Enzymes:

- **Outcome:** I can describe how the structure of an enzyme correlates to its function(s)

- **Drill:**

  What background knowledge do you have on enzymes?

Enzyme Structure and Function

- Enzymes are **protein catalysts**
- They speed up the rate at which reactions occur
- Lower the activation energy by creating a microenvironment that is energetically more favorable for a reaction

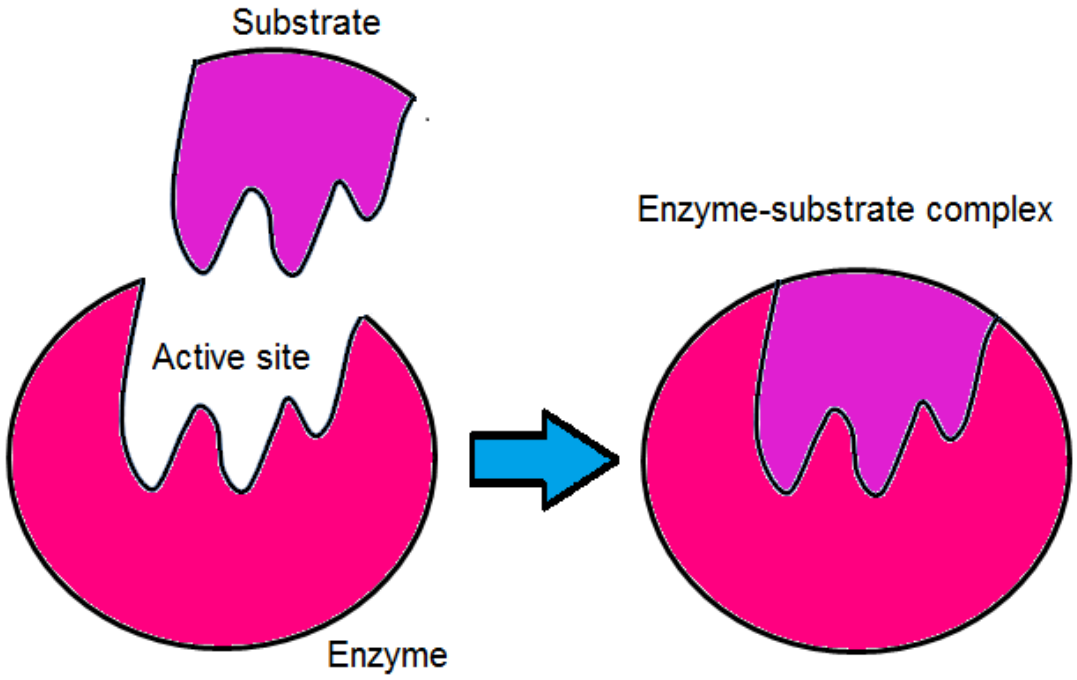
Features of Enzymatic Reactions

1. Enzymes do not make anything happen that could not happen on its own
   – they just make it happen much faster.
2. Reactions do not destroy or use up enzyme molecules.
3. Each type of enzyme recognizes and binds to only certain substrates.

   - '**substrate specificity**"

Enzyme-catalyzed Reactions

- Reactants in an enzyme-catalyzed reaction known as **substrates.** They bind to the enzyme



Enzyme-catalyzed Reactions

- Substrates bind to the enzyme's **active site**

  – interactions between the enzyme and the substrate stabilize the transition state

  – decrease the activation energy.

Active Site

- Pocket or crevice
- Site where substrates are bound
- Site of reaction catalysis
- Only substrates of specific size, shape, solubility, and charge can bind
- Basis of enzyme specificity

