

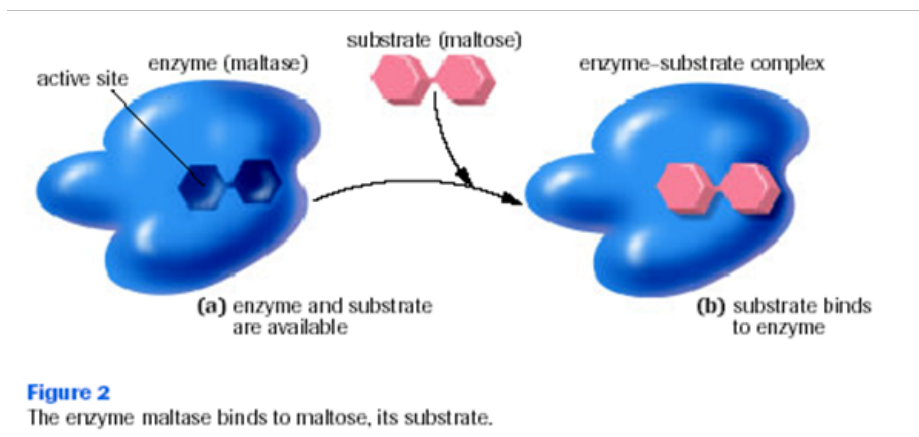
Nutrients, Enzymes and Digestion Lesson 2: Enzymes

Curricular Connection : *students will explain enzyme action and factors influencing their action (i.e., temperature, pH, substrate concentration, feedback inhibition, competitive inhibition)*

Enzymes

- Chemical reactions must proceed at relatively low temperatures within cells.
- **Catalysts** are chemicals that speed up chemical reactions at low temperatures without altering the products formed by the reaction.
- In living things **protein** catalysts called **enzymes** are used to speed up reactions
- The molecules on which the enzyme works are called the **substrates**.
- The **active site** of the enzyme is the area that joins with the substrate molecules.
- Each enzyme has a specially shaped active site that provides a “dock” for specific substrate molecules.

- This is called the ‘lock and key’ model



- Enzymes are identified by the suffix *-ase*, which is added to the name of the substrate that the enzyme combines with.

- sucrase breaks down sucrose into fructose and glucose

Animations of How Enzymes Work

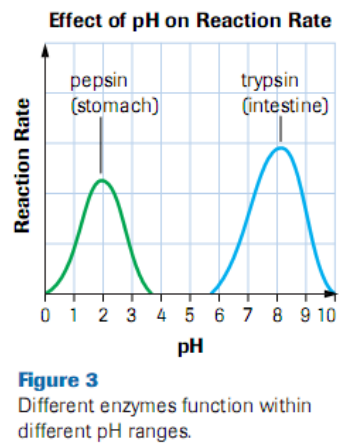
http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter2/animation_how_enzymes_work.html

http://highered.mcgraw-hill.com/sites/0072507470/student_view0/chapter25/animation_enzyme_action_and_the_hydrolysis_of_sucrose.html

Factors Affecting Enzyme Reactions

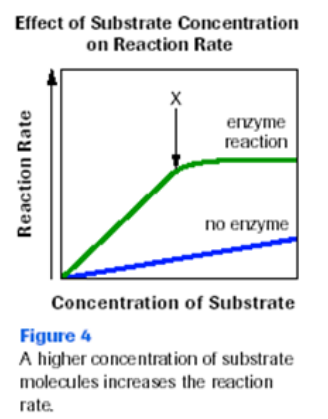
pH

- enzymes function best within certain pH ranges
- The addition of positively charged H^+ ions, characteristic of an acidic solution, or the introduction of negatively charged OH^- ions, characteristic of a basic solution, will affect the hydrogen bonds.
- the three-dimensional shape of an enzyme is altered by a change in pH



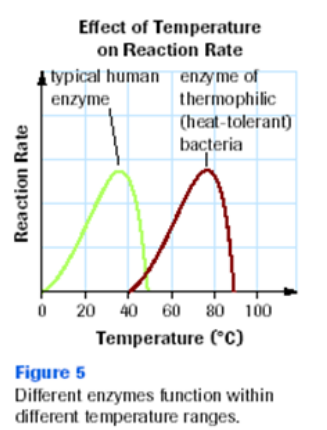
Substrate Molecule Concentration

- In chemical reactions, the greater the number of molecules reacting, the greater the number of reactions
- Reaction rate shown in **Figure 4** begins to level off at point X because there is a limit to the amount of enzyme available.
- Substrate molecules cannot join with the active site of an enzyme until it is free.



