

# Properties of Matter

2.3

# I. Physical Properties of Matter

- *Physical Properties* – the properties that you can observe without changing a substance into a new substance

# A. Density

1. *Density* is the measure of the mass of an object divided by its volume

$$D = m/v$$

2. Density is a physical property

3. Measurement is usually in grams per cubic centimeter

4. An object that is more dense than water will sink, whereas one that is less dense will float

# Density

You want to find the density of a small cube of an unknown material. It measures 1cm x 1 cm x 2cm. It has a mass of 8g.

$$D = m/v$$

$$\text{Mass} = 8 \text{ g}$$

$$\text{Volume} = 2 \text{ cm}^3$$

$$D = 8\text{g}/2 \text{ cm}^3$$

$$= 4 \text{ g/ cm}^3$$

## Density

Your Aunt brings you a souvenir gold bar from her visit to Fort Knox. It measures 10cm x 5 cm x 2 cm. It has a mass of 1930 g. Find the Density of Gold.

$$D = m/v$$

$$\text{Mass} = 1,930 \text{ g}$$

$$\text{Volume} = 100 \text{ cm}^3$$

$$D = 1,930 \text{ g}/100 \text{ cm}^3$$

$$= 19.3 \text{ g}/\text{cm}^3$$

# II. States of Matter

- Matter on Earth occurs in four physical states
  - Solids
  - Liquids
  - Gases
  - Plasma

# A. Solids

1. Solid matter occurs because atoms are very close together and can not switch positions
2. The Atoms or molecules in a solid are strongly attracted to one another and therefore are tightly packed – this helps to maintain their shape

## B. Liquids

1. In liquid, atoms remain close, but may change position
2. Atom's or molecules in a liquid are also strongly attracted to each other, but not as strongly attracted as those of a solid



3. Its molecules will move over and around each other, allowing it to change shape to fit to its container

4. Maintains volume

– If you have 100 ml in a tall glass and pour it into a bowl – it will change shape but the volume will remain at 100 ml

## C. Gas

1. Gases behave the way they do because their atoms or molecules have very little attraction to each other
2. Gases move around freely and fill the entire container they are in

# D. Plasma

1. Most of the matter in the universe is in the plasma state
2. Matter in the plasma state is composed of Ions and Electrons that have escaped from their electron cloud
3. Stars are composed of matter in the plasma state
4. On Earth, Plasma is found in lightning bolts

# III. Changing the State of Matter

a. Matter is changed from a liquid to a solid at its freezing point and from a liquid to a gas at its boiling point

–freezing point =  $0^{\circ}\text{C}$

–boiling point =  $100^{\circ}\text{C}$

b. Water is the only substance that occurs naturally on Earth as a solid, liquid and gas

c. Two factors that determine the state of matter are:

- the attraction between atoms
- their rate of movement

d. Changes in the state of matter can also occur because of increase or decrease in pressure

# IV. Changes in Physical Properties

- a. Chemical properties don't change when the matter changes state
  - But some of its physical properties change
  
- b. Most materials are more dense in their solid state than their liquid state
  
- c. Some physical substances don't change when they change state

# A. Classifying Matter

1. Chemical and physical properties allow us to identify matter
2. One way to classify matter is by its state
3. Matter in one state can often be changed to another state by adding or removing thermal energy