

Chapter 2 Matter

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Chapter 2 Section 1 What Is Matter?

Objectives

- **Explain** the relationship between matter, atoms, and elements.
- **Distinguish** between elements and compounds.
- **Describe** molecules, and explain how they are formed.
- **Interpret** and write some common chemical formulas.
- **Categorize** materials as pure substances or mixtures.



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Chapter 2 Section 1 What Is Matter?

Bellringer

Chemists and other scientists write the element names so often that they have developed a system of short symbols. Most of the symbols are one or two letters taken from the element's name. Some of the elements have symbols that derive from their Latin names. What is important about knowing the symbols is that scientists from all over the world are able to communicate, no matter what language they speak.



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Chapter 2 Section 1 What Is Matter?

Bellringer, *continued*

1. Complete the right column of the table below, using the following names: boron, bromine, calcium, magnesium, neon, nitrogen, silicon, sulfur, zinc.

Symbol	Element	Symbol	Element
O	oxygen	Mg	a.
H	hydrogen	Br	b.
Na	sodium	N	c.
K	potassium	S	d.
I	iodine	Ca	e.
C	carbon	B	f.
Cl	chlorine	Zn	g.
Fe	iron	Si	h.
Ag	silver	Ne	i.



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Chapter 2 Section 1 What Is Matter?

Bellringer, *continued*

2. Which four elements do you think were used before modern times?

(**Hint:** Prior to modern times, scientists frequently used Latin rather than English to communicate. Because of that, the symbols of these elements do not match the English names.)



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Chapter 2 Section 1 What Is Matter?

Composition of Matter

- Atoms are matter.
 - Everything in the universe is made up of matter.
- **Matter** is anything that has mass and takes up space
- **Chemistry** is the scientific study of the composition, structure, and properties of matter and the changes that matter undergoes.
- **Element** a substance that cannot be separated or broken down into simpler substances by chemical means
- **Atom** the smallest unit of an element that maintains the properties of that element



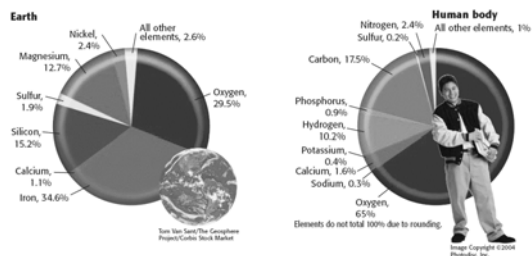
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Chapter 2 Section 1 What Is Matter?

Elements in the Human Body



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Chapter 2 Section 1 What Is Matter?

Matter

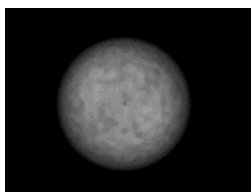


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Chapter 2 Section 1 What Is Matter?

Atom

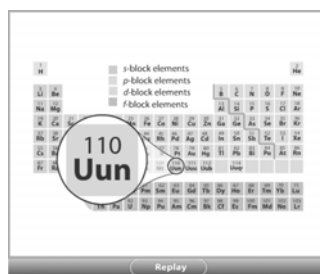


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Chapter 2 Section 1 What Is Matter?

Element



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Chapter 2 Section 1 What Is Matter?

Composition of Matter, *continued*

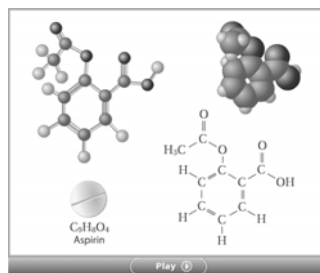
- Elements combine chemically to form a compound.
- **Compound** a substance made of atoms of two or more different elements that are chemically combined

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Chapter 2 Section 1 What Is Matter?

Compounds



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Composition of Matter, *continued*

- Compounds have unique properties.
 - Every compound is different from the elements it contains.
- When elements combine to form a specific compound, they always combine in the same proportions.



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Composition of Matter, *continued*

- A molecule acts as a unit.
 - Atoms can join together to make millions of molecules.
- **Molecules** are the smallest unit of a substance that keeps all all of the physical and chemical properties of that substance.

