contains only hydrogen and carbon. It is the main component of natural gas, which is burned in furnaces and gas stoves. Glucose is a sugar, and it is composed by hydrogen, carbon, and oxygen. It is burned in living cells in the process of cellular respiration to provide energy for life processes.

Multiple Choice

1. d
2. c
3. d
4. b
5. d
6. c
7. b

Matching

1. c
2. e
3. a
4. b
5. g
6. d
7. f

Fill in the Blank

1. synthesis
2. decomposition
3. decomposition
4. single replacement
5. double
6. ions
7. water

Critical Writing

Sample answer: Both single and double replacement reactions involve the exchange of charged particles called ions. In a single replacement reaction, one of the ions in a single ionic compound is replaced by another ion. In a double replacement reaction, two ionic compounds exchange ions, so two new ionic compounds are produced.

Lesson 8.4 Worksheet Answer Key

True or False

1. true
2. true
3. false
4. false
5. true
6. false
7. false
8. true
9. false
10. true

Critical Reading

1. The law of conservation of energy states that energy cannot be created or destroyed.
2. The energy that is absorbed in an endothermic reaction is stored in the chemical bonds of the products of the reaction.
3. In an exothermic reaction, the reactants have more stored chemical energy than do the products.

Multiple Choice

1. c
2. c
3. b
4. d
5. d
6. b
7. a

Matching

1. g
2. b
3. e
4. f
5. a
6. d
7. c

Fill in the Blank

1. exothermic
2. endothermic
3. exothermic
4. endothermic

5. quickly
6. increases
7. activation

Critical Writing

Sample answer: All chemical reactions—even exothermic reactions—require activation energy to begin for several reasons. Energy is needed for particles of reactants to move so they can come together and react. Energy may also be needed to overcome forces that push reactants apart. Still more energy is needed to start breaking bonds in reactants.

26.9 Chapter 9: Chemistry of Carbon

Lesson 9.1: Properties of Carbon

True or False

1. true
2. true
3. false
4. false
5. false
6. true
7. false
8. false
9. false
10. true

Critical Reading

1. Polymers are large molecules made up of smaller molecules called monomers, which are joined together by covalent bonds.
2. Like polymers, strings of beads are made up of small units (individual beads) that are joined together. The beads may be all the same or different, just as the monomers making up a polymer may be all the same or different.
3. Plastics are synthetic polymers. They are made in factories in synthesis reactions in which monomers bond together to form larger molecules.

Multiple Choice

1. d
2. d
3. c
4. c
5. d
6. d

Matching

1. b
2. f
3. e
4. d
5. a

6. g
7. c

Fill in the Blank

1. carbon
2. nonmetals
3. four
4. covalent
5. double
6. crystals
7. structural formula

Critical Writing

Sample answer: The three forms of crystalline carbon are diamond, graphite, and fullerenes. Although all three substances consist only of carbon atoms, they have different structures. Diamond has a strong, rigid, three-dimensional structure, which makes diamond extremely hard. Graphite is formed of layers of carbon atoms. Bonds are strong between carbon atoms within each layer but weak between layers. The weak bonds allow the layers to slide over one another, making graphite relatively soft and slippery. In fullerenes, carbon atoms are arranged in hollow spheres. The atoms are joined by single bonds and form a pattern similar to the surface of a soccer ball.

Lesson 9.2: Hydrocarbons

True or False

1. false
2. true
3. false
4. false
5. false
6. true
7. false
8. true
9. true
10. true

Critical Reading

1. The two basic classes of hydrocarbons are saturated hydrocarbons and unsaturated hydrocarbons. Saturated hydrocarbons contain only single bonds between carbon atoms. Unsaturated hydrocarbons contain at least one double or triple bond between carbon atoms.
2. Alkanes, alkenes, and alkynes are all types of hydrocarbons. Alkanes are saturated hydrocarbons, so they have only single bonds between carbon atoms. Alkenes and alkynes are unsaturated hydrocarbons. Alkenes have at least one double bond between carbon atoms, and alkynes have at least one triple bond between carbon atoms. All three types of hydrocarbons may have straight-chain, branched-chain, or cyclic molecules, but cyclic molecules are very rare in alkynes.

3. Aromatic hydrocarbons are cyclic alkenes that have a strong aroma. They have alternating single and double bonds between carbon atoms.

Multiple Choice

1. c
2. b
3. d
4. d
5. a
6. d
7. c

Matching

1. f
2. d
3. b
4. g
5. a
6. e
7. c

Fill in the Blank

1. hydrogen
2. methane
3. carbon
4. isomer
5. ethene
6. fuels
7. fossil fuels

Critical Writing

Sample answer: I agree that hydrocarbons are the "driving force of western civilization." Coal and other hydrocarbon fuels provided the energy to run locomotives, steam ships, and factories that allowed western civilization to become industrialized. These fuels continue to provide much of the energy we still rely on in the west. For example, gasoline and diesel fuel provide most of the energy for modern transportation. Hydrocarbon fuels such as coal are also used to provide much of the electricity that makes modern western civilization possible.

Lesson 9.3: Carbon and Living Things

True or False

1. true
2. false

3. false
4. false
5. true
6. false
7. false
8. false
9. true
10. true

Critical Reading

1. A nucleotide contains a phosphate group, a sugar, and one of four different nitrogen-containing bases. A nucleotide chain consists of many linked nucleotides. The sugars and phosphate groups of the nucleotides make up the "backbone" of the chain, and nitrogen bases stick out to the side from the backbone.
2. Nitrogen bases on the two nucleotide chains of DNA form hydrogen bonds with each other. These bonds hold together the two chains and give DNA its double helix shape.
3. DNA contains the genetic code and stores genetic information in the cells of all living things. RNA "reads" the genetic code in DNA and is involved in the synthesis of proteins based on the code.

Multiple Choice

1. d
2. b
3. a
4. d
5. a
6. b
7. b

Matching

1. f
2. b
3. e
4. d
5. g
6. a
7. c

Fill in the Blank

1. biochemical
2. starches
3. phospholipids
4. nucleotides
5. sugars
6. proteins
7. unsaturated

Critical Writing

Sample answer: All compounds found in living things are carbon-based compounds. Carbon is the basis of the four main classes of biochemical compounds: carbohydrates, lipids, proteins, and nucleic acids. These four classes of compounds make up the cells and tissues of organisms. They are also involved in life processes, such as making and using food for energy. For example, carbohydrates provide cells with energy and are also used to store energy. Lipids provide energy as well as making up cell membranes of all living things. Proteins have many functions, such as regulating life processes and speeding up biochemical reactions. Nucleic acids store and use genetic information. For these reasons, it is justified to claim that "carbon is the most important element in living things."

Lesson 9.4: Biochemical Reactions

True or False

1. false
2. true
3. false
4. true
5. false
6. false
7. true
8. false
9. false
10. false

Critical Reading

1. Enzymes are biochemical catalysts that speed up chemical reactions in living things. Most enzymes are proteins.
2. Human body temperature must remain within a narrow range around 37 °C (98.6 °F). At this temperature, most biochemical reactions would occur too slowly to keep us alive. Enzymes speed up the biochemical reactions so they can occur quickly enough to support life processes.
3. Amylase is found in saliva in the mouth. It catalyzes the breakdown of starches to sugars. Pepsin is found in fluid in the stomach. It catalyzes the breakdown of proteins into amino acids.

Multiple Choice

1. c
2. d
3. d
4. c
5. a
6. d

Matching

1. d
2. b

3. g
4. c
5. e
6. f
7. a

Fill in the Blank

1. cellular respiration
2. sun
3. chemical
4. water
5. proteins
6. digestion
7. proteins

Critical Writing

Sample answer: Photosynthesis and cellular respiration together provide energy to almost all of Earth's organisms. In photosynthesis, plants and certain other organisms use light energy to make glucose and oxygen from carbon dioxide and water. In cellular respiration, living things release energy by breaking down glucose (with oxygen) and produce carbon dioxide and water. The products of photosynthesis are the reactants of cellular respiration, and the products of cellular respiration are the reactants of photosynthesis. Therefore, cellular respiration and photosynthesis are related in a circular way.

26.10 Chapter 10: Chemistry of Solutions

Lesson 10.1: Introduction to Solutions

True or False

1. false
2. true
3. false
4. false
5. true
6. true
7. false
8. false
9. false
10. true

Critical Reading

1. A solute is the substance that dissolves in a solution. The substance it dissolves in is the solvent. For example, in ocean water, salt is the solute and water is the solvent.
2. If the solute and solvent are in different states of matter, the solute changes to the same state as the solvent. If the solute and solvent are already in the same state, the substance present in greater quantity is the solvent.

Multiple Choice

1. d
2. b
3. a
4. c
5. d
6. b
7. b

Matching

1. c
2. g
3. d
4. f
5. b
6. a
7. e

Fill in the Blank

1. solution
2. salt
3. nitrogen
4. ions
5. molecules
6. polar
7. freezing

Critical Writing

Sample answer: More of a solid solute dissolves in a given amount of solvent if it has a higher temperature. Therefore, to increase the amount of sugar that will dissolve in a given amount of water, you could heat the water to raise its temperature.

