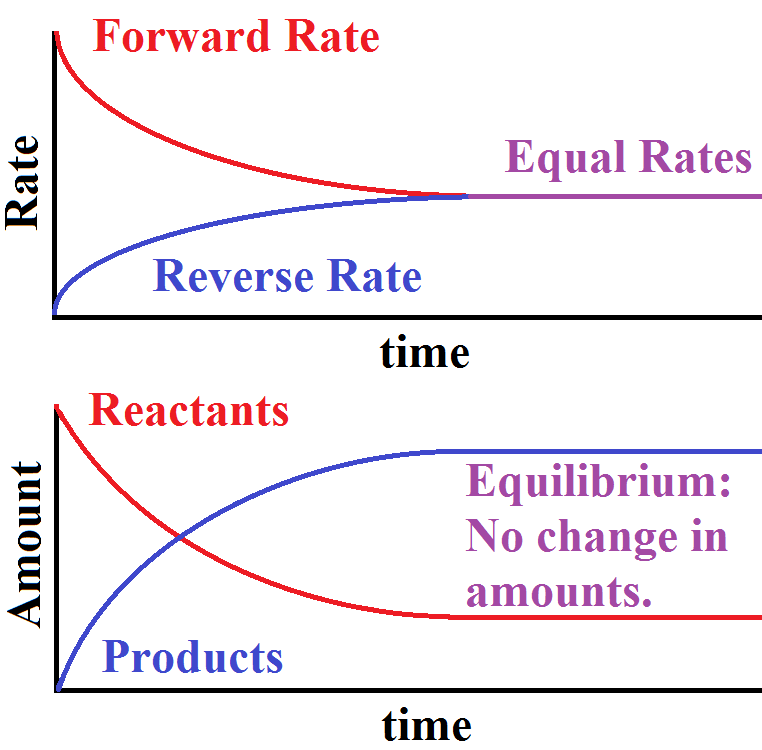
**Equilibrium & Le Châtelier’s Principle**

**YOYO:** Where have you heard the word equilibrium before? What do you think it means? Write down your thoughts.

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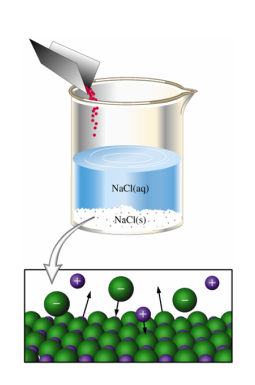
Irreversible vs. Reversible Reactions

* In an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the reactants react to form the products, which cannot change back into reactant
* A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, is one in which the conversion of reactants to products and the conversion of products to reactants occur simultaneously (at the same time).



Equilibrium

* Equilibrium occurs when the forward and reverse reactions occur at the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the reactants and products remain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Can only occur in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_system; reactants nor products can leave the system.
* The forward reaction will continue to slow as the reverse reaction proceeds until equilibrium is met.
  + That is chemical equilibrium.

Physical/Phase Equilibrium

* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at which a substance evaporates is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_which the substance condenses.
  + Example: Rate of melting = rate of freezing

Solution Equilibrium

* A saturated solution is at equilibrium; the rate of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_equals the rate of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Ex: NaCl(s) 🡪 NaCl(aq)

Chemical Equilibrium

* Chemical equilibrium is when the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the forward and reverse reactions are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a chemical reaction.
  + Making ammonia – The Haber process (N2 + 3H2 🡨🡪 2NH3)



Le Châtelier’s Principle

* Explains how a chemical reaction at equilibrium responds to relieve any stress on that reaction. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Reaction will counter the stress by shifting to the left to produce more reactant or shift to the right to produce more product.
* Sources of Stress:
  + Changes in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (amount)
  + Changes in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (added/subtracted heat)
  + Changes in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (only if gases are present)

Putting It All Together

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
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* All of this can be boiled down to four letters… AATT
  + A\_\_\_\_\_\_\_\_\_\_ A\_\_\_\_\_\_\_\_\_\_\_\_\_\_ T\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ T\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_