Matter

anything that takes up space (volume) & has mass (amount)

- 4 states of matter (phases)

	solid	liquid	gas	plasma
particles	tightly packed together	close together	far apart	very far apart
shape	definite	indefinite →		
volume	definite →		indefinite →	
movement	vibrate in position	flow past each other	fast & random	very fast & random
Kinetic energy (energy of motion)	lowest →			highest

↳ a gas that has gotten so hot, the electrons are pulled off the atoms.

Physical Properties/Changes (nouns) (verbs)

- can be observed without changing the matter's composition

Examples
- mass
- volume
- melting point
- odor
- color
- texture
- evaporation
- density
- solubility - ability to dissolve
- ductility - draw into a wire
- malleability - pound into thin sheet
- cutting

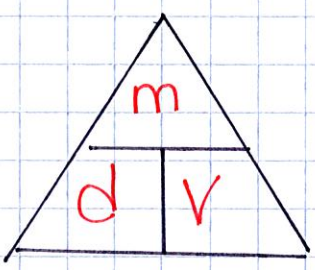
Chemical Properties/Changes (ideas) (actions)

- can only be observed when changing the matter's composition (something new forms)

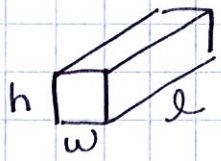
Examples
- combustibility
- tendency to react
- rusting
- digestion
- corrosion
- tarnishing

· Density = $\frac{\text{mass}}{\text{volume}}$

$d = \frac{m}{V}$ $\quad m = d \cdot V$ $\quad V = \frac{m}{d}$



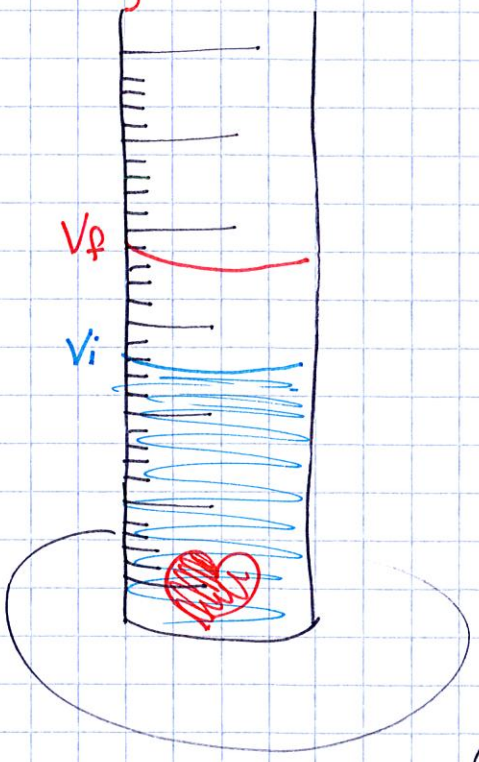
Volume of a rectangle



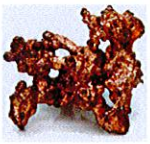
$V = l \times w \times h$

Volume of an oddly-shaped object - water displacement

1) Fill graduated cylinder with water & read the initial volume (V_i)
2) Place object carefully in cylinder & read the final volume
3) $V_{object} = V_f - V_i$

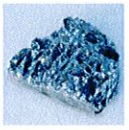


Density Examples d = m/V

1.  A piece of copper has a mass of 11.5 g and its volume was determined to be 1.283 mL. Calculate its density.

m V d

$$d = \frac{11.5\,g}{1.283\,mL} = 8.96\,g/mL$$

2.  A chunk of silver has a density of 10.49 g/cm^3 and its volume was calculated to be 5.88 cm^3. What is the mass of the silver?

d V m

$$m = 10.49\,\frac{g}{cm^3} \cdot 5.88\,cm^3 = 61.7\,g$$

$$\frac{g}{cm^3} \cdot \frac{cm^3}{1}$$

3.  What is the volume of a sample of liquid oxygen with a mass of 7.89 g and a density of 1.141 g/cm^3, what is the volume?

V

m d

$$\frac{g}{1} \cdot \frac{cm^3}{g}$$

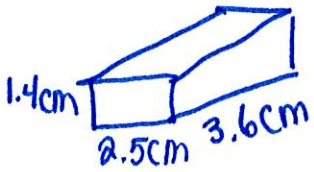
$$V = \frac{m}{d} = \frac{7.89\,g}{1.141\,g/cm^3} = 6.91\,cm^3$$

4. A cube of aluminum has a mass of 34.02 g. The length is 3.6 cm, the height is 1.4 cm, and its width is 2.5 cm. Calculate the volume of the cube and then the density of the aluminum.

m

V

d



$V = l \times w \times h = 3.6\text{cm} \times 2.5\text{cm} \times 1.4\text{cm}$

$V = 13\text{cm}^3$

$d = \frac{m}{V} = \frac{34.02\text{g}}{13\text{cm}^3} = 2.6\text{g/cm}^3$

5. A piece of glass was found at a crime scene and the forensic scientist needs to determine what it is made from. He finds the mass of the glass to be 18.85 g and he uses water displacement to determine its volume. He fills a graduated cylinder with water and determines the initial volume to be 34.3 mL. After that, he carefully lowers the glass into the cylinder and reads the final volume to be 49.9 mL. Calculate the volume of the glass sample and the density. Use the chart below to determine the type of glass.

m

V_i

V_f

Type of Glass	Density (g/cm³)
Sapphire glass	3.98
Flint glass	3.0
Common glass	2.6
Gorilla glass	2.54
Pyrex glass	2.21
Lexan glass	1.21

$V_{glass} = V_f - V_i$

$= 49.9\text{mL} - 34.3\text{mL}$

$V = 15.6\text{mL}$

$d = \frac{m}{V} = \frac{18.85\text{g}}{15.6\text{mL}} = 1.21\text{g/mL}$