Lesson 10.2: Solubility and Concentration

True or False

1. false
2. false
3. true
4. true
5. false
6. true
7. true
8. false
9. true
10. true

Critical Reading

1. Solubility is the amount of solute that can dissolve in a given amount of solvent at a given temperature.
2. A saturated solution contains as much solute as can dissolve in the solvent at a given temperature. An unsaturated solution contains less solute than can dissolve in the solvent at a given temperature.
3. A saturated solution of a highly soluble solute contains more solute than does a saturated solution of a less soluble solute (in the same amount of solvent at the same temperature).

Multiple Choice

1. d
2. a
3. b
4. b
5. b
6. b
7. c

Matching

1. d
2. e
3. f
4. g
5. c
6. b
7. a

Fill in the Blank

1. increases
2. decreases
3. increases
4. solution
5. dilute
6. concentrated
7. less

Critical Writing

Sample answer: Sugar is more soluble in water than is salt, so more sugar than salt can dissolve in the same amount of water at the same temperature. The amount of solute in a given amount of solution at a given temperature is the concentration of the solution. There can be more solute in a sugar-water than saltwater solution, so a sugar-water solution can be more concentrated than a saltwater solution.

Lesson 10.3: Acids and Bases

True or False

1. true
2. false
3. false
4. false
5. true
6. true
7. false
8. true
9. false
10. false

Critical Reading

1. Acidity is an important factor for living things because many living things do best within a certain range of pH. For example, many plants grow best in soil that has a pH between 6 and 7, and fish also need a pH close to 7.

2. Acid rain is rain that has a pH lower than the pH of normal rain. The pH may be 4 or even lower. Acid rain forms when certain air pollutants dissolve in water droplets in the air. This makes the water acidic.
3. Acid rain can kill trees and other plants. It can also lower the pH of surface waters such as ponds and lakes, making the water too acidic for fish and many other water organisms to survive.
4. Normal rain is slightly acidic because carbon dioxide in the air dissolves in raindrops, producing a weak acid called carbonic acid. This leads to the formation of underground caves because when acidic rainwater soaks into the ground, it can slowly dissolve rocks, especially if they contain calcium carbonate.

Multiple Choice

1. a
2. d
3. c
4. b
5. d
6. c
7. c

Matching

1. g
2. c
3. e
4. b
5. a
6. d
7. f

Fill in the Blank

1. acids
2. hydrogen
3. Bases
4. hydroxide
5. 7
6. acid
7. water

Critical Writing

Sample answer: Both acids and bases are ionic compounds that separate into individual ions when dissolved in water. When acids dissolve, they form positive hydrogen ions (H^+), but when bases dissolve, they form negative hydroxide ions (OH^-). Acids have a pH less than 7, whereas bases have a pH greater than # Both acids and bases can conduct electricity because they form charged particles in a water solution, but they differ in other properties. For example, acids taste sour and bases taste bitter. Another difference between acids and bases is how they change litmus paper. Acids turn blue litmus paper red; bases turn red litmus paper blue.

26.11 Chapter 11: Nuclear Chemistry

Lesson 11.1: Radioactivity

True or False

1. true
2. true
3. false
4. true
5. true
6. false
7. false
8. true
9. false
10. true

Critical Reading

1. A radioisotope is a radioactive isotope. Its atoms have unstable nuclei that give off radiation.
2. For a small nucleus with relatively few protons to be stable, it should have a 1:1 ratio of neutrons to protons. For a large nucleus with many protons to be stable, it should have about a 2:1 or even 3:1 ratio of neutrons to protons. For very large nuclei with more than 83 protons, no ratio of neutrons to protons is stable.

Multiple Choice

1. d
2. c
3. d
4. b
5. b
6. d

Matching

1. d
2. f
3. c
4. b
5. a
6. g
7. e

Fill in the Blank

1. element
2. uranium
3. neutrons
4. Geiger counter
5. cancer
6. carbon-14
7. 83

Critical Writing

Sample answer: Long-term exposure to radiation can damage biochemical molecules such as DNA and eventually cause cancer. Radiation that is taken up by cancer cells can be used to the kill the cells and cure cancer. Therefore, the statement that radiation can both cause and cure cancer is true, even though the statement sounds contradictory.

Lesson 11.2: Radioactive Decay

True or False

1. true
2. false
3. true
4. false
5. false
6. false
7. true
8. false
9. false
10. false

Critical Reading

1. Radioactive dating is the use of radioactive isotopes to estimate the ages of fossils and rocks.
2. Carbon-14 forms in Earth's atmosphere when cosmic rays strike atoms of nitrogen-14. Living things take in and use carbon-14, just as they do carbon-12.
3. Carbon-14 taken in by a living organism gradually decays to nitrogen-14. However, it is constantly replaced as the organism continues to take in carbon-14. As a result, the amount of carbon-14 in a living organism remains constant as long as the organism is alive. After the organism dies, the carbon-14 it already contains continues to decay, but it is no longer replaced. Therefore, the carbon-14 in a dead organism constantly declines at a fixed rate equal to the half-life of carbon-14.
4. If you measure how much carbon-14 is left in a fossil, you can determine how many half-lives (and years) have passed since the organism died.

Multiple Choice

1. d
2. b

3. d
4. b
5. c
6. d
7. a

Matching

1. c
2. f
3. e
4. g
5. b
6. a
7. d

Fill in the Blank

1. nuclear
2. Alpha
3. electron
4. helium
5. alpha particle
6. half-life
7. Gamma

Critical Writing

Sample answer: In the forms of radioactive decay called alpha decay and beta decay, the number of protons in the nucleus changes. This results in one element changing into another, because each element has a unique number of protons. In alpha decay, the nucleus emits two protons and two neutrons, so the nucleus changes to the element that has two fewer protons. In beta decay, a neutron in the nucleus breaks down to form a proton and an electron. Only the electron is emitted by the nucleus, so the nucleus changes to the element that has one more proton.

Lesson 11.3: Nuclear Energy

True or False

1. true
2. false
3. true
4. false
5. false
6. false
7. true
8. false
9. true
10. false

Critical Reading

1. In Einstein's equation, $E = mc^2$, E stands for energy, m stands for mass, and c stands for the speed of light.
2. According to Einstein's equation, the amount of energy in a given amount of matter equals the mass of the matter multiplied by the square of the speed of light.
3. Einstein's equation is so important because it changed how scientists view matter and energy, which are two of the most basic concepts in science. The equation shows that matter and energy are two forms of the same thing. It also shows how matter and energy are related.
4. Einstein's equation explains why nuclear fission and nuclear fusion produce so much energy. When a nucleus undergoes fission or fusion, a tiny amount of matter is changed to energy. The amount of mass is tiny, but it results in a great deal of energy. That's because the mass of the matter that is converted to energy is multiplied by the square of the speed of light, which is a very large number.

Multiple Choice

1. b
2. d
3. b
4. c
5. b
6. c
7. a

Matching

1. c
2. d
3. e
4. a
5. g
6. b
7. f

Fill in the Blank

1. neutrons
2. nuclear fission
3. waste
4. radiation
5. Nuclear fusion
6. fusion
7. fusion

Critical Writing

Sample answer: The pros of using nuclear fusion for energy include that it involves harmless elements (hydrogen and helium), produces no air pollution or harmful waste products, and uses a very plentiful fuel (hydrogen). The main pro of using nuclear fission for energy is that it produces no air pollution. The major con of using nuclear fusion for energy is the lack of technology for containing the extremely hot plasma that is needed for fusion to take place. The cons of using nuclear fission include the production of harmful radioactive waste products, the use of dangerous nonrenewable radioisotopes for fuel, and the risk of accidents that could release harmful radiation to the environment.

26.12 Chapter 12: Motion

Lesson 12.1: Distance and Direction

True or False

1. true
2. true
3. false
4. false
5. false
6. false
7. true
8. true

Critical Reading

1. Frame of reference is something that is not moving with respect to an observer that can be used to detect motion.
2. *Sample answer*: A frame of reference helps an observer detect the motion of a moving object by not moving with respect to the moving object.
3. *Sample answer*: If you were standing on a sidewalk and saw a bus go by, you could tell that the bus was moving by comparing its position with other objects that are not moving. Your frame of reference might be trees across the street that would be momentarily blocked from view by the bus passing by.

Multiple Choice

1. b
2. d
3. c
4. d
5. d
6. d

Matching

1. b
2. d
3. g
4. c
5. f
6. a
7. e

Fill in the Blank

1. frame of reference
2. direction
3. arrow
4. motion
5. distance
6. direction
7. distance

Critical Writing

Sample answer: Motion is a change in position. Whenever an object changes position, it moves a certain distance and in a certain direction, so motion involves both distance and direction. A vector is any quantity that includes both size and direction. Therefore, motion is a vector in which size refers to distance moved and direction refers to the direction of movement.

Lesson 12.2: Speed and Velocity

True or False

1. false
2. true
3. false
4. false
5. true
6. false
7. true
8. false
9. false
10. true

Critical Reading

1. Velocity is a measure of both the speed and the direction of motion.
2. Speed does not include direction, whereas velocity includes direction in addition to speed.
3. A vector is a measure that has both size and direction. Velocity and speed both include size, or how quickly an object is moving, but only velocity also includes direction.
4. If velocity is represented by an arrow, the head of the arrow represents direction and the length of the arrow represents speed.

