

جلسہ اول شیمی IMAT/ TolcF

- **Classification of Matters**
- **States of matter**
- **Change of states**
- **Types of mixtures**
- **Physical and Chemical changes**
- **Physical and chemical properties**

Chemistry:

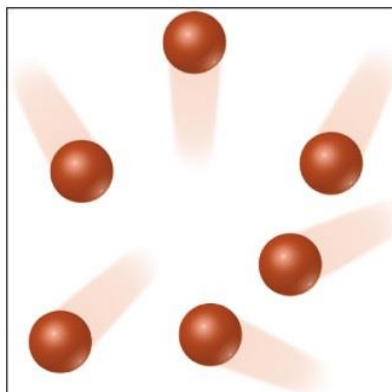
The science that seeks understanding the properties and behavior of matter by studying atoms and molecules.

- Chemistry is central to understand many other scientific fields.
- Virtually, everything around you is composed of “chemicals”.

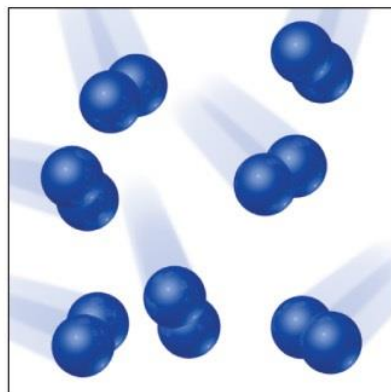
1.1 Atoms and Molecules

- **Atoms** are the building-blocks of **matter**.
- Each **element** is made of a unique kind of **atoms** (so far, 120 **elements** are identified in the universe, they are represented in the periodic table of elements).
- The **compound** is made of two or more atoms of different **elements**, bonded together to form **molecules** (molecules are the building-blocks of compounds).
- The properties of a substance are determined by the properties of its constituent molecules and atoms.

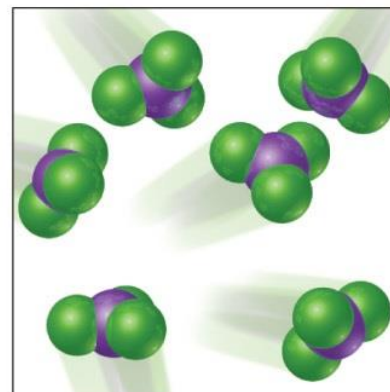
1.1 Atoms and Molecules



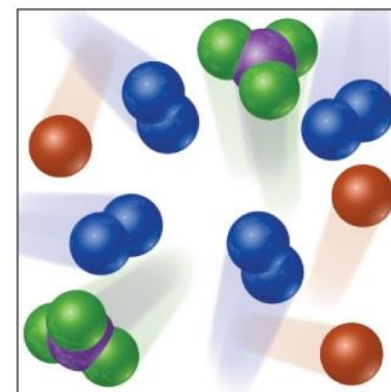
(a) Atoms of an element



(b) Molecules of an element



(c) Molecules of a compound



(d) Mixture of elements and a compound

Only one kind of atom is in any element.

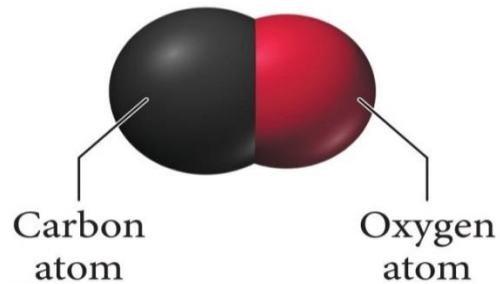
Compounds must have at least two kinds of atoms.

Important Note: some elements are present as “**molecules**” instead of “**free atoms**”, they are called:

“**Molecular Elements**”, such as: H_2 , N_2 , O_2 , F_2 , Cl_2 , Br_2 , I_2

1.1 Atoms and Molecules: Example 1

Carbon monoxide molecule



- ✓ The air contains **carbon monoxide** pollutant.
- ✓ Each molecule contains a carbon **atom** and an oxygen **atom** held together by a **chemical bond**.

