Unit 7: States of Matter *Mark the text by highlighting/underlining/ circling.*

Kinetic energy is the movement of particles.
Temperature is a measure of average kinetic energy. Greater the kinetic energy of a substance, the higher its temperature and the hotter the substance feels. **Kelvin scale:** K = 273 + °C

Kinetic Molecular Theory states that all particles of matter are always in motion! At absolute zero (0 K) there is no movement of particles.
Solid particles are tightly packed in *fixed* positions that vibrate because they have more attractive forces.
There are two types of solids: crystalline solids and amorphous solids. Crystalline solids have particles that are arranged in orderly, geometric, and repeating patterns. Whereas amorphous solid particles are "without shape" because the particles randomly arranged and have no repeating patterns. Examples of amorphous solids are glass, plastic, rubber.
Melting (also known as fusion) is when the solid's vibrations are strong enough to break the attractive forces.

> *Remember, electrostatic forces of attractions are the strongest and keep ionic compounds together. Whereas covalent molecules are attracted through intermolecular forces. The strongest intermolecular force is hydrogen bonding which is between hydrogen & nitrogen, oxygen, or fluorine. Dipole-Dipole force is between polar molecules. The weakest intermolecular force is London dispersion force which is between all types of molecules.*

Melting point = Freezing Point

Liquid particles are less ordered and more spread out than solid particles because the intermolecular forces are weaker. If the surface particles of the liquid have enough kinetic energy, they can overcome these attractive forces and escape into gas state.
Vaporization is the process in which a liquid changes into a gas. There are two ways this can happen, evaporation or boiling. **Evaporation ≠ Boiling**
Evaporation is the process of surface particles of a liquid turn into gas. The surface particles move faster are able to overcome the attractive forces that keep them in liquid state. Volatile liquids evaporate more easily because there is less attractive forces. Examples of volatile liquids are rubbing alcohol.
Boiling is when the internal vapor pressure is equivalent to the external vapor pressure. Increasing the temperature of the liquid, increases the internal (vapor) pressure of the liquid. The bubbles that appear are filled with gas of the liquid. If the external pressure is increased, then the internal pressure needs to increase which means the temperature of the liquid increases. This is how a pressure cooker works. On the other hand, if the external pressure is removed (a vacuum) then the internal pressure is reduced without changing the temperature.

Vaporization point = Condensation point

Pressure is a force or a "push" on an area and increases if the number of gas particle collisions increase. The atmosphere exerts pressure and is equal to the sum of individual partial pressures of all gases in the atmosphere.

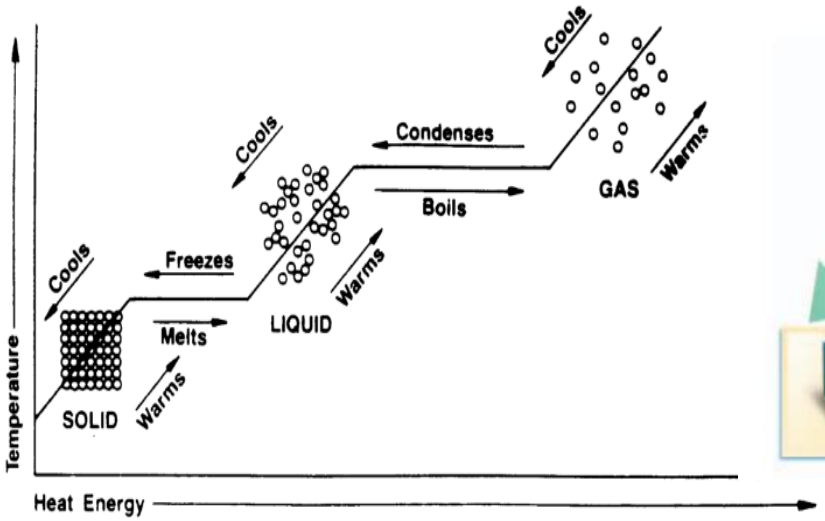
Standard Temperature & Pressure (STP) is 1.0 atm & 0°C

Sea level atmospheric pressure = 1.0 atm.

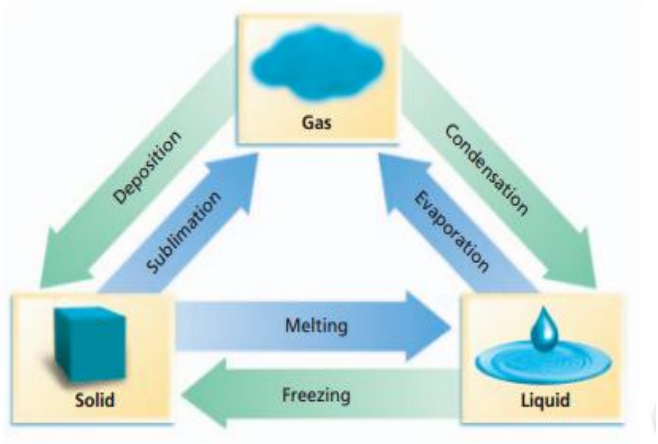
1 atmosphere (atm) = 760 mmHg = 101.3kPa

Gases have mass and take up space. Gas particles are far apart with no force of attraction and are in constant and random motion. Collisions between gas particles are elastic with no loss of kinetic energy and the energy is transferred from one particle to another. Gas particles colliding with the sides of a container cause pressure.
Liquids and gases both do not have fixed positions thus they both flow and will take the shape of their container. They are both considered to be fluids.
Plasma: formed when a gas is heated to a temperature at which atoms lose their electrons. It is the most common state of matter in the universe. Examples of plasmas are lightning, solar winds, tails of comets, stars, Earth's ionosphere, wielding arcs, neon signs, and florescent lights.

Phase Change Diagram



Phase Changes:



Dynamic Equilibrium is a condition in which two opposing changes occur at equal rates in a closed system. Example is the rate of evaporation = rate of condensation.

Heat is the energy transfer between samples of matter because of their temperature difference. It moves from a higher temperature to a lower temperature until the temperature is the same for both samples of matter. Once each sample has the same temperature, there is no more energy being transferred which means no more heat.

Enthalpy of Fusion (ΔH_{fus}): amount of heat needed to change 1 mole of solid into a liquid. → 13 kJ of Heat melts 1 Mole of Cu

Ex. If 300. kJ of heat is available, how much copper in grams can be melted? ΔH_{fus} Cu = 13.0 kJ/mol

given: 300 kJ Heat
Want: g Cu
Need: 13 kJ Heat = 1 mol Cu

given	need	
300 kJ Heat	1 mol Cu	63.55 g Cu
	13 kJ Heat	1 mol Cu

= 1466.5
= 1470 g Cu want

Enthalpy of Vaporization (ΔH_{vap}): amount of heat needed to change 1 mole of a liquid into a gas.

Ex. How much heat is absorbed when 24.8 g of water is evaporated? ΔH_{vap} H_2O = 40.65 J/mol

given: 24.8 g H_2O
want: J Heat
Need: 40.65 J Heat = 1 mole H_2O

given	need	
24.8 g H_2O	1 mol H_2O	40.65 J Heat
	18.02 g H_2O	1 mol H_2O

= 55.9 J Heat want

Phase Diagram :

Triple point: is the temp & pressure at which a solid, liquid, & gas coexist. AD Curve represents temp & pressure in which both a liquid & solid coexist. AC Curve represents temp & pressure in which both a liquid & vapor coexist.