# Chapter 3 - States of Matter

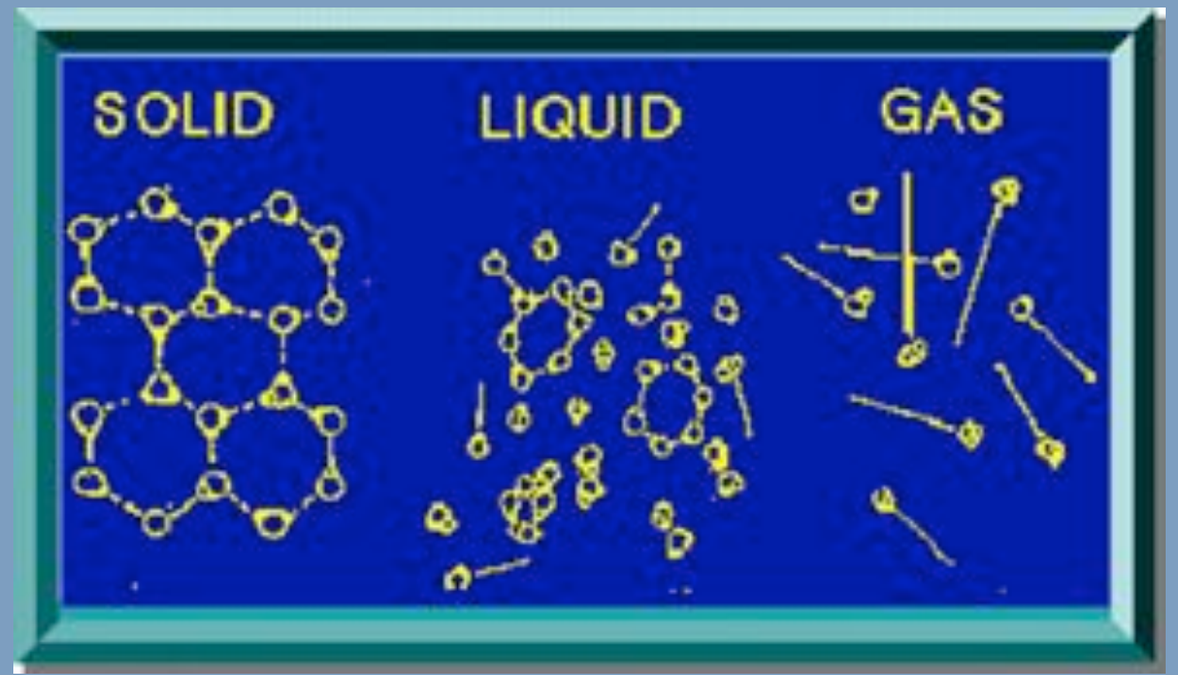
## Section 1 - Matter and Energy

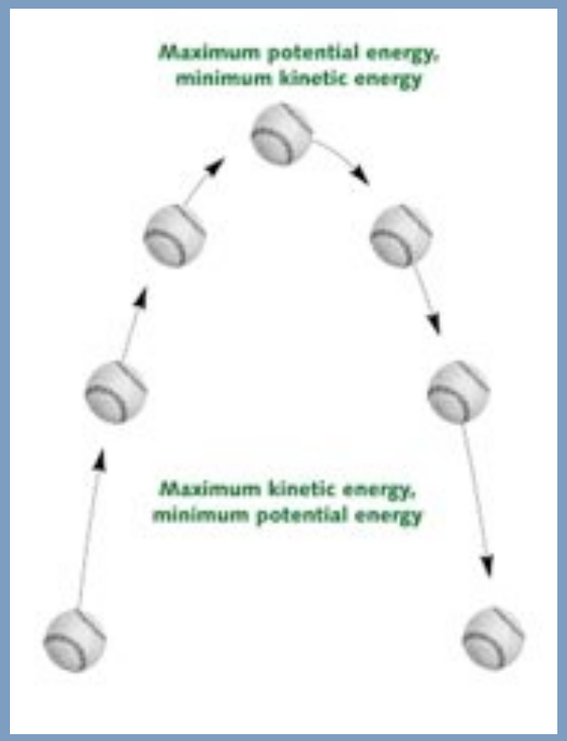
# Kinetic Theory

1. Matter is made of atoms

2. Atoms are in motion.  Higher temperature = faster motion

3. Heavy particles move slower than light ones

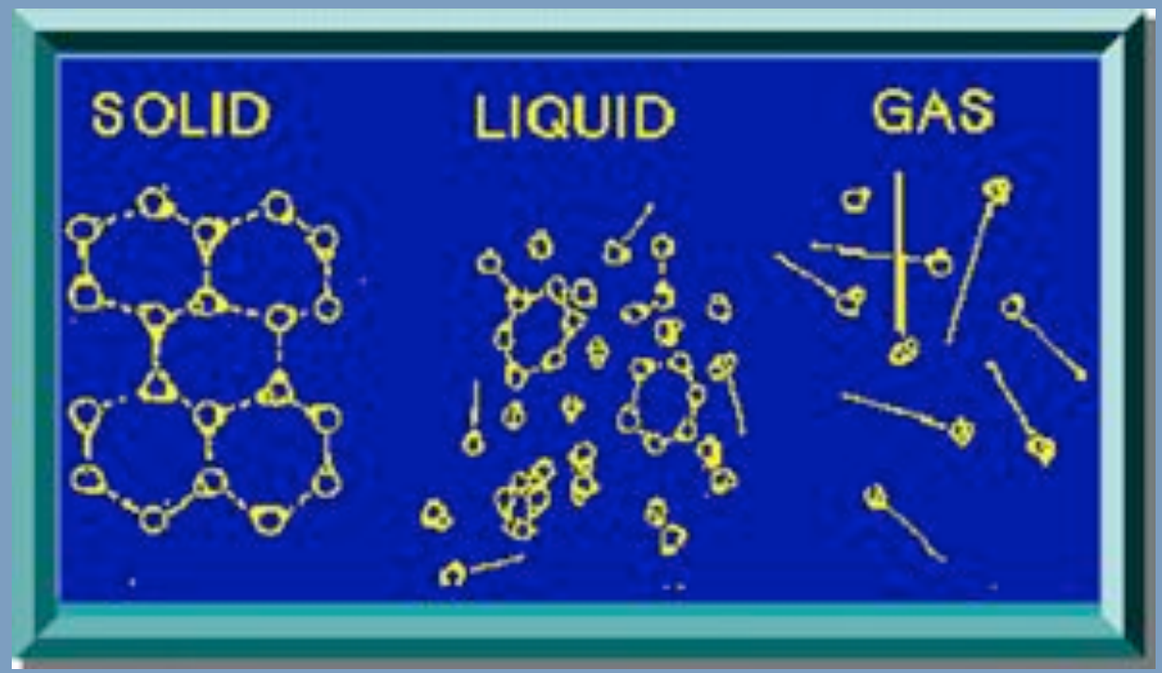





**<u>Kinetic Energy</u>** = energy of motion

increasing energy

solids - liquids - gases



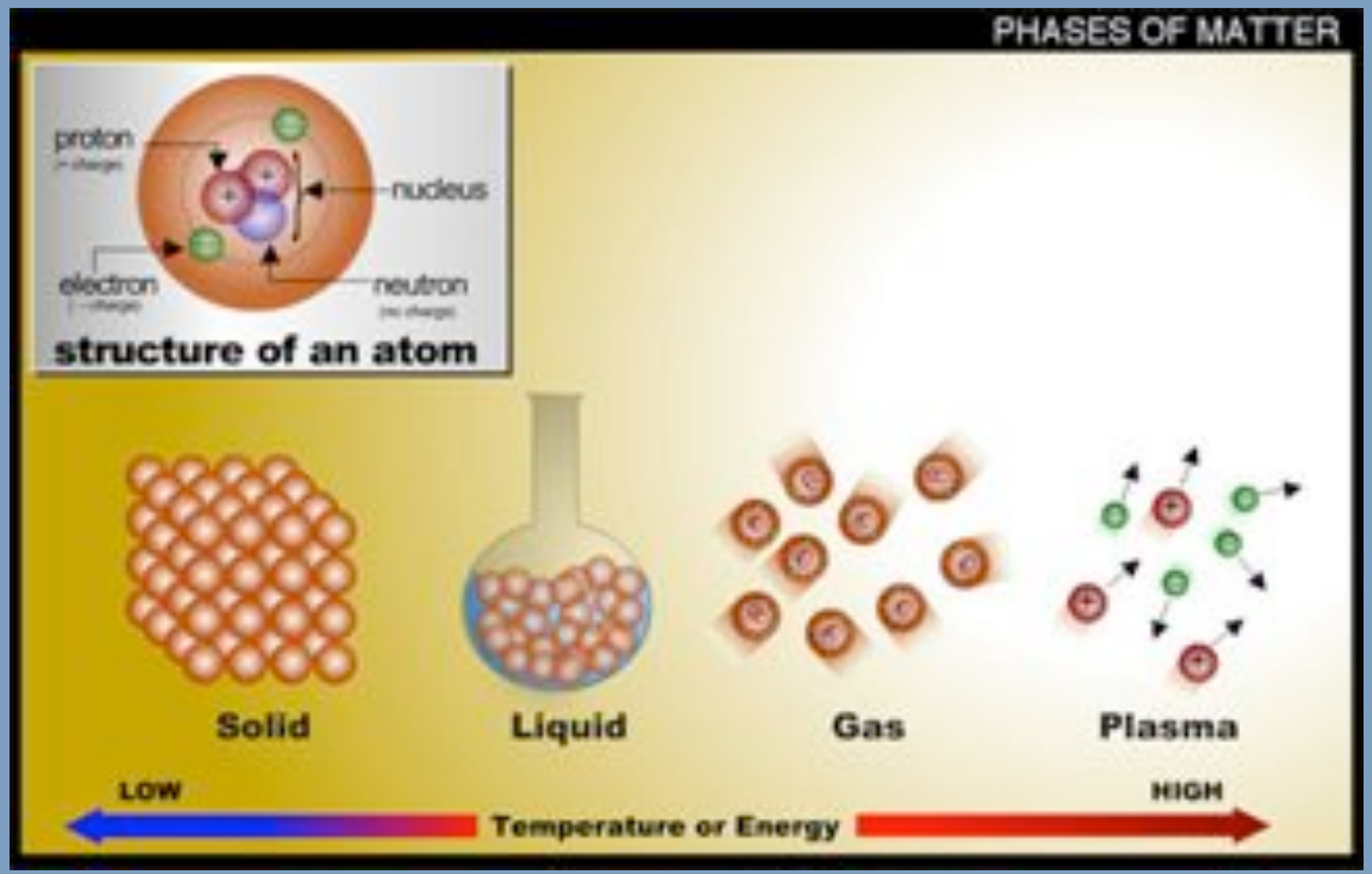