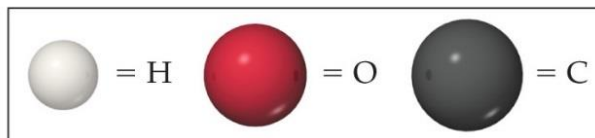
Exercise) how many elements and atoms are there in a molecule of glucose($C_6H_{12}O_6$) ?

atom \rightarrow 24

element \rightarrow 3

MEC

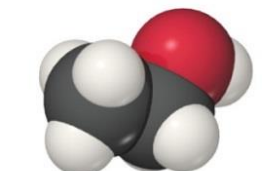
1.1 Atoms and Molecules: Example 2



Oxygen



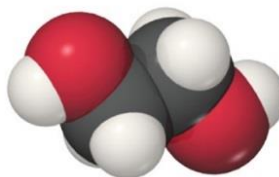
Water



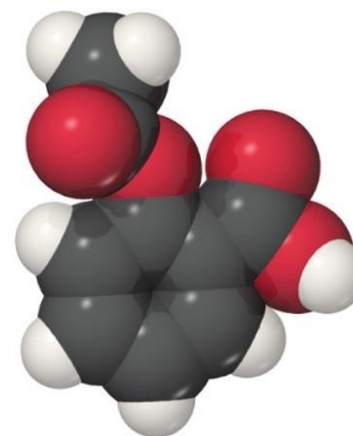
Ethanol



Carbon dioxide



Ethylene glycol



Aspirin

Note: Balls of different colors are used to represent **atoms** of different **elements**. Attached balls represent connections between atoms that are seen in nature. These groups of atoms are called **molecules**.

1.2 The Classifications of Matter

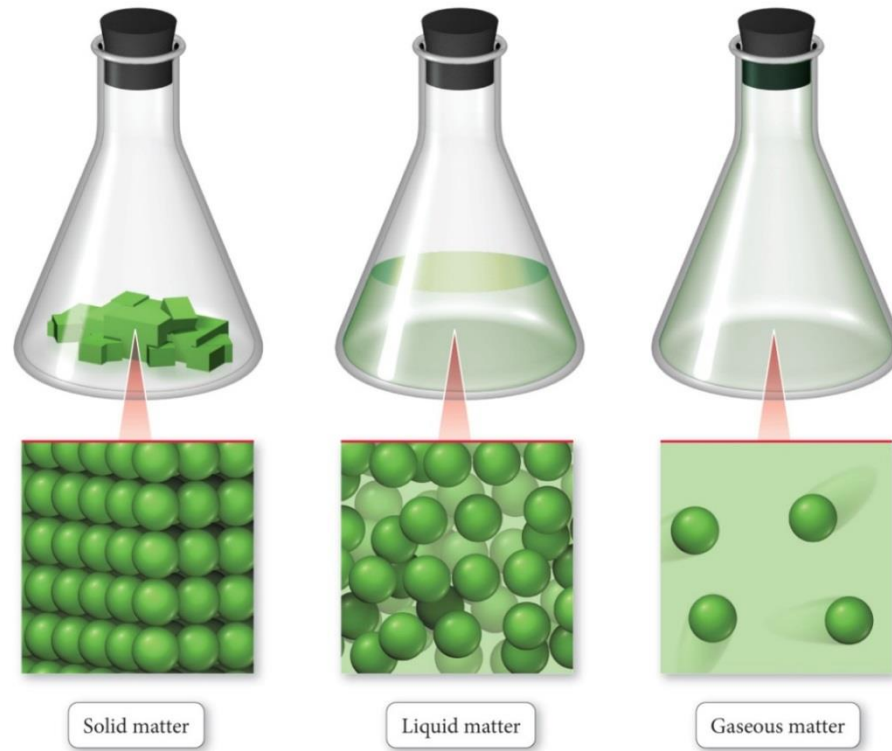
- **Matter** is anything that occupies space and has mass.

Examples: your textbook, your desk, the air around you, and even your body, are all composed of matter. **Matter is everything around us.**

- **Matter can be classified according to:**
 1. State (the physical form)
 2. Composition (the components that make it up)

The States of Matter

- **Matter** can exist in one of three main states: **solid**, **liquid**, or **gas**.



© 2014 Pearson Education, Inc.

The state of matter changes from solid to liquid to gas by **increasing temperature**, and vice versa!

Solid Matter

➤ **Solid Matter**: is composed of tightly packed particles (atoms or molecules). Solids retain their shapes because the particles are not free to move.

➤ Although the atoms and molecules vibrate in solids, they do not move around or past each other.



