States / Phases of Matter

A more in depth look at matter

The Kinetic Theory of Matter

The Kinetic theory states that matter is made of atoms and molecules that act like tiny particles that are always in motion.

We can see that higher temperature particles move faster and, if at the same temperature, larger particles will move slower than the smaller particles.

Quick Look Back

The three main states of matter are, **SOLID, LIQUID, AND GAS**

Solid objects have a definite shape and volume because the particles are so close together.

Liquid objects have a definite volume but change their shape to fit whatever vessel they are in. (their particles are looser)

Gases can change both their shape AND their volume

What about that other state?

PLASMA: a state of matter that consists of free-moving ions and electrons

Plasma is most often found in lightening, fires and the Aurora Borealis

Temperature!!

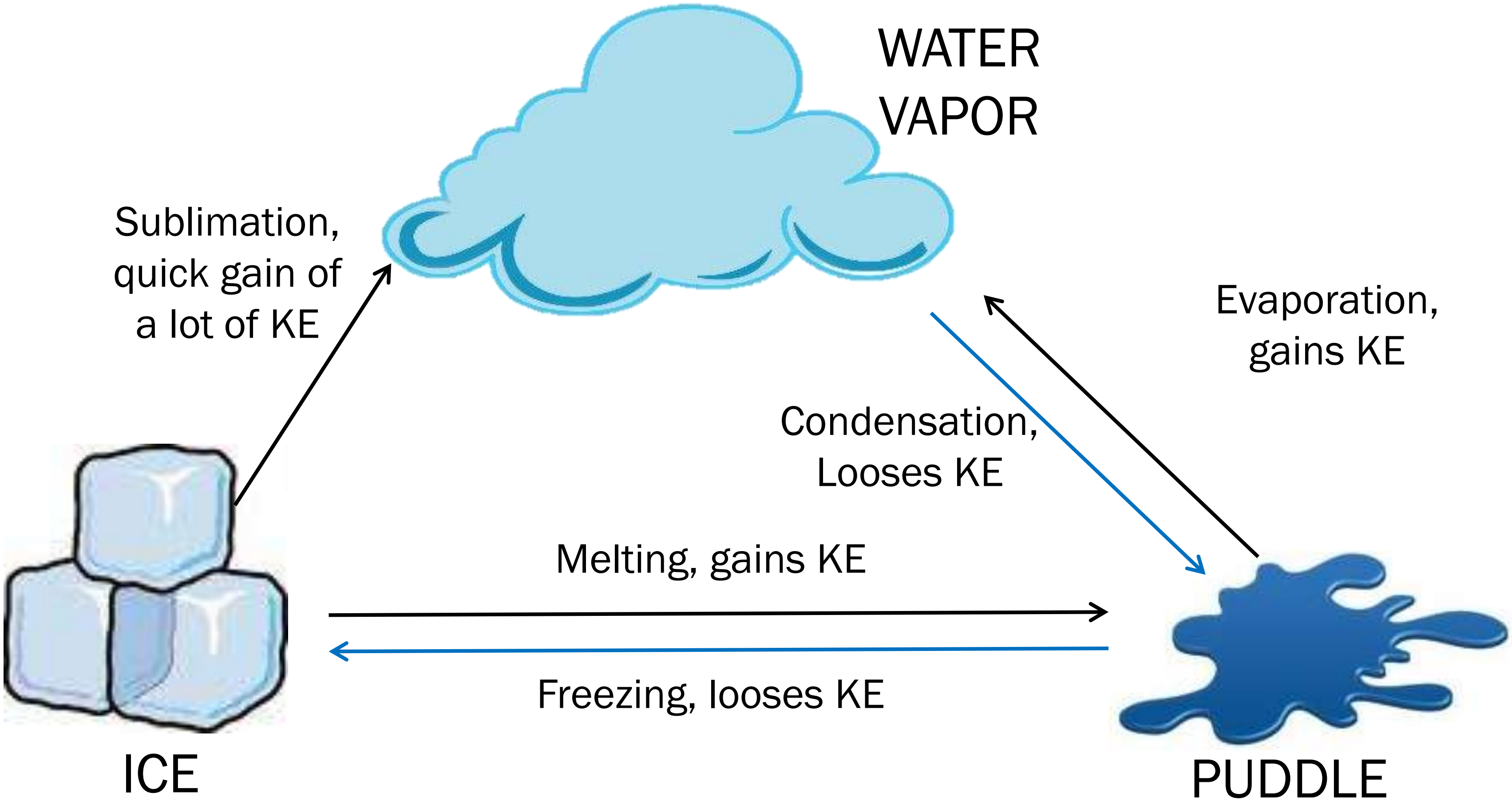
We know Temperature is a measure of hot or cold something is, but we also know it's the average kinetic energy of the particles in an object. The warmer something is, the more it is moving around.