# 4 States of Matter

Solid

Liquid

Gas

Plasma



## Solids

Definite shape and volume

**Crystalline Solids** - Orderly arrangement

Iron, diamonds, ice

**Amorphous Solids** - No order

Gum, Clay

# Liquids

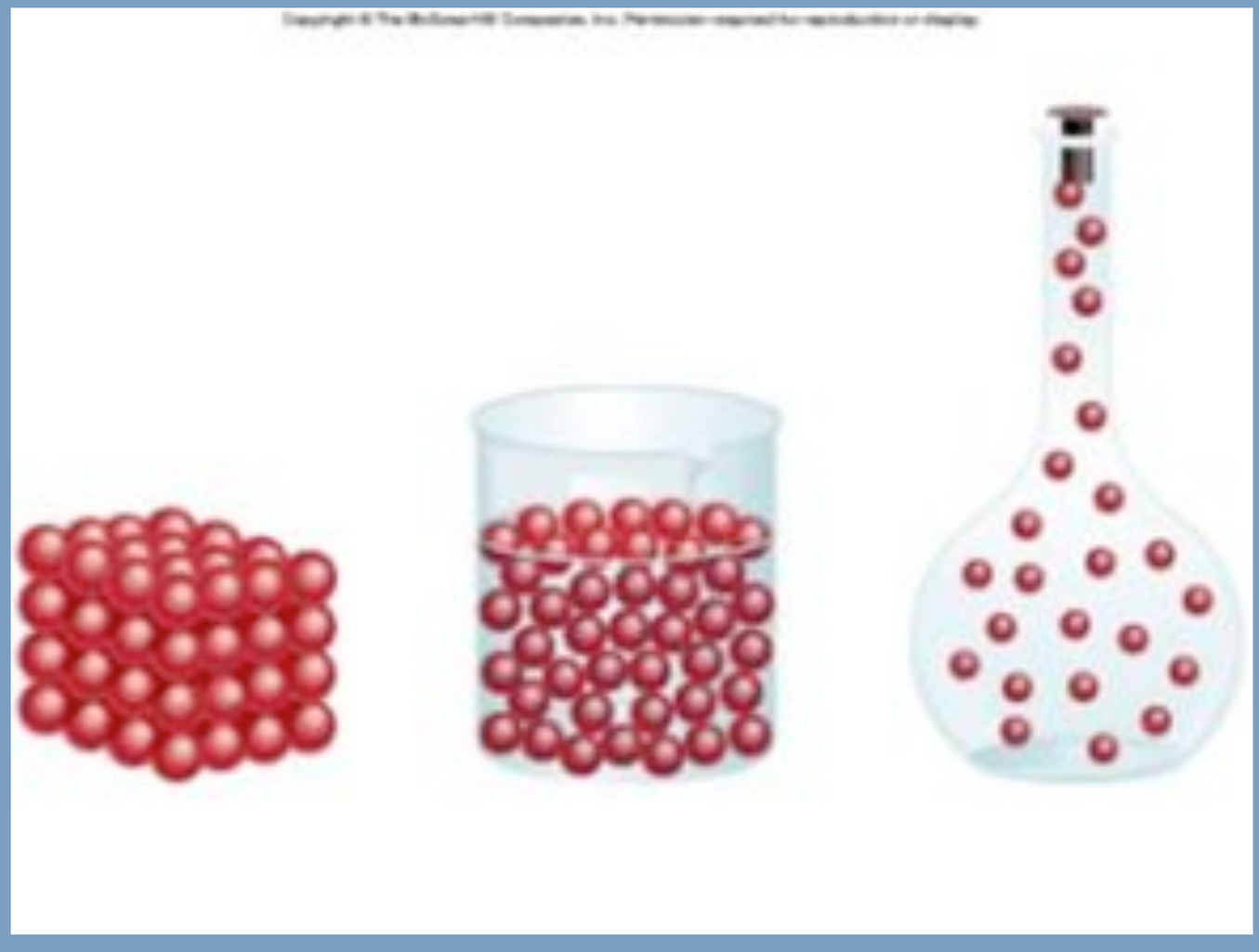
Change shape, not volume

Liquids have **surface tension**. A force that holds molecules together

# Gases

Change shape AND volume

Expand to fill



# Plasma

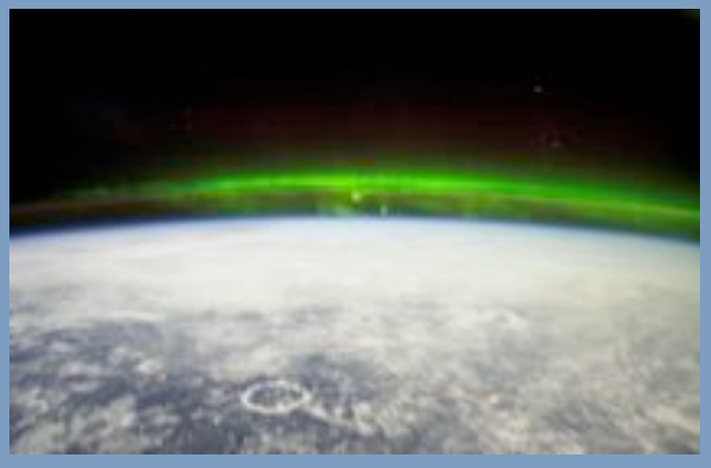
99% of all matter!