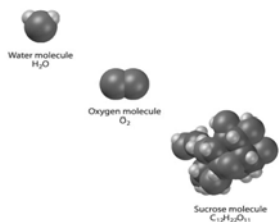


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Molecule



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Composition of Matter, *continued*

- Chemical formulas represent compounds and molecules.
 - A chemical formula shows how many atoms of each element are in a unit of a substance.
- **Chemical formula** a combination of chemical symbols and numbers to represent a substance.



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Chemical Formula



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Pure Substances and Mixtures

- Mixtures are formed by mixing pure substances.
- **Pure substance** a sample of matter, either a single element or a single compound, that has definite chemical and physical properties
- **Mixture** a combination of two or more substances that are not chemically combined



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Chapter 2 Section 1 What Is Matter?

Pure Substances and Mixtures, *continued*

Mixtures are classified by how thoroughly the substances mix.

- **Heterogeneous mixture** substances aren't mixed uniformly and are not evenly distributed
- **Homogeneous mixture** substances are evenly distributed, and the mixture is the same throughout
- **Miscible** substances that can be mixed
- **Immiscible** substances that cannot be mixed



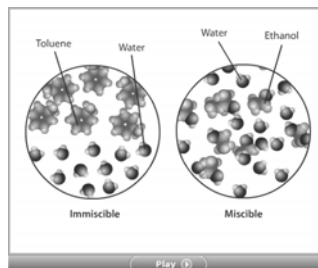
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Chapter 2 Section 1 What Is Matter?

Comparing Miscible and Immiscible Liquids



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Chapter 2 Section 1 What Is Matter?

Pure Substances and Mixtures, *continued*

- Gases can mix with liquids.
- Air is a mixture of gases.
- Examples of gases mixed with liquids include
 - carbonated drinks
 - oxygen dissolved in water
 - foam



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Chapter 2 Section 2 Properties of Matter

Objectives

- **Distinguish** between the physical and chemical properties of matter, and give examples of each.
- **Perform** calculations involving density.
- **Explain** how materials are suited for different uses based on their physical and chemical properties, and give examples.
- **Describe** characteristic properties, and give examples.



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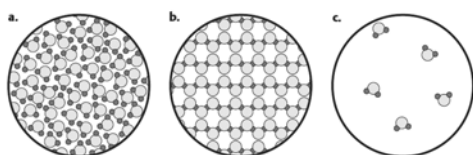
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Chapter 2 Section 2 Properties of Matter

Bellringer

You are already familiar with the most common states of matter: solid, liquid, and gas. For example you can see solid ice and liquid water. You cannot see water vapor, but you can feel it in the air on a humid summer day. How do you think the atoms and molecules are arranged in these different states? Examine the drawings shown below. Then answer the items that follow.



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Chapter 2 Section 2 Properties of Matter

Bellringer, *continued*

1. Think about the properties of ice. It is somewhat hard and cannot be compressed easily. Which drawing do you think represents a solid? Why?
2. Think about the properties of gases. They are not hard, and they can be compressed. Which drawing represents a gas? Why?
3. In which state(s) of matter are the particles touching?
4. In which drawing do you think the particles have the least effect on one another? Why?



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Chapter 2 Section 2 Properties of Matter

Physical Properties

- Physical properties describe matter.
 - Some physical properties of matter include shape, color, size, mass, volume, density, melting point and boiling point.
- Melting point** the temperature and pressure at which a solid becomes a liquid
- Boiling point** the temperature and pressure at which a liquid becomes a gas
- State** the physical form in which a substance exists such as solid, liquid, or gas



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Chapter 2 Section 2 Properties of Matter

Three States of Water



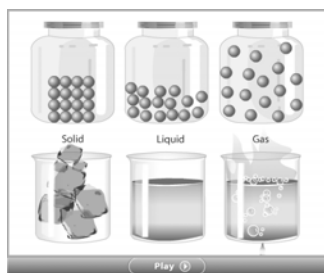
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Chapter 2 Section 2 Properties of Matter

Solid, Liquid and Gas



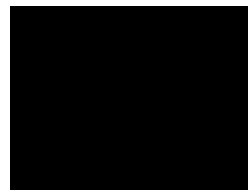
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Chapter 2 Section 2 Properties of Matter

Melting Point



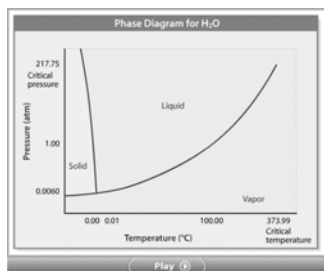
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Chapter 2 Section 2 Properties of Matter

