

Unit 9a – Measuring Matter

Matter is all around us. Matter is anything that has mass or takes up space. If it's made up of atoms or molecules, it's matter - and it matters!

In this unit we learn how to measure matter to better understand its **physical properties**. Matter can be measured in standard units of length, volume, temperature, mass, density, and weight.

Scientists use **standard units of the metric system** to measure matter.

Length is usually measured in millimeters, centimeters, meters, or kilometers using rulers, meter sticks, or tape measures.

Liquid volume is usually measured in milliliters or liters using beakers, measuring cups, or graduated cylinders.

The **volume of rectangular solids** may be calculated mathematically (length X width X height) in cubic centimeters (cm^3).

The volume of other solids may be measured using Archimedes' bathtub "Eureka" method – by submerging the object in a graduated cylinder and **measuring the amount of water displaced** in milliliters.

Volume conversion: 1 milliliter = 1 cm^3

Temperature is usually measured in degrees Celsius ($^{\circ}\text{C}$) or Fahrenheit ($^{\circ}\text{F}$) using a thermometer.

Vocabulary

matter

physical properties

length

volume

temperature

Mass

Mass is usually measured in grams or kilograms using a pan balance or a triple-beam balance.

All matter has mass that can be measured, even air.

Objects with the same volume do not necessarily have the same mass – for example a hollow plastic golf ball and Tiger Woods' golf ball, or a block of wood and an equal-sized block of solid steel.

Matter is made of tiny particles called atoms – the mass of an object depends partly upon how tightly those particles are packed inside the object.

Density

Density is the relationship between mass and volume. It describes how tightly matter is packed together.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

or, in short form:

$$d = \frac{m}{v}$$

An object will **float** if its density is less than the density of the liquid or gas in which it is placed.

The density of water is 1 g/cm³, so any object with a density less than 1 g/cm³ will float in water, anything with density greater than 1 g/cm³ will sink.

Hot air rises! Density can change with temperature. As air gets warmer, the air particles move faster and spread out. The heated air is less dense and rises above cooler, denser air.

Vocabulary

mass

density

Weight

Scientifically, **weight** and **mass** are not the same!

Weight measures the amount of pull (**gravity**) between an object and a planet.

Scientifically, weight is measured in metric **newtons** (N) using a scale.

The more mass an object has, the stronger the pull of gravity.

Gravity on the Moon is only 1/6 of Earth's gravity, so objects on the Moon weigh 1/6 of their weight on Earth. **Mr. Mac would weigh only 33 pounds on the Moon!**

The Metric System

Metric Prefixes, Symbols & Meanings

Prefix	Symbol	Meaning	
kilo-	k	1000	thousand
hecto-	h	100	hundred
deka-	da	10	ten
deci-	d	0.1	tenth
centi-	c	0.01	hundredth
milli-	m	0.001	thousandth

Vocabulary

weight

gravity

newton (N)
