Enzymes

Features

- Catalysts – increase rate of rxn (forward and reverse)
- Lowers **activation energy**
- Do **NOT** change:
  - ⇒ equilibrium constant
  - ⇒ free energy ΔG
  - ⇒ enthalpy ΔH
- Recycled in reaction (appear in products + reactants)
- Sensitive to **pH** and **temperature**
- Enzyme specificity for substrates

Cofactors + Coenzymes

purpose: to improve enzymatic function

Cofactors: inorganic molecules, metals ions (Zn^{+2}, Cu^{+2}, Fe^{3+})
Coenzymes: small, organic, vitamin derivatives (NAD^+, FAD, coenzyme A)

- **Apoenzymes**
- **Holoenzymes**
- **Prosthetic groups**

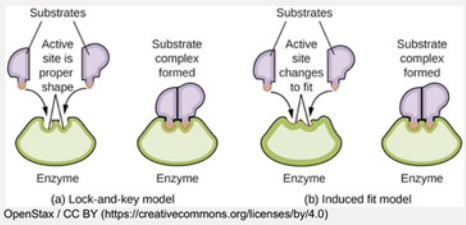
Six Classification

MNEMONIC
Main Enzymes – **LIL' HOT:**
Ligase
Isomerase
Lyase
Hydrolase
Oxidoreductase
Transferase

1. **Ligase** – join, use ATP (i.e. DNA Ligase)
2. **Isomerase** – rearrangement, isomers (constitutional and stereoisomers)
3. **Lyase** – cleavage **w/ out H_2O**
4. **Hydrolase** – cleavage **with H_2O**
5. **Oxidoreductase** – redox, transfer e^-
6. **Transferase** – transfer of functional group, include **kinases** (transfer P_i from ATP)

Enzyme Activity

- Enzyme-substrate binding
  - **Lock and key theory** (specificity)
  - **Inducted fit model** (accepted theory)



↓ K_m = ↑ **affinity**
- Enzyme activity *independent* of [S]

↑ K_m = ↓ **affinity** (more substrate needed)
- Enzyme activity highly *dependent* on [S]

Enzyme Kinetics

- ↑ Substrate concentration **[S]** = ↑ Reaction rate **[V]** until reaching **V_{max}** (**saturation**).

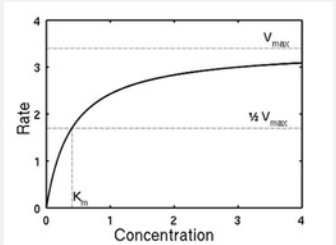
Michaelis-Menten equation

$$v = \frac{V_{max}[S]}{K_m + [S]}$$

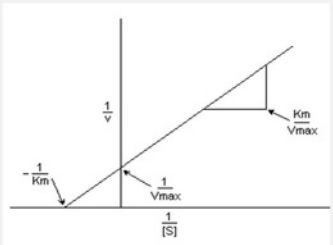
At 1/2 v_{max}, [S] = K_m

- **catalytic efficiency = k_{cat}/K_m**

Michaelis-Menten



Lineweaver-Burk



Enzyme Regulation

Feedback inhibition

negative feedback

A —enzyme 1→ B —enzyme 2→ C —enzyme 3→ D (high)

positive feedback: amplifies response to stimulus (i.e. childbirth)

Irreversible inhibition

- **Allosteric**
- **Phosphorylation**
- **Zymogens**

Reversible inhibition

	Competitive	Noncompetitive	Mixed	Uncompetitive
Binding Site	Active Site	Allosteric Site	Allosteric Site	Allosteric Site
Impact on K_m	Increases	Unchanged	Increases or Decreases	Decreases
Impact on V_{max}	Unchanged	Decreases	Decreases	Decreases