Boiling Point



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Chapter 2 Section 2 Properties of Matter

Physical Properties, *continued*

- Density is a physical property.
 - Density is a measurement of how much matter is contained in a certain volume of a substance.
 - A substance with a low density is "light" and a substance with a high density is "heavy" in comparison to other substances of the same volume.
- Density** the ratio of the mass of a substance to the volume of a substance



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Chapter 2 Section 2 Properties of Matter

Physical Properties, *continued*

- Density is often measured in units of g/cm^3
 - The equation for density is $D = m/V$
 - Density = mass/volume
 - The density of a liquid or solid is usually reported in units of grams per cubic centimeter (g/cm^3)

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Chapter 2 Section 2 Properties of Matter

Equation for Density

$$D = \frac{m}{V}$$
$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

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Chapter 2 Section 2 Properties of Matter

Math Skills

Density If 10.0 cm^3 of ice has a mass of 9.17 g , what is the density of ice?

1. List the given and unknown values.

Given: *mass*, $m = 9.17 \text{ g}$

volume, $V = 10.0 \text{ cm}^3$

Unknown: *density*, $D = ? \text{ g}/\text{cm}^3$

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Chapter 2 Section 2 Properties of Matter

Math Skills

2. Write the equation for density.

$\text{density} = m/V$ or $\text{density} = \text{mass}/\text{volume}$

3. Insert the known values into the equation, and solve.

$D = 9.17 \text{ g}/10.0 \text{ cm}^3$

$$D = 0.917 \text{ g}/\text{cm}^3$$

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Chapter 2 Section 2 Properties of Matter

Physical Properties, *continued*

- Physical properties help determine uses.
 - Physical properties are used to select substances that may be useful.
 - Examples of useful physical properties include:
 - low freezing point
 - high boiling point
 - water resistance
 - flexibility
 - electrical conductor
 - heat conductor

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Chapter 2 Section 2 Properties of Matter

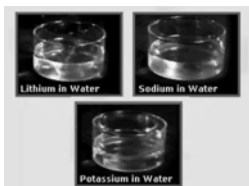
Chemical Properties

- Chemical properties describe how a substance reacts.
 - Chemical properties are related to the specific elements that make up substances.
 - Chemical properties describe how a substance changes into a new substance when in contact with other elements.
- Reactivity** the ability of a substance to combine chemically with another substance
- Flammability** the ability of a substance to react in the presence of oxygen and burn when exposed to a flame

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Chapter 2 Section 2 Properties of Matter

Reactivity



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Chapter 2 Section 2 Properties of Matter

Comparing Physical and Chemical Properties

- Characteristic properties help to identify and classify substances.
 - The table below compares some physical and chemical properties.

Substance	Physical property	Chemical property
Helium	less dense than air	nonflammable
Wood	grainy texture	flammable
Baking soda	white powder	reacts with vinegar to produce bubbles
Powdered sugar	white powder	does not react with vinegar
Rubbing alcohol	clear liquid	flammable
Red food coloring	red color	reacts with bleach and loses color
Iron	malleable	reacts with oxygen

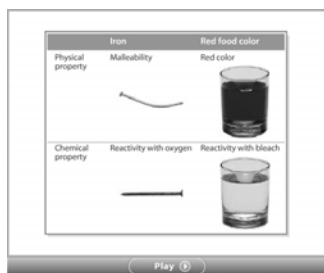


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Chapter 2 Section 2 Properties of Matter

Comparing Physical and Chemical Properties



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Chapter 2 Section 3 Changes of Matter

Objectives

- Explain** physical change, and give examples of physical change.
- Explain** chemical change, and give examples of chemical changes.
- Compare and contrast** physical and chemical changes.
- Describe** how to detect whether a chemical change has occurred.



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Chapter 2 Section 3 Changes of Matter

Bellringer

Physical properties are characteristics of a substance that can be observed without changing the composition of the substance. Physical properties are often used to separate a mixture into its original components. Imagine that you have been given a mixture of sand, sugar, and iron filings. You know that iron is attracted to a magnet, sugar dissolves in water and sand does not, and sugar has a higher boiling point than water. Each of these properties is a physical property.