Multiple Choice

1. a
2. c
3. c
4. b
5. c

6. b
7. c

Matching

1. b
2. g
3. c
4. f
5. a
6. d
7. e

Fill in the Blank

1. m/s (meters per second)
2. speed
3. average
4. constant
5. zero
6. direction
7. direction

Critical Writing

Sample answer: Velocity includes both speed and direction. If you know the constant speed and direction of a moving object, you can predict correctly where it will be at a given time. You can calculate the distance it will travel and plot the distance in the given direction from the starting point. If you know only the constant speed and not the direction of a moving object, you can calculate the distance it will travel in a given amount of time, but you won't know the direction that it travels. It could travel in any direction and even in many different directions in the given time and end up in one of many different possible locations.

Lesson 12.3: Acceleration

True or False

1. false
2. false
3. false
4. true
5. true
6. false
7. false

Critical Reading

1. Acceleration is a measure of the change in velocity of a moving object. It shows how quickly velocity changes.

2. Deceleration is negative acceleration. It occurs with a decrease in speed. An example of deceleration is a car slowing down as it approaches a stop sign.
3. Acceleration can occur when speed is constant if direction is changing.

Multiple Choice

1. d
2. d
3. c
4. c
5. b
6. d
7. c

Matching

1. f
2. c
3. g
4. e
5. a
6. b
7. d

Fill in the Blank

1. acceleration
2. vector
3. deceleration
4. time
5. slope
6. zero
7. positive

Critical Writing

Sample answer: A velocity-time graph shows how velocity changes over time. The y-axis represents velocity, and the x-axis represents time. In a velocity-time graph, acceleration is represented by the slope of the graph line. If the line slopes upward, acceleration is positive. If the line slopes downward, acceleration is negative. If the line is horizontal, acceleration is zero.

26.13 Chapter 13: Forces

Lesson 13.1: What is Force?

True or False

1. false
2. true
3. false
4. true
5. false
6. true
7. true
8. false
9. false
10. true

Critical Reading

1. When two forces act on an object in opposite directions, the net force is calculated by subtracting the lesser force from the greater force.
2. When opposing forces are balanced, or equal in strength, they produce a net force of zero. With a net force of zero acting on an object, its motion does not change. If it isn't moving, it remains stationary. If it is moving, its speed and direction stay the same.
3. Unbalanced forces are unequal in strength, so they produce a net force greater than zero. With a net force greater than zero acting on an object, its motion changes. If it is stationary, it starts moving. If it is already moving, its speed and/or direction change.

Multiple Choice

1. d
2. b
3. c
4. c
5. a
6. b
7. a

Matching

1. c
2. d
3. a

4. g
5. f
6. e
7. b

Fill in the Blank

1. force
2. vector
3. 1 N
4. mass
5. strength (size)
6. unbalanced
7. sum

Critical Writing

Sample answer: If forces act on an object in the same direction, the strength of the forces are added to produce a stronger net force. The combined forces cause a greater change in motion than either force acting alone. If forces act on an object in opposite directions, the strength of the forces partially or totally cancel out, so the net force is less than the stronger of the two opposing forces. If the opposing forces are equal in strength, the net force is zero, and the object's motion does not change.

Lesson 13.2: Friction

True or False

1. false
2. true
3. true
4. false
5. true
6. true
7. false
8. false
9. true
10. false

Critical Reading

1. Friction is a force that opposes motion between two surfaces that are touching.
2. Examples may vary. *Sample answer*: An example of friction that is useful is static friction between your shoes and the sidewalk. It prevents you from slipping when you walk. An example of friction that is not useful is sliding friction between moving parts of a machine. It causes heating and wearing out of the parts.
3. Friction occurs because no surface is perfectly smooth. Even surfaces that look smooth to the unaided eye appear rough or bumpy when viewed under a microscope. All those mountains and valleys catch and grab the mountains and valleys of any other surface that contacts it. This creates friction.

Multiple Choice

1. a
2. d
3. a
4. d
5. c
6. d
7. c

Matching

1. e
2. d
3. a
4. b
5. c
6. g
7. f

Fill in the Blank

1. more
2. more
3. Fluid
4. Static
5. sliding friction
6. rolling
7. static

Critical Writing

Sample answer: In the sport of basketball, there is friction between the players' hands and the ball. This friction is helpful because it allows them to catch the ball and hang on to it. There is also friction between the players' shoes and the floor. This friction is helpful because it helps them run on the court without slipping and falling.

Lesson 13.3: Gravity

True or False

1. true
2. false
3. true
4. true
5. false
6. true
7. false
8. true

9. true
10. false

Critical Reading

1. Newton's law of universal gravitation states that all objects in the universe are attracted toward each other. Newton's law also states that more massive objects and objects that are closer together have a greater force of attraction.
2. According Einstein's theory, objects curve toward one another because of curves in space and time that occur around massive bodies. This is different from Newton's idea that objects are attracted to each other by a force.

Multiple Choice

1. c
2. d
3. c
4. c
5. d
6. d
7. d

Matching

1. g
2. e
3. a
4. f
5. d
6. c
7. b

Fill in the Blank

1. gravity
2. 10 newtons (N)
3. weight
4. Newton
5. 9.8 m/s^2
6. projectile
7. orbital

Critical Writing

Sample answer: The moon's gravity is weaker that Earth's gravity. As a result, you would be pulled downward by gravity with less force on the moon than on Earth. Weight is a measure of the force of gravity pulling down on an object, so you would weigh less on the moon than you do on Earth.

Lesson 13.4: Elastic Force

True or False

1. true
2. true
3. false
4. true
5. false

Critical Reading

1. Elasticity is the ability of a material to return to its original shape after being stretched or compressed.
2. Elastic force is the counter force exerted by an elastic material as it is stretched or compressed.
3. If you stretch a rubber band, elastic force is exerted in a direction opposite to the stretching force.

Multiple Choice

1. c
2. b
3. a
4. d
5. d

Matching

1. b
2. e
3. c
4. a
5. d

Fill in the Blank

1. elastic
2. Elastic
3. opposite
4. elastic
5. Springs

Critical Writing

Sample answer: I commonly use elastic force in my gym shorts, bedsprings, and sweat bands. The elastic material in the waistband of my gym shorts stretches so I can put on the shorts. Then elastic force returns the waistband to its original shape so it holds the pants snugly around my waist. The springs in my bed compress with the weight of my body so the bed conforms to my shape and feels more comfortable. When I get out of bed, elastic force returns the springs to their original position so the bed has a flat surface again. The elastic material in my sweatbands allows me to stretch the bands so they fit over my hands. Then elastic force holds the sweatbands tightly in place around my wrists so they don't fall off.

26.14 Chapter 14: Newton's Laws of Motion

Lesson 14.1: Newton's First Law

True or False

1. false
2. false
3. true
4. false
5. true
6. false
7. true
8. false
9. true
10. false

Critical Reading

1. Inertia is the tendency of an object to resist a change in its motion.
2. If an object is already at rest, inertia will keep it at rest. If an object is already moving, inertia will keep it moving.
3. The inertia of an object depends on its mass. Objects with greater mass have greater inertia.

Multiple Choice

1. a
2. c
3. b
4. d
5. c
6. c

Matching

1. f
2. c
3. d
4. e
5. b
6. a

Fill in the Blank

1. inertia
2. unbalanced
3. inertia
4. greater
5. inertia
6. inertia
7. zero

Critical Writing

Sample answer: Newton's first law of motion states that an object's motion will not change unless an unbalanced force acts on the object. If the object is at rest, it will stay at rest. If the object is in motion, it will stay in motion. Newton's first law of motion is also called the law of inertia because inertia is the tendency of an object to resist a change in motion. If an object is already at rest, inertia will keep it at rest. If an object is already moving, inertia will keep it moving. Inertia explains why an unbalanced force must act on an object in order for its motion to change.

Lesson 14.2: Newton's Second Law

True or False

1. false
2. true
3. true
4. true
5. false
6. false
7. true
8. false
9. false
10. false

Critical Reading

1. Weight is a measure of the force of gravity pulling on an object of a given mass.
2. The weight of an object is directly related to its mass. As an object's mass increases, so does its weight. For example, if mass doubles, weight doubles as well.
3. If an object has a mass of 50 kg, its weight is 50 kg $\times$ 9.8 m/s^2, or 490 kg • m/s^2, which equals 490 N.