Solid objects have the least amount of internal kinetic energy, with it increasing to liquid then gas.

The Thermal energy of an object is the total kinetic energy of a substance's atoms, and it depends on the number of particles in the substance.

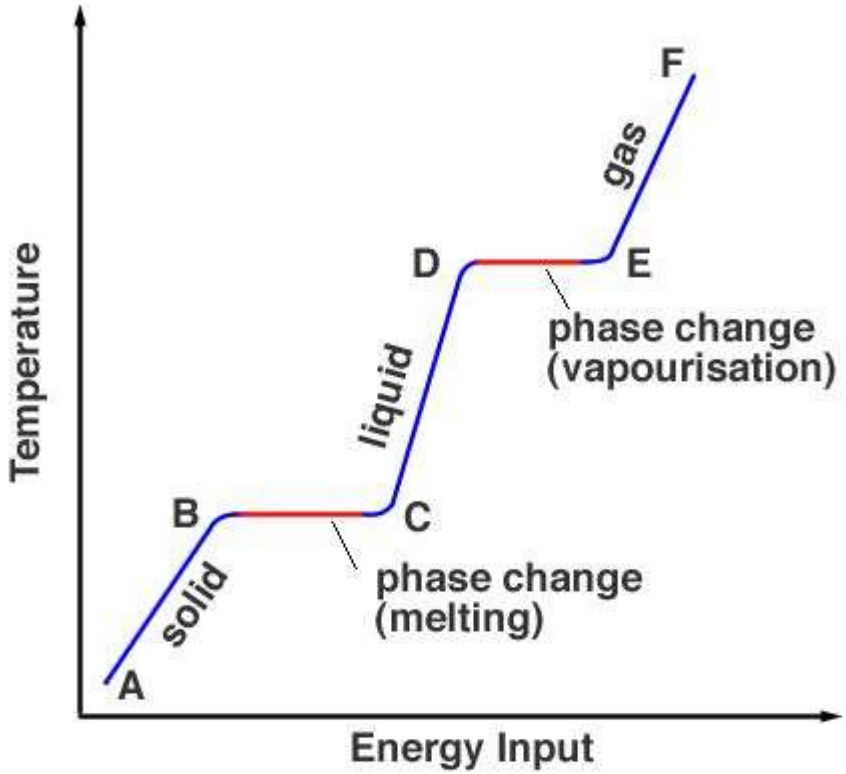
What's going on?

Going from state to state in a substance (Ice melting then evaporating) changes the internal energy of the substance.



Energy vs Temperature Graph

As the energy of the system (this is water) increases so does the temperature, and the states change accordingly



Pressure, Archimedes, and Density

Pressure is the force exerted per unit area on a surface.

$$P = \frac{F}{A}$$

Archimedes' Principal states that the <u>BOUYANT</u> Force on an object in a fluid is an upward Force equal to the weight of the fluid that the object displaces.

An object will float if its density is less than the density of the substance it is trying to float in.

Hydraulics

Pascale's Principle: A change in pressure at any point in an enclosed fluid will be transmitted equally to all parts of the fluid. This is the idea behind hydraulics.