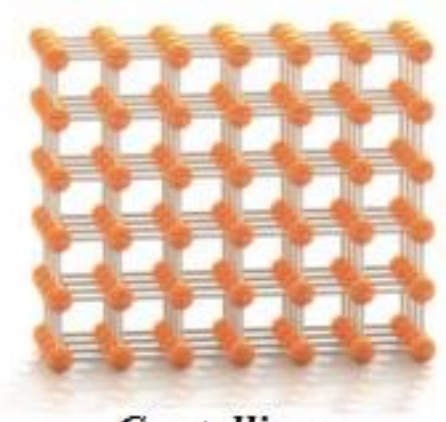
➤ Consequently, solid matter has a **fixed (definite) volume** and a **fixed (rigid) shape**.

- **Examples of solids:** Ice, aluminum, iron, wood, salt, and diamond.



Solid Matter: **Crystalline or Amorphous?**

- **Crystalline Solids:** atoms or molecules are arranged in “patterns” with a long-range repeating order.
 - **Important Examples on crystalline solids:**
 - table salt (NaCl) and diamond.
- **Amorphous Solids:** atoms or molecules are not arranged in long-range patterns.
 - **Important Examples on amorphous solids:**
 - graphite, rubber, glass and plastic.



Crystalline



Amorphous

Liquid Matter

- **Liquid Matter:** is made of more loosely packed particles than in solids. Particles can move about within a liquid, but they are packed densely enough that volume is maintained.
- The ability of liquids to flow, makes them take the shapes of their containers.
- Liquids have **fixed volume** but **no fixed shape**.
 - **Examples of liquids:** water, oil, and gasoline.

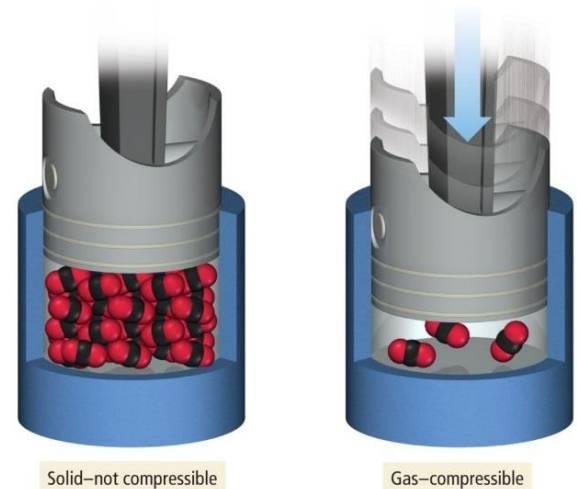


Gaseous Matter

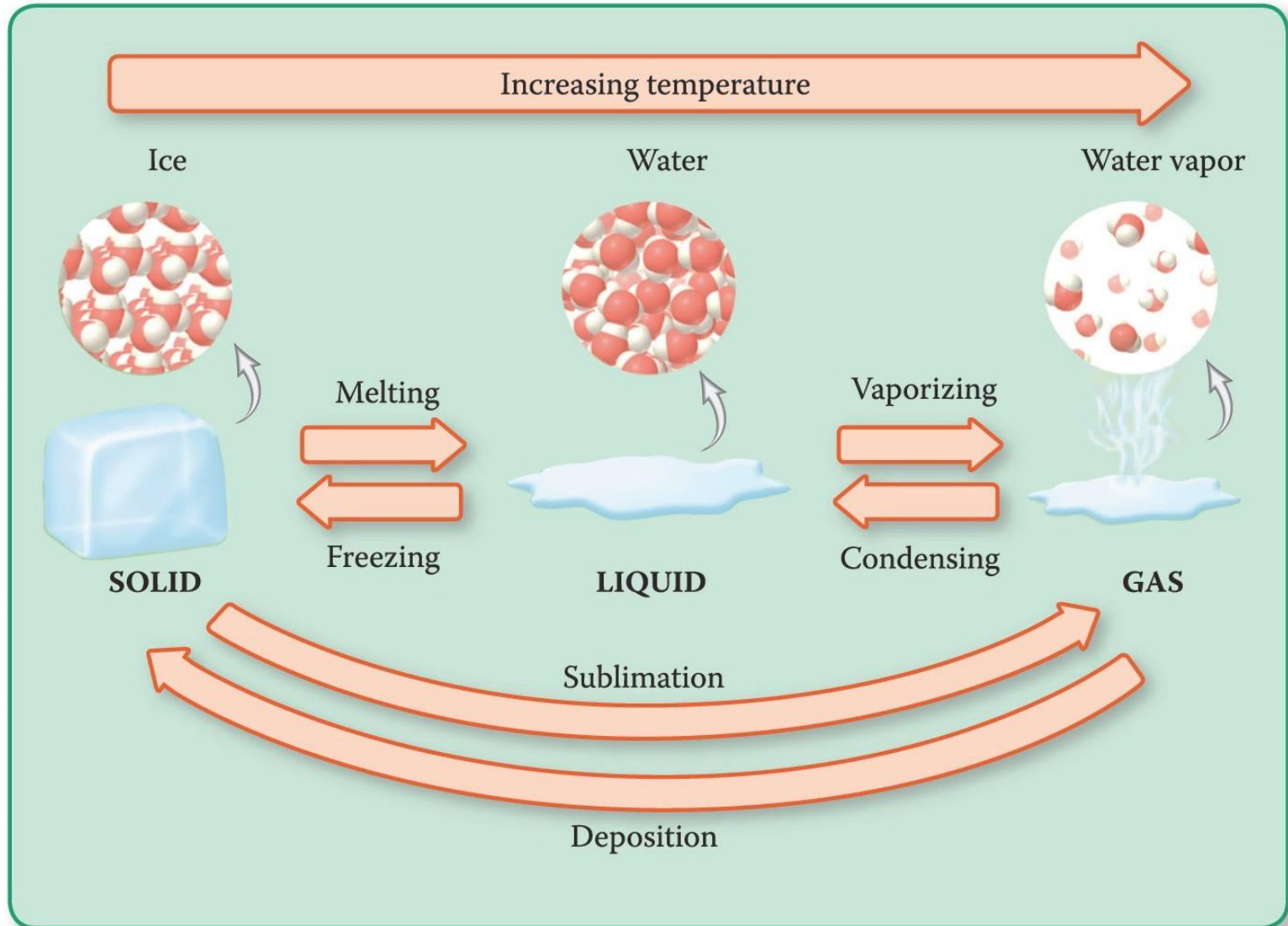
- **Gaseous Matter**: is composed of particles packed so loosely that it has neither a defined shape nor a defined volume.
- Particles of gases (atoms or molecules) are free to move relative to one another.
- Gases have **no fixed volume** and **no fixed shape**, they take the volume and shape of their containers.

