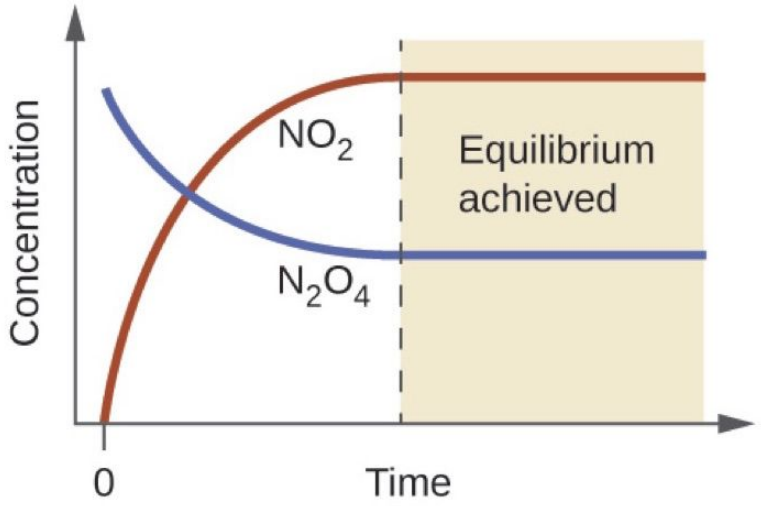
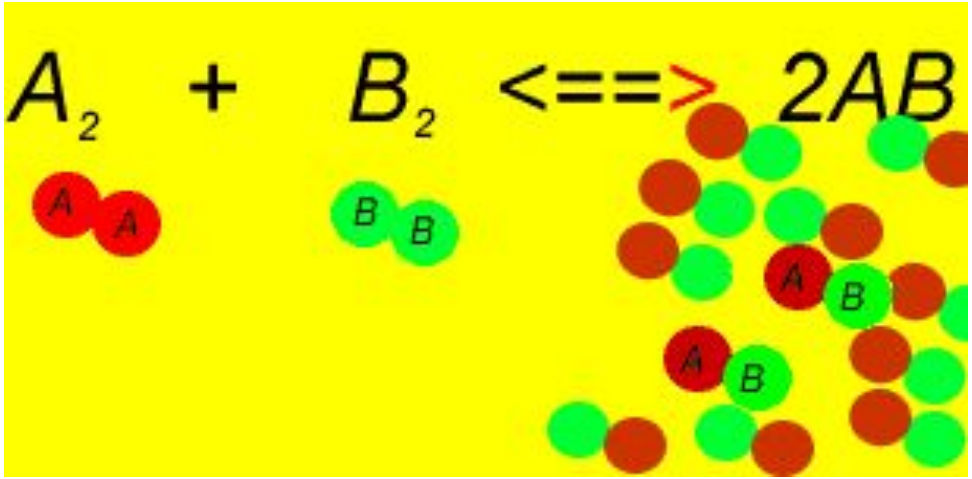
Equilibrium

A state of equilibrium is reached when the rates of the forward and reverse reactions are equal





- Equilibrium reactions are written using a double arrow
  - Each of the arrows only has a single-sided head

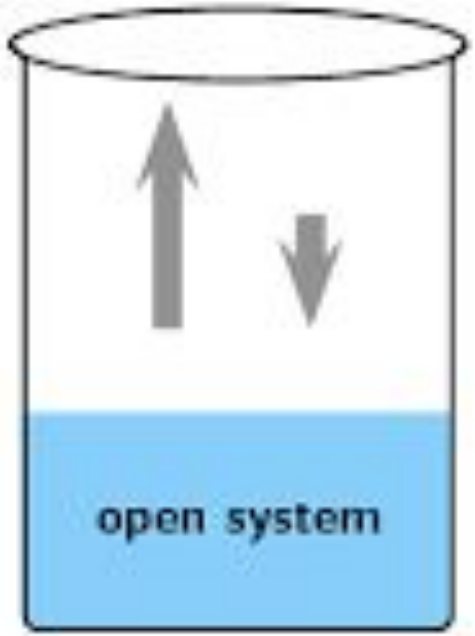
- The unit will make a lot of reference to the rate of the:
  - **'forward reaction'** (reactants becoming products)
  - **'back reaction'** (products becoming reactants)

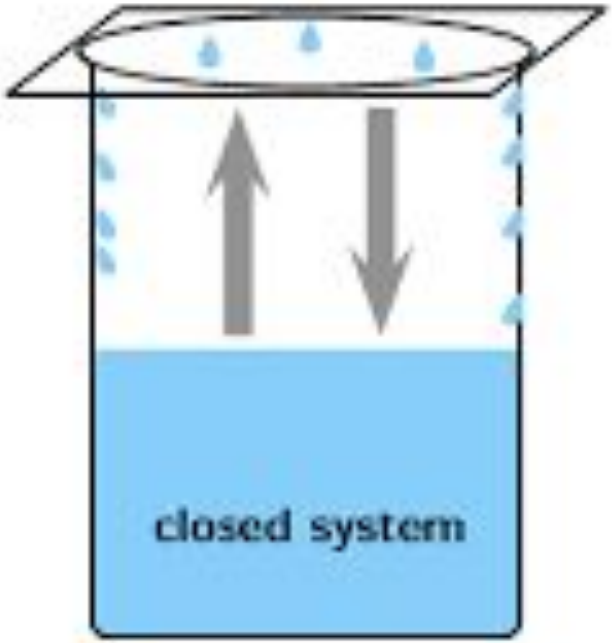
Characteristics of Equilibrium

1. Properties are **constant** at equilibrium (no color change or change in density)
2. The rate of the forward reaction is **equal** to the rate of the reverse reaction
3. There is no change in concentration of reactants and products
4. Equilibrium can only be obtained in a **closed system**
5. All species in the chemical equation are present in the equilibrium reaction mixture
6. Equilibrium can be obtained from either direction
7. Changes such as temperature, pressure, or concentration of reactants or products can affect the equilibrium

= condensation

= evaporation





LE CHATELIER'S PRINCIPLE

STRESS	SHIFT	WHY?
increase concentration of a substance	*away* from substance	extra concentration needs to be used up
decrease concentration of a substance	*towards* substance	need to produce more of substance to make up for what was removed
increase pressure of system	towards *fewer* moles of gas	for gas: pressure increase = volume decrease
decrease pressure of system	towards *more* moles of gas	for gas: pressure decrease = volume increase
increase temperature of system	*away* from heat/ energy *exothermic* reaction is favored	extra heat/ energy must be used up
decrease temperature of system	*towards* heat/ energy *exothermic* reaction is favored	more heat/ energy needs to be produced to make up for the loss
add a catalyst	NO SHIFT	The rates of both the forward and reverse reactions are increased by the same amount.

Dynamic Equilibrium Summary

[Dynamic Equilibrium Video]