

## Category II Summaries for Physical Science Examples

### Alerting teacher to commonly held ideas

#### Material B

Although the material includes a component labeled “Misconceptions,” the only item listed that is relevant for the key ideas states that “students may identify matter as only things that they can see.” (p. 135t). All other items focus on peripheral issues, such as “students may identify steam as gas.” (p. 140t) or “dissolving a substance is a chemical change” (p. 147t). The material does not alert teachers to any of the difficulties noted in research studies that students may have with regard to the kinetic molecular theory. For example, research on student understanding of the structure of matter reveals that many students think that particles (atoms or molecules) are *in* substances and/or that there is something (e.g., air) between the particles, rather than that substances consist of nothing except molecules with empty spaces between them (Brook, Briggs, & Driver, 1984; Nussbaum, 1985). Research also reveals that students are often confused between observable properties of substances and properties of molecules themselves. For example, students may think that molecules themselves become hot or cold, or that molecules themselves expand causing substances to expand (Johnston & Driver, 1989; Lee, Eichenger, Anderson, Berkheimer, & Blakeslee, 1993). Teachers are not alerted to these commonly held student ideas.



## Themes in Science

**Scale and Structure** From the moon, you could see swirls and different colors on the earth's surface, but it still looks like a single piece of matter. From an airplane, however, you can observe more detail, such as water and land. Similarly, an organism looks like just a single animal until a part of it is viewed with-

out a microscope. Under a microscope, however, individual living cells can be seen. With an electron microscope, scientists can see that living and nonliving matter is composed of very tiny particles. Have students describe a blueberry muffin from across the classroom, from two meters away, and using a hand lens.

## 6.1 Matter

### Objectives

- ▶ **Define** matter and describe its major properties.
- ▶ **Explain** how the arrangement of particles in a substance may determine its properties.
- ▶ **Classify** kinds of matter based on their properties.
- ▶ **Make a model** illustrating the particle model of matter.

**I**magine you are an astronaut approaching the earth from space. At first the earth appears as a distant blue and white sphere. As you get closer, you see the shapes of continents. Then rivers, mountains, highways, and cities come into view. When you near the surface, you see cars on the highways, houses in the cities, and beaches by the ocean. If you land on a beach, you see sand and waves. Looking closer, you see even the individual grains of sand that make up the beach. Do you think the grains of sand are made of things that are still smaller?

### Particle Model of Matter

Grains of sand and everything else you see, hear, smell, touch, and taste are made of **matter**. Matter is anything that has mass and takes up space. Matter exists in many shapes, colors, textures, and forms. Water, rocks, living things, and stars are all made of matter.

To understand matter, you need to take a closer look at it. As an astronaut approaches the earth from outer space, the features of the planet's surface become more visible. Similarly, as you examine matter more closely, more of its parts are revealed.

All forms of matter are made up of tiny particles that are in constant motion. This idea is known as the **particle model** of matter. The particles that make up matter are much too small to see. Even the tiniest speck of matter contains huge numbers of particles. Particles vary in their size, shape, arrangement, motion, and individual properties. These factors help explain the properties of matter.

### ACTIVITY

#### Observing

##### Likenesses

What do all of the following things have in common?

- ♦ air
- ♦ Jupiter
- ♦ an apple
- ♦ an elephant
- ♦ water
- ♦ this book

Make a list of ways they are alike.

#### SKILLS WARMUP

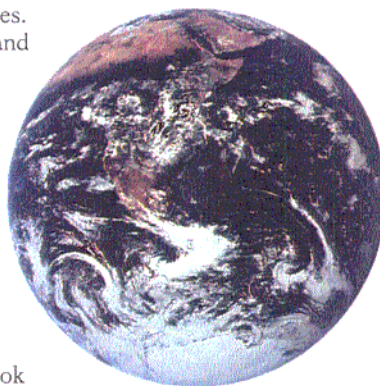


Figure 6.1 ▲

The closer you get to something, the more you can observe about the parts that make it up. What can you observe about the earth when standing on its surface that you can't observe from outer space? ①

## SECTION

# 6.1

### Section Objectives

For a list of section objectives, see the Student Edition page.

### Skills Objectives

Students should be able to:

**Observe** similarities among objects.

**Make a Model** demonstrating a property of matter.

**Classify** objects by grouping them according to physical properties.

### Vocabulary

matter, particle model

## MOTIVATE

### Skills WarmUp

To help students understand some of the properties of matter, have them do the Skills WarmUp.

**Answer** Students' lists will vary, but should indicate that all substances have mass and take up space.

### Misconceptions

Students may identify matter as only things that they can see.

Stress that there are two ways to identify matter: Does it take up space and have mass? Demonstrate that air is matter by squeezing a sealed plastic bag to show how it moves when displaced.

### Answer to In-Text Question

① Answers will vary; example: people, insects, buildings, plants, slight variations in elevation.



### The Living Textbook: Physical Science Side 1

Chapter 21 Frame 12941  
Atomic Molecular Theory (Movie)  
Search: Play:





## SECTION

# 6.2

### Section Objectives

For a list of section objectives, see the Student Edition page.

### Skills Objectives

Students should be able to:

**Classify** substances.

**Predict** the outcome of an experiment.

**Make a Model** to illustrate Charles' Law.

### Vocabulary

solid, liquid, gas, plasma

## MOTIVATE

### Skills WarmUp

To help students understand the three phases of matter, have them do the Skills WarmUp.

**Answer** Students' tables and lists may vary. Similarities: Students might record that ice, steam, and water are all forms of water. Differences: Ice holds its shape, water pours, and steam moves readily into the air.

### Misconceptions

Students may identify steam as a gas. Remind them that steam is condensed water vapor made of tiny water droplets. Have students view a boiling tea kettle at a safe distance. Ask them what they observe. (Nothing close to the spout because the space is filled with invisible water vapor; a short distance from the spout, they will see steam.)