Stars

No definite shape

Particles are broken apart

Lightening, fire, aurora borealis

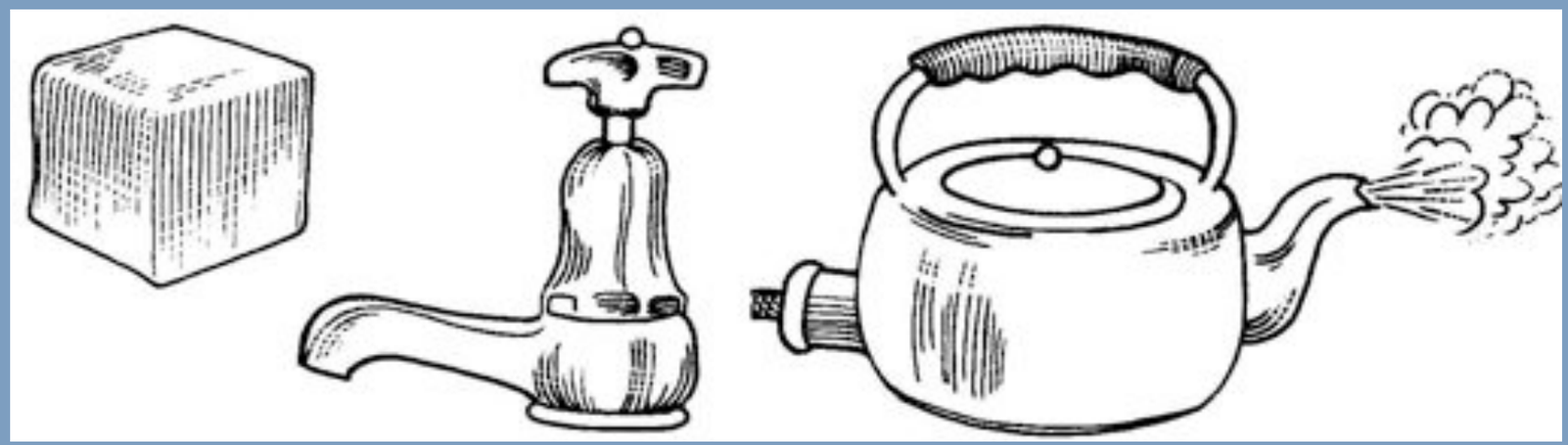


**Energy** - Capacity to do work

**Thermal Energy** - Total kinetic energy depends on temp. and amount

When state changes, identity is still the same

Only energy has change



Ice ⟶ Water ⟶ Steam

Still $H_2O$, just more energy

**Endothermic Changes** require energy

**Melting**

**Boiling**

**Sublimation**

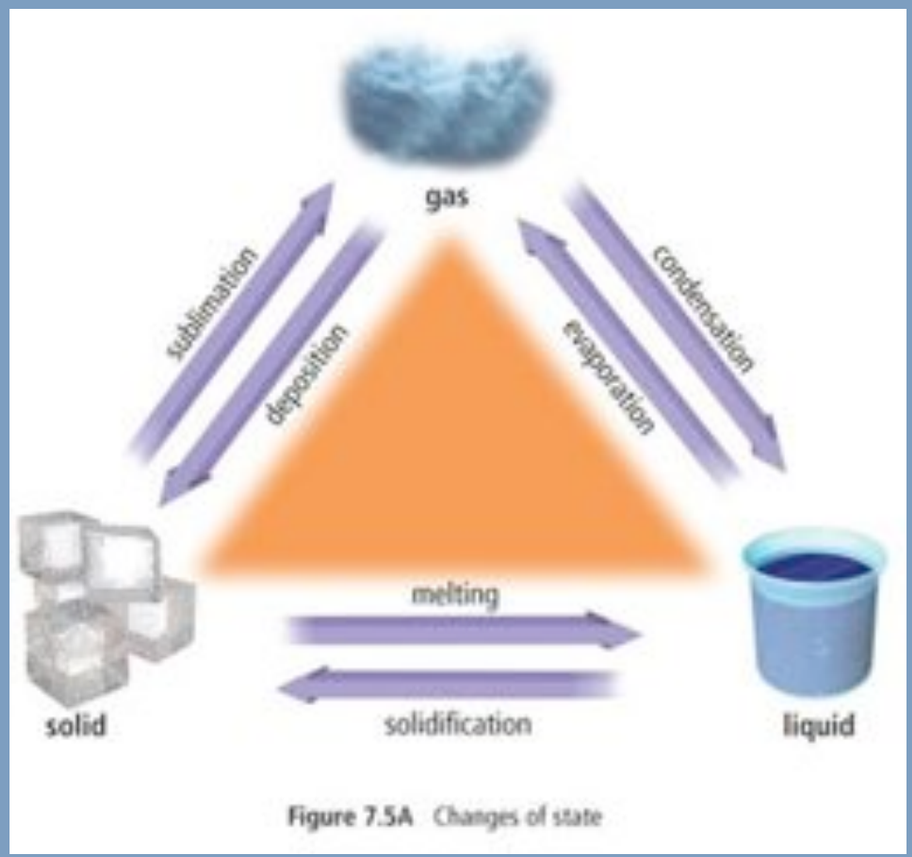


Figure 7.5A Changes of state

Think of sweating...why does this cool you down?

