Chapter 2

States of Matter

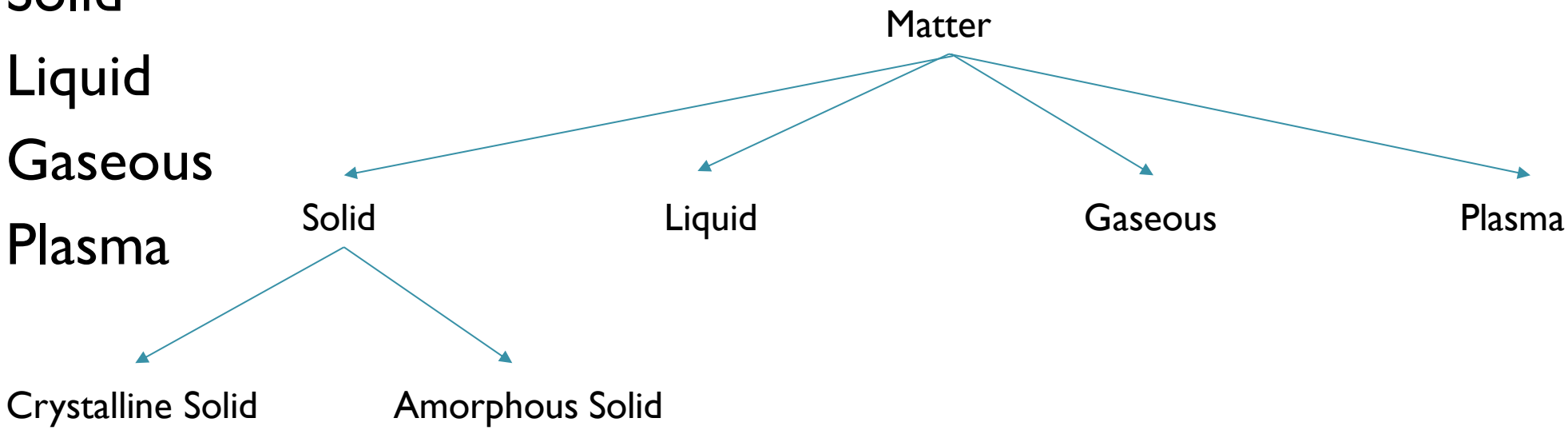
2 - 1 Matter

Matter

- Matter – Anything that takes up space and has mass.
- Is air matter ?
  - Yes. It takes up space and has mass. It has atoms.
- All matter is made up of atoms. (Dalton's Theory)
  - Each particle attracts other particles.
    - Atoms have gravity.
  - The atoms are in constant motion.
    - The amount of motion and the strength of the attraction between the particles determine the state of matter.

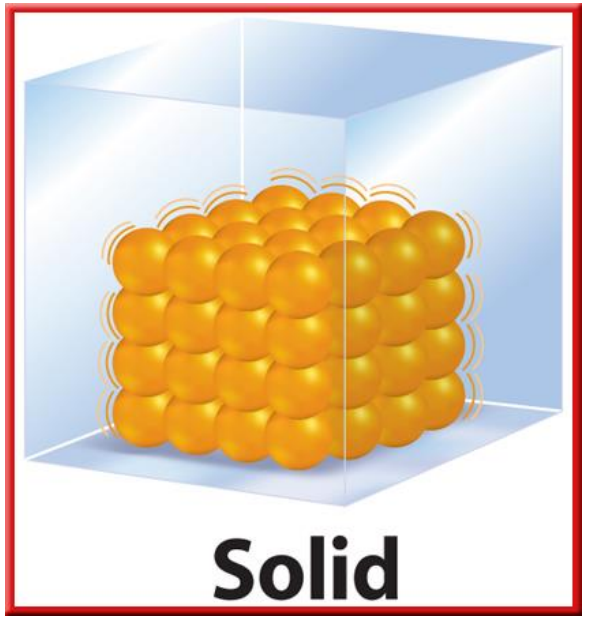
States of Matter

- There are 4 states of matter:
  1. Solid
  2. Liquid
  3. Gaseous
  4. Plasma



Solids

- Solid – Matter with a definite shape and a definite volume.
  - Definite Shape – the atoms cannot change position
  - Definite Volume – the atoms cannot spread out
  - The atoms move mainly by vibrating.