Multiple Choice

1. d
2. d
3. a
4. d
5. d
6. c

7. a

Matching

1. g
2. f
3. d
4. b
5. e
6. a
7. c

Fill in the Blank

1. Acceleration
2. mass
3. net force
4. 1 m/s^2
5. direct
6. kilograms (kg)
7. zero

Critical Writing

Sample answer: Newton's second law of motion states that the acceleration of an object equals the net force acting on the object divided by the object's mass. This can be represented by the equation:

$$a = \frac{F}{m}$$

You can use this equation to calculate the acceleration of an object if you know its mass and the net force acting on it. For example, if an object has a mass of 10 kg and a net force of 100 N is acting on the object, its acceleration is:

$a = \frac{100\text{ N}}{10\text{ kg}} = 10$ N/kg, or 10 m/s^2

Lesson 14.3: Newton's Third Law

True or False

1. true
2. false
3. false
4. true
5. false
6. true
7. false
8. false
9. false
10. false

Critical Reading

1. Newton's third law of motion states that every action has an equal and opposite reaction.
2. *Sample answer*: An example of an action and reaction that results in motion is hitting a volleyball back over the net. The action is the player's hands striking the ball. The reaction is the ball pushing off the hands and moving in the opposite direction.
3. Action-reaction forces are equal and opposite, and they act on different objects. Balanced forces are also equal and opposite, but they act on the same object, so they cancel out.

Multiple Choice

1. b
2. a
3. d
4. d
5. d
6. c
7. d

Matching

1. g
2. d
3. f
4. e
5. a
6. c
7. b

Fill in the Blank

1. velocity
2. zero
3. 60 kg • m/s
4. opposite
5. different
6. momentum
7. doubles

Critical Writing

Sample answer: In a game of soccer, players repeatedly use action and reaction forces to control movements of the ball. For example, the action of a player kicking the ball has the reaction of the ball moving in the same direction that it was kicked. The action of a goalie blocking the ball has the reaction of the ball changing direction and moving away from the net.

26.15 Chapter 15: Fluid Forces

Lesson 15.1: Pressure of Fluids

True or False

1. true
2. false
3. true
4. false
5. true
6. true
7. false
8. true
9. false
10. false

Critical Reading

1. If you add air to a flat tire through a single small entry hole, the air spreads out to fill the tire because when particles of a fluid are crowded together in one place, they quickly spread out to fill whatever space is available. That's because the particles always move from a region of higher pressure to a region of lower pressure until the pressure is the same throughout.
2. When the same amount of force is applied to a smaller area, pressure increases.
3. If 20 N of force are exerted on an area of 2 m^2, the pressure applied to that area is 20 N/2 m^2 = 10 N/m^2, or 10 Pa.

Multiple Choice

1. b
2. b
3. c
4. c
5. b
6. a
7. a

Matching

1. c
2. d
3. g
4. b

5. e
6. f
7. a

Fill in the Blank

1. Pressure
2. pascal
3. pressure
4. increases
5. sea level
6. Pascal's
7. Bernoulli's

Critical Writing

Sample answer: Pressure and force have a direct relationship. This means that for a given area, pressure increases when force increases and pressure decreases when force decreases. Pressure and area, in contrast, have an inverse relationship. This means that for a given force, pressure increases when area decreases and pressure decreases when area increases.

Lesson 15.2: Buoyancy of Fluids

True or False

1. false
2. false
3. true
4. false
5. false
6. false
7. true
8. false
9. false
10. true

Critical Reading

1. Displacement is the act of an object placed in a fluid in which it moves some of the fluid out of its way. A solid object with a volume of 9 cm^3 displaces 9 cm^3 of water, assuming that the object is completely submerged.
2. The buoyant force acting on an object equals the weight of the fluid displaced by the object.
3. An object floats if the buoyant force acting on the object is greater than the force of gravity acting on the object, which is the object's weight.

Multiple Choice

1. b

2. d
3. a
4. b
5. d
6. c
7. b

Matching

1. g
2. f
3. d
4. a
5. b
6. c
7. e

Fill in the Blank

1. buoyant
2. gravity
3. sink
4. floats
5. volume
6. weight
7. Archimedes'

Critical Writing

Sample answer: I think it is easier to float if you spread out in the water than if you curl up into a ball. When you spread out in the water, your body will displace more water, so the weight of the displaced water will be greater than if you curl up into a ball. This will create greater

26.16 Chapter 16: Work and Machines

Lesson 16.1: Work

True or False

1. true
2. false
3. true
4. true
5. false
6. false
7. false
8. true
9. true
10. true

Critical Reading

1. Power is a measure of the amount of work that can be done in a given amount of time.
2. Power can be calculated by dividing the amount of work done by the amount of time it takes to do the work. Power is expressed as joules per second (J/s) or as watts (W), where 1 watt equals 1 joule of work per second
3. A more powerful device can do more work in the same time or the same work in less time than a less powerful device.

Multiple Choice

1. d
2. b
3. c
4. c
5. c
6. c
7. b

Matching

1. b
2. a
3. d
4. g
5. f
6. e

7. c

Fill in the Blank

1. more
2. joule
3. watt
4. 2
5. more
6. power
7. James Watt

Critical Writing

Sample answer: Work is the use of force to move an object. For work to be done, force must be applied in the same direction that the object moves. If force is applied in a different direction than the object moves, no work is done. For example, if you pick up a box and then walk across the room holding it, you do work when you raise the box because you are applying force in the same direction that the box moves. However, when you walk across the room holding the box, the upward force you use to hold the box is not applied in the same direction that the box is moving. Therefore, you do no more work on the box after you start walking. This example illustrates that not all force that is used to move an object does work on the object.

Lesson 16.2: Machines

True or False

1. false
2. false
3. false
4. true
5. true
6. false
7. true
8. true
9. true
10. false

Critical Reading

1. A machine is any device that makes work easier by changing a force.
2. Machines make work easier by increasing the amount of force that is applied, increasing the distance over which the force is applied, or changing the direction in which the force is applied.
3. The work that is done on a machine or by a machine always equals force multiplied by distance. Because a machine doesn't change the amount of work that is done, a machine that increases force must apply the force over a shorter distance.

Multiple Choice

1. d
2. a
3. a
4. c
5. d
6. a
7. a

Matching

1. d
2. e
3. a
4. b
5. g
6. f
7. c

Fill in the Blank

1. less
2. friction
3. efficiency
4. actual
5. ideal
6. greater
7. less

Critical Writing

Sample answer: Mechanical advantage is the number of times a machine multiplies the input force. The actual mechanical advantage of a machine equals the output force divided by the input force. If a machine has a mechanical advantage of less than one, this means that the output force is less than the input force. In other words, the machine applies less force than is applied to the machine. When this occurs, the machine must apply the force over a greater distance because the product of force and distance, or work, is not changed by the machine. A machine that increases the distance over which force is applied can help you do work. For example, when you paddle a canoe, you move the handle ends of the paddles over a short distance, but the paddle ends move over a longer distance. To cover the greater distance, the paddle ends must move faster. The water pushes back against the fast-moving paddles, causing the canoe to shoot forward.

Lesson 16.3: Simple Machines

True or False

1. false
2. true

3. false
4. false
5. true
6. false
7. true
8. true
9. false
10. true

Critical Reading

1. An inclined plane is a simple machine consisting of a sloping surface that connects lower and higher elevations.
2. An inclined plane is used to move objects uphill against the force of gravity. The sloping surface of the inclined plane supports part of the weight of the object as it moves up the slope, so it takes less force to move the object to a higher elevation.
3. The ideal mechanical advantage of an inclined plane is always greater than 1 because the input distance (the sloped side of the inclined plane) is always greater than the output distance (the maximum height of the inclined plane).

Multiple Choice

1. c
2. a
3. c
4. d
5. c
6. c
7. b

Matching

1. c
2. e
3. f
4. d
5. g
6. a
7. b

Fill in the Blank

1. wedge
2. lever
3. inclined plane
4. moves
5. less
6. direction
7. 2

Critical Writing

Sample answer: Single fixed pulleys are attached to a beam or other secure surface and remain fixed in place. Single moveable pulleys are not attached to a surface and can move. In a single fixed pulley, only one rope segment lifts the object, so the ideal mechanical advantage is 1. This type of pulley changes the direction but not the strength of the force. In a single moveable pulley, two rope segments lift the object, so the ideal mechanical advantage is 2. This type of pulley increases the strength but not the direction of the force.

Lesson 16.4: Compound Machines

True or False

1. true
2. false
3. true
4. false
5. true
6. false
7. true

Critical Reading

1. Compound machines tend to have lower efficiency than simple machines because they have more moving parts. This means they are likely to have more friction to overcome, and efficiency is a measure of how greatly friction reduces the output work of a machine.
2. The mechanical advantage of a compound machine is the product of the mechanical advantages of all of its component simple machines. Therefore, a compound machine that consists of 200 simple machines will have a greater mechanical advantage than a compound machine that consists of just 2 simple machines.

Multiple Choice

1. d
2. b
3. d
4. a
5. b
6. c

Matching

1. b
2. f
3. c
4. a
5. e
6. d
7. g

Fill in the Blank

1. compound
2. fulcrum
3. first
4. wedges
5. second
6. lower
7. greater

Critical Writing

Sample answer: A pair of scissors is an example of a compound machine. It contains two levers and two wedges. The levers are first class levers, so they change the direction of the applied force. The input force is applied to the handle ends of the two levers, and the output force is exerted by the blade ends of the levers. The handle ends allow the user to open and close the blades on the material being cut. The blades are wedges, which are blunt on one edge and sharp on the other edge. The sharp edges of the blades cut the material.