Think about how you can use these facts about the physical properties of the sand, sugar, and iron filings in order to separate them out of the mixture.

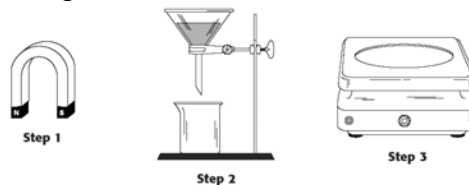


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Chapter 2 Section 3 Changes of Matter

Bellringer, continued



- What do you separate in the first step? How?
- What is separated out in the second step? How?
- What happens in the third step?



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Chapter 2 Section 3 Changes of Matter

Physical Changes

- Physical changes do not change a substance's identity.
 - Physical changes affect only the physical properties of a substance.
- Physical change** a change of matter from one form to another without a change in chemical properties

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Chapter 2 Section 3 Changes of Matter

Physical Changes, *continued*

- Dissolving is a physical change.
 - When a substance dissolves, the molecules of the substance do not change.
- Dissolving a solid in a liquid, a gas in a liquid, or a liquid in a liquid are all physical changes.

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Chapter 2 Section 3 Changes of Matter

Physical Changes, *continued*

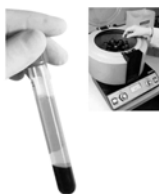
- Mixtures can be physically separated.
 - Because mixtures are not chemically combined, each component of the mixture has the same chemical makeup it had before the mixture was formed.
- Mixtures can be separated based on their physical properties.

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Chapter 2 Section 3 Changes of Matter

Separating Mixtures



Centrifuge
A centrifuge is a tool used to separate mixtures. It spins a sample of a mixture rapidly until the components of the mixture separate. You can see different layers in this sample of blood because it has been separated into its components.



Distillation
The distillation device shown here can separate components of mixtures that have different boiling points. When heated, the component that boils and evaporates first, separates from the mixture and collects in another beaker.



Magnets
Magnets can be used to separate mixtures that have components containing iron. In this mixture of nails, the magnet attracts and separates the nails containing iron from the nails that do not contain iron.

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Chapter 2 Section 3 Changes of Matter

Chemical Changes

- Chemical changes happen everywhere.
 - Examples of chemical changes include:
 - burning
 - rusting
 - digesting
 - decomposing
- Chemical change** a change that occurs when a substance changes composition by forming one or more new substances

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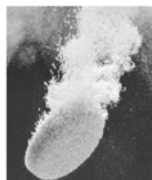
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Chemical Changes

Examples of Chemical Changes



Souring of Milk
Soured milk smells bad because bacteria have formed new substances in the milk.



Effervescent Tablets
Effervescent tablets bubble when the citric acid and baking soda in them react with water to produce CO_2 .



Rusting
The Statue of Liberty is made of shiny, orange-brown copper. But the metal's interaction with carbon dioxide and water has formed a new substance, copper carbonate.

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Chapter 2 Section 3 Changes of Matter

Chemical Changes, *continued*

- Chemical changes form new substances that have different properties.
 - The results of a chemical change are substances that have completely different properties from the properties of the original substances.



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Chapter 2 Section 3 Changes of Matter

Chemical Changes, *continued*

- Chemical changes can be detected.
 - Changes in physical properties can be an indication of a chemical change.
 - Examples include:
 - change of color
 - change of smell
 - fizzing
 - production of heat
 - production of sound
 - production of light



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Chapter 2 Section 3 Changes of Matter

Chemical Changes, *continued*

- Chemical changes cannot be reversed by physical changes.
 - Because new substances are formed in a chemical change, the change cannot be reversed by using physical changes.
 - Many chemical changes are impossible to reverse, for example it is impossible to “unbake” a cake.



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Chapter 2 Section 3 Changes of Matter

Chemical Changes, *continued*

- Compounds can be broken down through chemical changes.
 - Some compounds undergo chemical changes to form elements, others break down to form simpler substances.

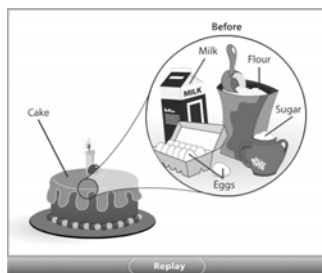


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Comparing Physical and Chemical Changes



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