Types of Solids

- 2 Types of Solids

1. Crystalline Solid
2. Amorphous Solid

Crystalline Solid

- The atoms are arranged in a repeating, three-dimensional pattern called a crystal.
- Examples :

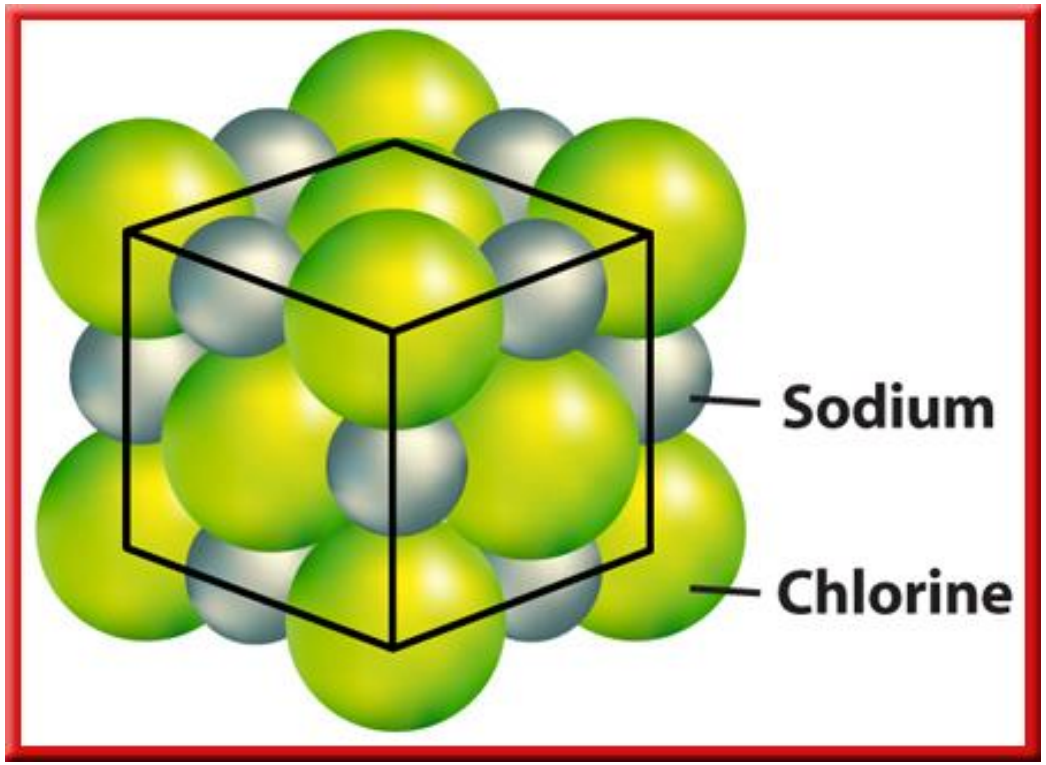
Salt

Diamond

Sand

Sugar

Snow



- www.discovery.com/tv-shows/frozen-planet/videos/filming-snowflakes-forming.htm?utm_source=twitter.com&utm_medium=social&utm_campaign=Discovery&hootPostID=6f85882b6d310589a8913c9f2efa7fbd

Amorphous Solid

- The atoms are NOT arranged in a pattern
- Examples :