These qualities make gases **compressible**.

- **Examples of gases:**
oxygen, nitrogen, CO₂, water vapor



Summary of State Changes of Matter



IMAT real test) which name of the following phase changes is **NOT** correct? (2013)

A Solid to liquid = Melting

✓ B Gas to solid = Freezing

C Solid to gas = Sublimation

D Liquid to gas = Evaporation

E Gas to liquid = Condensation

MEC

Classification of Matter According to its Composition

➤ **Matter can be divided into two classes:**

1. Mixtures: are composed of more than one substance and can be physically separated into its component substances.

2. Pure substances: are composed of only one substance and can NOT be physically separated.

Mixtures

There are **two types of mixtures**:

1. Heterogeneous mixtures

مخلوط نامی

2. Homogeneous mixtures

همگن

✓ **Heterogeneous Mixture:** does NOT have uniform properties throughout.

– (sand + water), (oil + water) or (gasoline + water) are examples on heterogeneous mixtures.

✓ **Homogeneous Mixture:** has uniform properties throughout.

– (salt water), (sugar + water) and alloys are homogeneous mixtures.

Pure Substances

There are two types of pure substances:

1. **Compounds**

2. **Elements**

✓ **Compound**: can be chemically separated into individual elements.

There are millions of compounds in the universe.