**Exothermic Changes** release energy

**Freezing**

**Condensation**

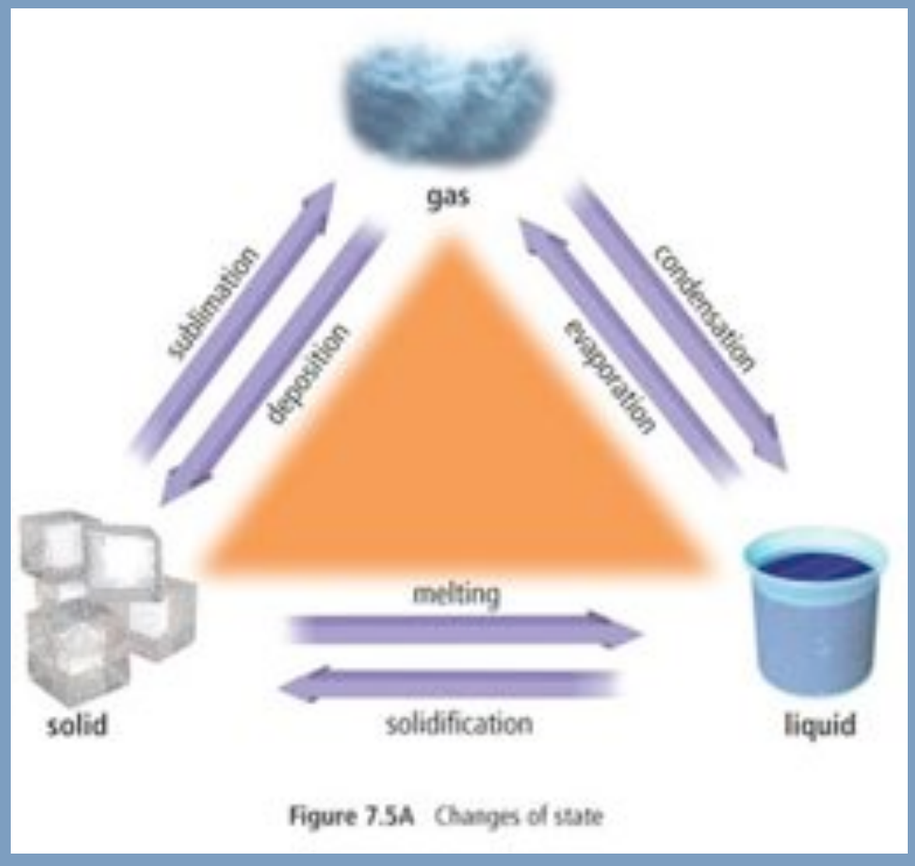


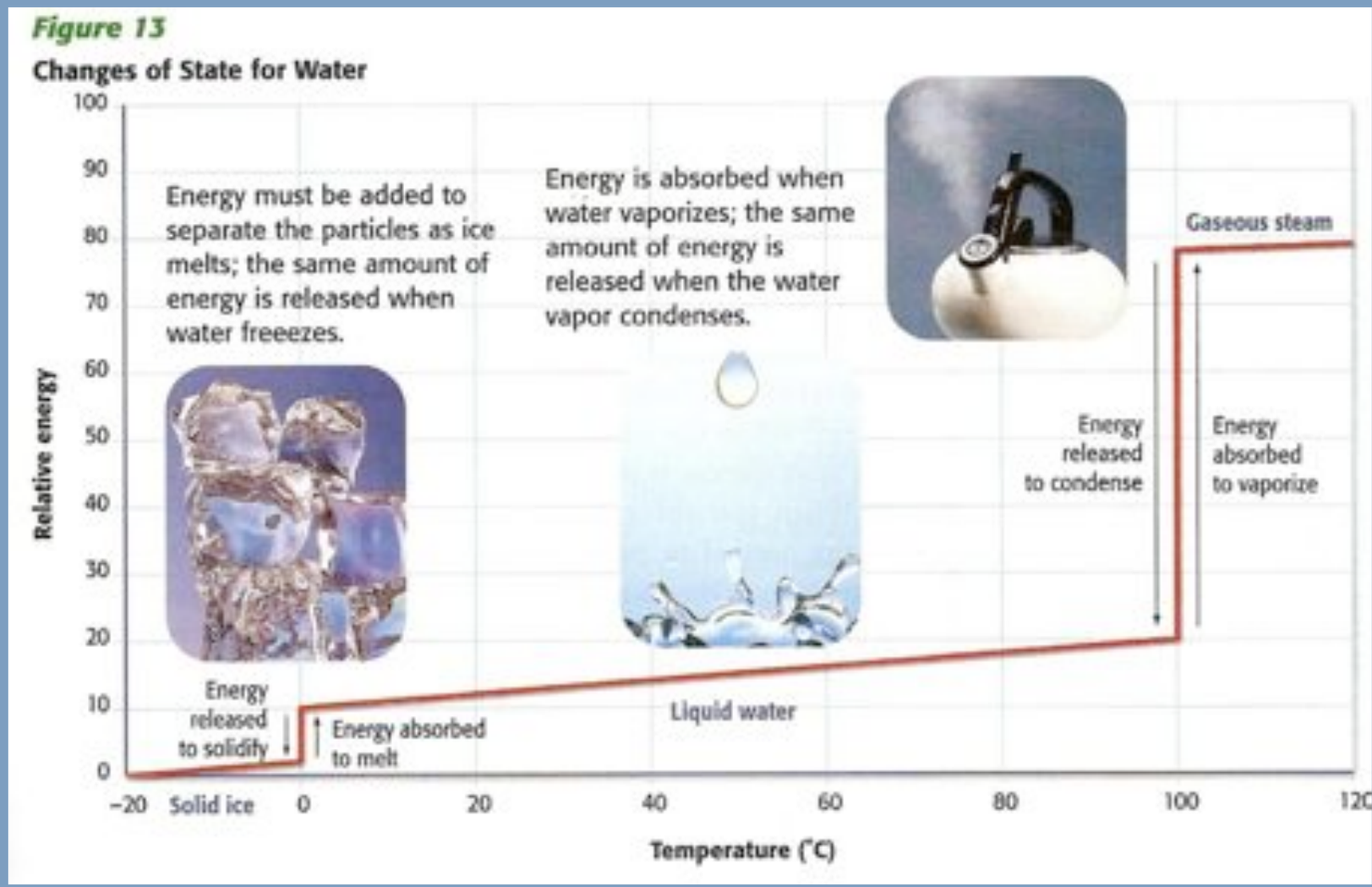

Figure 7.5A Changes of state

When you add energy to something it either:

Increases its temperature

or

Changes state

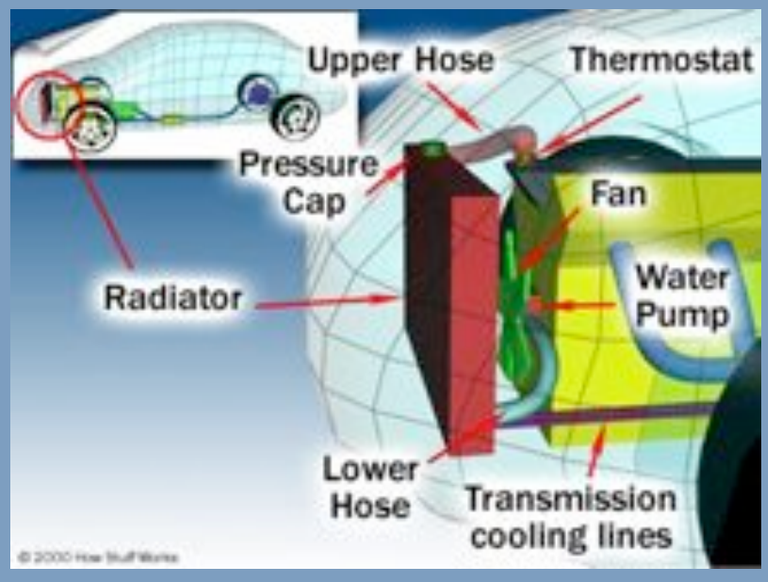


# Conservation of Mass and Energy

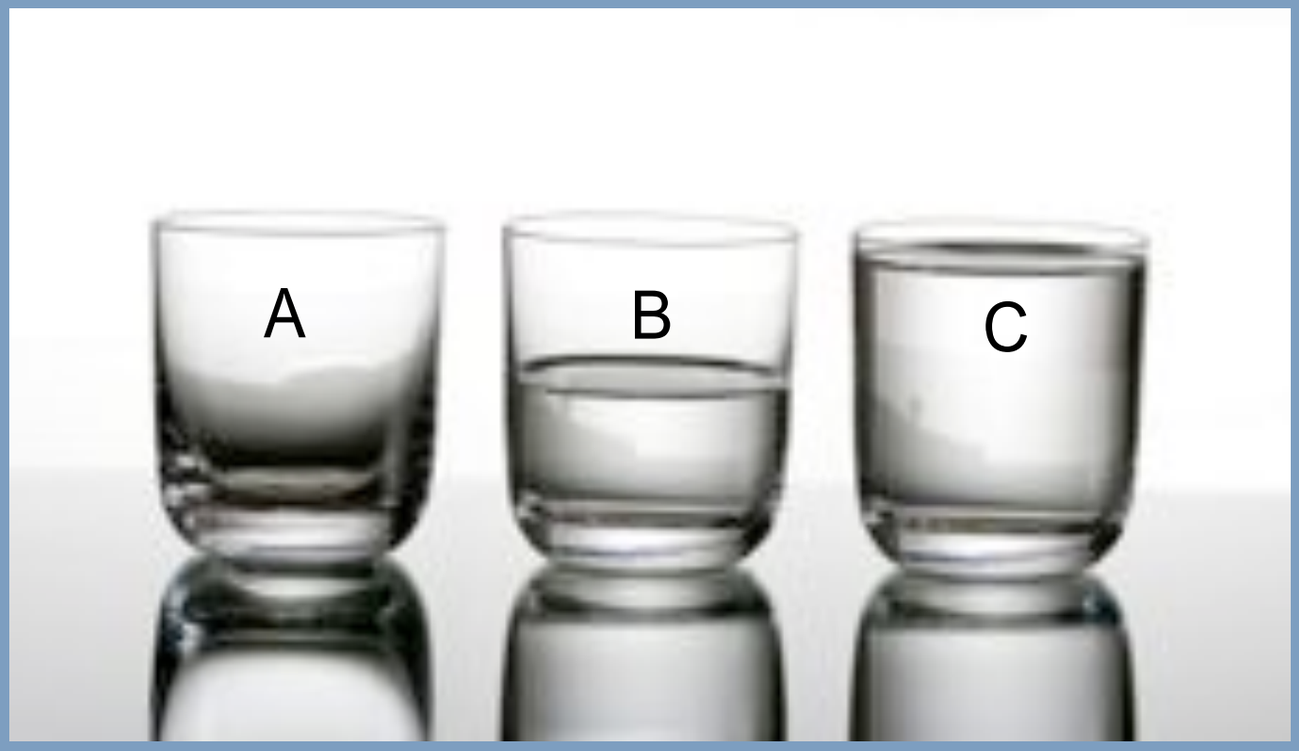
Mass and energy is neither created or destroyed