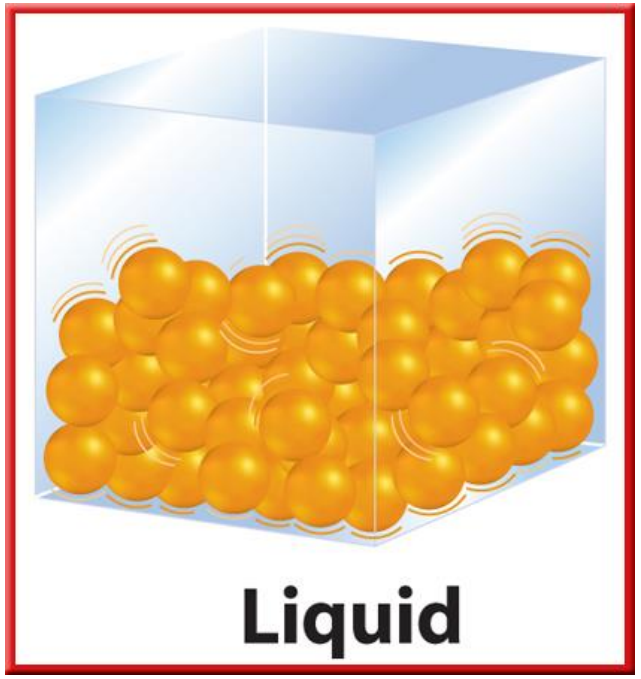
Rubber

Plastic

Glass

Liquids

- Liquid – Matter with no definite shape but with definite volume.
  - No Definite Shape – the atoms can change position
  - Definite Volume – the atoms cannot spread out
  - Has the ability to flow.
  - Takes the shape of its container



Viscosity

- Viscosity – A liquid's resistance to flow.
  - Example – pouring honey vs pouring water.
- Typically, liquids pour slower as they get colder.
- The slower a liquid flows, the greater its viscosity.

- http://www.youtube.com/watch?v=3KU_skfdZVQ
- http://www.youtube.com/watch?v=_5te9X4sNrU