Temperature

- reaction rates increase as the temperature increases because as energy is added, the molecules begin to move faster.
- At high temperatures, enzymes **denature** and are no longer effective
- What is the advantage of being a homeotherm (an animal that maintains a constant body temperature)??



Competitive Inhibition

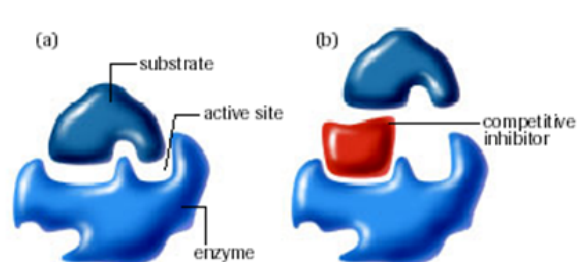
- **Inhibitor** molecules can affect enzyme reactions
- Competitive inhibitors have a **shape** similar to that of the **substrate**
- As long as the inhibitors remain joined to the enzyme, the substrate cannot bind, and the enzyme cannot function properly

<http://bcs.whfreeman.com/thelifewire/content/chp06/0602001.html>



Figure 6

- (a) The substrate normally binds to the active site.
- (b) A competitive inhibitor competes with the substrate for the active site.

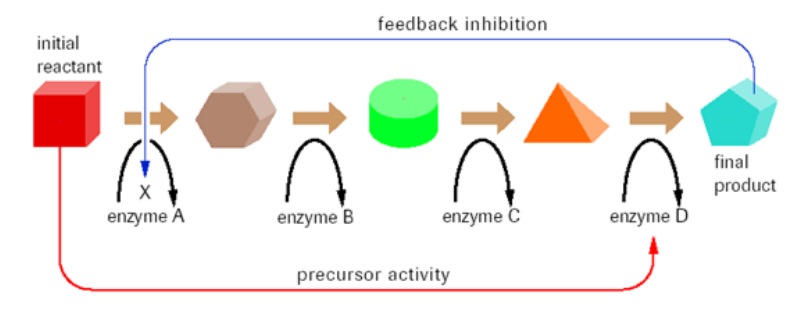


Metabolic Pathways and Enzyme Regulation

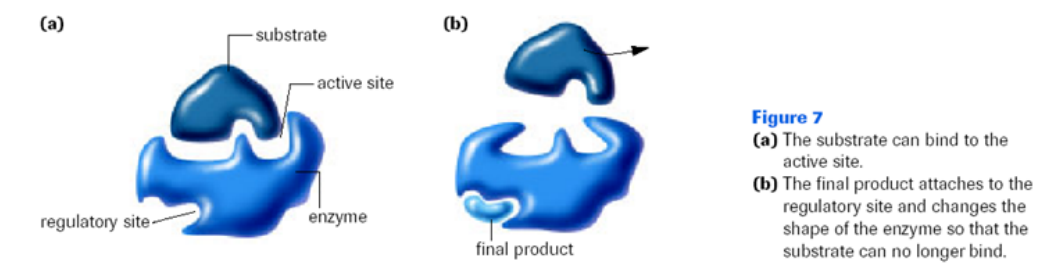
- Metabolic pathways are orderly sequences of chemical reactions, with enzymes regulating each step of the reaction.
- When the product from a series of chemical reactions begins to accumulate within a cell, it interferes with one of the enzymes

- This is known as **feedback inhibition**

http://highered.mcgraw-hill.com/sites/0072943696/student_view0/chapter2/animation_feedback_inhibition_of_biochemical_pathways.html



- The final product of the metabolic pathway interferes with the enzyme by combining with its **regulatory site** (on/off switch)



- This works the opposite way as well, when there is little of the final product, the final product leaves the regulatory site and the enzyme is 'turned back on'