26.17 Chapter 17: Introduction to Energy

Lesson 17.1: Types of Energy

True or False

1. true
2. false
3. false
4. false
5. true
6. true
7. false
8. true
9. true
10. false

Critical Reading

1. Energy conversion is the process in which energy changes from one type or form to another.
2. The diver has kinetic energy as he climbs up the steps to the diving board. The higher he climbs, the more gravitational potential energy he gains. He has only gravitational potential energy as he stands on the diving board above the water. As soon as he jumps off the diving board, his gravitational energy starts changing to kinetic energy again.
3. According to the law of conservation of energy, energy is not used up when it changes from one type to another. Although some energy may be released as heat due to friction, the total amount of energy is conserved.

Multiple Choice

1. c
2. d
3. c
4. b
5. d
6. d
7. d

Matching

1. g
2. f
3. d
4. b

5. e
6. a
7. c

Fill in the Blank

1. energy
2. potential
3. kinetic
4. velocity
5. weight
6. conserved
7. elastic

Critical Writing

Sample answer: Work is done whenever a force is used to move matter. Kinetic energy is the energy of moving matter. Therefore, an object with kinetic energy always does work.

Lesson 17.2: Forms of Energy

True or False

1. true
2. true
3. false
4. true
5. true
6. true
7. true
8. false
9. false
10. false

Critical Reading

1. When a drumstick strikes the drumhead, the kinetic energy of the moving drumstick changes to sound energy because it makes the drumhead vibrate.
2. When wood burns, the chemical energy stored in the wood changes to thermal and light energy.
3. The Energy Star program is a U.S. government program that certifies the energy efficiency of appliances. An "Energy Star" label represents an appliance that uses energy efficiently and thereby reduces energy use.

Multiple Choice

1. c
2. c
3. d

4. b
5. d
6. b
7. b

Matching

1. c
2. d
3. a
4. f
5. g
6. b
7. e

Fill in the Blank

1. Mechanical
2. potential
3. electrical
4. fission
5. Thermal
6. electromagnetic
7. conversion

Critical Writing

Sample answer: A device I commonly use that changes energy from one form to two or more different forms is a hair dryer. It changes electrical energy to thermal energy, mechanical energy, and sound energy. The hair dryer has a fan inside of it that blows air on my hair. The moving fan has mechanical energy. The hair dryer produces heat, which gives it thermal energy and helps dry my hair. The hair dryer also produces noise, which is sound energy.

Lesson 17.3: Energy Resources

True or False

1. true
2. false
3. true
4. false
5. false
6. true
7. false
8. true
9. false
10. true

Critical Reading

1. Renewable resources are natural resources that can be replaced in a relatively short period of time or are virtually limitless in supply.
2. Renewable energy resources are not likely to run out. They also produce little if any pollution and do not contribute to global warming.
3. *Sample answer*: Three renewable energy resources are sunlight, moving water, and biomass. Not all areas get enough sunlight for solar energy to be feasible. Damming rivers to make use of moving water floods lands upstream and reduces water flow to lands downstream. This may destroy ecosystems. Biomass takes land away from food crops, and it produces air pollution and carbon dioxide when burned.

Multiple Choice

1. d
2. d
3. d
4. b
5. d
6. d
7. d

Matching

1. a
2. g
3. d
4. c
5. f
6. b
7. e

Fill in the Blank

1. fossil fuels
2. fission
3. renewable
4. petroleum
5. U.S.
6. petroleum
7. natural gas

Critical Writing

Sample answer: I would choose nuclear energy. Nuclear energy produces no air pollution or carbon dioxide, so it doesn't directly harm people's health or contribute to global warming. These are all drawbacks of using fossil fuels and they affect the entire planet. Dangers of using nuclear energy are the risk of accidents at power plants and the accumulation of radioactive wastes. These problems can potentially be eliminated or greatly reduced with appropriate technology. They are also limited to a relatively small area of the planet.

26.18 Chapter 18: Thermal Energy

Lesson 18.1: Temperature and Heat

True or False

1. false
2. true
3. false
4. false
5. false
6. true
7. false
8. true
9. true
10. false

Critical Reading

1. In physical science, heat is defined as the transfer of thermal energy between objects that have different temperatures.
2. Thermal energy is always transferred from an object with a higher temperature to an object with a lower temperature. Fast-moving particles of the warmer object transfer some of their energy to the slower-moving particles of the cooler object. The particles of the cooler object start moving faster and become warmer, causing the temperature of this object to rise. Because particles of the warmer object lose some of their kinetic energy, the particles of this object start to move more slowly, causing the temperature of the warmer object to fall.
3. The transfer of thermal energy ends when both objects have the same temperature.

Multiple Choice

1. d
2. b
3. b
4. d
5. d
6. d
7. d

Matching

1. d
2. a

3. g
4. c
5. f
6. b
7. e

Fill in the Blank

1. 0 °C
2. moving
3. joule
4. thermometer
5. gaseous
6. less
7. temperatures

Critical Writing

Sample answer: Thermal energy is the total kinetic energy of the particles of an object. Temperature is the average kinetic energy of the particles of an object. The thermal energy of an object depends on its temperature and also on its total number of particles, or mass. When objects have different temperatures, thermal energy is transferred from the object with the higher temperature to the object with the lower temperature, until both objects have the same temperature. The transfer of thermal energy is called heat.

Lesson 18.2: Transfer of Thermal Energy

True or False

1. true
2. false
3. false
4. true
5. true
6. false
7. false
8. true
9. true
10. false

Critical Reading

1. Convection is the transfer of thermal energy by particles moving through a fluid.
2. Particles of soup near the bottom of a pot get hot first. This gives them more energy, so they spread out and become less dense. With lower density, they rise to the top of the pot, transferring some of their thermal energy as they move. By the time they reach the top of the pot, they have cooled. This gives them less energy, so they crowd together and become denser. With higher density, the particles sink to the bottom of the pot, and the cycle repeats. The moving particles form a convection current, which eventually transfers thermal energy throughout all the soup in the pot.

3. Other examples of fluids in which thermal energy is transferred by convection currents include molten rock inside Earth, water in the oceans, and air in the atmosphere.

Multiple Choice

1. b
2. d
3. a
4. d
5. c
6. d
7. a

Matching

1. d
2. e
3. f
4. b
5. g
6. a
7. c

Fill in the Blank

1. conduction
2. conductors
3. insulator
4. lowest
5. wind
6. radiation
7. Radiation

Critical Writing

Sample answer: Conduction works better in solids because it requires direct contact between particles. The particles of solids are close together, so nearby particles can easily collide and transfer thermal energy. Convection occurs when particles actually move from warmer to cooler areas and transfer thermal energy as they move. This can happen only in gases and liquids because the particles of gases and liquids can pull apart from one another and flow, whereas the particles of solids are locked into place.

Lesson 18.3: Using Thermal Energy

True or False

1. false
2. false

3. false
4. true
5. true
6. true
7. false
8. true
9. true
10. false

Critical Reading

1. A cooling system is a system such as an air conditioner or refrigerator that keeps homes, cars, or food cool.
2. A cooling system does the work of reversing the normal direction of heat flow by moving thermal energy from a cooler to a warmer place.
3. In a cooling system, the role of the refrigerant is to absorb thermal energy from cool air and release the energy to warm air.

Multiple Choice

1. d
2. b
3. d
4. b
5. c
6. c
7. d

Matching

1. c
2. g
3. e
4. f
5. a
6. b
7. d

Fill in the Blank

1. cooler
2. rises
3. work
4. refrigerant
5. combustion engine
6. internal
7. external

Critical Writing

Sample answer: An external combustion engine produces thermal energy by burning fuel outside the engine. The thermal energy is used to turn water to steam, and the pressure of the steam moves a piston back and forth in a cylinder. The kinetic energy of the moving piston can be used to do the work of turning a turbine or other device.

26.19 Chapter 19: Waves

Lesson 19.1: Characteristics of Waves

True or False

1. true
2. false
3. false
4. true
5. false
6. true
7. true
8. false
9. true
10. true

Critical Reading

1. A mechanical wave is a disturbance in matter that transfers energy from place to place.
2. A mechanical wave begins when matter is disturbed.
3. The medium of a mechanical wave is the matter through which a mechanical wave travels.
4. Particles of the medium just vibrate in place when a mechanical wave pass through them. They move back-and-forth or up-and-down in one spot, always returning to their original positions.

Multiple Choice

1. d
2. d
3. d
4. d
5. d
6. a
7. c

Matching

1. c
2. f
3. g
4. e
5. b
6. a

7. d

Fill in the Blank

1. transverse
2. crests
3. secondary (S)
4. compressions
5. primary (P)
6. surface
7. surface

Critical Writing

Sample answer: When a mechanical wave passes through a medium, particles of the medium vibrate in place. As they vibrate, they transfer some of their energy to the particles next to them. These particles then vibrate and transfer some of their energy to the particles next to them, and so. The particles pass the energy of the wave from particle to particle in the direction that the wave travels.

