Day 3 week 1

chapter 15

Classification of Matter

section 2 Properties of Matter

What You'll Learn

- to identify substances using physical properties
- differences between physical and chemical changes
- how to identify chemical changes
- the law of conservation of mass

Before You Read

When you see someone, how do you identify that person as a friend or a stranger? How do you identify a friend on the phone? What are some things about people that help you recognize them? On the lines below, list some things you use to identify people.

_____

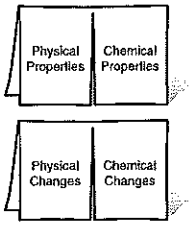
_____

Study Coach

Make Flash Cards For each heading in this section, make a flash card. The flash card should contain the main point of the paragraphs below the heading. When you finish the section, review the flash cards.

FOLDABLES

Compare and Contrast Make the following Foldables to help you understand how physical and chemical properties are different, and how physical and chemical changes are different.



Read to Learn

Physical Properties

You can stretch a rubber band, but you can't stretch a piece of string very much. You can bend a piece of wire, but you can't bend a matchstick easily. The rubber band and the wire change shape, but the substances that they are made of do not change.

The ability to stretch or bend is a physical property. A **physical property** is a feature or characteristic that describes an object or substance. Some examples of physical properties are color, shape, size, density, melting point, and boiling point.

How do physical properties describe appearance?

How would you describe a tennis ball? You could describe some of its physical properties, such as shape and color. You could say it is a solid, not a liquid or a gas. For example, you might describe a tennis ball as a brightly colored, hollow sphere. You could also measure some physical properties of the ball. You could measure its diameter with a tape measure. You could measure its mass with a balance. You could measure how high it will bounce.

To describe a soft drink in a cup, you could start by saying it is a brown liquid. You could measure the volume and the temperature of the soft drink. Each of these characteristics is a physical property of that soft drink.

Why doesn't the identity change?

When a substance freezes, boils, evaporates, or condenses, it undergoes a physical change. A **physical change** is a change in size, shape, or state of matter. Heat might be added or removed during a physical change. Changes in energy do not change the identity of the substance being heated or cooled. All substances have distinct properties that are constant, or never change. The properties of density, specific heat, boiling point, and melting point are constant for substances. These properties can be used to identify unknown substances in a mixture.

Iron is a substance that changes states when it absorbs or releases energy. At high temperatures, iron melts. However, iron has the same physical properties that identify it as iron, whether it is in the liquid or solid state.

Reading Check

3. **Define** What effect does an energy change have on the identity of a substance?

_____

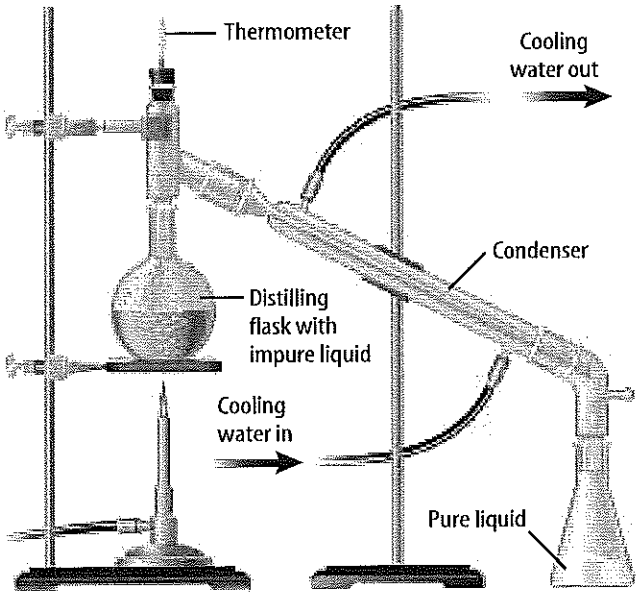
_____

What is distillation?

Distillation is the process of separating substances in a mixture by evaporating a liquid and condensing its vapor. A laboratory distillation process is shown below.

To distill a liquid, it is heated until it vaporizes. Then, the vapors are cooled until they condense. All solid material is left behind. Distillation is used to make drinking water out of salt water.

Liquids with different boiling points can be separated by distilling. The mixture is heated slowly until it begins to boil. Vapors of the liquid with the lowest boiling point form first. They are condensed and collected. As temperature increases, the second liquid boils. Its vapors are condensed and collected. Distillation is used often in industry. Natural oils such as mint are distilled.



Picture This

4. **Observe** Where would you expect to find the solid material left behind in the distillation process?

_____

_____

Weathering—Chemical or Physical Change?

The forces of nature continuously shape Earth's surface. Rocks split, rivers carve deep canyons, sand dunes shift, and interesting formations develop in caves. These changes are known as weathering. Weathering changes are both physical and chemical changes.

What is physical weathering?

As a stream cuts through rock to form a canyon, small particles of rock are carried downstream. The large rocks and the particles of rock have the same properties. Their properties are not changed, so this weathering is physical.

What is chemical weathering?

