# Enzymes

Ch 3: Macromolecules

- Living things use different chemical reactions to get the energy needed for life

# Chemical Reactions

- Reactants = substance that is changed
- Products = new substance that forms
  - Ex: ATP ←→ ADP + P + energy
  - Ex: H2O←→ H + OH
    - The double arrow means the reaction build and then break down (can do forward and reverse reactions)

- Types
  - Exothermic = releases energy (breaks down)
  - Endothermic = absorbs energy (builds)

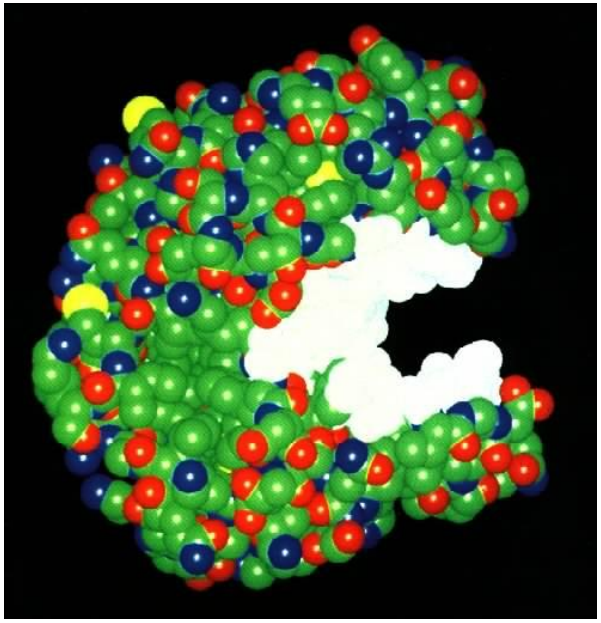
# Chemical Reactions

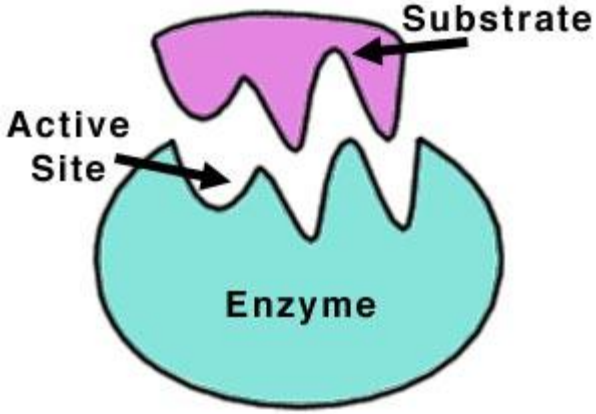
- Activation Energy = energy needed to start a chemical reaction
  - Ex: A ball on top of a hill will not start rolling unless someone pushes it (input of energy), just like reactions will not occur unless energy is added to start it