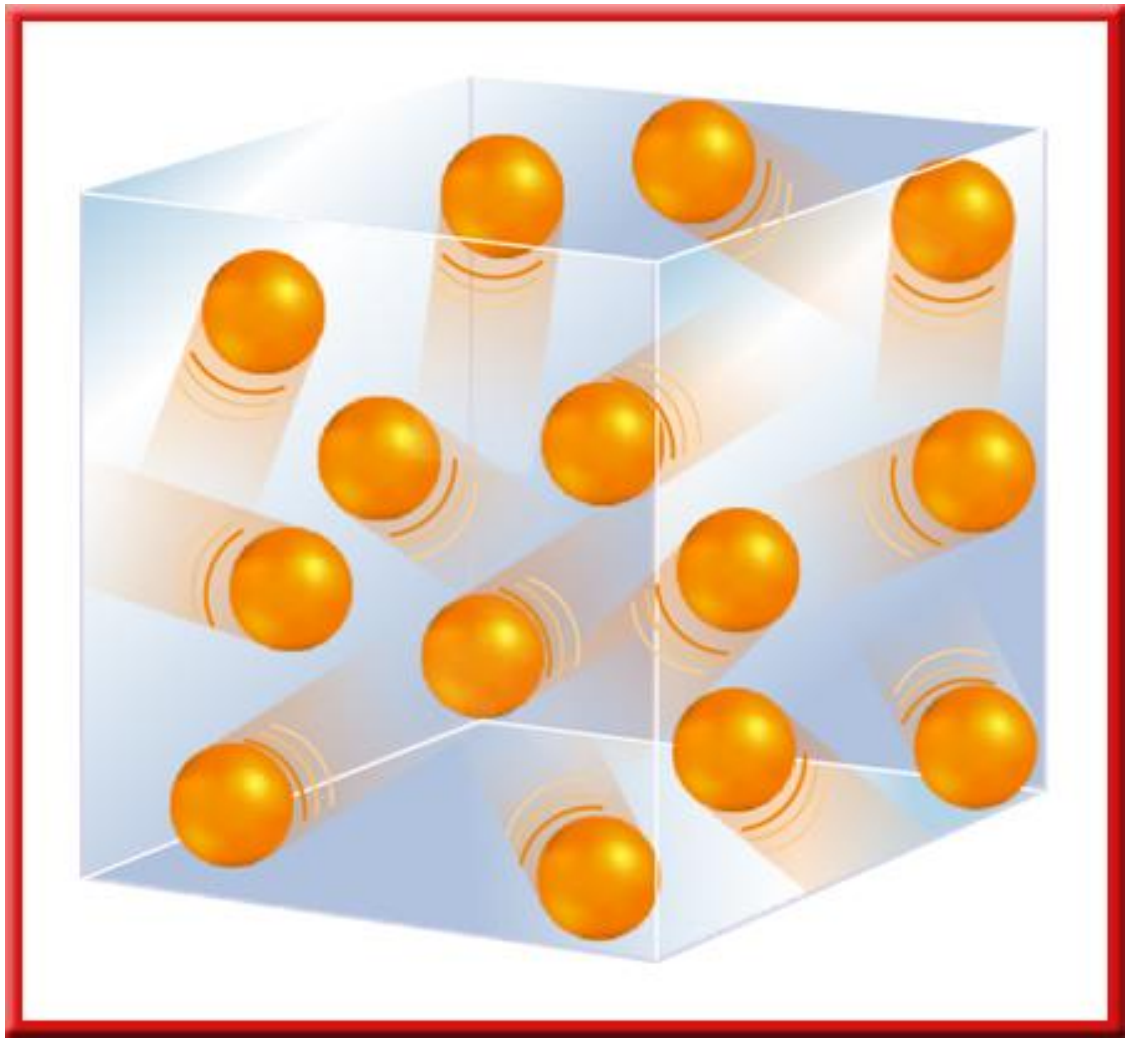
Surface Tension

- Surface Tension – The uneven forces acting on the atoms on the surface of a liquid.

Gaseous

- Gaseous – Matter that has no definite shape and no definite volume.
  - No Definite Shape – the atoms can change position
  - No Definite Volume – the atoms can spread out

  - Because the atoms can spread out to fill their container, they can also be compressed into a smaller space.
  - Vapor – matter that exists in the gaseous state but is generally a liquid or solid at room temperature.
    - Example : Water Vapor



2 – 2 Changes of State

Kinetic Energy

- Kinetic Energy – the energy that an object has due to its motion.
  - The faster an object moves, the greater its kinetic energy.

Potential Energy

- Potential Energy – The energy that an object has that can be changed into kinetic energy.

Thermal Energy

- Thermal Energy – The total kinetic and potential energy of all of the atoms in a sample of matter.
- The amount of thermal energy is affected by :
  1. The number of atoms present.
  2. The amount of energy each atom has.

Temperature

- Temperature – The average kinetic energy of the atoms in a sample of matter.
  - If the atoms move faster, the temperature increases.

Heat

- Heat – The movement of thermal energy from a substance at a higher temperature to one at a lower temperature.
  - Heat is NOT how hot something is.

Specific Heat

- Specific Heat – The amount of thermal energy required to raise the temperature of 1g of a substance 1°C.
  - Every type of substance has a different specific heat.

Melting

- Melting – The change from the solid state to the liquid state.
  - The temperature at which a substance melts is its melting point.
- Amorphous Solids get softer until they have reached the liquid state
- Crystalline Solids change from solid to liquid instantaneously, little by little.

Freezing

- Freezing – The change from the liquid state to the solid state.
- As an atom slows down, eventually it is moving so slow that the attractive forces of other atoms lock it into position.

Vaporization

- Vaporization – The change from the liquid state to the gaseous state.
- 2 forms of vaporization :
  1. Boiling – vaporization occurs below the surface
  2. Evaporation – vaporization occurs at the surface
- Sweating
  - The energy needed from the liquid to change to a gas comes from our body, the resulting loss of energy cools our body.