Limestone is made up mostly of a chemical called calcium carbonate. Calcium carbonate does not dissolve easily in water. But if the water is even slightly acidic, calcium carbonate reacts. A new substance, calcium hydrogen carbonate, is formed. This substance dissolves in water. This change in limestone is a chemical change. The calcium carbonate changes to calcium hydrogen carbonate in the chemical reaction. Rainwater can dissolve limestone because of this reaction. This chemical change leads to weathering. Chemical changes like this one create caves and the rock formations that are found in them.

Think it Over

7. **Apply** How are shifting sand dunes an example of physical weathering?

The Conservation of Mass

Wood is combustible, which means it can burn. As you have learned, this is a chemical property of wood. Think about a log burning in a fireplace. After you burn a piece of wood, there is nothing left but a small pile of ashes. During the fire, the wood gives off heat, light, and smoke. These changes in the wood are all signs of a chemical reaction.

Where did all the matter in the log go as it burned? At first, you might think that matter was lost as the log burned, since the pile of ashes is so small. The ashes have a smaller mass than the wood you started with. But imagine that you could collect all the smoke and gases that escaped from the log while it burned. If you added this all up, you would find that no mass was actually lost.

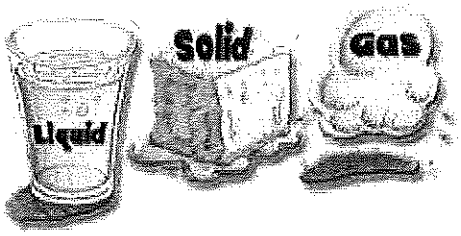
Mass is not lost during burning. In the same way, mass is not gained or lost in any chemical change. In other words, matter is not created or destroyed in a chemical change. The **law of conservation of mass** states that the mass of all the substances before a chemical change equals the mass of substances after a chemical change.

Reading Check

8. **Explain** what the law of conservation of mass means.

Day 5 week 1

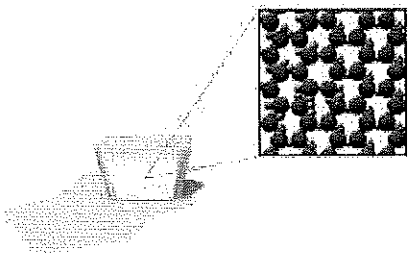
Zooming in on States of Matter



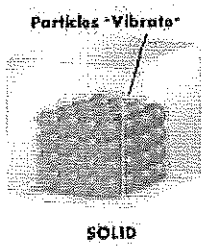
1. What makes a gas different from a liquid or solid? Why are some substances gases at room temperature, while others are not?

2. Solids, liquids, and gases are three states of matter. The fourth state of matter is called plasma (a man-made version is found in a plasmaTV, but we'll save that topic for later). The following definitions will help you to identify a substance's state of matter and to describe the changes from one state to another.

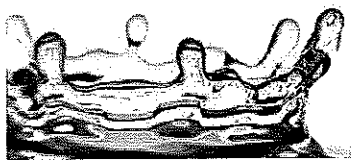
3. Before you being, make sure you know the following terms. "Definite" means a clearly defined or unchanging set of limits. For example, the sun will always rise in the East. This happens every day without fail. "Indefinite" means just the opposite where properties or limits are flexible, uncertain, and changeable. For example, the weather forecast is indefinite.



4. *Solids* have a definite shape and volume. True solids keep their shape and take up a definite volume for a given amount of mass. The particles are packed closely together in solids. They are "locked" into a fixed position. This happens because the forces of attraction between particles of a solid are very strong.Because of this tightly packed and highly organize arrangement, solidscannot be compressed and they are unable to flow like a liquid. All materials become solid if their temperatures are loweredenough or the pressure exerted on them becomes high enough. Many people will mistakenly believe that particles of a solid are not moving. They do move! If you could see the molecules with a high powered microscope you would see that they vibrate slightly. It's almost like they are buzzing. The solid state of H_2O (water) is ice.

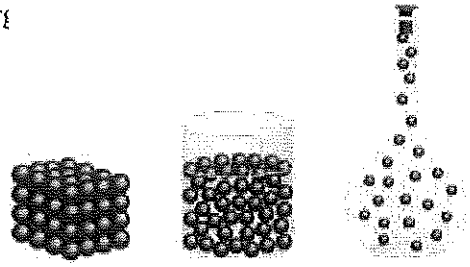


5. *Liquids* however do not have a definite shape and are not compressible. The particles in a liquid are close together. Liquids do have a definite volume for a given mass. This means that liquids are not easily compressed as they are NOT squishable. You might be able to squirt water through your fingers or slosh it around in the bathtub, but you cannot make the water take up less space (it is not compressible). Liquids, unlike a solid, will flow to take the shape of the container they are in. A cup of water will change its shape to fit in a bottle, a cup, or spilled on the table.This happens because there is slightly less attraction between the particles of a liquid substance than those of a solid. Therefore, they are able to move more than the particles of a solid. They are able to slip and slide over and around one another. The liquid state of H_2O is water.



