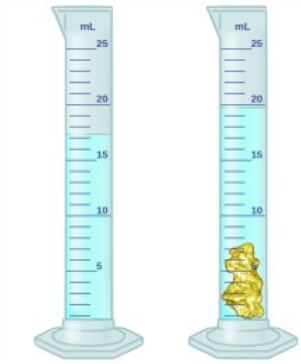
Density of Materials



- **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).

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	#	Object Mass (g)	Object Volume (mL) (change in water level)	Density (g/mL)	Material
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.

If you used 4 pennies instead of 8:
Do you think the mass would change? Yes / No
Do you think the volume would change? Yes / No
Do you think the density would change? Yes / No

Discuss: What if you were to break your zinc nugget in half – do you think its density would change?

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

Extra Part 3 (if you have time): Identifying More Materials

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

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

7. 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