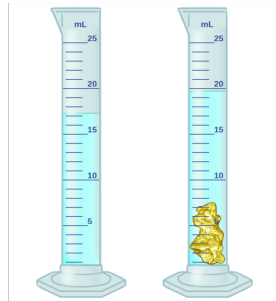


Understanding Materials: Density



- **Mass:** how much material is in an object, measured with a scale
- **Volume:** how much space an object takes up
- **Density:** mass per volume of an object

Part 1: Describing Materials

1. Pick up and handle the following objects. Discuss which appears to have lower or higher **mass**. Do not measure yet, just estimate.

Arrange the objects from least to greatest mass.



(a) big wooden block

(b) penny

(c) green marble

(d) wooden wedge

least
mass

greatest
mass

2. Discuss which of the objects has the biggest or smallest **volume** (estimate!)
List the objects from lower or higher volume.

least
volume

greatest
volume

3. Discuss which two objects do you think have similar density (circle 2). Why?

big wooden block

penny

marble

wooden wedge

Part 2: Identifying Materials by Measuring Density

0. You will compare the materials of zinc nuggets, copper nails, pennies, and dimes.

First make a guess (and discuss why you think so):

I think pennies are mostly made of: zinc / copper

I think dimes are mostly made of: zinc / copper

For each object:

1. Use the scales provided to measure mass (in grams).

Put the suggested number of objects on the left side of the scale. Put standard masses on the right side, and slide the slider to balance the scale.

2. Use the graduated cylinder to measure volume (in milliliters: mL).

Fill with water to exactly 30 mL (use a pipette to be precise)

Put in the objects (tilt the cylinder and slide down the side to avoid splashing.)

Write down how much the volume **increased above** 30 mL

3. Calculate density: divide the mass by the volume.



Object	#	Material	Mass (g)	Volume (mL)	Density (g/mL)
Zinc nuggets	1	zinc			
Copper nails	6	copper			
Dimes	8				
Pennies	8				

4. The actual density of zinc is 7.1 g/mL.

Discuss: did you get exactly this number? Did the group next to you? Why might your numbers be a little different?

All measurements have some error to them. Scientists try to measure as carefully as possible, but always keep in mind the possible errors in their measurements.

Do you think the density would change if you used 4 pennies instead of 8? yes / no

Discuss:

- What if you were to break your zinc nugget in half - do you think its density would change?
- What determines the density of an object?

Density is a **material property**. It does not matter how much of that material you have or what shape it is in, the density will stay the same.

5. Follow in Archimedes' footsteps! Use your density measurements to decide what the coins are really made of:

Pennies are mostly made of: zinc copper plastic
 Dimes are mostly made of: zinc copper plastic

6. Now try measuring the density of these other objects:

Object	#	Material	Mass (g)	Volume (mL)	Density (g/mL)
Green marbles	2				
Red marbles	2				
Sparkly rock					

6. Here is a table of densities for a few materials (measured by other scientists):

Material	Density
Glass ¹	2.5 g/mL
Plastic (acrylic)	1.2 g/mL
Gold	19 g/mL
Silver	10.5 g/mL
Pyrite ("fool's gold")	5 g/mL



What material are the green marbles made of? Glass Plastic Copper
 What material are the red marbles made of? Glass Plastic Copper
 What material is the sparkly rock made of? Gold Silver Pyrite

¹ Density of glass varies. This is a typical value for common window glass