

**PS6 FACT SHEET**  
**MEASURING MASS, VOLUME, AND DENSITY**

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**CLASSWORK AGENDA FOR THE WEEK**

- (1) Explain the difference between mass and weight.
  - (2) Measure the mass of a variety of "weightless" objects.
  - (3) Measure the volume of oddly shaped objects.
  - (4) Calculate the density of a variety of objects.
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Space and time are not the only things that scientists can measure. As you learned in an earlier lesson, mass is another property of matter that can be measured directly. **Mass** is the amount of matter in an object and the unit of measure for mass is the gram. Water is the material standard used to find out how many grams of matter there are in an object. By definition, one cubic centimeter of water at 4° Celsius at sea level is equal to one **gram**.

In addition to space, time, and mass, there are a variety of other measureable quantities that can be calculated or "derived." Derived units of measure can be found by combining units of measure for distance, mass, and time. For example, speed is a **derived measure**. Speed describes how fast an object is moving. The speed of a moving object can be found by dividing the distance the object has travelled by the time it took to travel that distance. When we say an automobile is travelling at 70 kilometers per hour (kph) we are comparing a measure of distance (kilometers) with a measure of time (hours). Another derived unit of measure is weight. **Weight** is the force of gravity, or pull of the earth, exerted on an object that has mass. *Weight and mass do not have the same meaning.* Weight is a force. Mass is an amount of matter.

Another derived unit of measure is the gram per cubic centimeter. A **gram per cubic centimeter** measures the density of an object. **Density** describes how tightly matter is packed inside an object. Density (**D**) is the mass (**m**) per unit volume (**v**) of a substance. Twenty kilograms of cotton has the same mass as twenty kilograms of iron. However, the iron is normally more densely packed. It occupies a smaller amount of space than the fluffy cotton. Density can be calculated using the following mathematical formula:

$$D = m \div v$$

There are many objects in our universe that are extremely dense. **Neutron stars** and **black holes** are two such objects. Scientists calculate that the matter inside a neutron star is so tightly packed that a chunk of such an object no larger than your thumb would weigh as much as a mountain. The matter at the center of a black hole is so tightly jammed together that everything inside the black hole must be "crushed" out of existence. You might think that the sun is a very dense object. But the sun is less dense on average than earth. Earth is the densest planetary object in our solar system. Earth is a rocky planet made mostly of solid iron. As large as it is, the sun is made mostly of gas like the giant outer planets, Jupiter, Saturn, Uranus, and Neptune.

## PS6 Fact Sheet (cont'd)

### Homework Directions

SHOW ALL MATHEMATICAL FORMULAS AND CALCULATIONS IN SOLVING PROBLEMS #1, #2, AND #3. BE SURE TO INCLUDE CORRECT UNITS OF MEASURE WITH YOUR ANSWER.

1. A piece of metal has a mass of 18.3 grams and a volume of 6.1 cubic centimeters. What is the density of the metal?
2. A block of wood has a mass of 0.124 kilograms and displaces 248 milliliters of water. What is the density of the block?
3. On average, the metal alloy used to build a ship has a density of 8.0 grams per cubic centimeter. The ship has a mass of 18,000 kilograms. How much water will the ship need to displace in order to stay afloat? *Hint:* An object will float in a fluid if it is less dense than the fluid into which it is placed. Find the density of water in Paragraph #1 of this Fact Sheet.

Assignment due: \_\_\_\_\_

USE THE CARDBOARD BALANCE YOU CONSTRUCTED IN CLASS TO CREATE A SMALL "GRADUATED" PAPER CUP (i.e., LIKE A GRADUATED CYLINDER) THAT WILL HELP YOU TO MEASURE THE VOLUME OF LIQUIDS IN 6 MILLILITER STEPS TO AT LEAST 60 MILLILITERS.

Assignment due: \_\_\_\_\_

\_\_\_\_\_  
Student's Signature

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Parent's Signature

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Date