Condensation

- Condensation – The change from the gaseous state to the liquid state.

Sublimation

- Sublimation – The change from the solid state directly to the gaseous state.

2 – 3 Behavior of Fluids

Pressure

- Pressure – The force exerted on a surface divided by the total area over which the force is exerted.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

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

Solve

- A box has a weight of 120 Newtons and the bottom of the box is 12 m^2. What is the pressure the box exerts on the floor ?

- A bronze statue weighs 2400 N and has a base that is 4 meters by ½ meter. What is the pressure the statue exerts on the floor ?

- What is the weight of an object that has a base which is 3 m^2 which exerts a pressure of 21 Pa ?

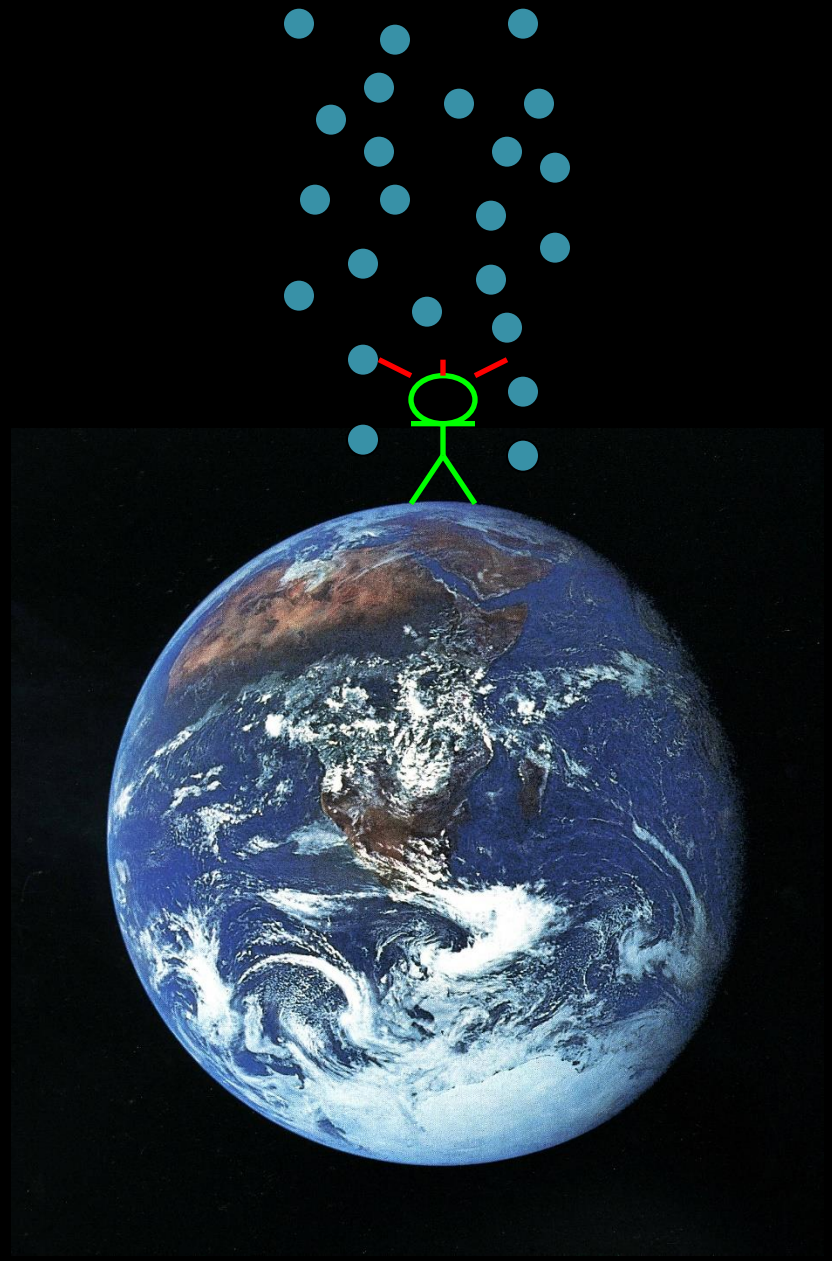
- What does a car weigh if its tires cover an area of 4 m^2 and each tire exerts a pressure of 1000 Pa on the ground ?

