

CLASSIFICATION OF MATTER

• A sample of matter can be a gas, a liquid, or a solid. These three forms of matter are called the **states of matter**.



Solid State Ordered and dense Has a definite shape and volume. Solids are very slightly compressible.



Liquid State Disordered and usually slightly less dense. Has a definite volume and takes the shape of the container. Liquids are slightly compressible.



Gas State Disordered and much lower density than crystal or liquid. Does not have definite shape and volume. Gases are highly compressible.

STATES OF MATTER

- How do you change a solid into a liquid?
- Melting
- How do you change a gas into a liquid?
- Condensing (Condensation)

PURE SUBSTANCES

- A **pure substance** (usually referred to simply as a *substance*) is matter that has distinct properties and a composition that doesn't vary from sample to sample.
- A pure substance can be an element, compound, or a mixture.



ELEMENTS

"This glorious book is more than just a guide to the elements; it will fundamentally deepen your appreciation of the substances that make up our world." **Obver Sacks**

All substances are either elements or compounds.
Elements cannot be decomposed into simpler substances. On the molecular level, each element is composed of only one kind of atom.

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COMPOUNDS AND MIXTURES

- **Compounds** are substances composed of two or more elements, so they contain two or more kinds of atoms.
- **Mixtures** are combinations of two or more substances in which each substance retains its own chemical identity.



(a) Atoms of an element



(b) Molecules of an element



(c) Molecules of a compound



(d) Mixture of elements and a compound

WHAT IS MATTER?

• Everything that has mass and volume is called

matter.



WHAT KIND OF CHANGES DOES MATTER UNDERGO?

•All matter, regardless of state, undergoes **physical** and **chemical changes**. These changes can be microscopic or macroscopic.

PROPERTIES OF MATTER

Property	Description	Example
Electrical conductivity	ability to carry electricity	Copper is a good electrical conduc- tor, so it is used in wiring.
Heat conductivity	ability to transfer energy as heat	Aluminum is a good heat conductor, so it is used to make pots and pans.
Density	mass-to-volume ratio of a substance; measure of how tightly matter is "packed"	Lead is a very dense material, so it is used to make sinkers for fishing line.
Melting point	temperature at which a solid changes state to become a liquid	Ice melts to liquid water at the melting point of water.
Boiling point	temperature at which a liquid boils and changes state to become a gas at a given pressure	Liquid water becomes water vapor at the boiling point of water.
Index of refraction	extent to which a given material bends light passing through it	The index of refraction of water tells you how much light slows and bends as it passes through water.
Malleability	ability to be hammered or beaten into thin sheets	Silver is quite malleable, so it is used to make jewelry.
Ductility	ability to be drawn into a thin wire	Tantalum is a ductile metal, so it is used to make fine dental tools.

WHAT IS A PHYSICAL CHANGE?

- A **physical change** occurs when the substance changes state but does not change its chemical composition.
- For example: water freezing into ice, cutting a piece of wood into smaller pieces, etc. The form or appearance has changed, but the properties of that substance are the same (i.e. it has the same melting point, boiling point, chemical composition, etc.)



CHARACTERISTICS OF PHYSICAL CHANGES

- Melting point
- Boiling point
- Vapor pressure
- Color
- State of matter

- Density
- Electrical conductivity
- Solubility
- Adsorption to a surface
- Hardness



- A **chemical change** occurs when a substance changes into something new. This occurs due to heating, chemical reaction, etc.
- You can tell a chemical change has occurred if the density, melting point or freezing point of the original substance changes.
- Many common signs of a chemical change can be seen (bubbles forming, mass changed, etc).

CHARACTERISTICS OF CHEMICAL CHANGES

- Reaction with acids
- Reaction with bases (alkalis)
- Reaction with oxygen (combustion)
- Ability to act as oxidizing agent

- Ability to act as reducing agent
- Reaction with other elements
- Decomposition into simpler substances
- Corrosion



OBSERVATIONS OF A CHEMICAL CHANGE

- Formation of gas (bubbles)
- Color change
- Exchange of heat energy (endotherm exothermic reactions)
- Production of light
- Precipitate forms







EXTENSIVE AND INTENSIVE PROPERTIES

Extensive Property

• Extensive properties such as <u>mass</u> and <u>volume</u> do depend on the quantity of the sample.

Intensive Property

• Intensive properties such as density, color, and boiling point do not depend on the size of the sample of matter and can be used to identify substances.

PHYSICAL PROPERTIES VS. CHEMICAL PROPERTIES

- **Physical properties** are those that we can determine without changing the identity of the substance we are studying (i.e. **intensive property**)
- Chemical properties describe the way a substance can change or react to form other substances. These properties, then, must be determined using a process that changes the identity of the substance of interest(i.e. extensive properties).

How do you know what property?

- The **physical properties** of sodium metal can be observed or measured. It is a soft, lustrous, silver-colored metal with a relatively low melting point and low density.
- Hardness, color, melting point and density are all physical properties.
- In other words, we have to define **chemical properties** of a substance by the chemical changes it undergoes.