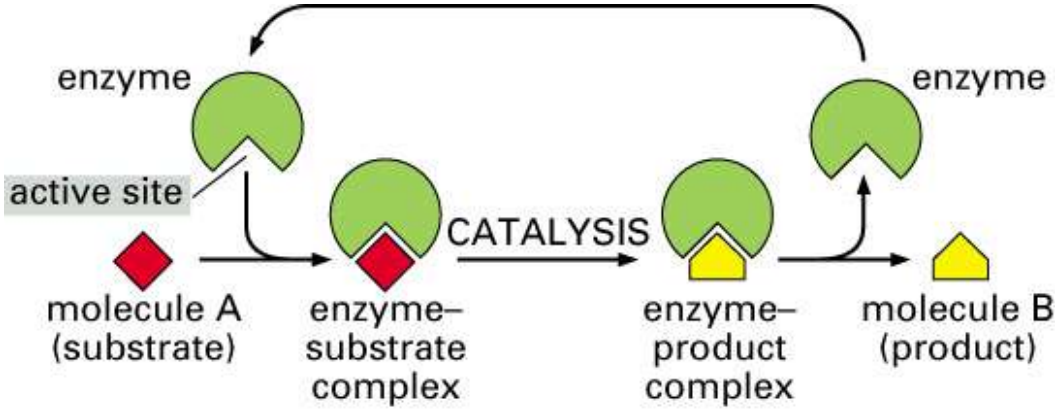
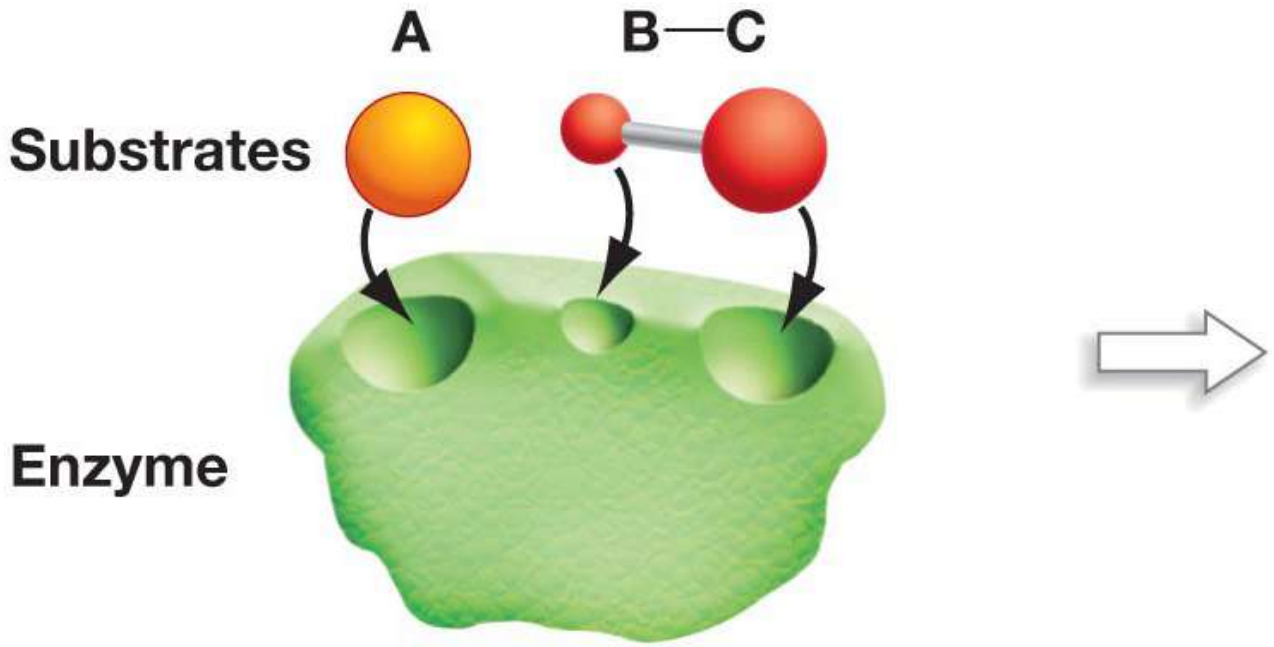


Figure 2–47. Molecular Biology of the Cell, 4th Edition.