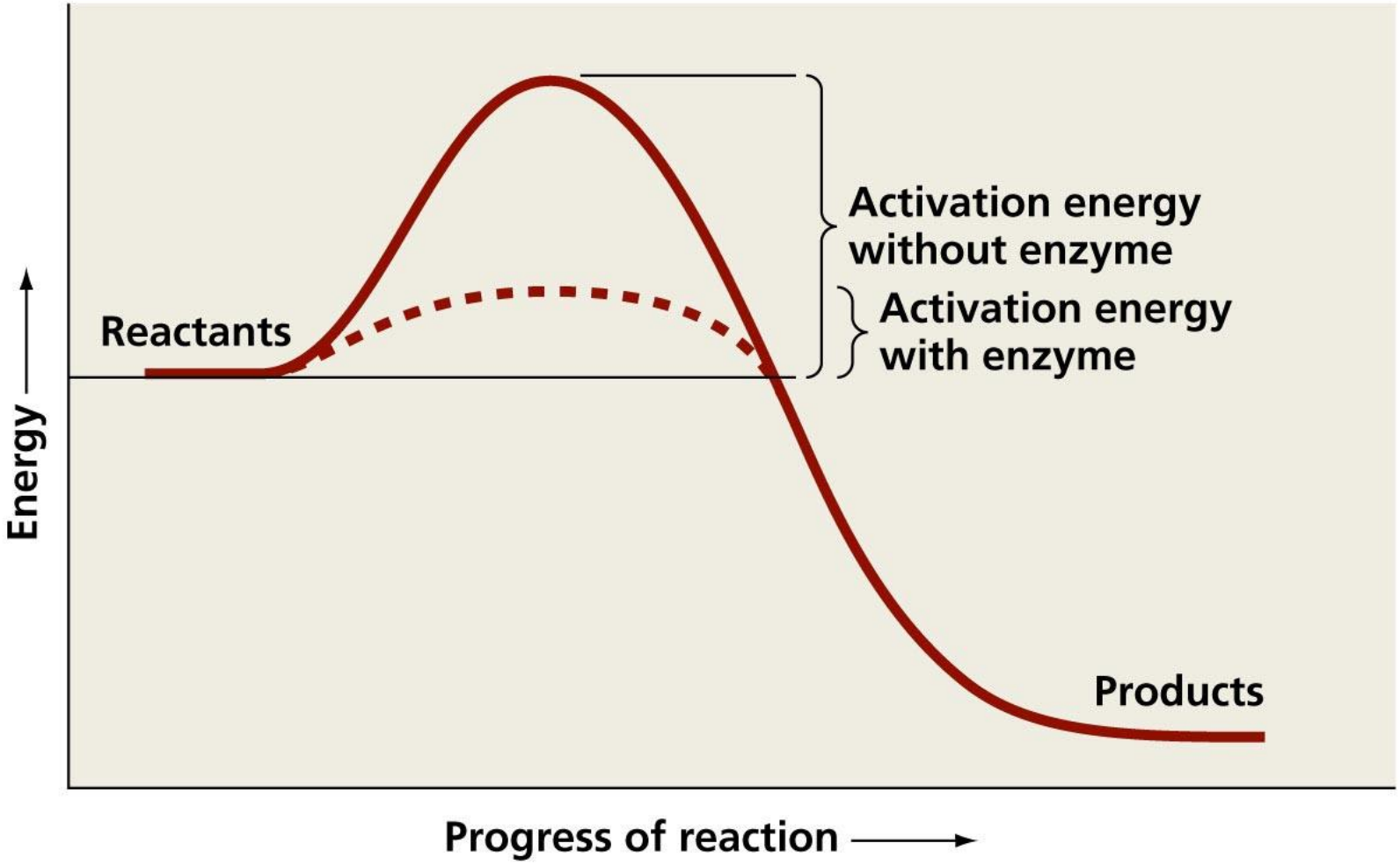
- Normally, our body can't wait for molecules to build up enough energy on their own in order to combine or break apart
- So, reactions require enzymes

# Enzymes

- Enzymes = group of catalysts in living things
  - Helps start chemical reactions by lowering the activation energy (HOW ENZYMES FUNCTION)
- Substrate = molecule that binds to a specific enzyme
- Active site = place on the enzyme where substrate binds





