

# RAFT IDEAS

**Topics:** Measurement, Volume, Experimentation Skills

## Materials List

- ✓ Preform or other narrow, cylindrical container
- ✓ Way to hold preform upright
- ✓ Fine-tip permanent marker
- ✓ 5 ml pipette, syringe, or similar precise measuring device
- ✓ Cup
- ✓ Water

This activity can be used to teach:

- Volume (Common Core Math Standards: Measurement & Data, Grade 3, 2; Grade 4, 2)
- Measurement (Common Core Math Standards: Grade 4, Measurement & Data, 1)
- Convert between units (Common Core Math Standards: Grade 5, Measurement & Data, 1)
- Science & Engineering Practices (Next Generation Science Standards: Grades: K – 12)



# Graduated Preforms

## The Pomp and Circumstance of Lab Ware

**Volume** measures the amount of space taken up by an object.

**Mass** measures the amount of matter in an object.



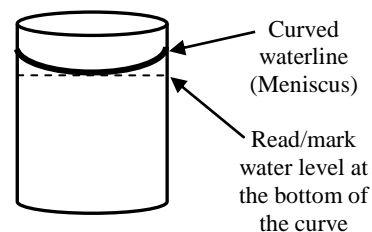
**Weight** measures how strongly gravity pulls on an object (weight = mass x acceleration due to gravity).

**Density** measures how tightly packed the matter is in an object (density = mass/volume).

Precise measurement is a crucial skill for many scientific and engineering fields, such as biochemistry, environmental science, medicine, pharmacology, and materials engineering. In this activity, students will use a 5 ml pipette to create a graduated preform that they can then use to do experiments involving volume measurements.

### To Do and Notice (Do not use preforms with hotplates, Bunsen burners, etc. because extreme heat will melt them!)

1. Place the preform into a holder that will hold the preform upright.
2. Fill a pipette or syringe with 5 ml (or other set amount) of water and dispense the water into the preform.
3. Make sure the preform is level and then draw a line at the waterline, forming a graduated mark. When measuring a liquid in a narrow-diameter tube the waterline may have a curve, called a **meniscus**. When a meniscus is seen, always measure, or mark, at the bottom of the curve.
4. Label the line (i.e. – “5 ml”).
5. Continue with steps 2 to 4 until the preform is full. A “2-liter size” preform will hold 35 ml, “1½ liter size” preform will hold 25ml, and a “1-liter size” (“mini”) preform will hold 10 ml. (The “liter” size for a preform refers to the volume the preform would hold after being heated and expanded into a bottle.)
6. Optional: Using a similar technique, add graduated marks at 1 ml increments.



### The Science Behind the Activity

The 4 general properties of matter are: volume, mass, weight, and density. Volume measures the amount of space taken up by an object. The metric unit of volume is the liter. In this activity, students are using a smaller unit of measurement, the milliliter (1000 ml = 1 liter). By definition, a centimeter cube is 1 milliliter in volume; and it can be expressed as ml (milliliter), cm<sup>3</sup> (cubic centimeter), or cc (cubic centimeter).

### Taking it Further

Graduated preforms can be used for a variety of matter and chemical experiments as long as they do not involve extreme heat.

Students can measure the volume of small, irregular solids by measuring the water they displace. An object will displace water equal to its volume when **submerged** (no part above the waterline). Begin with a preform filled with 10 ml or 15 ml of water and note the starting level. Add the object and note the ending level. The difference between the starting and the ending water levels is the volume of the object.

**Web Resources** (Visit [www.raft.net/raft-idea?isid=88](http://www.raft.net/raft-idea?isid=88) for more resources!)