Where does the match go?

Energy can be converted to different forms



1 Which glass has the most thermal energy?




D There the same

2 A gas turning into a liquid is called

A Evaporation

B Condensation

C Sublimation

D Melting

3 A solid turing directly into a gas is called

A Evaporation

B Condensation

C Sublimation

D Melting

# Section 2 - Fluids

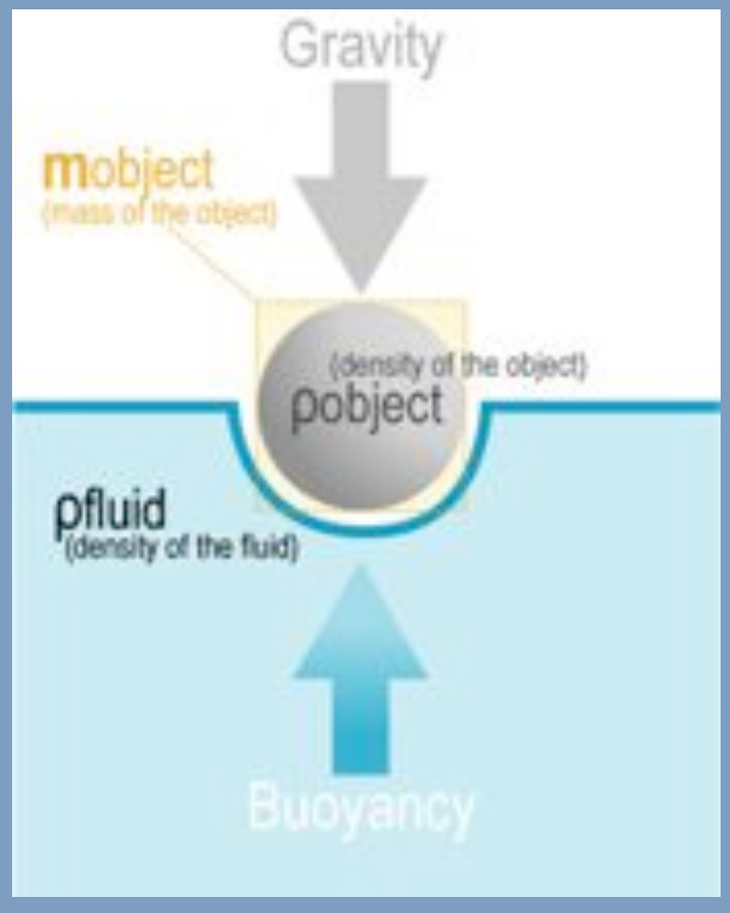
**Fluids** have ability to flow

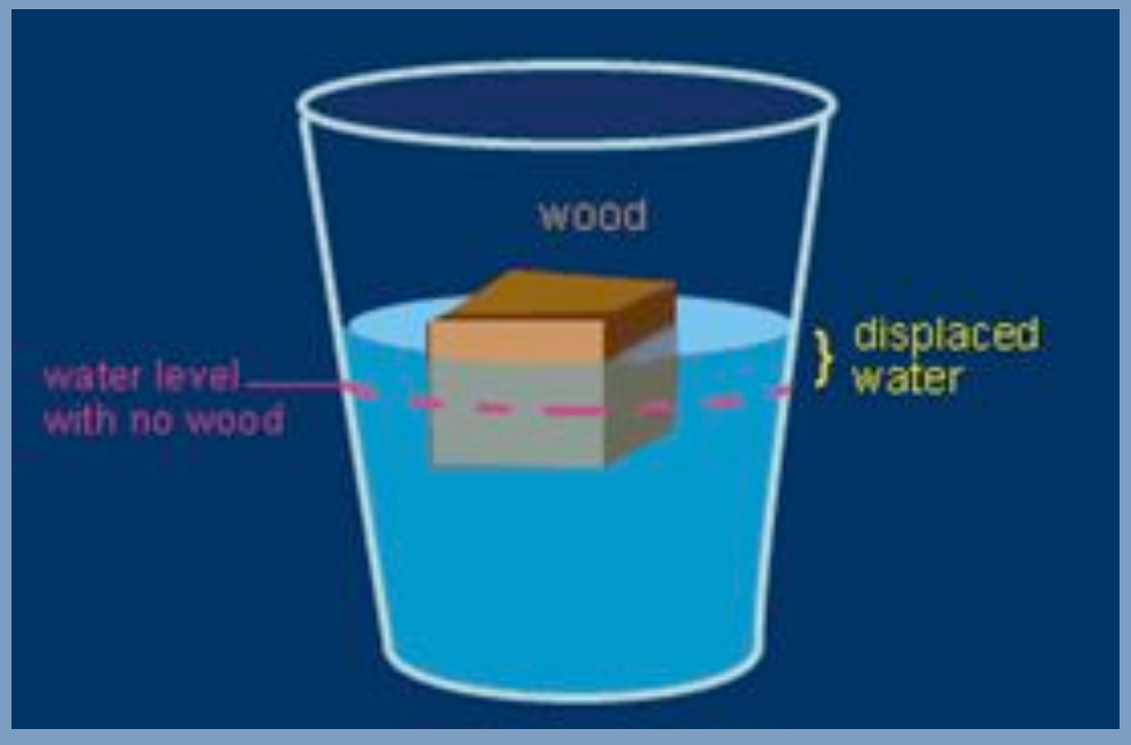
Liquids AND gases


Fluid properties allow boats to float and planes to fly!