PROCESS: A MODEL OF ENZYME ACTION

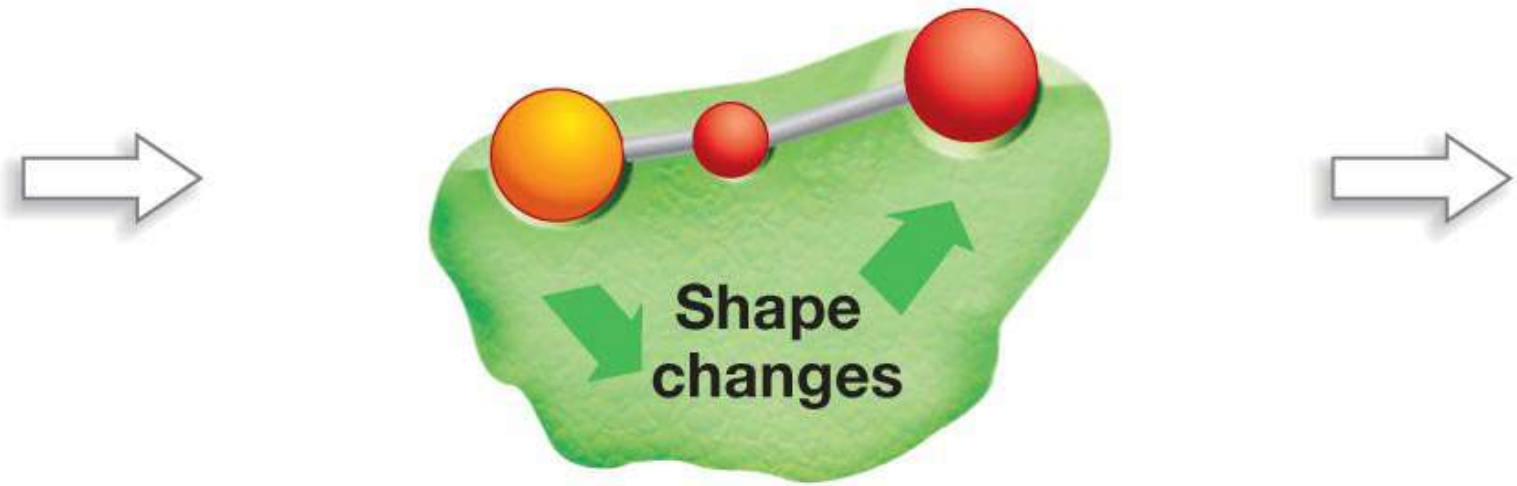


1. Initiation: Reactants bind to the active site in a specific orientation, forming an enzyme-substrate complex.

PROCESS: A MODEL OF ENZYME ACTION

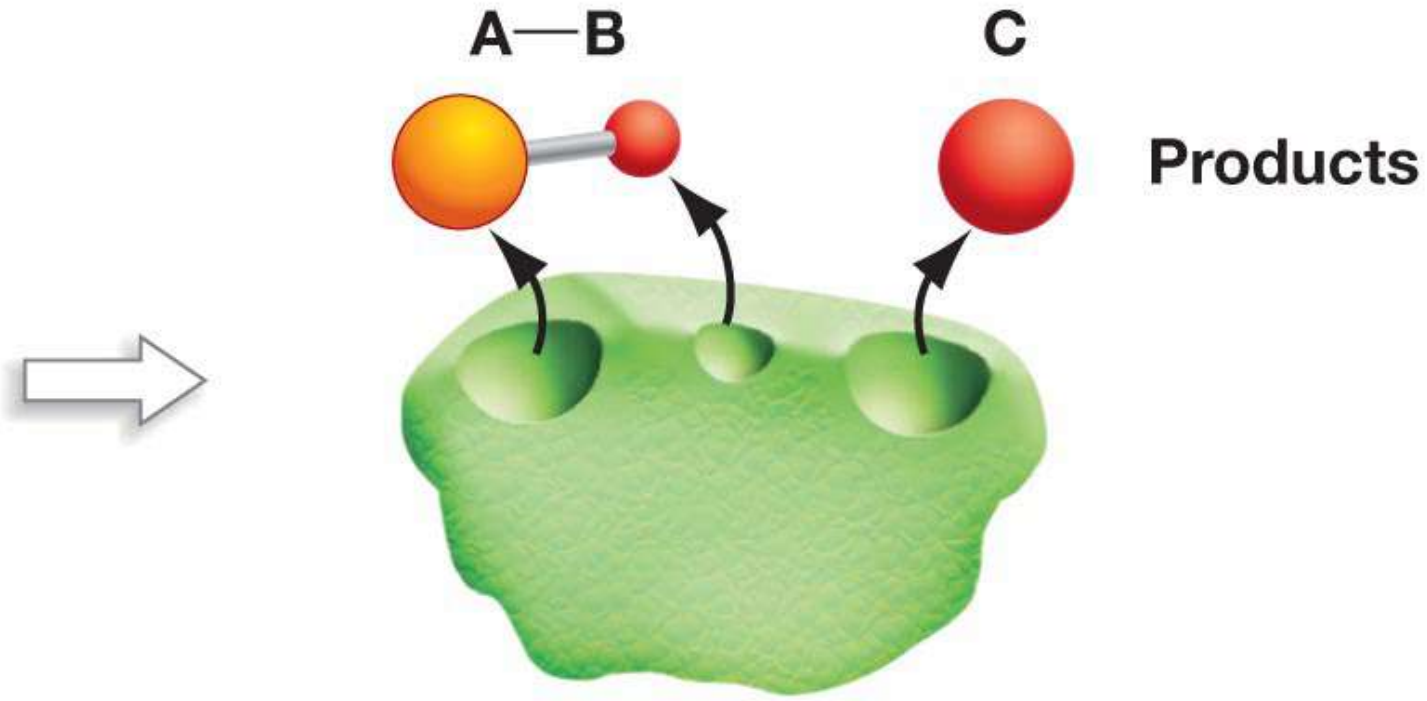
A- - - -B- - - -C

Transition state



2. Transition state facilitation: Interactions between enzyme and substrate lower the activation energy required.

PROCESS: A MODEL OF ENZYME ACTION