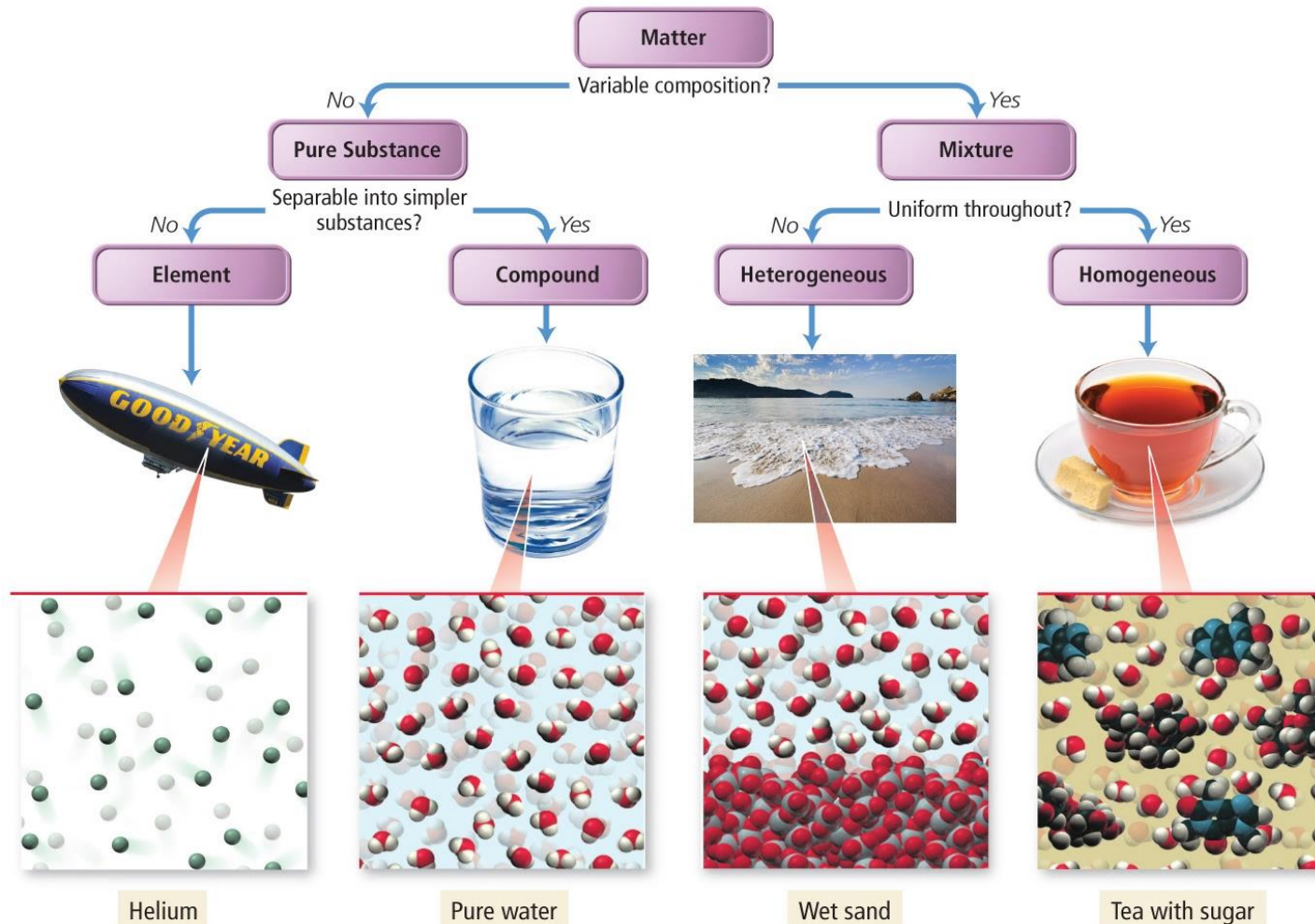
➤ Water is a compound that can be separated into hydrogen and oxygen.

✓ **Element**: cannot be broken down further by chemical reactions.

➤ Elements are the 120 members of the periodic table of elements, such as: Sodium, Iron, Gold, Silver, Hydrogen, Oxygen, Carbon etc

Summary of Types of Matter

Matter can be classified according to its composition into: **pure substances** (*elements or compounds*) and **mixtures** (*homogeneous or heterogeneous*):



Assessment

1- The process in which a solid substance is transformed directly into a gas is called sublimation and it requires increase of temperature.

2- _____ is the physical process which changes a gas into a liquid, and it needs _____ of temperature.

3- Which state of matter has a fixed volume but not a fixed shape.

4- A _____ matter is able to assume both the shape and volume of its container.

5- The ability of both _____ and _____ states of matter to flow makes them able to change their shape to the shape of their reservoir.

6- Classify each substance as a pure substance or a mixture, and indicate the type of each of them (element, compound or homogeneous, heterogeneous):

a. sweat

b. carbon dioxide

c. aluminum

d. salt

pure subs.
low p.

e. rust

f. wet sand

g. air

h. oxygen gas

i. bronze alloy

j. honey

mixture
homog.