Lesson 19.2: Measuring Waves

True or False

1. false
2. true
3. true
4. false
5. false
6. false
7. true
8. true
9. true
10. false

Critical Reading

1. Wave frequency is the number of waves that pass a fixed point in a given amount of time. The SI unit for wave frequency is the hertz (Hz), where 1 hertz equals 1 wave passing a fixed point in 1 second.
2. The frequency of a wave is determined by the frequency of the vibrations that caused the wave.
3. A higher-frequency wave has more energy because the vibrations that cause the wave must occur more rapidly and causing more rapid vibrations requires more energy.

Multiple Choice

1. d
2. d
3. b

4. c
5. b
6. b
7. d

Matching

1. c
2. e
3. g
4. f
5. b
6. d
7. a

Fill in the Blank

1. amplitude
2. energy
3. more
4. more
5. speed
6. inverse
7. solid

Critical Writing

Sample answer;;: In a longitudinal wave, amplitude is measured by how compressed particles of the medium become when the energy of the wave passes through them. The closer together the particles in a compression are, the greater the amplitude of the wave. The wavelength of a longitudinal wave, like the wavelength of a transverse wave, is the distance between two corresponding points on adjacent waves. For example, wavelength could be measured as the distance between two adjacent compressions or between two adjacent rarefactions. The frequency of any wave, including a longitudinal wave, is measured by counting the number of waves that pass a fixed point in a given amount of time. The frequency of a longitudinal wave could be measured by counting the number of compressions or the number of rarefactions that pass the fixed point each second.

Lesson 19.3: Wave Interactions and Interference

True or False

1. false
2. false
3. false
4. true
5. false
6. false
7. true

8. false
9. true
10. false

Critical Reading

1. Diffraction is the spreading out of waves as they travel around a barrier.
2. Diffraction occurs when waves reach an obstacle they cannot pass through or when they pass through an opening in a barrier.
3. How greatly a wave is diffracted depends on the size of the obstacle or opening in the obstacle and the wavelength of the wave.

Multiple Choice

1. a
2. b
3. b
4. b
5. d
6. d
7. a

Matching

1. e
2. c
3. g
4. d
5. b
6. a
7. f

Fill in the Blank

1. reflection
2. reflect
3. diffraction
4. wavelength
5. Constructive
6. refraction
7. incidence

Critical Writing

Sample answer: Reflection, refraction, and diffraction are three different ways that waves may interact with matter, but the nature of the interaction differs in the three ways. Reflection occurs when waves bounce back from an obstacle they cannot pass through. For example, sound waves may be reflected by the wall of a building, creating an echo. Refraction occurs when waves enter a new medium at an angle and change direction as they travel at a different speed in the new medium. For example, light waves are refracted when they pass from air to water, making a pencil in a glass of water appear to be bent. Diffraction occurs when waves reach an obstacle and spread out around the obstacle or through an opening in the obstacle. For example, sound waves spread out around the corner of a building, allowing you to hear sounds around the corner.

26.20 Chapter 20: Sound

Lesson 20.1: Characteristics of Sound

True or False

1. true
2. false
3. false
4. true
5. true
6. false
7. false
8. false
9. false
10. true

Critical Reading

1. Sound waves begin with vibrating matter. The vibrating matter repeatedly pushes against the particles next to it, causing them to vibrate. This starts waves of vibrations that travel through matter in all directions away from the original vibrations. The vibrations travel through matter as longitudinal waves, in which particles vibrate back and forth in the same direction that the waves travel.
2. Robert Boyle placed a ticking clock in a sealed glass jar. The clock could be heard ticking through the air and glass of the jar. Then Boyle pumped the air out of the jar, and the ticking could no longer be heard. This demonstrated that sound waves cannot travel through empty space.
3. Answers may vary. *Sample answer*: I know sounds can travel through liquids because I can hear sounds when I swim underwater. I know sounds can travel through solids because I can hear sounds outside my room even when the door is closed.

Multiple Choice

1. a
2. d
3. d
4. b
5. b
6. a
7. a

Matching

1. a

2. f
3. d
4. g
5. c
6. b
7. e

Fill in the Blank

1. longitudinal
2. Speed
3. more
4. intensity
5. frequency
6. hertz (Hz)
7. Doppler effect

Critical Writing

Sample answer: The loudness of sound to a listener is determined by the intensity of sound. The intensity of sound, in turn, depends on the amplitude of sound waves and the distance they have traveled from the sound source. The closer to the sound source the waves are, the less they have spread out and decreased in intensity. Therefore, as you move closer to the source of a sound, the louder the sound is.

Lesson 20.2: Hearing Sound

True or False

1. false
2. true
3. false
4. true
5. true
6. false
7. true
8. true
9. true
10. true

Critical Reading

1. The outer ear includes the pinna, ear canal, and eardrum. The pinna catches sound waves and funnels them into the ear canal. The ear canal carries sound waves into the ear to the eardrum. The eardrum vibrates when sound waves strike it, and sends the vibrations on to the middle ear.
2. When sound waves are transmitted through the middle ear, the three tiny bones in the middle ear work together like a lever and increase the amplitude of the sound waves.
3. The cochlea is a structure in the inner ear that is shaped like a shell and filled with fluid. The inner surface of the cochlea is lined with hair cells. When the oval window vibrates, the vibrations are passed on to the

cochlea. This causes waves in the cochlear fluid. The waves bend the hair-like projections of hair cells, and this triggers electrical impulses.

Multiple Choice

1. d
2. b
3. c
4. a
5. d
6. d
7. b

Matching

1. d
2. g
3. c
4. b
5. e
6. f
7. a

Fill in the Blank

1. ear
2. deafness
3. Earplugs
4. destructive
5. eardrum
6. oval window
7. pinna

Critical Writing

Sample answer: The most common cause of hearing loss is exposure to loud sounds, which damage hair cells. Even a single brief exposure to sound louder than 115 decibels can cause hearing loss. The hearing loss caused by loud sounds is permanent, so it is important to prevent it from occurring in the first place. Hearing protectors, including simple earplugs and electronic hearing protectors, can greatly reduce exposure to loud sounds and protect hearing. Therefore, anyone who is exposed to loud sounds should wear hearing protectors to prevent damage to their ears and hearing loss.

Lesson 20.3: Using Sound

True or False

1. false

2. true
3. false
4. true
5. true
6. true
7. false

Critical Reading

1. All musical instruments create sound by causing matter to vibrate. The vibrations start sound waves moving through the air.
2. Resonance is the vibration of an object in response to sound waves of a certain frequency. A musical instrument uses resonance to amplify sound waves through constructive interference, and this makes the sounds louder.
3. When an instrument changes the frequency of sound waves, the pitch of the sound is changed. If the frequency increases, the pitch gets higher. If the frequency decreases, the pitch gets lower.

Multiple Choice

1. d
2. b
3. a
4. b
5. c
6. d
7. d

Matching

1. b
2. f
3. d
4. c
5. a
6. e

Fill in the Blank

1. amplify
2. pitch
3. reflected
4. ranging
5. vibrate
6. constructive
7. frequency

Critical Writing

Sample answer: A sonar device on a boat sends ultrasound waves into the water. When the waves reflect off an underwater object, they return to the sonar device, which detects them. The distance to the underwater object can be calculated from the known speed of sound in water (1437 m/s) and the time it takes for the waves to travel to the object, which is half of the time it takes the waves to travel to the object and back to the sonar device. The equation for the calculation is: Distance = Speed $\times$ Time.

26.21 Chapter 21: Electromagnetic Radiation

Lesson 21.1: Electromagnetic Waves

True or False

1. true
2. true
3. false
4. false
5. true
6. false
7. true
8. false
9. false
10. true

Critical Reading

1. Electromagnetic radiation behaves like waves of energy most of the time, but sometimes it behaves like particles.
2. The wave-particle theory of electromagnetic radiation is the theory that explains how electromagnetic radiation can behave as both a wave and a particle. When an electron returns to a lower energy level, it gives off a tiny "packet" of energy like a particle that travels as a wave.
3. A photon is the name of the "packet" of energy given off when an electron returns to a lower energy level. The amount of energy in a photon depends on the frequency of electromagnetic radiation. The higher the frequency is, the more energy a photon has.

Multiple Choice

1. d
2. c
3. d
4. d
5. d
6. c
7. d

Matching

1. e
2. f
3. g

4. d
5. a
6. b
7. c

Fill in the Blank

1. transverse
2. space
3. charged
4. thermal
5. Einstein
6. frequency
7. sun

Critical Writing

Sample answer: An electromagnetic wave begins when an electrically charged particle vibrates. This causes its electric field to vibrate as well. A vibrating electric field, in turn, creates a vibrating magnetic field. The two types of vibrating fields combine to create an electromagnetic wave. The electric and magnetic fields of an electromagnetic wave occur at right angles to each. Both fields are also at right angles to the direction that the wave travels, so an electromagnetic wave is a transverse wave. However, unlike a mechanical transverse wave, an electromagnetic wave can travel across space without a medium as well as through a medium.

Lesson 21.2: Properties of Electromagnetic Waves

True or False

1. true
2. true
3. false
4. false
5. false
6. true
7. false

Critical Reading

1. The speed of light is the speed at which all electromagnetic waves travel across space. It is equal to 300 million, or 3.0×10^8, m/s.
2. Electromagnetic waves travel more slowly through matter than they do across space. Their speed may also vary from one medium to another. For example, they travel more slowly through water than through air.