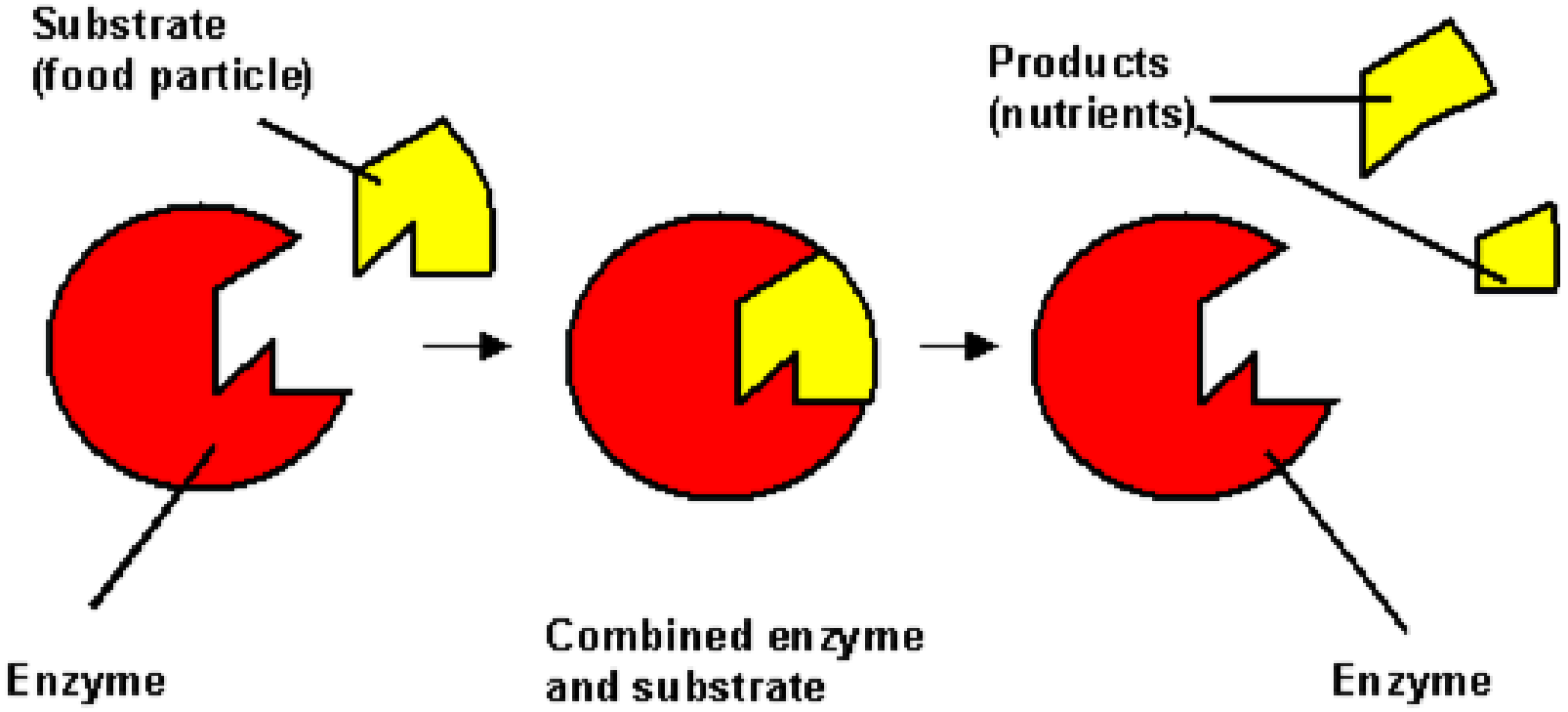


# 4 Characteristics of Enzymes

- Speed up reactions that would otherwise take a long time to start
- Not used up (can react over and over)
- Same enzyme does building and breaking down (forward and reverse reaction)
- Highly selective to what substrate it binds to

# Steps of Enzyme Activity

- Substrate binds to an enzyme's active site like a key in a lock (**Lock and Key Mechanism**)
- Enzyme holds the substrate in place by changing its shape slightly (**Induced Fit Model**), which causes some bonds to break or new ones to form in the substrate
- Unchanged enzyme releases the product when the reaction is over and binds to the next substrate