3. Termination: Products have lower affinity for active site and are released. Enzyme is unchanged after the reaction.

Do Enzymes Act Alone?

- Some enzymes require **cofactors** to function normally.

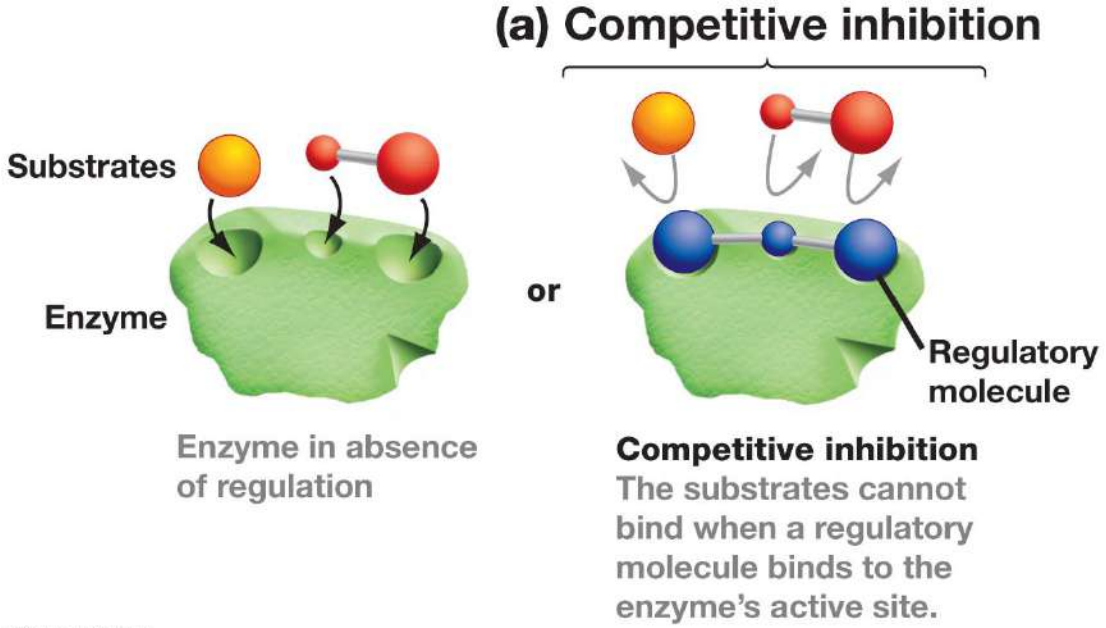
  -these are either metal ions or small organic molecules called **coenzymes**.

- The cofactors usually are in the active site and are involved in transition state stabilization.