1.3 Physical and Chemical Changes & Properties

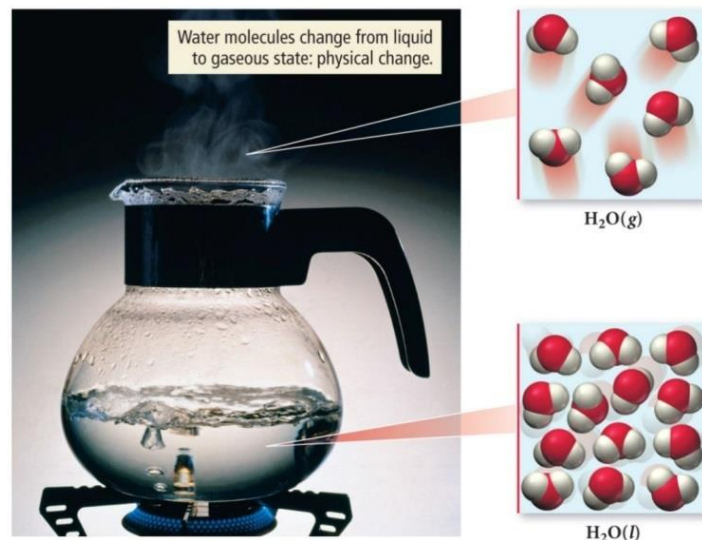
Physical Changes:

- A process that does NOT cause a substance to become a different substance (i.e. only the appearance (state or shape) is changed, but NOT the chemical composition).
- Physical changes are **reversible**.

Example 1: when water (H_2O) boils, it changes its state from liquid to gas.

➤ The gas remains composed of H_2O , so this is a “physical change”.

Example 2: when a piece of paper is shredded, or a glass window is broken, only their shapes have changed, but their chemical compositions remains unchanged.



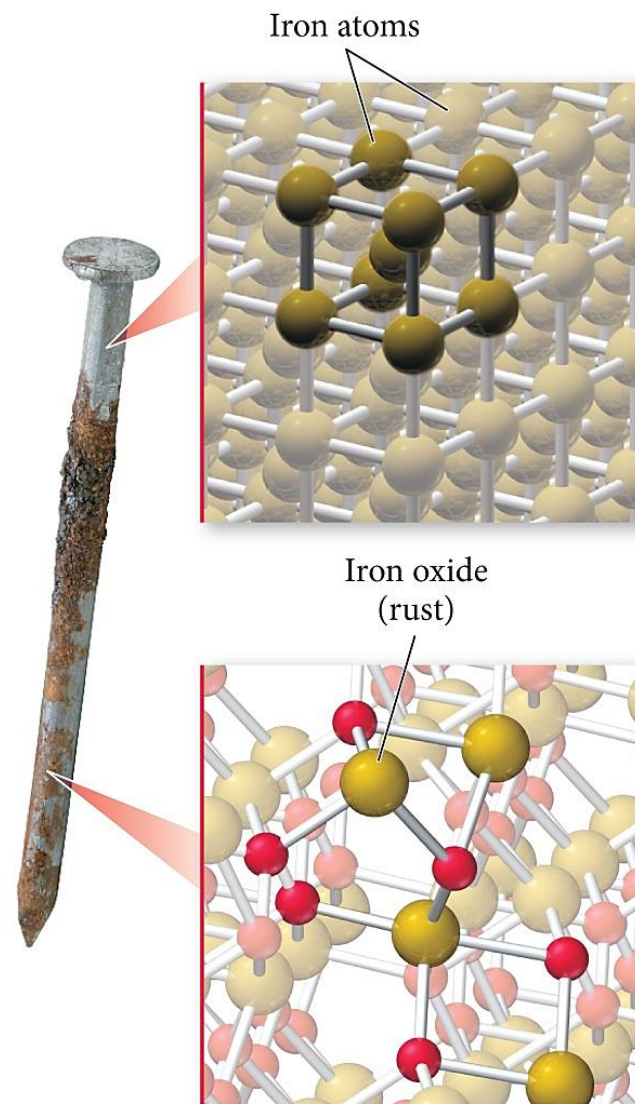
1.3 Physical and Chemical Changes & Properties

Chemical Changes:

- A process that causes a substance to change into a new substance with a new chemical composition.
- During a chemical change, atoms rearrange themselves to make different substances.
- Chemical changes are **irreversible**.

