Name _____ Date _____ Class _____

Measuring Matter

Key Concepts

- What is the difference between weight and mass?
- What units are used to express the amount of space occupied by matter?
- How is the density of a material determined?

There are many ways to measure matter. Weight and mass are two of them. **Weight** is a measure of the force of gravity on an object. The force of gravity on the moon is much weaker than on Earth, so you would weigh less on the moon than on Earth. The **mass** of an object is the measurement of how much matter it contains. **Unlike its weight, an object's mass will not change if the force of gravity on it changes.**

Scientists use the **International System of Units** to measure the properties of matter. The system is abbreviated "SI," after its French name, Système International d' Unités. The SI unit for mass is the kilogram (kg). The gram (g) is a smaller unit. There are exactly 1,000 grams in a kilogram. A nickel has a mass of about 5 grams, and the mass of a baseball is about 150 grams.

The amount of space that matter occupies is called its **volume**. Solids, liquids, and gases all have volume. The volume of rectangular objects, such as a brick, can be found by multiplying the measurements of length, width, and height.

$$\text{Volume} = \text{Length} \times \text{Width} \times \text{Height}$$

When you multiply these measurements, you must multiply the units as well as the numbers (for example, cm × cm × cm). **A common unit of volume is the cubic centimeter (cm^3). Other units of volume include the liter (L) and the milliliter (mL).** Both are often used for liquids. A milliliter is exactly 1 cubic centimeter. There are 1,000 milliliters in one liter.

Samples of different materials may have the same volume but not the same mass. An important property of matter is density. **Density** relates the mass and volume of an object or material. **To calculate the density of a sample, divide its mass by its volume.**

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

The unit of density is always a unit of mass, such as grams, divided by a unit of volume, such as cubic centimeters. One typical unit of density is written as "g/cm^3," which is read as "grams per cubic centimeter." For liquids, density is often given in grams per milliliter, or g/mL.

Sometimes you can compare the densities of materials by observing them. A solid block of a material that sinks in water has a greater density than water. A solid block that floats in water has a lower density than water.

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This section explains the difference between mass and weight. It also explains what the density of a substance is.

Use Target Reading Skills

Before you read, preview the red headings. In the left column of the chart, write a what or how question for each heading. As you read, complete the chart by writing the answers to your questions.

Measuring Matter

Question	Answer
How are weight and mass different?	Weight is a measure of . . .