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
**Kinetic Energy** = 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 \( \text{H}_2\text{O} \), just more energy
**Endothermic Changes** require energy

- **Melting**
- **Boiling**
- **Sublimation**

Think of sweating...why does this cool you down?
**Exothermic Changes** release energy

**Freezing**

**Condensation**
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 turning 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?

**Buoyant Force** - 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

\[
\text{Pressure} = \frac{\text{Force}}{\text{Area}} = \frac{\text{Newtons}}{m^2} = 1 \text{ pascal}
\]
Car tires have air molecules "packed" into a small area
Fluids exert pressure evenly in all directions.

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 cm\(^2\) and the area of the large piston \( (A_2) \) equally 400 cm\(^2\), what force needs to be exerted on the small piston to lift the car?
**Hydraulic Devices** - Use fluids to transmit pressure

Basically multiply forces!

Tractors, brakes, lifts, dump trucks, backhoes, etc
What happens when 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
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

For a given mass, at constant pressure, the volume is directly proportional to the temperature

\[ V = C \cdot T \]
Guy-Lussac's Law

Volume = constant

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

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