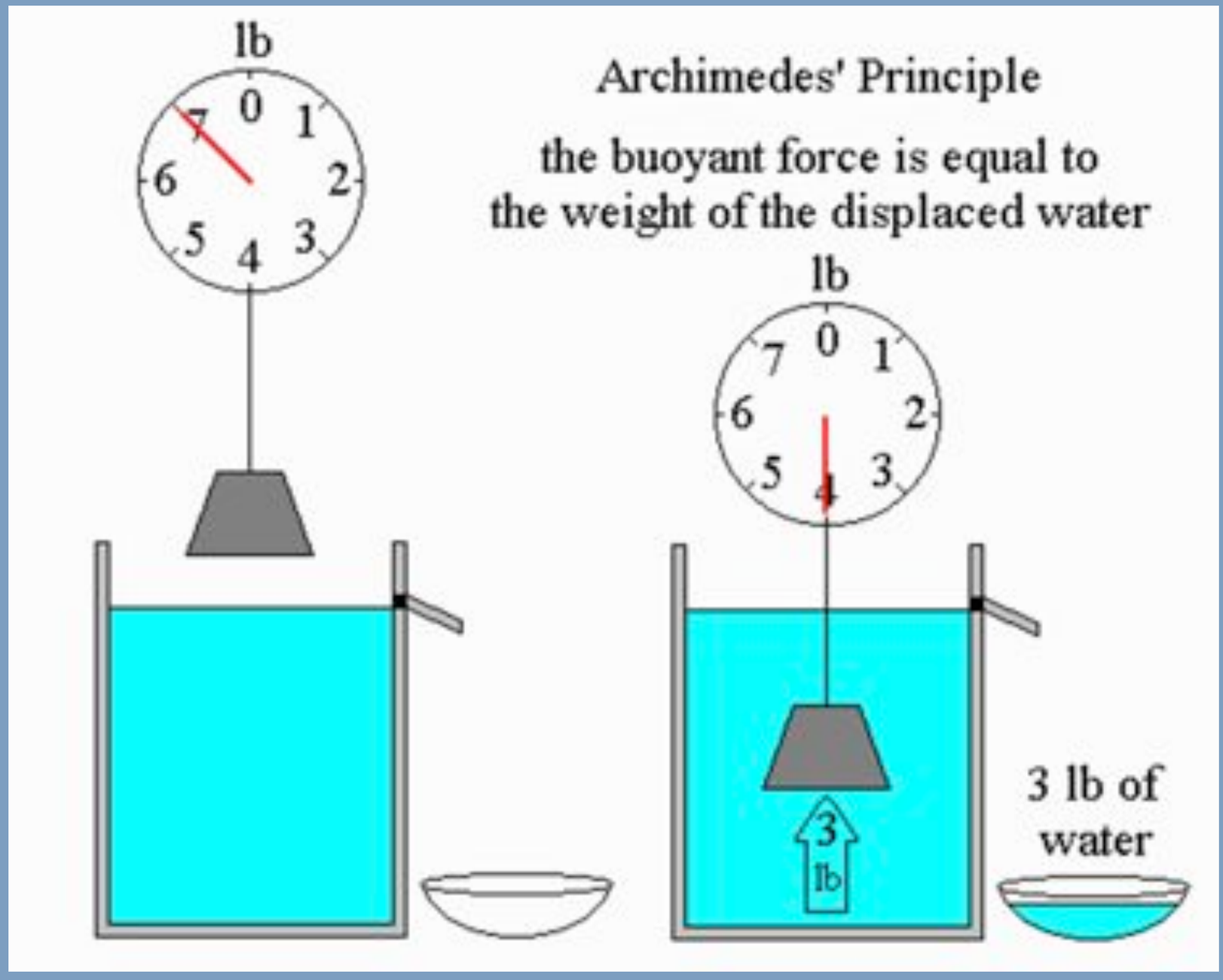
# Why can things float?

**<u>Buoyant Force</u>** - Upward force exerted on objects in a fluid



**Archemedes Principle** - Buoyant force equals the weight of fluid that is displaced



Buoyant force is a **pressure**

amount of force exerted over an area

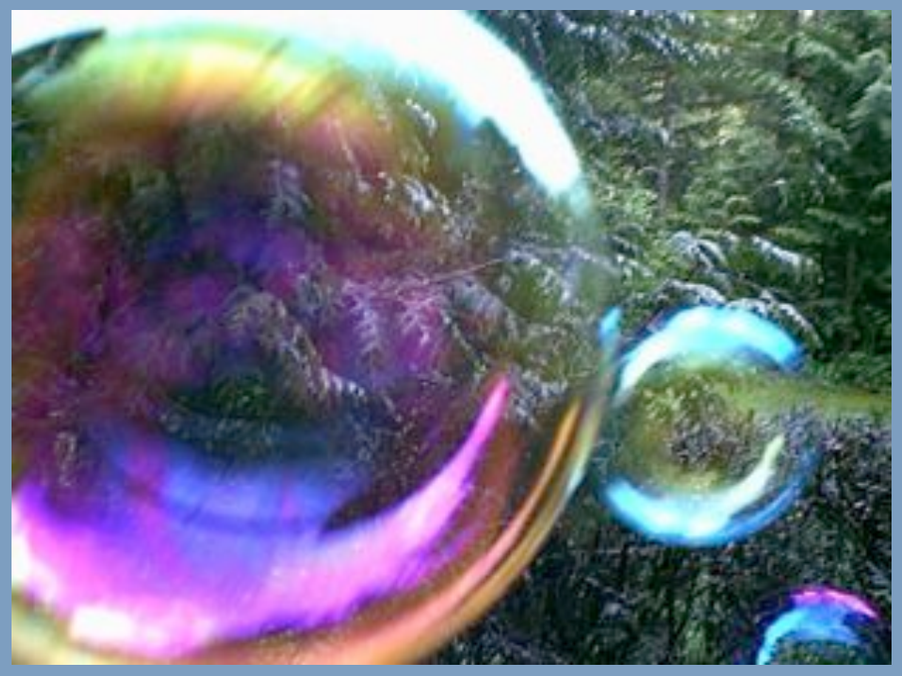
$$\text{Pressure} = \frac{\text{Force}}{\text{Area}} \qquad \frac{\text{Newtons}}{m^2} = 1 \text{ pascal}$$

Car tires have air molecules "packed" into a small area

high pressure

Fluids exert pressure evenly in all direction

Bubbles are round!

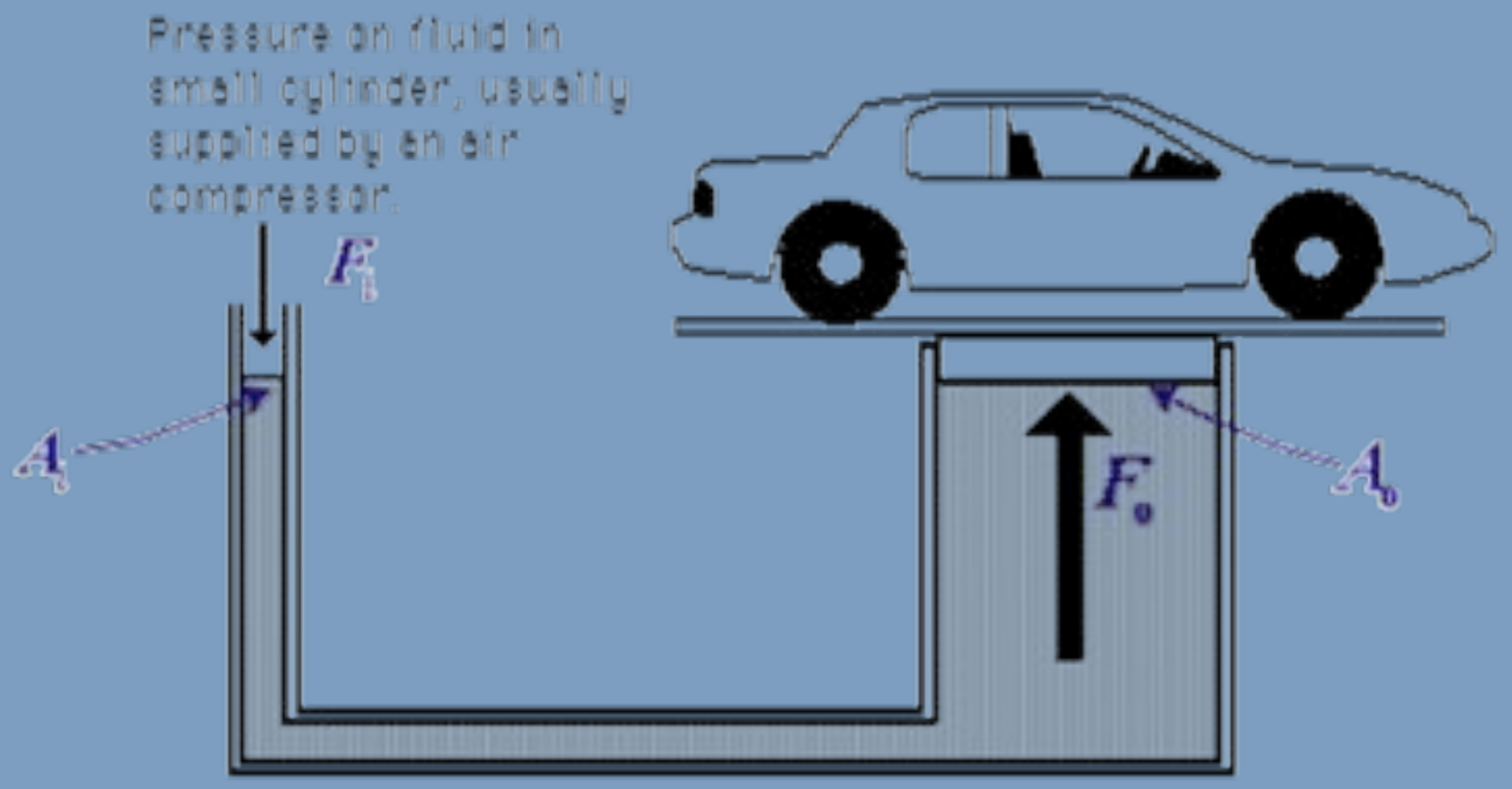


**Pascal's Principle** - In a closed system, a pressure change is transmitted evenly throughout the fluid


This means that $P_1 = P_2$

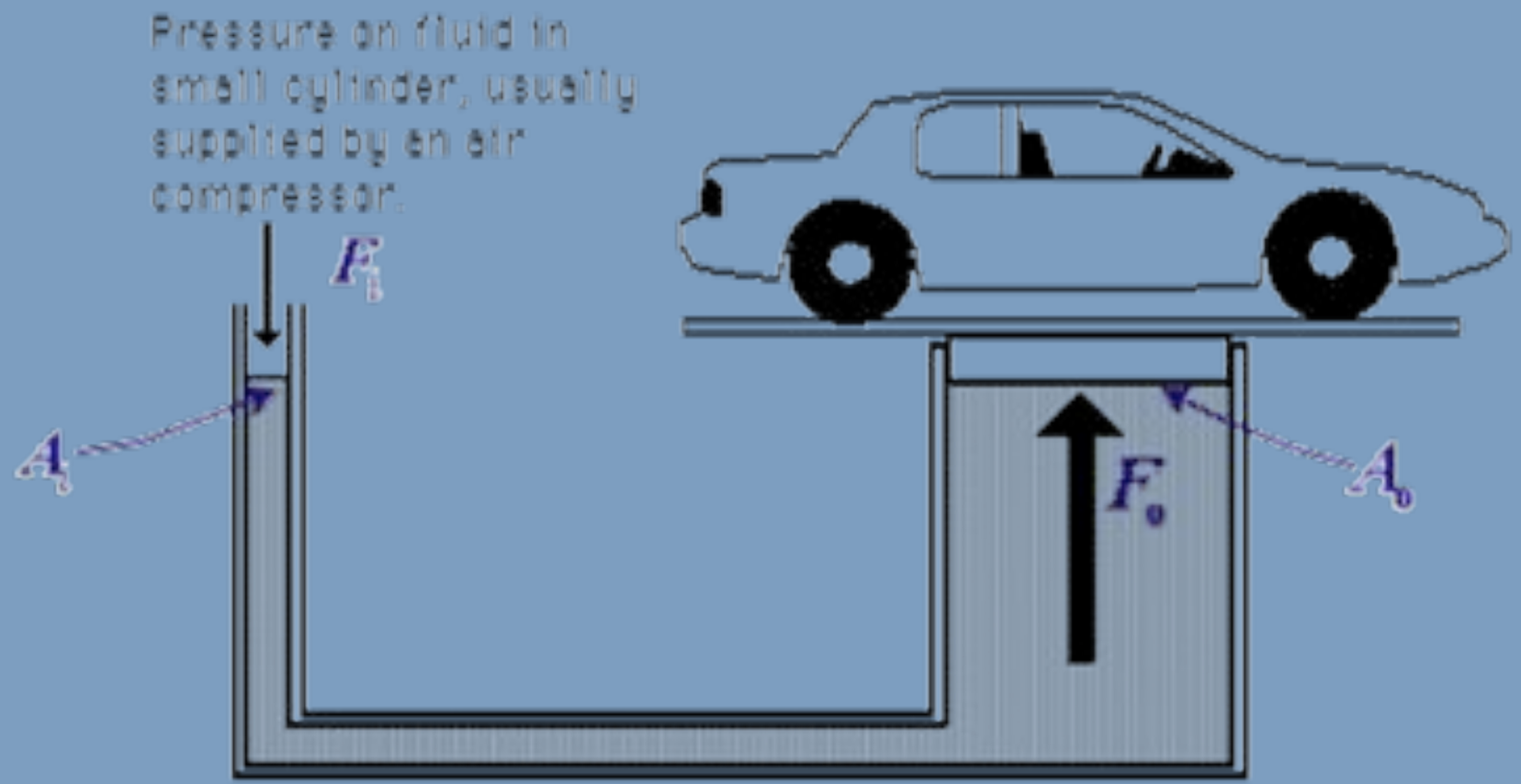
pressure we put in is what we get out

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$



# A hydraulic lift makes use of Pascal's principle

A car has a weight of 19,000 N (4,500 lbs). If the area of the small piston ($A_1$) equals 10.5 cm² and the area of the large piston ($A_2$) equally 400 cm², what force needs to be exerted on the small piston to lift the car?



**<u>Hydraulic Devices</u>** - Use fluids to transmit pressure

Basically multiply forces!

Tractors, brakes, lifts, dump trucks, backhoes, etc


What happens what you put your finger over a running hose?

Do you get more or less water total?