6. *Gases* have no definite shape or volume of their own. Therefore, if the volume of a gas container changes, do does the volume of the gas. This means if you have a can of Axe Body Spray in the classroom and it cracks open, the volume of the gas will expand to take the shape of the classroom (the new container). The particles are very far apart in a gas because the attractive forces are so weak that they cannot hold the particle together, allowing them to move freely and independently of other gas molecules. All of these individual characteristics of gases are due to the fact that at room

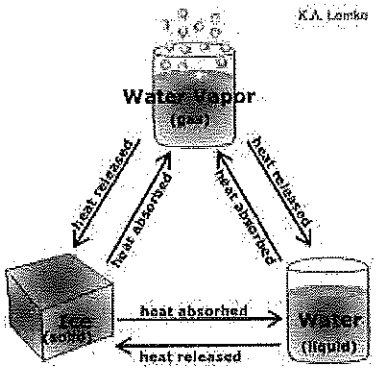
temperature the particles of a gas have almost no attraction for one another. The gaseous state of H_2O is water vapor. Take note that individual molecules do not change size when they are vaporized (the fancy word for turning something into a gas), or when under



Intermolecular Forces of Attraction

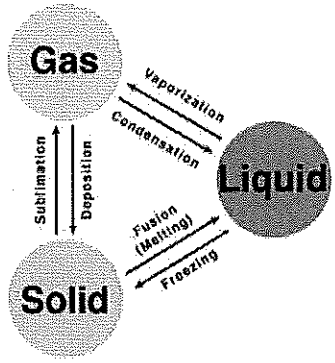
7. The fundamental difference between the states of matter is the space between the molecules due to the strength of the intermolecular forces (IMF) of attraction!

8. In the *solid phase*, the particles (atoms or molecules) are not able to move around much because they have a fairly strong attraction for one another that lock them in place. These intermolecular forces are electrical in nature with a positive charge attracting a negatively charged particle. IMFs arerelated to the number of electrons in a molecule. In a solid, particle motion consists only of vibrating in place, giving solids a definite volume and shape. Solids can be heated until the vibrations become so severe that the particles begin to break free from their place in the structure and become liquid. This happens because heat energy becomes kinetic (moving) energy and overcomes some of the intermolecular forces of attraction, allowing the solid to transform into a liquid. Solids have less kinetic energy than liquids.



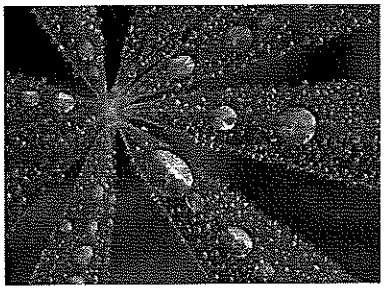
9. In the *liquid phase*, the particles are still attracted to each other and are still in contact with each other. However, they are not locked into a fixed place by the attractive forces. The liquid particles are free to move past each other, as well as vibrate. Liquids have a definite volume but not a definite shape. A liquid can be heated until the kinetic energy of its particles overcomes the remaining forces of attraction and the substance becomes a gas. Gases have the highest kinetic energy of the three phases.

10. The intermolecular forces of attraction have not been changed by these phase changes. The process of going from solid to liquid to gas by adding heat energy can be reversed by cooling. By removing heat energy, a gas will become a liquid, and a liquid will become a solid. This happens because the particles are slowed enough that the still-present intermolecular forces of attraction exert their effect.



Changes of State: A Physical Change

11. In your upcoming lab, you are exploring boiling, also called vaporization. Boiling is a change from a liquid to a gas phase. The temperature at which this occurs for a given substances can also be called the condensation point. Condensation is when a gas becomes a liquid. The condensation point and the boiling point occur at the same temperature.



12. When water boils or steam condenses, a physical change takes place. A physical change is one that involves changes in the state or phase of a material. It does not involvethe creation of new materials. The water boils and turns to water vapor (steam) and water vapor condenses to form liquid water. There is no change to the molecular structure or size of the water molecules!It is still H_2O. The phase change does, however, involve an input or output of energy (heat). To boil water, the water must gain heat energy and to condense water or freeze it, water must lose heat energy.

Zooming in on States of Matter Analysis Questions

Vocabulary: Define the following terms:

- Definite:
- Indefinite:

Definite or Indefinite?	**Solid**	**Liquid**	**Gas**
Shape			
Volume			

Change of state	**From**	**To**	**Heat Energy (gained or lost)**
Boiling	Liquid	Gas	Gained (added heat)
	Gas	Liquid	
Evaporation	Liquid		
Vaporization			
	Liquid	Solid	
Fusion			Gained (added heat)

What does it mean?

Chemistry explains the *macroscopic* phenomenon (what you observe) with a description of what happens at the *nanoscopic* level (atoms, molecules, bonding) using *symbolic* structures as a way to communicate. Complete the chart below:

MACRO	NANO (10^{-9})	SYMBOLIC
Describe two observable features (sight, touch, feel…) of water as a solid (ice), liquid and gas (vapor).	Compare and contrast the nanoscopic nature of a solid, a liquid, and a gas by examining the atoms, molecules, or intermolecular forces.	A phase change graph can be used to summarize the change from solid to liquid to gas. Create your own phase change graph.

MACRO:_____

_____

_____

NANO: _____

_____

_____

SYMBOLIC: