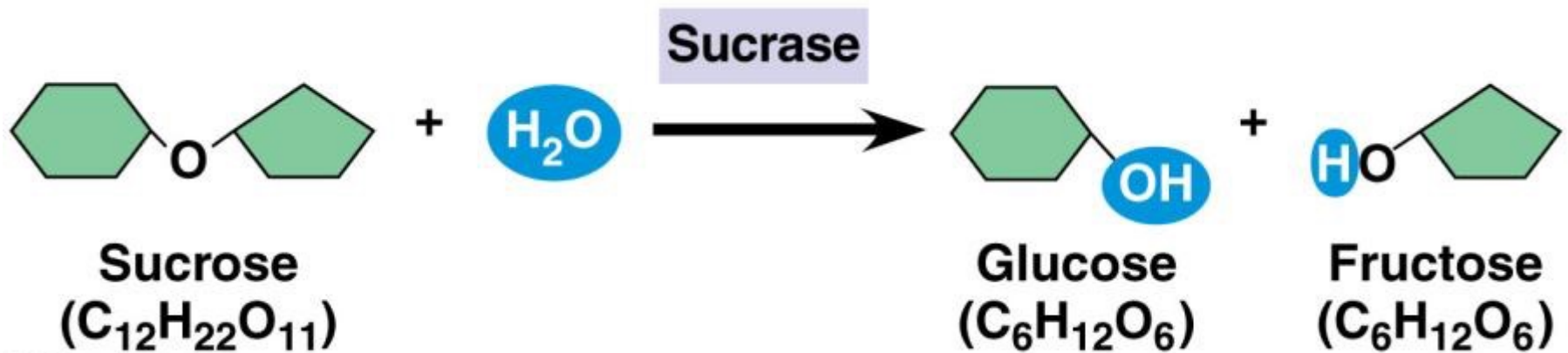


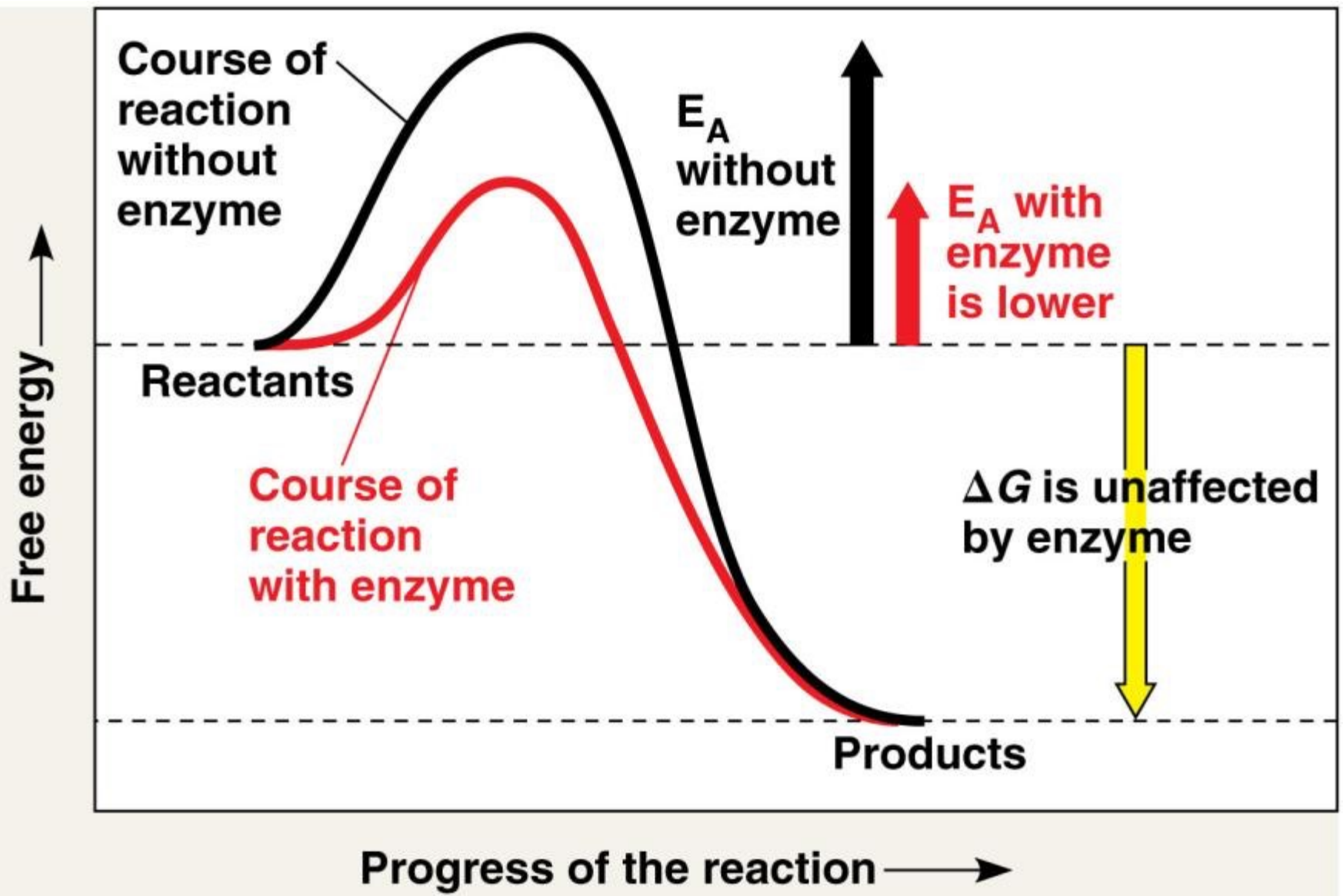
- **Catalyst**: substance that can change the rate of a reaction without being altered in the process
- **Enzyme** = biological catalyst