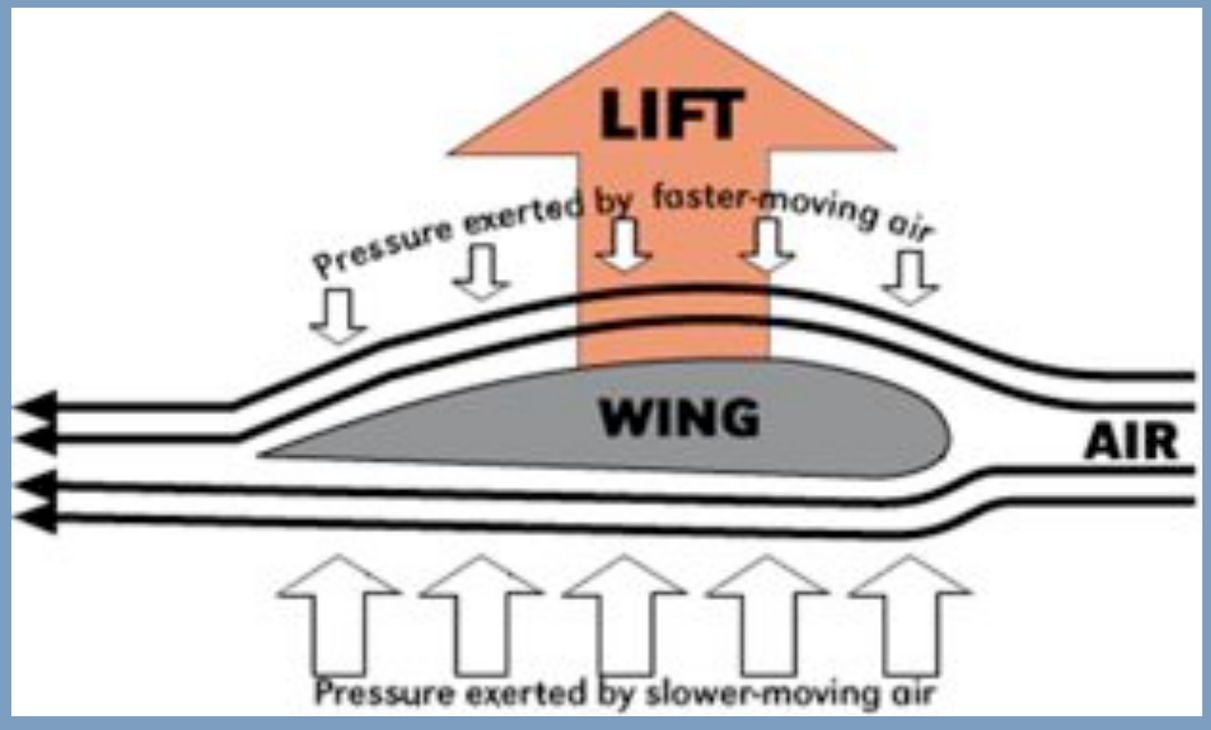
Fluids flow at different rates

**Viscosity** - resistance to flow


*Steel balls of equal weight dropped into test tubes filled with motor oils fall at different rates. Their rate of fall depends on the viscosity of the oil. The ball travelling through the light SAE 20 oil has travelled farthest, while the ball in the heavy SAE 50 has travelled least.*

# Bernoulli's Principle

increase in fluid speed = decrease in pressure



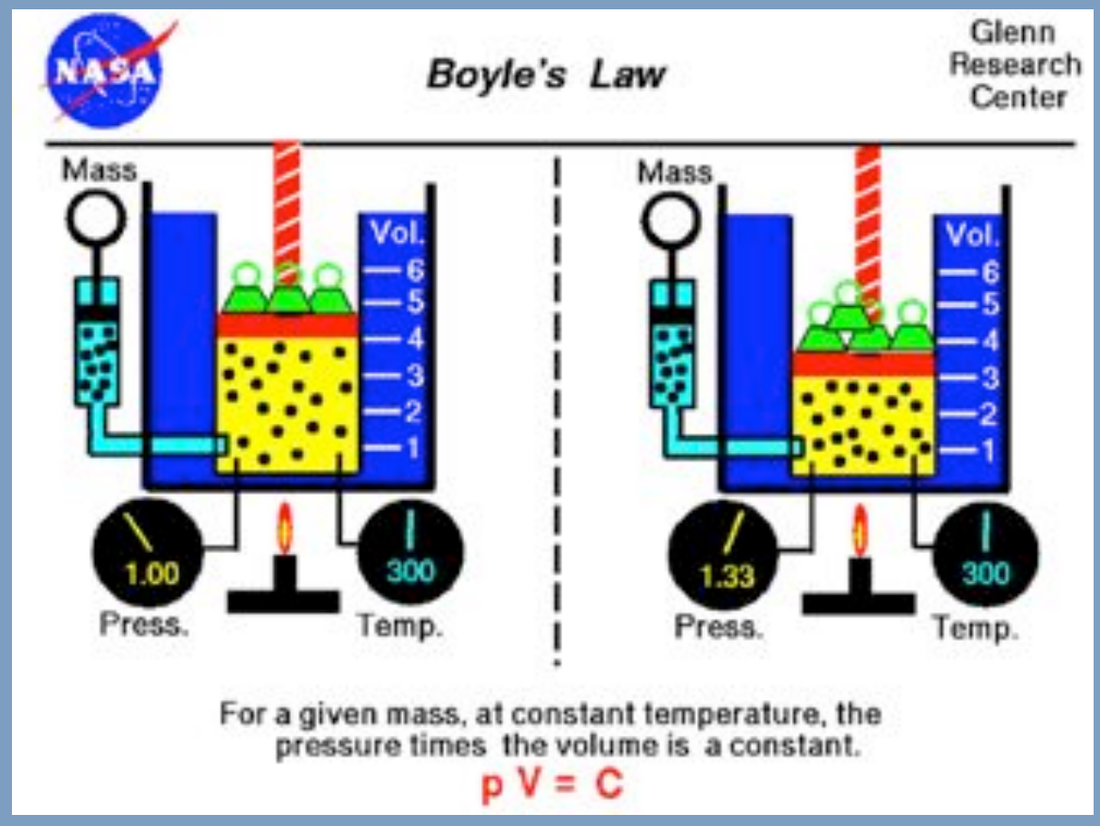

This is why 20 ton planes can fly!

# Section 3 - Behavior of Gases

# Boyles Law

Temperature = Constant

If volume increase...what happens to pressure?



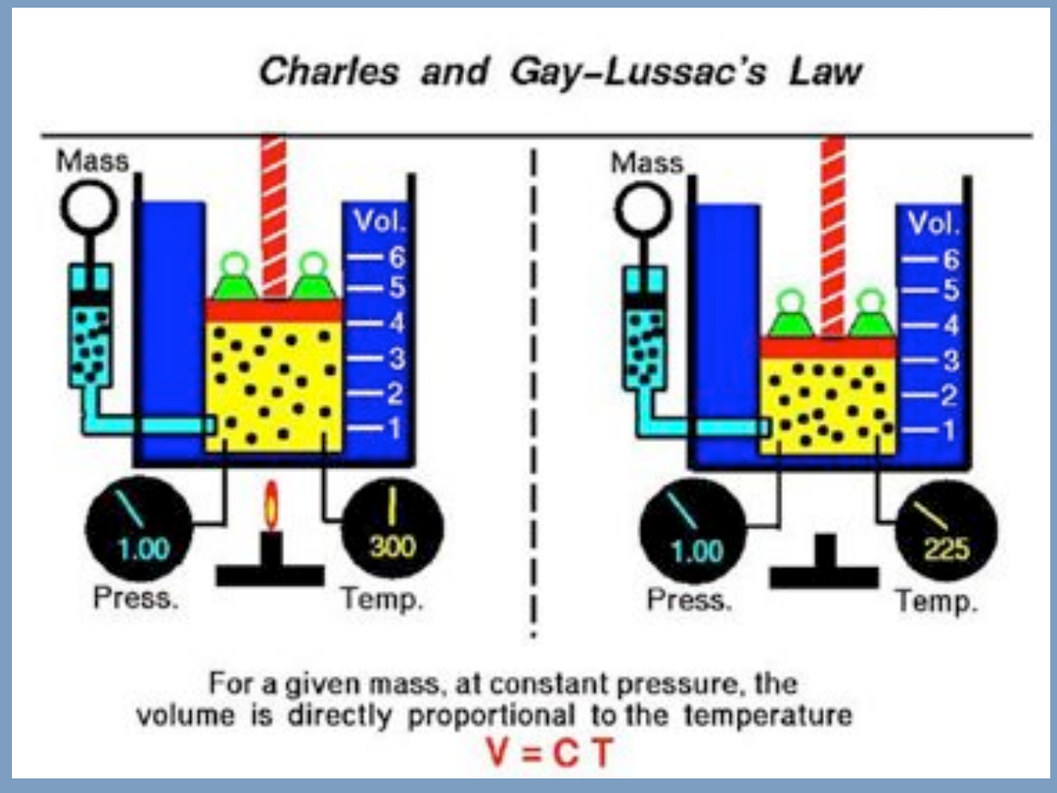
# Charles Law

Pressure = Constant

If you increase the temperature...what happens to volume?

Heat balloon = expand

Cool balloon = contract



# Guy-Lussac's Law

Volume = constant

Increase in temperature....what happens to pressure?

As you drive your car what happens to tire pressure? Why?