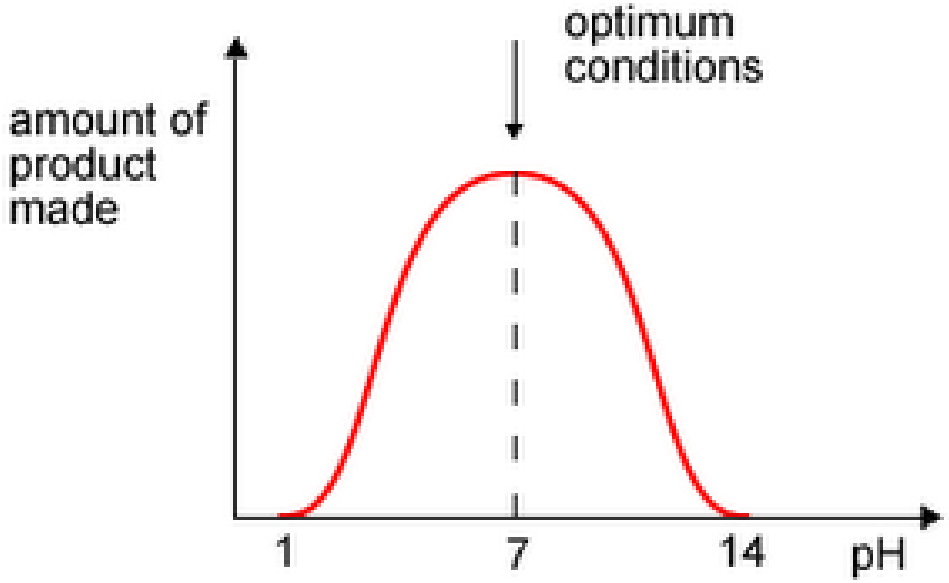



*How enzymes break down food into nutrients*

- How Enzymes Work

# Factors Affecting Enzyme Function

- Increase in temperature = enzyme denatures (breaks bonds) which changes the shape of the enzyme
  - The enzyme can no longer bind to substrates
- Change in pH = enzyme denatures
- Increase enzyme or substrate concentration = rate (speed) of reactions increases
  - More people working to clean up, means the clean up happens faster
- Addition of inhibitors (molecules that cause the substrate not to bind to the enzyme = decreases the rate of the reaction


optimum
conditions
amount of
product
made
1
7
14
pH

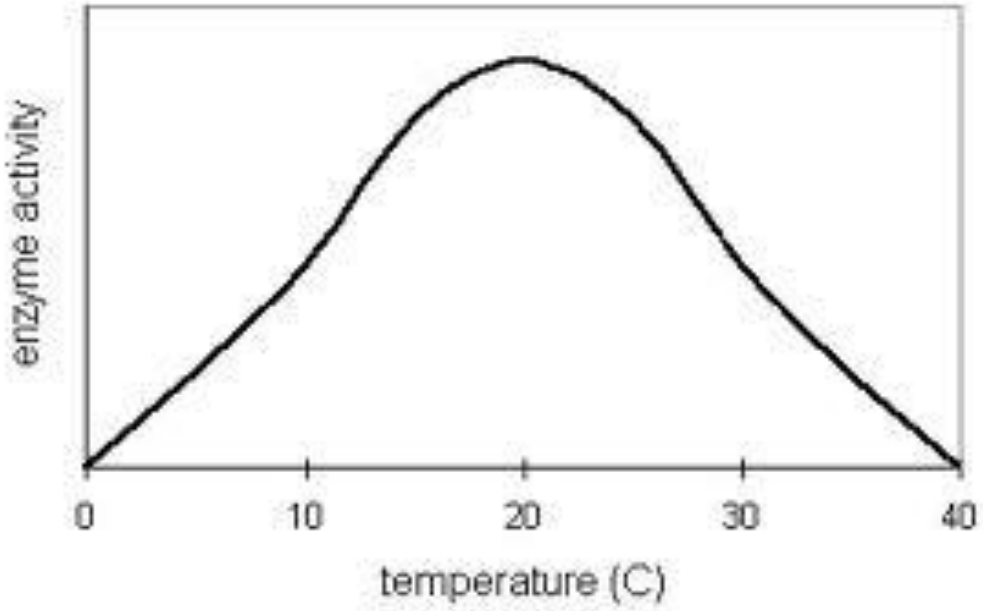

enzyme activity
0
10
20
30
40
temperature (C)

Figure 6.14 Enzyme inhibition


(a) Substrate can normally bind to active site of enzyme.

(b) Competitive inhibitor mimics substrate and competes for active site.

(c) Noncompetitive inhibitor alters conformation of enzyme so active site is no longer fully functional.