

DENSITY

Mass per unit volume

amount of material space occupied

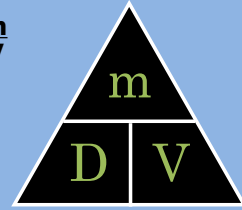
$$D = \frac{m}{V}$$

Typical units: g/cm³ or g/L

$$D = \frac{m}{V}$$

$$V = \frac{m}{D}$$

$$m = D \times V$$



Density Problems

Ex: $D = ?$ $m = 25 \text{ g}$ $v = 1.0 \text{ cm}^3$
 $D = m/v$ $D = 25\text{g}/1.0 \text{ cm}^3 = \mathbf{25 \text{ g/cm}^3}$

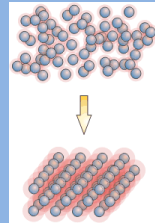
Ex: $D = 2.16 \text{ g/cm}^3$ $m = ?$ $v = 1.0 \text{ cm}^3$
 $m = D v$ $m = (2.16 \text{ g/cm}^3)(1.0 \text{ cm}^3) = \mathbf{2.16 \text{ g}}$

Ex: $D = 8.92 \text{ g/cm}^3$ $m = 50 \text{ g}$ $v = ?$
 $v = m/D$ $v = 50 \text{ g}/8.92 \text{ g/cm}^3 = \mathbf{5.61 \text{ cm}^3}$

Density is the measure of the "compactness" of a material

How close the particles are to each other

- Gases: very low density
- Liquids: moderate density
- Solids: high densities



What would take up more space?
A kilogram of feathers...or a kilogram of steel?

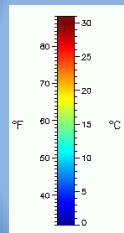


OR



Factors that affect Density

- Temperature
- Pressure
- Concentration of solutions



Generally,

- As temperature \uparrow , density \downarrow
(Exception: ice to water, density increases)
- As pressure \uparrow , density \uparrow
- As concentration of solutions \uparrow , density \uparrow

Floating

- Objects will **float** if they are **less dense** than the material they are placed in
- Objects will **sink** if they are **more dense**

**Density Table**

SUBSTANCE	DENSITY (G/CM ³)
AIR	0.0013
WOOD (OAK)	0.85
WATER	1.00
ICE	0.93
ALUMINUM	2.7
LEAD	11.3
GOLD	19.3
ETHANOL	0.94
METHANOL	0.79

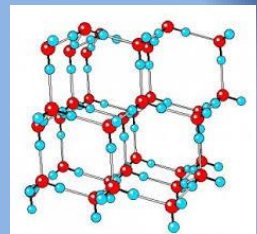
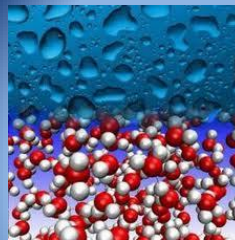
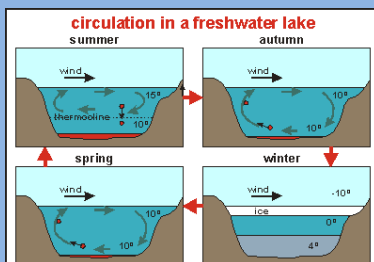
SINK or FLOAT in Water?
(D = 1.0 g/mL)

Float
Float
Float
Sink
Sink
Sink
Float
Float

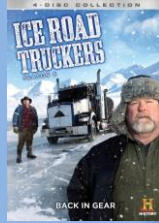
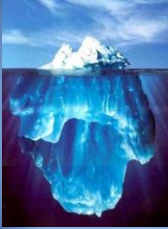
- Lead density = 11.34 g/cm³
- Mercury density = 13.60 g/cm³

**Density and Lakes**

- Cold water is more dense than warm water
- Temperature changes through the seasons creates a constant mixing of water, nutrients, and other substances



- Ice is less dense than water...
So as ice forms on lakes in winter it stays on the surface



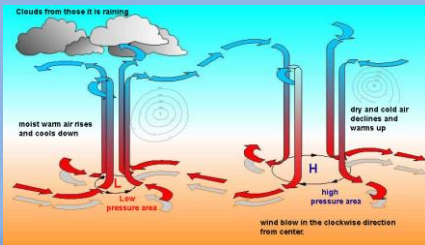
Density and Submarines and Fish

- Swim bladder in bony fish controls density in order to rise or dive....buoyancy
- Air is added by diffusion through the blood and the fish becomes less dense
- When air is removed fish become more dense and sinks
- Submarines work the same way



Density and Weather

- Low pressure weather system - warmer air, less dense, air tends to rise
- High pressure systems indicate a colder more dense air mass that will..... SINK!!!



SCIENTIFIC MEASUREMENT

To calculate density, you have to know how to take measurements properly!



Relative Density

- The density of a material or substance, relative to another substance
- Expressed in a ratio: water = 1g/cc
- Water is the substance to which we generally compare other substances
- ALSO known as SPECIFIC GRAVITY

Absolute DENSITY

- The density of a material in its closest "packed form"
- For water: Absolute Density = 1000kg/m^3
at 4°C and 1 atm (pressure)
in other words, the greatest density of water is at 4°C