

Measurement

To measure the properties of matter, scientists use a system called the International System of Units.

International System of Units: the system of units used by scientists to measure the properties of matter.

This system is abbreviated SI after its French name Système International.

Weight and Mass

weight: a measure of the force of gravity on an object.

mass: a measurement of the amount of matter in an object.

*Unlike weight, mass does not change with location, even when the force of gravity on an object changes.

-This means you would weigh less on the moon than on Earth, but your mass would stay the same.

*This is why scientists prefer to measure matter by its mass rather than its weight.

SI basic unit of mass: gram (g)
smaller: milligram (mg) 1g = 1,000 mg
larger: kilogram (kg) 1kg = 1,000g

Volume

volume: the amount of space matter occupies.

*Solids, liquids, and gases all have volume

SI basic unit of volume for liquids: liter (L)

smaller: milliliter (mL) 1L = 1,000mL

larger: kiloliter (kL) 1kL = 1,000L

SI basic unit of volume for solids: Cubic centimeters (cm³)

*Suppose you want to find the volume of a rectangular object, such as a brick. First, you measure the brick's length, width, and height, then you multiply them

$$\text{volume} = \text{length} \times \text{width} \times \text{height}$$

Measurements always have units. So, when you multiply the three measurements, you multiply the units as well as the numbers!

$$\text{Units} - \text{cm} \times \text{cm} \times \text{cm} = \text{cm}^3$$

*Suppose you want to measure the volume of an irregular object, such as a piece of fruit or a rock.

You would submerge the object in water in a graduated cylinder. The water level will rise by an amount equal to the volume of the object in milliliters.

Density

density: the mass of an object in a given volume

Two materials may have the same volume, but they don't necessarily have the same mass.

A kg of sand and a kg of feathers have the same mass but a kg of sand takes up much less space than a kg of feathers.

The volumes differ because sand & feathers have different densities.

*Density is expressed as the number of grams in one cubic centimeter (cm³)

For example, gold has a density of 19 g/cm³

This means that every gram of gold has a volume of 1/19 cm³

*Notice that the word "per" is replaced by the fraction bar in the units of density.

This bar tells you that you can determine the density of a sample of matter by dividing its mass by its volume.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$