- A round tube weighs 30 N. If the tube is stood on end it pushes down on the floor with a pressure of 2 Pa. What is the area of the end of the tube ?

- The pressure a box pushes down on the floor is 50 Pa. If the box weighs 400 N, what is the area of the base of the box ?

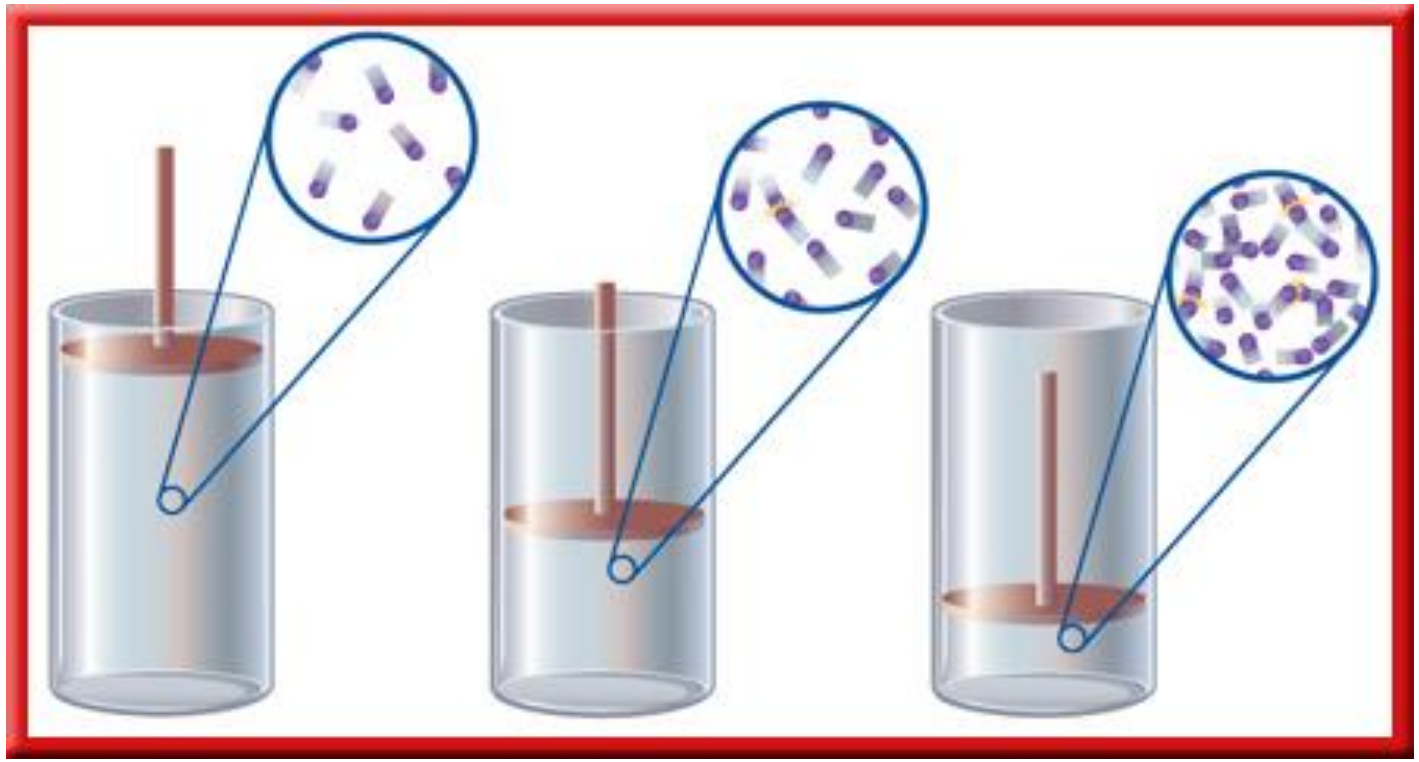
Atmospheric Pressure

- Atmospheric Pressure is the pressure exerted by the air (atmosphere) around us.