Regulation of Enzyme Action

Enzyme activity can be regulated by molecules which are not part of the enzyme

- **Competitive inhibition**: molecule similar in size and shape to substrate binds to active site.
  - "competes" with substrate for active site



Allosteric Regulation

•Allosteric regulation either increases or decreases enzyme activity depending on the way in which enzyme shape changes

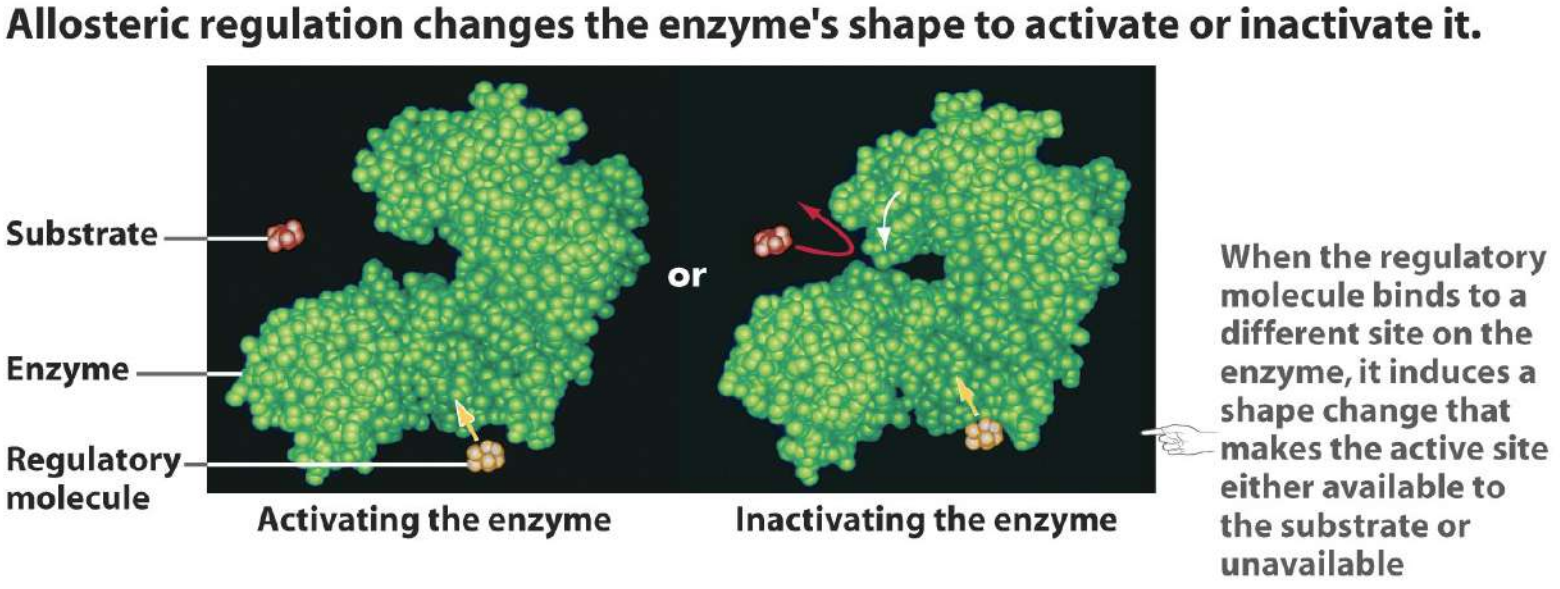
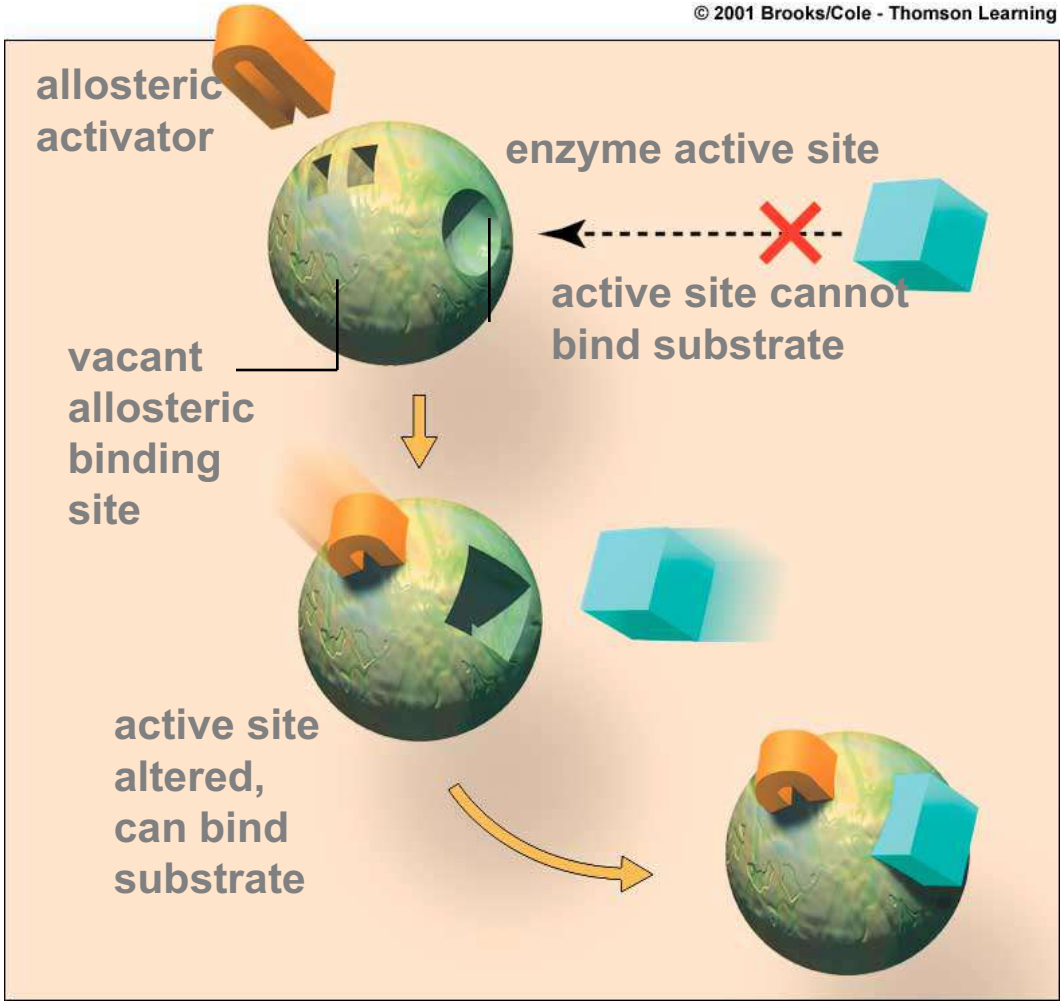
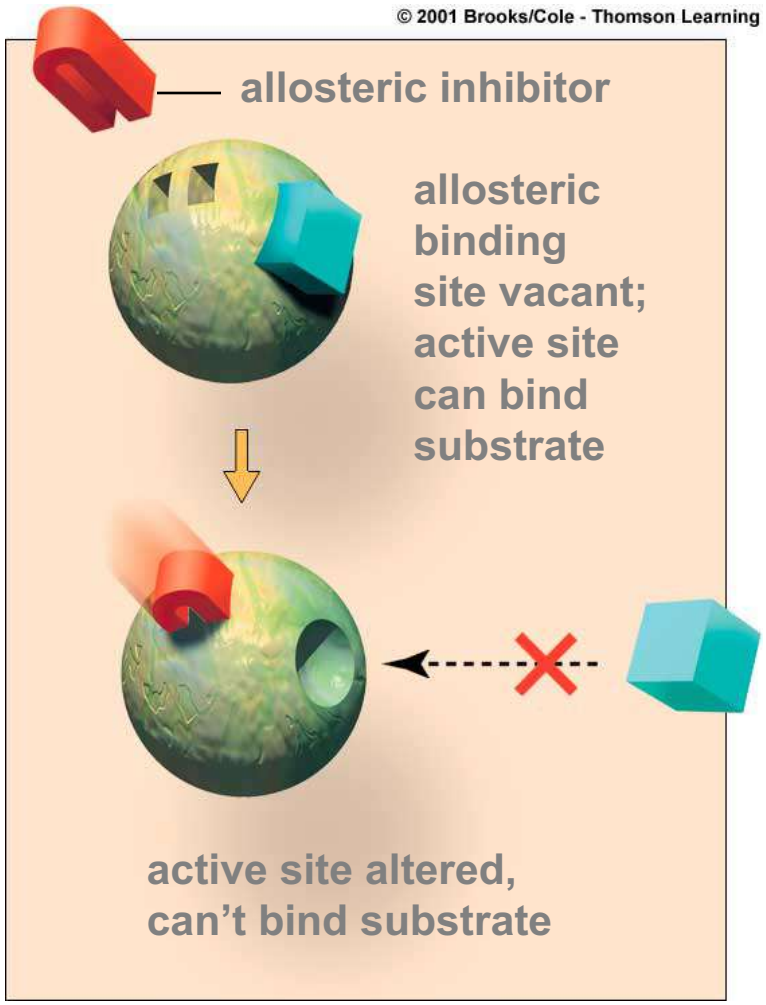


