

What Is Matter?

Every object that you can think of, including you, is made of matter. Matter is anything that has mass and takes up space.

Common Properties of All Matter

The food you eat, the liquid you drink, and the air you breathe are examples of matter. These things seem so different. For example, you can't see the air you breathe because it is not visible. But all matter shares two properties. First, all matter has mass. Mass is a measure of the amount of matter in an object. Second, all matter has volume. Volume is a measure of the amount of space that an object takes up.

Matter: Anything that has mass and takes up space.

Both mass and volume are measurable and observable properties. Mass and volume can also be used to distinguish one substance from another.

Mass

Looking at an object is not a reliable way to measure how much matter is in the object. Sometimes, very large objects can be made of a small amount of matter. For example, even large sponges have little mass. This is true because sponges are made of matter that is not packed very closely together. Also, it is possible for small objects, such as lead fishing sinkers, to be made up of a great deal of matter. Scientists often measure an object's mass by using a balance. A balance compares an object's mass to known standards of mass. The mass of an object remains the same regardless of where the object is located in the universe.

Mass: A measure of the amount of matter in an object.

Mass, Not Weight

You probably do not know your mass. On the other hand, you have been weighed many times over the course of your life. Are mass and weight two ways to measure how heavy something is? No, mass and weight measure two different things.

Weight is a measure of the gravitational force on an object. An object feels heavy because of the force of gravity. Because the force of gravity changes based on an object's location, the object's weight also changes based on the object's location.

Weight: A measure of the gravitational force exerted on an object; its value can change with the location of the object in the universe.

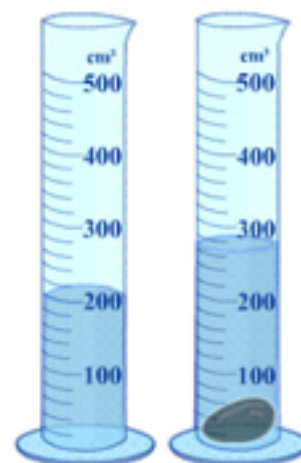
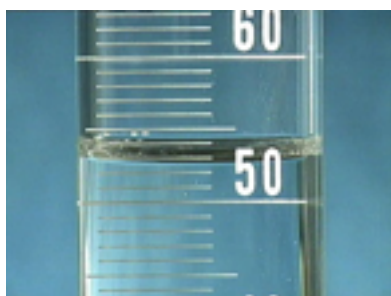
Volume

The way in which you measure volume depends on the kind of matter you are measuring. The volume of a regularly shaped solid, such as a cube or rectangular block, can be measured by using a ruler. The volume of a rectangular object (such as a box) can be found by multiplying the three linear dimensions: ***volume = length x width x height***. There are also formulas for the volumes of other regular solids, such as spheres and cones.

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

Volume of Liquids

Can you imagine using a ruler to measure the volume of a liquid? Instead of using a ruler, you measure the volume of a liquid by using a graduated cylinder. A graduated cylinder is a measuring device that is specifically designed for measuring liquids. When poured into a graduated cylinder, a liquid often forms a ***meniscus***, or curve, at its surface. When you use a graduated cylinder, the liquid's volume is read by finding the mark that is closest to the bottom of the meniscus.



Volume of Irregularly Shaped Solids

Think about all of the solid objects that have odd shapes. How do you find the volume of a rock, a coin, or a marble? A graduated cylinder comes in handy in these situations, too.

The volumes of irregularly shaped solids can be found by immersing the solids in a liquid and seeing how much of the liquid is displaced.

Density: Relating Mass and Volume

You have learned that mass and volume are important properties that all matter possesses. Another property of all matter is density. Density is a measure of the amount of matter in a given amount of space. You can calculate density by dividing the mass of an object by the volume of the object.

Two different objects that have the same volume may have different masses. Density is an important way in which substances can differ. Scientists often use density calculations to determine the kind of substance with which they are dealing. The reason is that the density of most substances differs from the density of other substances.

$$\text{Density} = \text{mass} / \text{volume}$$