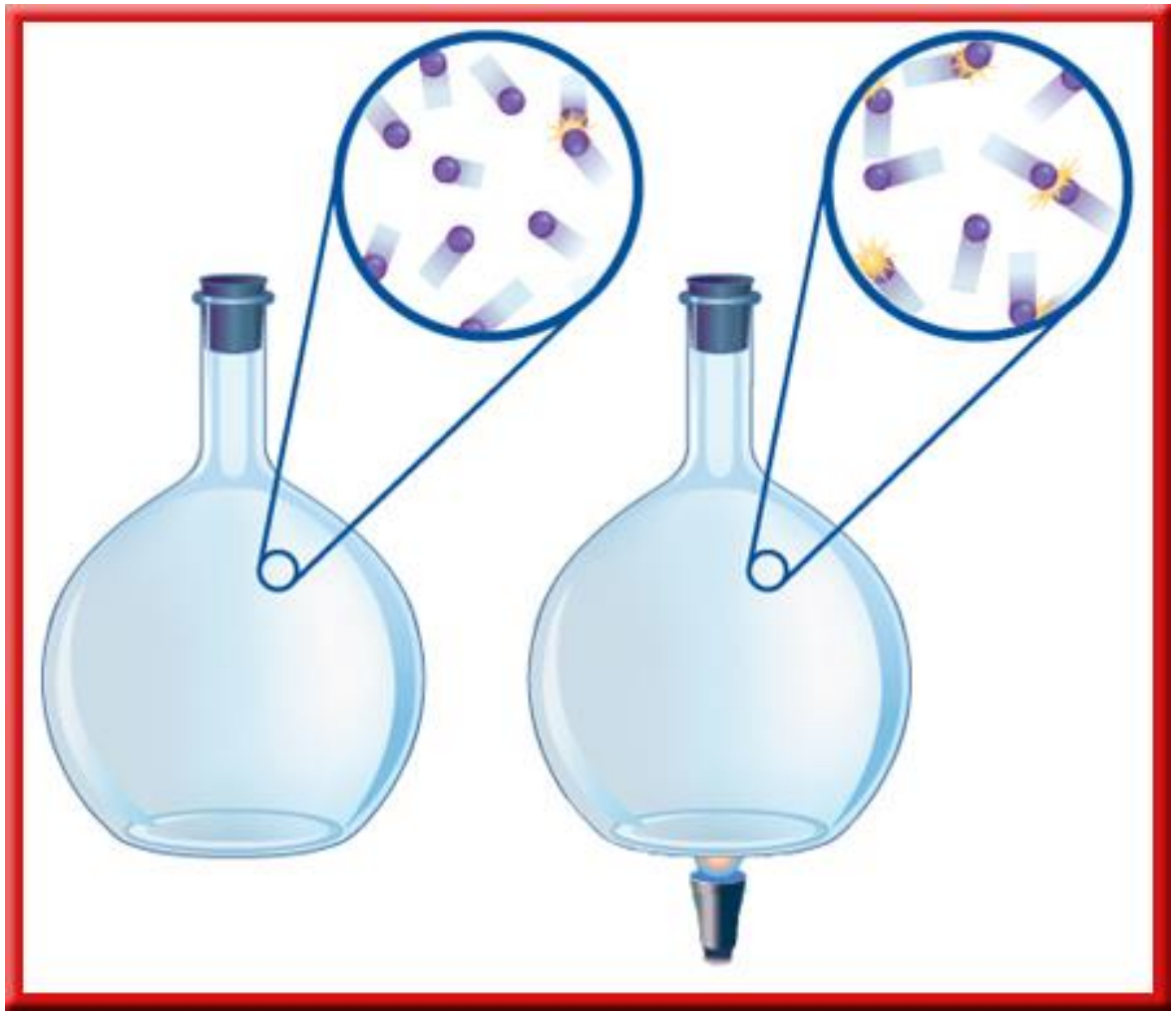
Pressure and Volume

- Squeezing a gas into a small space (less volume) forces the atoms closer to each other.
- Because the atoms are closer to each other, they collide with each other more often.
- The increase in collisions increases the pressure.



Pressure and Temperature

- Increasing the temperature causes the atoms to move faster.
- Since the atoms are moving faster, they are colliding more often.
- Since they are colliding more often, the pressure increases.



Float or Sink

- As you go deeper into the water, water pressure increases.

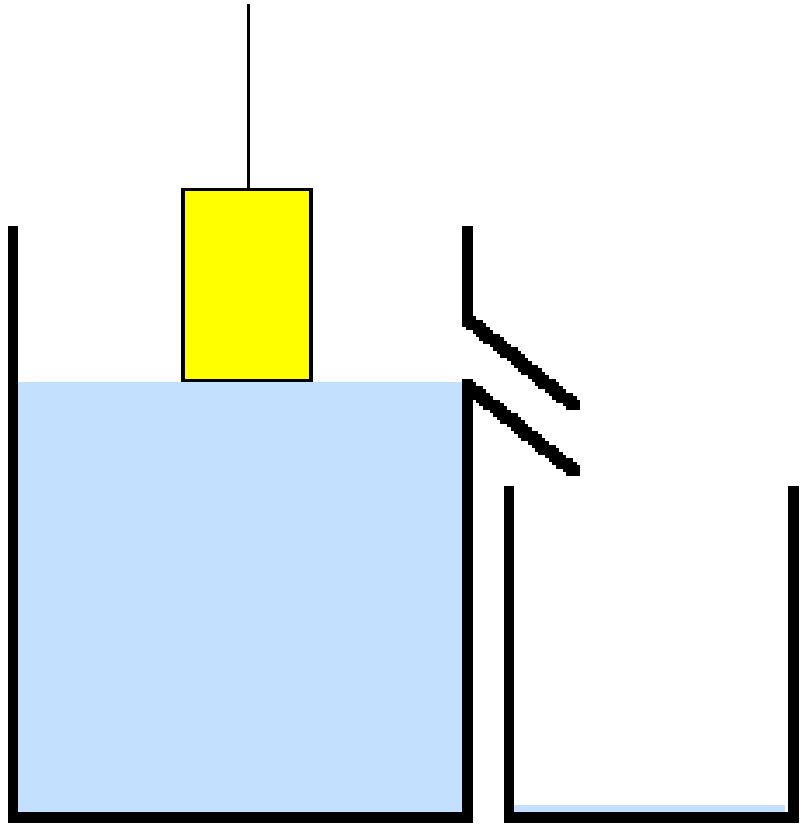

Pressure pushing down
Pressure pushing up

Buoyant Force

- Buoyant Force – the upward force exerted on an object immersed in a fluid.
  - If the buoyant force is less than the weight of the object, the object will sink.
  - If the buoyant force is equal to the weight of the object, the object will float.
  - If the buoyant force is greater than the weight of the object, the object will rise.

What determines the buoyant force ?

- Archimedes' Principle – the buoyant force on an object is equal to the weight of the fluid displaced by the object.



Density

- Density – the mass of an object divided by its volume.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

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

Pascal's Principle

- Pascal's Principle – when a force is applied to a confined fluid, an increase in pressure is transmitted equally to all parts of the fluid.