### The Living Textbook: Physical Science Sides 1-4

Chapter 4 Frame 00926  
Phases of Matter: Properties and Particles  
(1 Frame)  
Search:



## INTEGRATED LEARNING



### Themes in Science

**Energy** The three phases of matter, solid, liquid, and gas, are distinguished by the energy of the particles in the matter. Remind students that in solids the particles have a small amount of kinetic energy and remain in a rigid pattern. Particles of a liquid move around one

another and have greater kinetic energy. Ask students to describe a gas in terms of the energy of its particles. (Particles of a gas move in random patterns through space; particles in gases have more kinetic energy than particles in solids or liquids.)

## ACTIVITY

### Comparing

#### Alike and Different

How are ice, steam, and water alike? How are they different? Make a table and list their similar and different properties. Compare your table with that of a classmate.

### SKILLS WARMUP

## 6.2 Phases of Matter

### Objectives

- ▶ **Give examples** of solids, liquids, and gases.
- ▶ **Relate** the particle model to solids, liquids, and gases.
- ▶ **Make models** illustrating the gas laws.

**I**magine that you and your classmates represent particles of matter. During class, everyone is seated at desks in neatly arranged rows. This arrangement of students is like the arrangement of particles in a solid. You can move in your seats while at your desks, just as particles in a solid move about a fixed point.

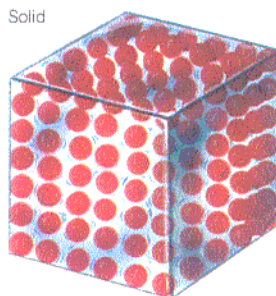
At the end of class, you get up from your desks and move freely toward the door of the classroom. This close, but unorganized, movement resembles the motion of particles in a liquid. Finally, as you and your classmates leave the classroom, you travel in many different directions through the school grounds. This movement is similar to the way particles of a gas spread out to fill a space.

### Familiar Phases of Matter

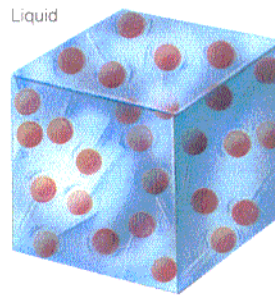
The three most familiar states of matter are solid, liquid, and gas. Each of these states of matter is called a phase. Like the students described above, particles of matter in each phase are arranged differently and have different ranges of motion.

**Figure 6.4**  
In each phase of matter, the particles move about in a different way. ▼

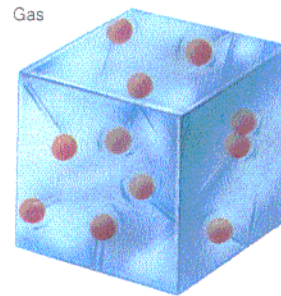
Solid



Liquid



Gas







## Themes in Science

### Patterns of Change/Cycles

When matter gains or loses energy, it may change phase. A phase change is a physical change that alters the size, shape, texture, or appearance of the matter, but does not alter the particles that

make up the matter. Ask students to identify which of the following are physical changes: tearing paper, burning wood, mixing baking soda and vinegar, mixing oil and water. (Tearing paper, mixing oil and water)

## 6.3 Changes in Matter

### Objectives

- ▶ Give examples of physical and chemical changes.
- ▶ Compare and contrast physical and chemical changes.
- ▶ Interpret data about a phase change.

If you hang your wet washcloth in the bathroom, it will dry. If you forget to clean your paintbrush and the paint dries, the paintbrush becomes hard and useless. The drying washcloth and the hardening paint are examples of changes in matter. The water in the washcloth and also in the paint changed to water vapor in the air. As the water in the paint changed to water vapor, the paint hardened. The small particles in the paint joined together to form long chainlike particles. This change made the paint form a hard, shiny film on the brush.

### Physical Changes in Matter

If you break a piece of glass, the shape of the glass changes. However, the fragments of glass contain the same particles and have the same properties as the original piece of glass. If you cut and sand a piece of wood to make a model, only the size and shape of the wood changes. When you freeze water into an ice cube and then let it melt, the liquid that remains is still water.

When matter undergoes a change in size, shape, or phase, it is a **physical change**. Physical changes do not change the particles that make up matter. The arrangement of the particles, however, may be moved around during a physical change.

Are you causing a physical change when you mix salt and water? A mixture of salt and water can be compared to a mixture of nails and screws. You can separate a mixture of nails and screws by hand. In a similar way, a mixture of pebbles and sand can be separated with a strainer. If you make a mixture of salt and water, the particles are too small for you to separate by hand or strainer. However, the water can be boiled away, leaving the salt behind.

### ACTIVITY

#### Hypothesizing

##### It's in the Bag

If you place a pencil, a piece of bread, and a piece of apple in separate, sealed, plastic bags, what will happen? State your hypothesis about which items will change and which items will not change.

#### SKILLS WARMUP



Figure 6.12 ▲

What physical change will occur as the warm sun strikes these icicles? ③

### MOTIVATE

#### Skills WarmUp

To help students understand changes in matter, have them do the Skills WarmUp.

**Answer** The pencil will not change; the bread and apple will eventually change. The bread will grow moldy and the apple will turn brown.

#### Misconceptions

Students may think that dissolving a substance is a chemical change. Emphasize that though thoroughly mixed together, salt and water still keep their properties. During evaporation, the water moves into the air, leaving salt behind.

#### Answer to In-Text Question

③ The icicles will turn to water as they melt.



#### The Living Textbook: Physical Science Sides 1-4

Chapter 5 Frame 01076  
Physical Change: Ice Melting  
(8 Frames)

Search:

Step:

