Chapter 8
Density

http://www.youtube.com/watch?v=-CDkJuo_LYs&feature=fvwp&NR=1

Mass

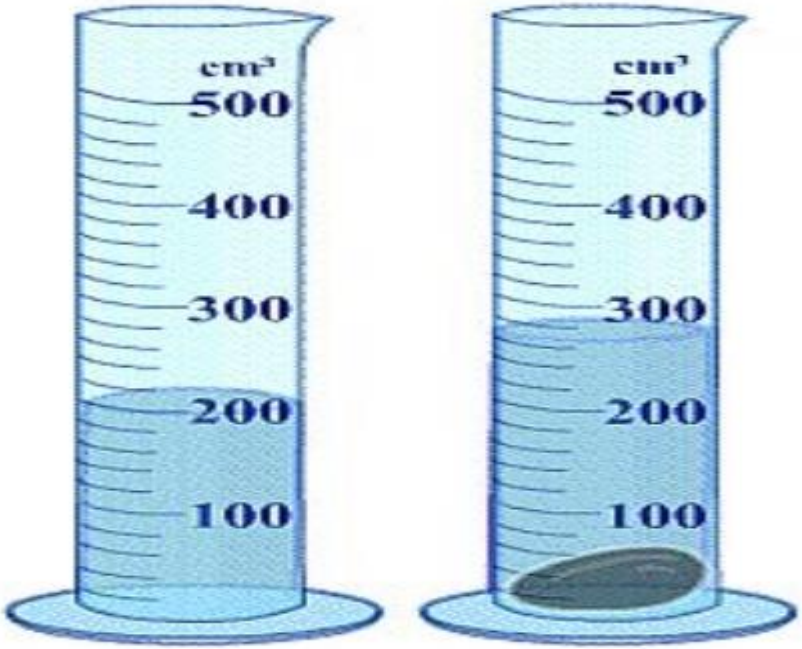
- *The amount of matter in a substance.*
- mass is the same everywhere
- measured in grams (g)

Volume

- *The amount of space occupied by a substance*.
- volume of solids are measured in cm^3
- volume of fluids are measured in mL
- 1 cm^3 = 1 mL

How can we measure volume?

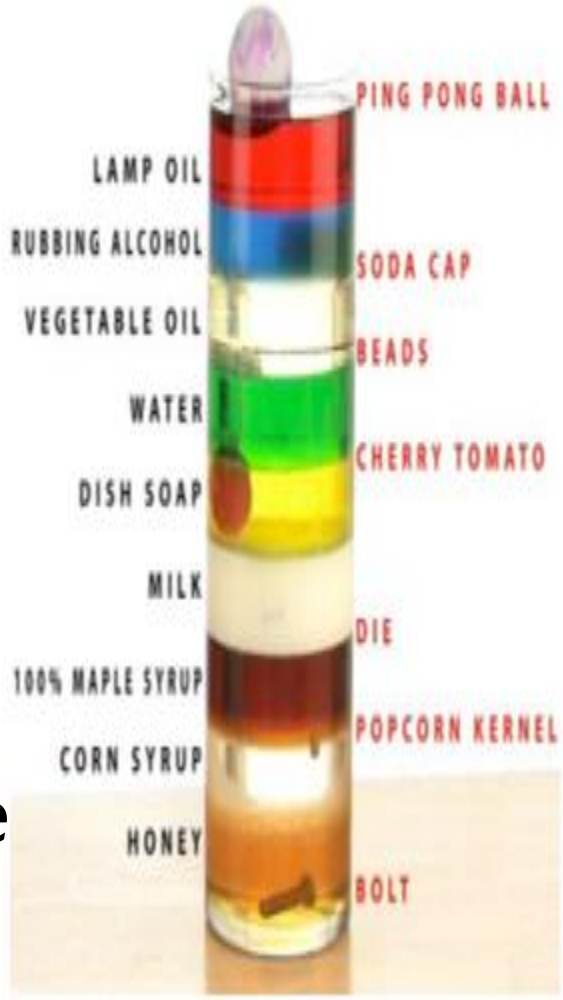
- Displacement of water
  - Can be used to measure the volume of irregularly shaped objects
- http://phet.colorado.edu/en/simulation/density



Density

- A measure of the mass contained in a given volume.
- Measured in g/cm^3 (Solid) or g/mL (fluid)
- Recall from unit 1: Describes how closely packed together the particles are in a material

- A substance with a lower density will float on liquids with higher densities - *remember from the lab, tap water floated on top of the salt water because the salt water had a higher density*
- A substance with a higher density will sink in liquids with lower densities - *remember also from the lab, the salt water in the dropper sank to bottom*



Density and the PTM

- Particle Theory of Matter:
  - different substances have different sized particles
  - there are spaces between the particles

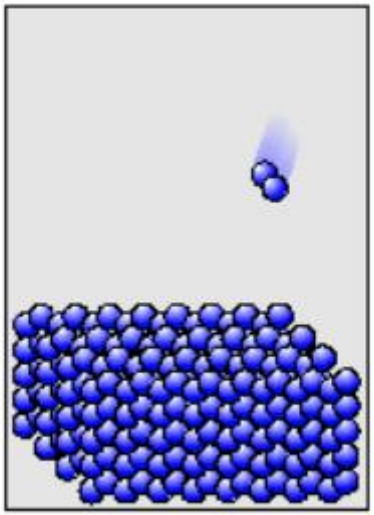
	Solid	Liquid	Gas
Particles	Very Close	Close	Far Apart
Density	High	Moderate	Low

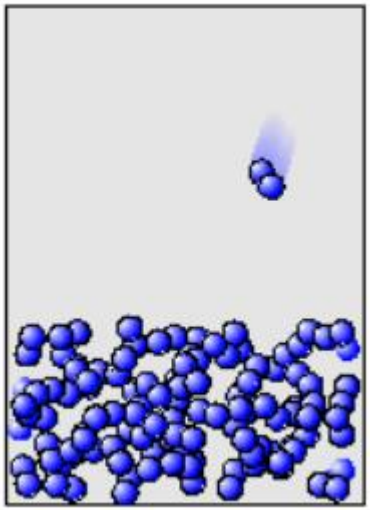
- The larger the spaces between the particles, the less particles, and therefore the lower the density.

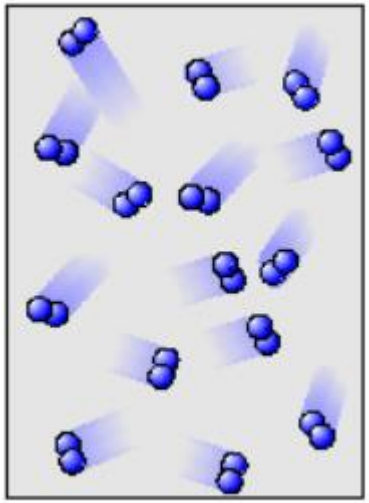
Density of solid, liquids, and gases

In general:

Density of solids > Density of liquids > Density of gases







Examples: Which is more dense?

- Wood vs. lead

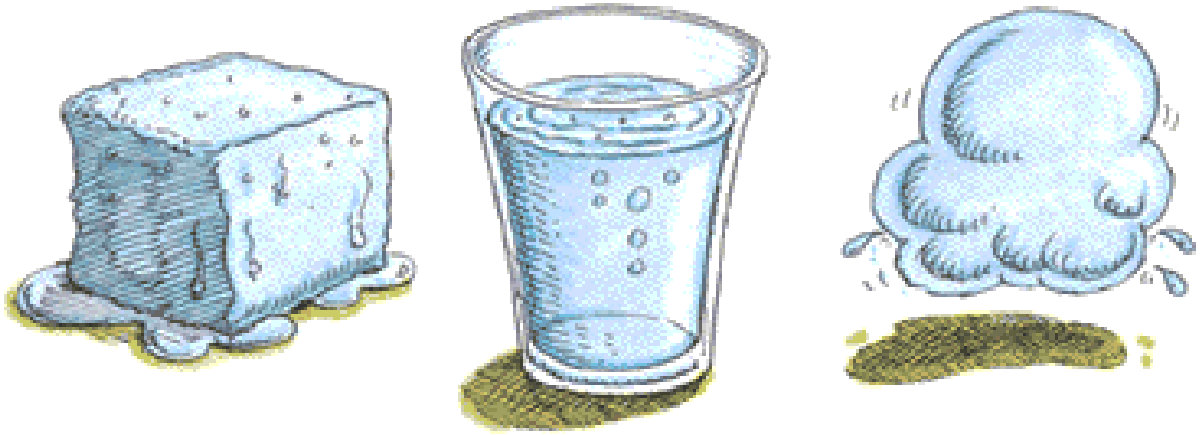
- Corn syrup vs. water

- Helium vs. air

EXCEPTION ALERT!!

Water

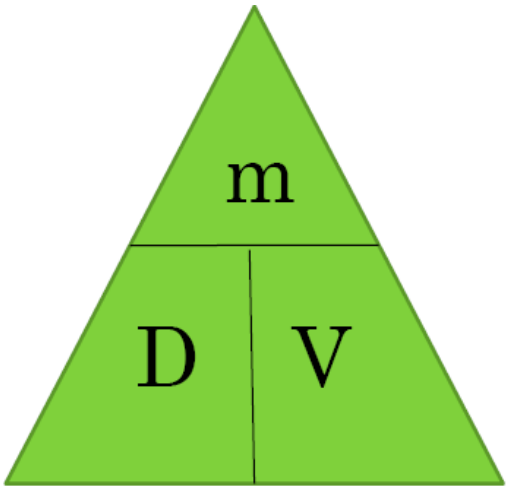
- Liquid water is MORE dense than both the solid state (ice) and gas state (steam/water vapour).



Formula:

$$\text{Density (D)} = \frac{\text{Mass (m)}}{\text{Volume (V)}}$$

$$\text{Volume (V)} = \frac{\text{Mass (m)}}{\text{Density (D)}}$$



Mass = Density (D) x Volume (V)

NOTE: The mass – to – volume ratio of a material is a constant value!

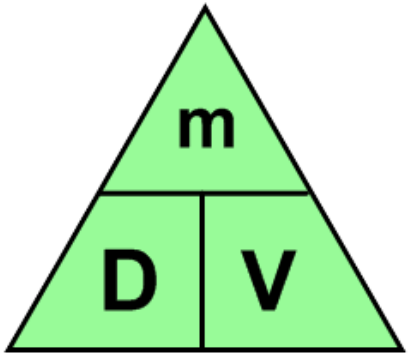
For some examples we will need to use the table on page 312 of your textbook.

Table 8.1 Approximate Densities of Common Fluid Substances and Solid Substances

Fluid	Density (g/mL)	Solid	Density (g/cm³)
hydrogen	0.00009	styrofoam	0.005
helium	0.0002	cork	0.24
air	0.0013	oak	0.70
oxygen	0.0014	sugar	1.59
carbon dioxide	0.002	salt	2.16
ethyl alcohol	0.79	aluminum	2.70
machine oil	0.90	iron	7.87
water	1.00	nickel	8.90
seawater	1.03	copper	8.92
glycerol	1.26	lead	11.34
mercury	13.55	gold	19.32

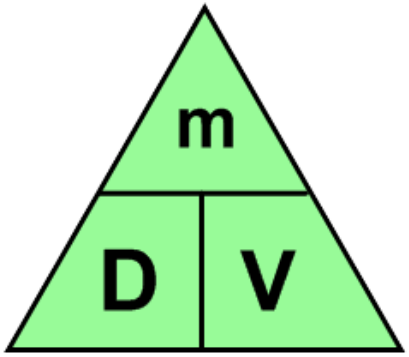
Example

If a cube has a mass of 4g and a volume of $2cm^3$, what is the density?



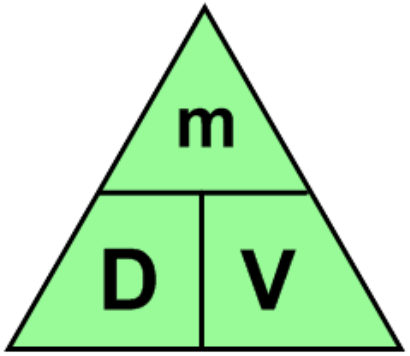
Example

You want to put 10g of salt into a container. What is the volume of the container if the salt completely fills it? (refer to table on page 312)



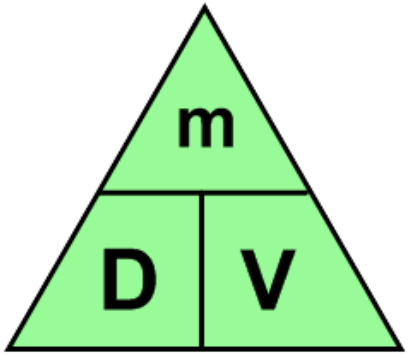
Example

If a liquid has a density of 6g/mL and a volume 3mL, what is the mass?



Example

Find the density of a 10g mass of a substance that has a volume of 2.0cm^3.

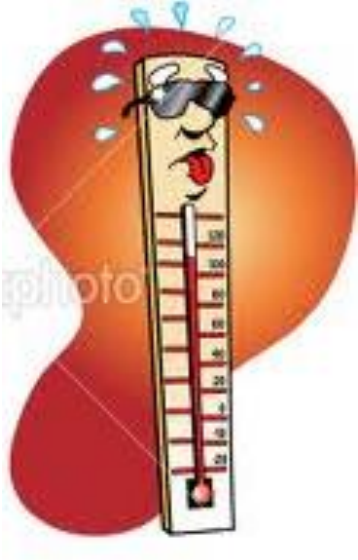


- Text page 312 #'s 1-3; p. 313 #'s 1-3; p. 314 #'s 1-3; p. 323 #'s 1-3
- Density Assignment
- Core Lab 8-2B: Determining Density

Changes in temperature and density

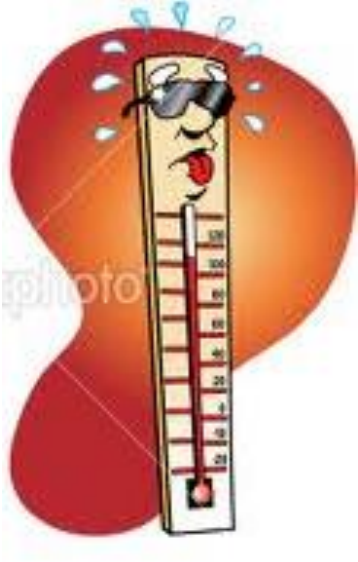
When the temperature of a substance changes, it changes the density, and therefore the state changes.

As temperature Increases ↑



- Particles gain energy
- Spread out
- Volume increases ↑

As temperature Increases ↑



Density decreases ↓

Solids, liquids, and gases **expand.**

http://phet.colorado.edu/en/simulation/states-of-matter

As temperature decreases ↓

- Particles lose energy
- Move closer together
- Volume decreases ↓

As temperature decreases ↓

Density increases ↑

Solids, liquids, and gases **contract.**

http://phet.colorado.edu/en/simulation/states-of-matter

Examples:

- Hot air balloon

- Warm vs. cold air in tires

- 3 states of water

  (water is densest as a liquid because water particles move apart as they freeze)

Examples:

- Drying of wood

- Salt water is easier to float in than fresh water

http://www.teachertube.com/viewVideo.php?video_id=207631

Explain why…

- A helium-filled balloon shrinks when exposed to cold temperatures
- Alcohol, in a thermometer, rises when heated
- Vinyl siding installed during cold weather must have spaces between each piece
- Power lines sag in the summer