Multiple Choice

1. d
2. b

3. d
4. a
5. d
6. d
7. c

Matching

1. b
2. a
3. f
4. c
5. e
6. d

Fill in the Blank

1. 3.0×10^8 (300 million)
2. more
3. refracts
4. wavelength
5. more
6. higher
7. less

Critical Writing

Sample answer: The energy of electromagnetic waves depends on their frequencies. Waves with higher frequencies have greater energy. Electromagnetic waves with relatively low frequencies have too little energy to be dangerous. Electromagnetic waves with very high frequencies have so much energy that they may be extremely dangerous.

Lesson 21.3: The Electromagnetic Spectrum

True or False

1. true
2. false
3. true
4. false
5. false
6. true
7. false
8. false
9. true
10. true

Critical Reading

1. X rays and gamma rays are the electromagnetic waves with the shortest wavelengths and highest frequencies.
2. X rays have enough energy to pass through soft tissues such as skin but not enough to pass through bones and teeth. Instead, X rays are absorbed by these very dense structures. The bright areas on an X ray film show where X rays were absorbed by bones or teeth.
3. Gamma rays are the most dangerous form of electromagnetic radiation because they have the most energy. Gamma rays can be used to destroy cancerous cells.

Multiple Choice

1. c
2. d
3. d
4. b
5. c
6. d
7. d

Matching

1. g
2. e
3. f
4. c
5. a
6. b
7. d

Fill in the Blank

1. gamma rays
2. amplitude
3. microwaves
4. wavelengths
5. infrared
6. ultraviolet
7. absorbed

Critical Writing

Sample answer: Radio and television broadcasts both use radio waves to encode sounds, or sounds and pictures in the case of television. The encoded waves are sent out through the atmosphere from radio or television towers and detected by radio or television receivers, which change the waves back to sounds or sounds and picture. In AM radio broadcasts, sound signals are encoded by changing the amplitude of radio waves. This is called amplitude modulation. In FM radio broadcasts, sound signals are encoded by changing the frequency of radio waves. This is called frequency modulation. In television broadcasts, sounds are encoded by frequency modulation, and pictures are encoded by amplitude modulation.

26.22 Chapter 22: Visible Light

Lesson 22.1: The Light We See

True or False

1. true
2. false
3. true
4. false
5. false
6. true
7. false
8. true
9. false
10. false

Critical Reading

1. Both incandescence and luminescence are ways of producing visible light. Incandescence occurs when objects become so hot that they glow. Luminescence occurs in various ways without objects becoming very hot.
2. Three types of luminescence include fluorescence, electroluminescence, and bioluminescence. Fluorescence is the process in which a substance absorbs ultraviolet light and then gives off the energy as visible light. Electroluminescence is the process in which a substance gives off light when an electric current runs through it. Bioluminescence is the production of light by living things through chemical reactions.

Multiple Choice

1. c
2. b
3. d
4. d
5. a
6. b
7. c

Matching

1. f
2. d
3. g
4. a
5. e

6. b
7. c

Fill in the Blank

1. Fluorescence
2. bioluminescence
3. electroluminescence
4. Scattering
5. wavelength
6. primary
7. pigments

Critical Writing

Sample answer: The human eye can distinguish only three colors of light, called the primary colors of light. The primary colors of light are red, green, and blue light. When the primary colors of light combine, they form other colors of light. All other colors of light can be produced by mixing the primary colors in various combinations and proportions. This explains why we can see objects of other colors besides just red, green, and blue.

Lesson 22.2: Optics

True or False

1. false
2. true
3. false
4. true
5. false
6. true
7. false
8. true
9. false
10. true

Critical Reading

1. Laser light is a very focused beam of light of just one wavelength and color.
2. Laser light is produced in a tube. Electrons in a material such as a ruby crystal are stimulated to radiate photons of light of one wavelength. There are concave mirrors at the ends of the tube, and the photons of light bounce back and forth off the mirrors. This focuses the light, causing the crests and troughs of the waves to line up. The mirror at one end of the tube is partly transparent, allowing a constant stream of photons to pass through it. This forms the laser beam.
3. Laser light is used to scan bar codes and to carry communication signals in optical fibers.

Multiple Choice

1. d
2. b
3. a
4. d
5. b
6. d
7. a

Matching

1. d
2. b
3. a
4. f
5. g
6. c
7. e

Fill in the Blank

1. reflection
2. plane
3. real
4. convex
5. concave
6. reflecting
7. concave

Critical Writing

Sample answer: Both mirrors and lenses are typically made of glass, and both focus light to form images. The surface of a mirror may be flat, concave, or convex. A lens has one or two curved surfaces, which are either concave or convex. Mirrors form images by reflection, whereas lenses form images of refraction. Convex mirrors form only virtual images, and concave mirrors form either real or virtual images depending on the location of the object relative to the focal point. Concave lenses form only virtual images, and convex lenses form either real or virtual images depending on the location of the object relative to the focus.

Lesson 22.3: Vision

True or False

1. true
2. false
3. true
4. false
5. true

6. true
7. false
8. true
9. false
10. false

Critical Reading

1. The role of the eyes in vision is to collect and focus visible light so images are formed on the retina at the back of the eye.
2. Rods and cones in the retina send electrical signals about an image on the retina to the brain through the optic nerve.
3. The brain interprets electrical signals about images as shape, color, and brightness. It also interprets the images as though they were right-side up. The brain does this automatically, so what we see is always right-side up. The brain also "tells" us what we are seeing.

Multiple Choice

1. b
2. c
3. b
4. a
5. c
6. c
7. d

Matching

1. b
2. e
3. g
4. d
5. a
6. c
7. f

Fill in the Blank

1. convex
2. electrical
3. muscles
4. optic nerve
5. myopia (nearsightedness)
6. hyperopia (farsightedness)
7. convex

Critical Writing

Sample answer: Light first passes through the cornea, which is the transparent outer covering of the eye. The cornea helps to focus the light, which passes next through the pupil, an opening at the front of the eye. The pupil automatically gets bigger or smaller to let more or less light in as needed. The size of the pupil is controlled by the iris, the colored part of the eye. Next, the light passes through the convex lens, which fine-tunes the focus so an image forms on the retina at the back of the eye. The shape of the lens is controlled by tiny muscles to adjust the focus for nearby or distant objects.

26.23 Chapter 23: Electricity

Lesson 23.1: Electric Charge

True or False

1. true
2. true
3. false
4. false
5. true
6. true
7. false
8. false
9. true
10. false

Critical Reading

1. Lightning is static discharge on a large scale that occurs when there is a sudden discharge of static electricity between a cloud and the ground or between two clouds.
2. Charges build up in a cloud due to the movement of air molecules, water drops, and ice particles in the cloud.
3. Negative charges are concentrated at the bottom of the cloud. The ground below the cloud becomes positively charged through polarization.
4. A channel of charged particles starts to form in the air between the cloud and the ground. When the channel of charges is complete, static electricity is suddenly discharged as a bolt of lightning.

Multiple Choice

1. d
2. c
3. d
4. a
5. d
6. a
7. d

Matching

1. f
2. d
3. e
4. b

5. c
6. a
7. g

Fill in the Blank

1. electrons
2. attract
3. repel
4. cations
5. anions
6. conduction
7. static discharge

Critical Writing

Sample answer: Electric charge is a physical property of particles or objects that causes them to attract or repel each other without touching. Objects become electrically charged when they gain or lose electrons. This can occur in three different ways: friction, conduction, or polarization. Electrons are transferred by friction when materials that differ in their ability to give up or accept electrons rub together. Electrons are transferred by conduction when there is direct contact between materials that differ in their ability to give up or accept electrons. Electrons are transferred within a neutral object by polarization when it is affected by the electric field of a nearby charged object. The electric field causes electrons in the neutral object to move to the other side of the object, giving it regions of positive and negative charge.

Lesson 23.2: Electric Current

True or False

1. false
2. true
3. false
4. true
5. true
6. false
7. false
8. false
9. true
10. true

Critical Reading

1. *Sample answer*: Greater voltage results in more current, whereas greater resistance results in less current.
2. Current $= \frac{9 \text{ volts}}{3 \text{ ohms}} = 3$ amps
3. Current flowing through a wire that is connected to a battery is similar to water flowing through a hose that is connected to a tap. Opening the tap wider allows more water to flow through the hose. This is like increasing the voltage of the battery, which allows more current to flow through the wire. Stepping on the hose allows

less water to flow through it. This is like increasing resistance in the wire, which allows less current to flow through it.

Multiple Choice

1. b
2. d
3. b
4. a
5. c
6. d
7. d

Matching

1. e
2. d
3. g
4. b
5. c
6. a
7. f

Fill in the Blank

1. Current
2. ampere
3. volt
4. dry cell
5. negative
6. light
7. ohm

Critical Writing

Sample answer: Voltage, or potential difference, is a difference in electric potential energy. Electric charges always move from a position where they have higher potential energy to a position where their potential energy is lower. Moving charges create an electric current. Therefore, an electric current requires a difference in electric potential energy, or voltage, so charges can move.

