

Name: _____

Mystery Materials!

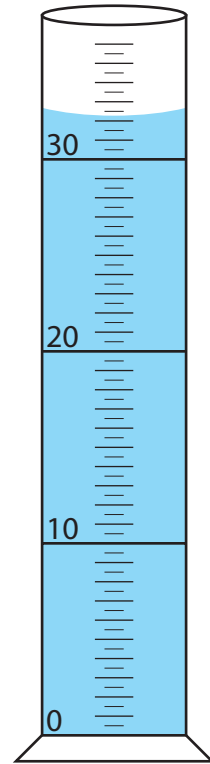
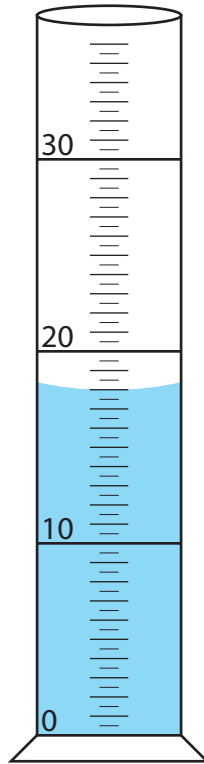
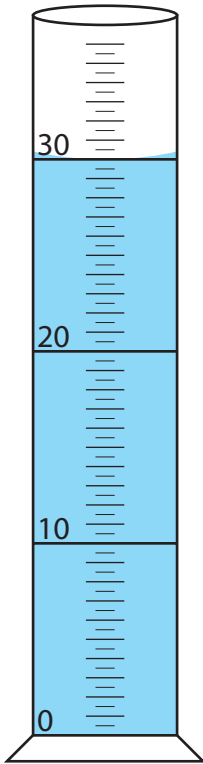
CAN A MATERIAL BE IDENTIFIED BY MEASURING ITS DENSITY?

Definitions

- Mass** - the amount of matter in an object
- Weight** - the force exerted on an object due to gravity
- Volume** - the amount of space an object occupies
- Density** - a number found by dividing an object's mass by its volume
- Meniscus** - the curvature of the surface of a liquid caused by the liquid interacting with the walls of its container
- Balance** - a device that is used to measure an object's mass
- Scale** - a device that is used to measure an object's weight

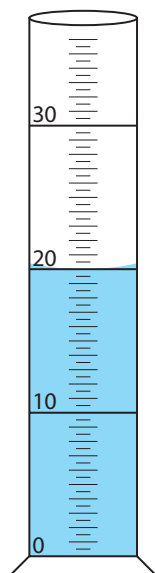
Practice Measurements

How much liquid is in each graduated cylinder?

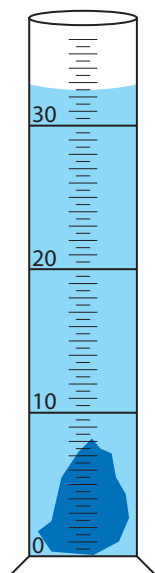


Procedure

1. To do this experiment, your team will need:
 - 2 samples of 3 unknown materials
 - A graduated cylinder
 - An electronic scale
 - A beaker of water
 - A small eye dropper
2. Obtain a sample of one unknown material and determine its mass with the scale.
3. Record the mass of the sample on the data chart.
4. Partly fill the graduated cylinder with water from the beaker. You can use the eye dropper to add small amounts of water to get the level to a 'nice' level. Make certain that there is enough water in the graduated cylinder to completely submerge the sample, but not so much water that the graduated cylinder will overflow when the sample is placed in it.
5. Record the volume of water in the graduated cylinder on the data chart.
6. Place the sample in the graduated cylinder. The water level in the graduated cylinder will rise because the sample has a volume, too. Since the water can't go into the space that the sample is occupying, the water gets 'pushed' out of the way, causing the level to rise.
7. Record the new level on the data chart.
8. Pour the water in the graduated cylinder back into the beaker and return the sample.
9. Repeat steps 2 through 8 with a second sample of the same unknown material.
10. Repeat steps 2 through 9 with two more unknown materials.
11. Calculate the densities of each of the unknown materials.
12. Use the calculated densities and the Densities of Common Materials chart to identify the three unknown materials.



Volume of Water = 20.0 mL



Volume with Sample = 32.5 mL



Volume of Sample = _____

Data Collection and Analysis

Material 1

	Mass of Sample	Volume of Water	Volume with Sample	Volume of Sample
Sample 1	<input type="text"/>	_____	_____	<input type="text"/>
Sample 2	<input type="text"/>	_____	_____	<input type="text"/>

$$\text{Density of Material 1} = \frac{\text{Total Mass}}{\text{Total Volume}} = \frac{\left(\begin{array}{c} + \\ + \end{array} \right)}{\left(\begin{array}{c} + \\ + \end{array} \right)} = \text{_____} = \boxed{}$$

Material 2

	Mass of Sample	Volume of Water	Volume with Sample	Volume of Sample
Sample 1	<input type="text"/>	_____	_____	<input type="text"/>
Sample 2	<input type="text"/>	_____	_____	<input type="text"/>

$$\text{Density of Material 2} = \frac{\text{Total Mass}}{\text{Total Volume}} = \frac{\left(\begin{array}{c} + \\ + \end{array} \right)}{\left(\begin{array}{c} + \\ + \end{array} \right)} = \text{_____} = \boxed{}$$

Material 3

	Mass of Sample	Volume of Water	Volume with Sample	Volume of Sample
Sample 1	<input type="text"/>	_____	_____	<input type="text"/>
Sample 2	<input type="text"/>	_____	_____	<input type="text"/>

$$\text{Density of Material 3} = \frac{\text{Total Mass}}{\text{Total Volume}} = \frac{\left(\begin{array}{c} + \\ + \end{array} \right)}{\left(\begin{array}{c} + \\ + \end{array} \right)} = \text{_____} = \boxed{}$$

Densities of Common Materials

Aluminum	2.70 g/cm ³	Lithium	0.53 g/cm ³	Sodium	0.97 g/cm ³
Copper	8.93 g/cm ³	Mercury	13.53 g/cm ³	Tungsten	19.3 g/cm ³
Gold	19.28 g/cm ³	Nickel	8.91 g/cm ³	Titanium	4.5 g/cm ³
Iron	7.87 g/cm ³	Platinum	21.46 g/cm ³	Uranium	18.95 g/cm ³
Lead	11.34 g/cm ³	Silver	10.50 g/cm ³	Zinc	7.13 g/cm ³

Conclusions

Material 1 appears to be _____.

Material 2 appears to be _____.

Material 3 appears to be _____.

Questions to Think About

1. Is knowing an object's density always enough information to identify what it is?
2. Water has a density of 1.00 g/cm³. Two of the materials listed on the Densities of Common Materials chart will float on water. Which are they?
3. Boats are made from steel. Steel is mostly iron. If iron is denser than water, why do boats float?
4. Which is denser, 100 kilograms of aluminum or 1 kilogram of lead?