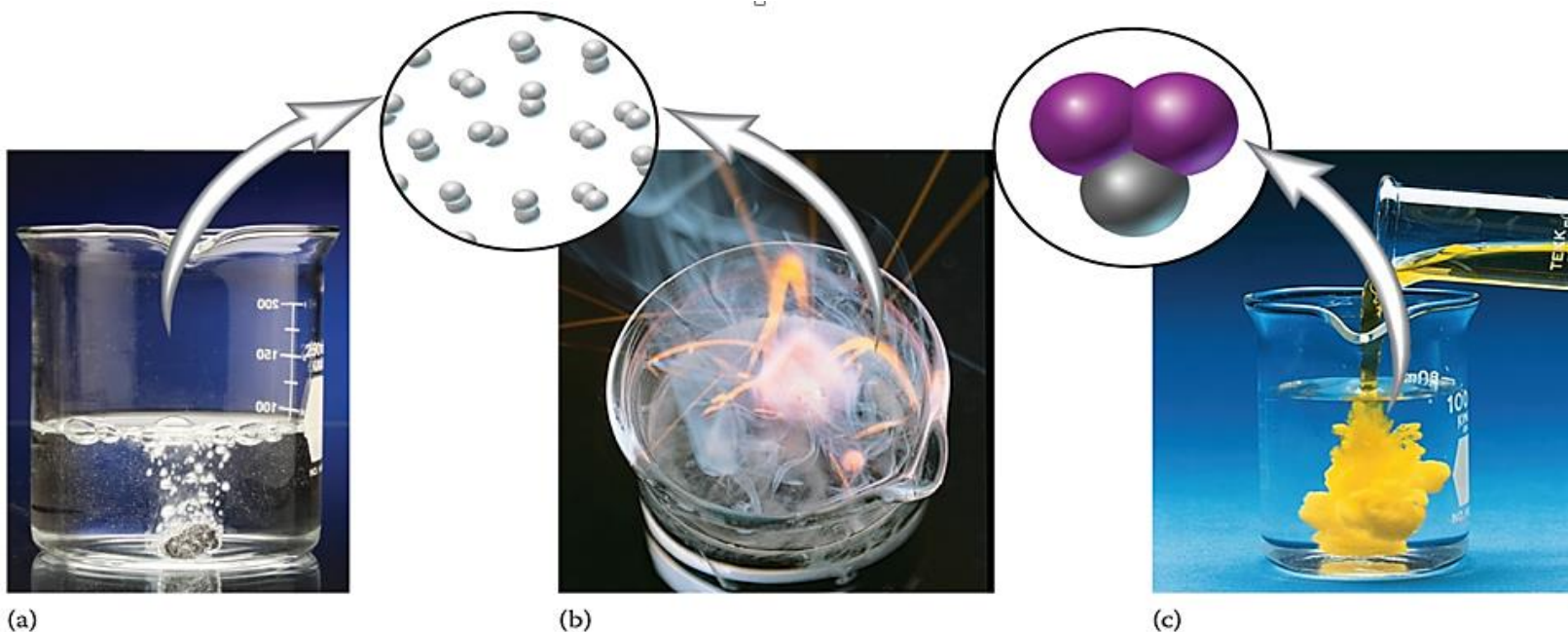
Example 1: rusting of iron is a chemical change: $4 \text{Fe} + 3 \text{O}_2 \rightarrow 2 \text{Fe}_2\text{O}_3$

Example 2: burning of gasoline produces $\text{CO}_2 + \text{H}_2\text{O}$, so, it's a chemical change