Lesson 23.3: Electric Circuits

True or False

1. true
2. false
3. true

4. false
5. false
6. true
7. true
8. false
9. true
10. true

Critical Reading

1. A parallel circuit has two (or more) loops through which current can flow, whereas a series circuit has only one loop through which current can flow.
2. Series circuits are used in devices such as flashlights. Parallel circuits are used to wire houses.
3. A drawback of series circuits is that interrupting the circuit any point prevents current from flowing through the circuit so no devices in the circuit will work.

Multiple Choice

1. d
2. d
3. a
4. d
5. a
6. c
7. d

Matching

1. g
2. c
3. d
4. f
5. a
6. e
7. b

Fill in the Blank

1. electric short
2. circuit breaker
3. GFCI (ground fault circuit interrupter)
4. ground
5. conductor
6. voltmeter
7. series

Critical Writing

Sample answer: The electrical energy used by a device is a product of the device's power and the amount of time the device is used. This means that the energy used by a device is directly related to the device's power. The more powerful a device is, the more energy it uses in a given amount of time.

Lesson 23.4: Electronics

True or False

1. false
2. false
3. false
4. true
5. true
6. false
7. true
8. false
9. true
10. false

Critical Reading

1. An electronic signal is a message encoded by rapidly and repeatedly changing the voltage of an electric current.
2. Both digital and analog electronic signals encode messages by changing the voltage of a current. However, the two types of signals change the voltage in different ways. In a digital signal, there are repeated pulses of voltage as current is switched off and on. This type of signal encodes information as a string of 0's (current off) and 1's (current on). In an analog signal, the voltage increases and decreases in a continuous manner without being turned off or on.

Multiple Choice

1. d
2. c
3. a
4. b
5. a
6. a
7. b

Matching

1. c
2. d
3. f
4. b
5. a
6. g

7. e

Fill in the Blank

1. binary
2. silicon
3. n-type
4. p-type
5. diode
6. transistor
7. ROM

Critical Writing

Sample answer: Integrated circuits are tiny chips of silicon that consist of layers of electronic components such as transistors. An integrated circuit as small as a fingernail can contain millions of electronic components. Current flows extremely rapidly through an integrated circuit because it doesn't have far to travel. A computer contains integrated circuits that encode, analyze, transmit, and store information. Because the circuits of a computer are so tiny and close together, the computer can be very fast and capable of many complex tasks while remaining small.

26.24 Chapter 24: Magnetism

Lesson 24.1: Magnets and Magnetism

True or False

1. false
2. false
3. true
4. true
5. true
6. false
7. true
8. false
9. true
10. false

Critical Reading

1. Some examples of nonmagnetic materials are wood, glass, plastic, paper, copper, and aluminum. These materials are nonmagnetic because the north and south poles of their atoms point in all different directions rather than being lined up in the same direction.
2. Ferromagnetic materials are materials that can be magnetized when placed in a magnetic field. Elements that are ferromagnetic are iron, cobalt, and nickel.
3. Ferromagnetic materials can become magnets because they have magnetic domains, which are areas where the north and south poles of their atoms are lined up in the same direction.

Multiple Choice

1. d
2. c
3. d
4. d
5. d
6. d
7. c

Matching

1. e
2. b
3. a
4. f

5. d
6. g
7. c

Fill in the Blank

1. poles
2. attract
3. magnet
4. magnetic field
5. magnetite (lodestone)
6. interact
7. permanent

Critical Writing

Sample answer: Even permanent magnets can be demagnetized if they are dropped or heated to high temperatures. These actions demagnetize permanent magnets by moving their magnetic domains out of alignment so they no longer all point in the same direction.

Lesson 24.2: Earth as a Magnet

True or False

1. false
2. true
3. false
4. true
5. true
6. true
7. false
8. false
9. false
10. true

Critical Reading

1. A magnetic field reversal is an event in which Earth's magnetic poles switch places.
2. Evidence for magnetic reversals comes from rocks on the ocean floor. The rocks formed continuously as magma pushed up through a ridge and then hardened into rock. When the rock hardened, its magnetic domains were frozen in place. Rocks that formed in different time periods have been found to have magnetic domains aligned in opposite directions, showing that Earth's magnetic field has reversed repeatedly through time.

Multiple Choice

1. d
2. c

3. d
4. d
5. b
6. c
7. d

Matching

1. d
2. g
3. b
4. c
5. a
6. e
7. f

Fill in the Blank

1. magnetic
2. south
3. poles
4. reversals
5. outer core
6. sun
7. seismograph

Critical Writing

Sample answer: Earth's magnetic field is a huge region that extends outward from Earth for several thousand kilometers in all directions. The field is strongest at the poles, and it resembles the magnetic field of a bar magnet. Earth's magnetic field benefits Earth's organisms by protecting them from harmful particles given off by the sun. Most of the particles are attracted to the poles, where the magnetic field is strongest and the fewest organisms live. Another benefit of Earth's magnetic field is its use for navigation. People use compasses to detect Earth's north magnetic pole and tell direction. Many animals have natural "compasses" that serve the same purpose.

26.25 Chapter 25: Electromagnetism

Lesson 25.1: Electricity and Magnetism

True or False

1. true
2. false
3. false
4. true
5. false
6. false
7. false

Critical Reading

1. The magnetic field around a wire that is carrying current forms concentric circles around the wire.
2. To find the direction of the magnetic field around a wire when the direction of the current is known, use the right hand rule. Point the thumb of the right hand in the same direction as the current. The fingers of the right hand will then curl around the wire in the direction of the magnetic field.

Multiple Choice

1. b
2. a
3. a
4. d
5. d

Matching

1. e
2. d
3. b
4. c
5. a

Fill in the Blank

1. Oersted
2. current
3. electromagnet
4. compass

5. current

Critical Writing

Sample answer: To create a magnetic field with a wire and a battery, you could connect one end of the wire to one terminal of the battery and the other end of the wire to the other terminal of the battery. Current would then flow through the wire, and this would generate a magnetic field around the wire.

Lesson 25.2: Using Electromagnetism

True or False

1. true
2. false
3. true
4. true
5. false
6. false
7. true
8. false
9. false
10. true

Critical Reading

1. An electromagnet is a solenoid (coil of wire) wrapped around a bar of iron or other ferromagnetic material. An electromagnet has a magnetic field when electric current flows through the wire of the solenoid.
2. The solenoid of an electromagnet magnetizes the ferromagnetic bar inside it by aligning its magnetic domains. The combined magnetic force of the magnetized iron bar and wire coil makes the magnetic field of the electromagnet stronger than the magnetic field of the solenoid alone.
3. Four factors that affect the strength of an electromagnet are the number of turns in the coil of wire, the amount of current flowing through the wire, the size of the bar of ferromagnetic material, and the ease with which the ferromagnetic material is magnetized.

Multiple Choice

1. c
2. b
3. d
4. d
5. c
6. a
7. b

Matching

1. e

2. b
3. g
4. f
5. c
6. d
7. a

Fill in the Blank

1. stronger
2. magnetic domains
3. electromagnets
4. stronger
5. electric motors
6. electromagnet
7. permanent magnet

Critical Writing

Sample answer: An electric motor contains an electromagnet located between the north and south poles of permanent magnets. When current flows through the electromagnet, it becomes magnetized, and its poles are repelled by the like poles of the permanent magnets. This causes the electromagnet to turn. A device called a commutator then changes the direction of the current, which reverses the poles of the electromagnet. The reversed poles are once again repelled by the like poles of the permanent magnets, so the electromagnet continues to turn. These events keep repeating, so the electromagnet rotates continuously. The rotating electromagnet is connected to a shaft, which turns along with the electromagnet. In this way, an electric motor changes the electrical energy of an electric current to the kinetic energy of a rotating electromagnet and shaft.

Lesson 25.3: Generating and Using Electricity

True or False

1. true
2. false
3. true
4. true
5. false
6. true
7. false
8. true
9. true
10. false

Critical Reading

1. A step-up transformer is used as electric current leaves a power plant in order to increase the voltage of the current. By increasing the voltage, the amount of current is decreased so less energy is lost as the current travels through power lines to homes.

2. A step-down transformer is needed before electric current enters a home because the voltage in power lines is too high to be safe for home circuits. The step-down transformer reduces the voltage to a safe level.

Multiple Choice

1. d
2. d
3. b
4. d
5. a
6. b
7. b

Matching

1. e
2. c
3. d
4. g
5. a
6. f
7. b

Fill in the Blank

1. electric current
2. electric motor
3. alternating
4. electric transformer
5. more
6. step-up transformer
7. step-down transformer

Critical Writing

Sample answer: An electric transformer consists of two wire coils wrapped around an iron core. When alternating current passes through the first coil (coil P), it magnetizes the iron core. Because the current is alternating, the magnetic field of the iron core keeps reversing. This changing magnetic field induces alternating current in the other coil (coil S), which is part of another circuit. If direct current were used in coil P instead of alternating current, the magnetic field of the iron core would not change. As a result, the magnetic field would not induce current in the coil S, because electromagnetic induction occurs only when the magnetic field is changing relative to the conductor.