In order for hydraulics to work, a force must be applied to a smaller area of liquid that then exerts pressure on the liquid and is transmitted equally to a larger area, where the pressure creates a greater force. (Think about the breaks in your car)

Hydraulics use pipes to control the speed of the liquid. If a pipe gets smaller the fluid's speed is increased and the pressure is decreased.

The viscosity of a fluid is the fluid's ability to resist flowing.

Gas Properties

Gases will expand to fill their containers. They spread out easily and mix with any other gases they come into contact with.

They have low densities and are compressible

Gases keep balloons inflated because the particles are constantly ramming into the walls of the balloon.

Gas Laws

Boyle's Law: for a fixed amount of gas at a constant temperature, the volume of a gas increases as the gas' pressure decreases, and vice-versa.

$$P_1V_1 = P_2V_2$$

Guy-Lussac's Law: The pressure of a gas increases as the temperature increases, assuming the volume does not change.

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Charles' Law: For a fixed amount of gas at a constant pressure, the volume of the gas increases as the temperature increase

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Standard Temperature and Pressure STP

- Standard Temperature

  273K (0^{o}C)

  [Remember: K = ^{o}C + 273]

- Standard Pressure

  1 atm

  760 mmHg (torr)

  101.325 kPa

Boyle's Law

If the amount and temperature of a gas remain constant, the pressure exerted by the gas varies inversely with the volume.

↓V P↑ OR ↑V P↓

$$P_1V_1 = P_2V_2$$

Boyle's Practice

A gas occupies a volume of 259cm^3 at 112 kPa. What volume will gas occupy at standard pressure?

? V_2

$P_1V_1 = P_2V_2$

$V_1 = 259\ cm^3$

$P_1 = 112\ kPa$

$P_2 = 101.325\ kPa$

STP

$$(112\ kPa)\ (259\ cm^3) = (101.325\ kPa)\ (V_2)$$

$$\frac{29008\ \cancel{kPa}\ cm^3}{(101.325\ \cancel{kPa})} = \frac{\cancel{(101.325\ kPa)}\ (V_2)}{\cancel{(101.325\ kPa)}}$$

$V_2 = 286\ cm^3$

Charles' Law

If the amount and pressure of a gas remain constant, the volume varies directly with the **Kelvin** temperature.

↓T V↓ OR ↑T V↑

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

VERY IMPORTANT

Temperature MUST, MUST, MUST be in **KELVIN**

Charles Practice

A gas occupies $907 cm^3$ at 19.0°C. If the pressure remains constant what volume will the gas occupy at standard temperature?

? V_2

$V_1 = 907\ cm^3$

$T_1 = 19.0°C + 273 = 292K$

$T_2 = 273K$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{907 cm^3}{292K} = \frac{V_2}{273K}$$

Cross Multiply!

$$(273K)\ (907\ cm^3) = (292K)\ (V_2)$$

$$\frac{(247611K\ cm^3)}{(292K)} = \frac{(292K)\ (V_2)}{(292K)}$$

$$V_2 = 848 cm^3$$

STP

Gay-Lussac's Law

If the amount and volume of a gas remain constant, the pressure varies directly with the Kelvin temperature.

$\downarrow T \quad P \downarrow$ OR $\uparrow T \quad P \uparrow$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

VERY IMPORTANT

Temperature MUST, MUST, MUST be in

KELVIN

Gay-Lussac Practice

A gas at 715mmHg has a temperature of 25.0ºC. If the volume is held constant, what will the temperature of the gas be at standard pressure?

? T_2

P_1 = 715mmHg

T_1 = 25.0ºC + 273 = 298K

P_2 = 760mmHg

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$\frac{715\text{mmHg}}{298\text{K}} = \frac{760\text{mmHg}}{T_2}$$

Cross Multiply!

$$(T_2)\ (715\text{mmHg}) = (760\text{mmHg})\ (298\text{K})$$

$$\frac{(T_2)(715\text{mmHg})}{(715\text{mmHg})} = \frac{(226480\text{mmHg K})}{(715\text{mmHg})}$$

T_2 = 317K

STP