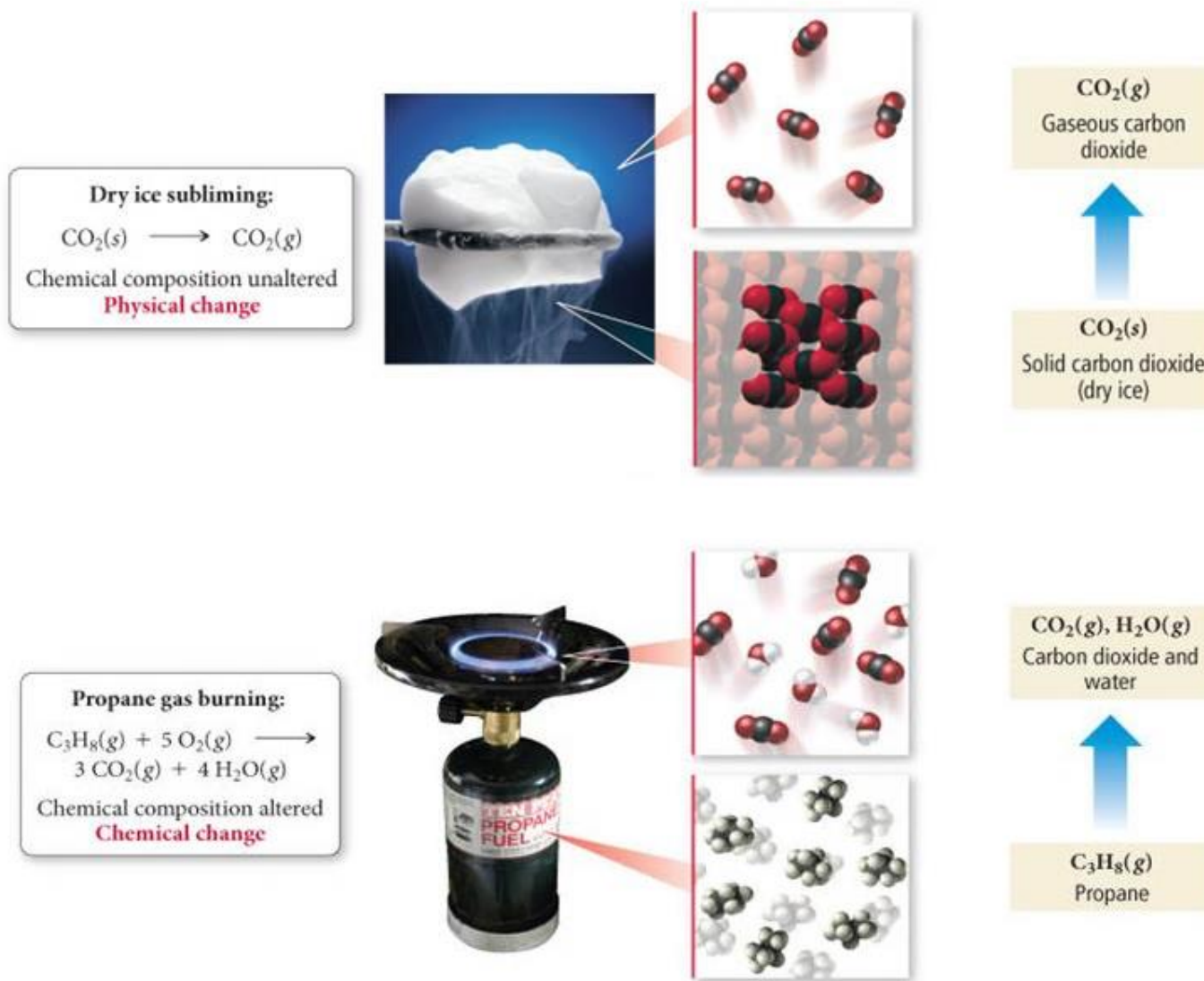
Evidences for Chemical Changes

- a) Release of a gas (e.g. bubbles or smoke)
- b) Emission of light or heat (e.g. burning of wood)
- c) Permanent change in color (e.g. the brown layer of iron rust)



Physical and Chemical Changes: Examples

Physical Change versus Chemical Change



Physical and Chemical Properties of Matter

1. Physical Properties: any characteristic that can be measured without changing the substance's chemical identity or composition (i.e. without any chemical reactions).

Examples on Physical Properties:

- Color
- Odor
- Taste
- Density
- Melting Point
- Boiling Point
- Viscosity
- Temperature
- Hardness
- Metallic Luster
- Malleability
- Ductility

و رنگ خواری

تورق پذیری

Physical and Chemical Properties of Matter

2. Chemical Properties: any characteristic that can be measured only by changing a substance's chemical identity or composition (i.e. in a chemical reaction).

Examples on Chemical Properties:

- Reactivity with other chemicals (acids, water, oxygen,)
- Acidity and Basicity
- Flammability
- Chemical stability
- Toxicity
- Heat of combustion
- Oxidation state

Assessment

Identify the following as chemical or physical changes or properties:

- | | | | |
|-----------|--|--|-----------------------|
| phy. Prop | 1. <u>blue color</u> | 2. <u>melting point</u> <i>phys prop.</i> | 3. <u>density</u> |
| | 4. reaction with water | 5. flammability | 6. hardness |
| | 7. toxicity | 8. boiling point | 9. reaction with acid |
| | 10. luster | 11. perfume odor | 12. sour taste |
| | 13. coal Burns | 14. dry ice sublimates | |
| | 15. Ag (Silver) tarnishes | 16. milk sours | |
| | 17. an apple is cut | 18. fruit rot | |
| | 19. heat changes H ₂ O to steam | 20. pancakes cook | |
| | 21. baking soda reacts to vinegar | 22. grass grows | |
| | 23. iron rusts | 24. a tire is inflated → <i>Phys. change</i> | |
| | 25. alcohol evaporates | 26. food is digested <i>chem chan</i> | |
| | 27. ice melts | 28. paper absorbs water <i>Phy. change</i> | |