Figure 3-25b Biological Science, 2/e

Allosteric Activation

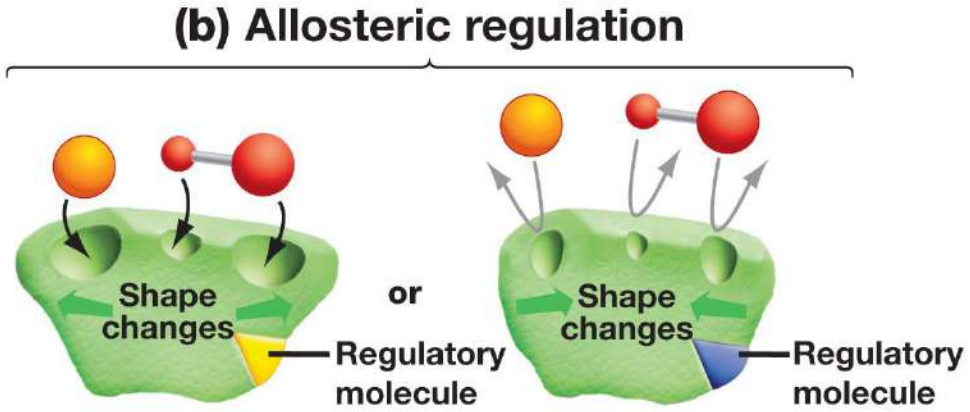


Allosteric Inhibition



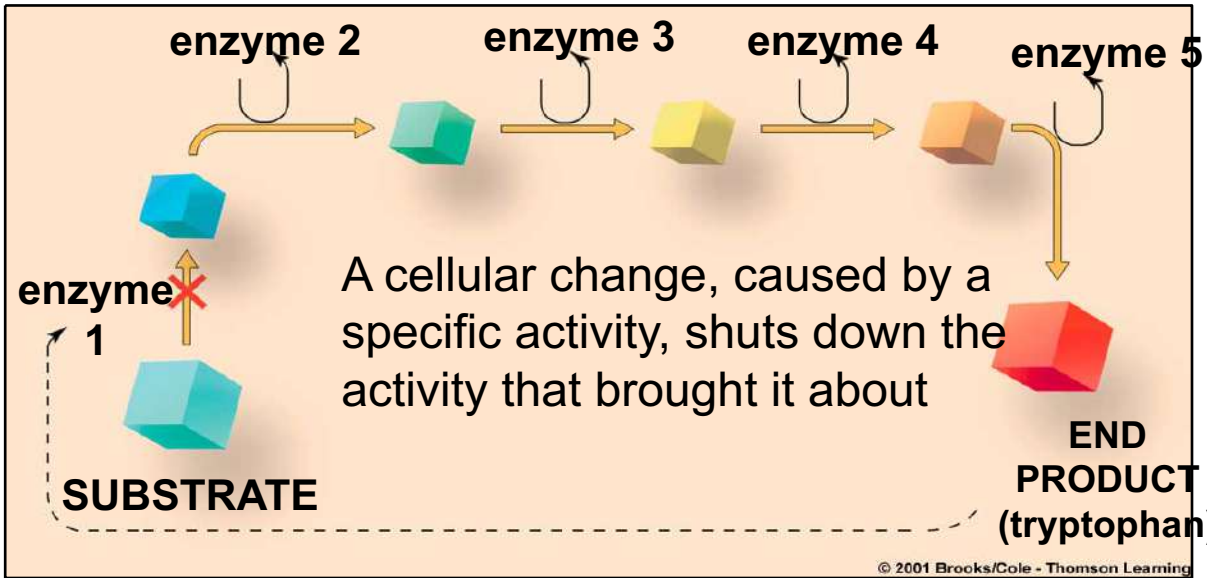
Regulation of Enzyme Action

- **Allosteric inhibition**: regulatory molecule binds at site other than active site (allosteric = different structure)
  - binding changes shape of active site



Feedback Inhibition

- **Feedback inhibition** of enzyme activity occurs in pathways which require multiple enzyme-catalyzed steps
- The end product of the pathway inhibits the first enzyme in the pathway
  - when there is an abundance of product the pathway is shut down



Enzymes:

- **Exit Ticket:**
- What is the difference between competitive inhibition and allosteric inhibition?