© 2011 Pearson Education, Inc.

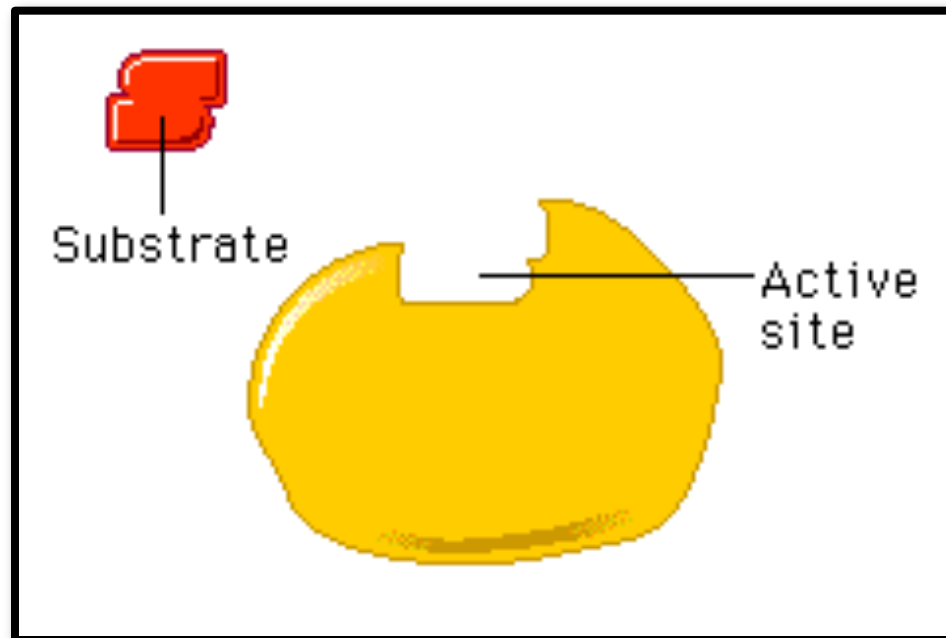
- Speeds up metabolic reactions by lowering the **activation energy** (energy needed to start reaction)



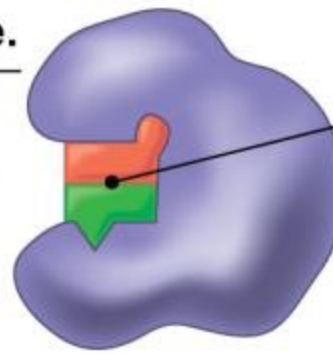


# SUBSTRATE SPECIFICITY OF ENZYMES

- The reactant that an enzyme acts on is called the enzyme's **substrate**
- The enzyme binds to its substrate, forming an **enzyme-substrate complex**
- The **active site** is the region on the enzyme where the substrate binds

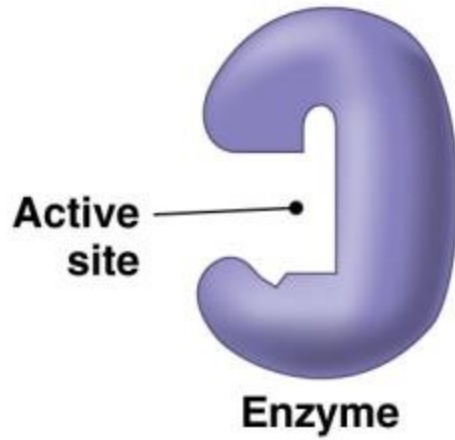


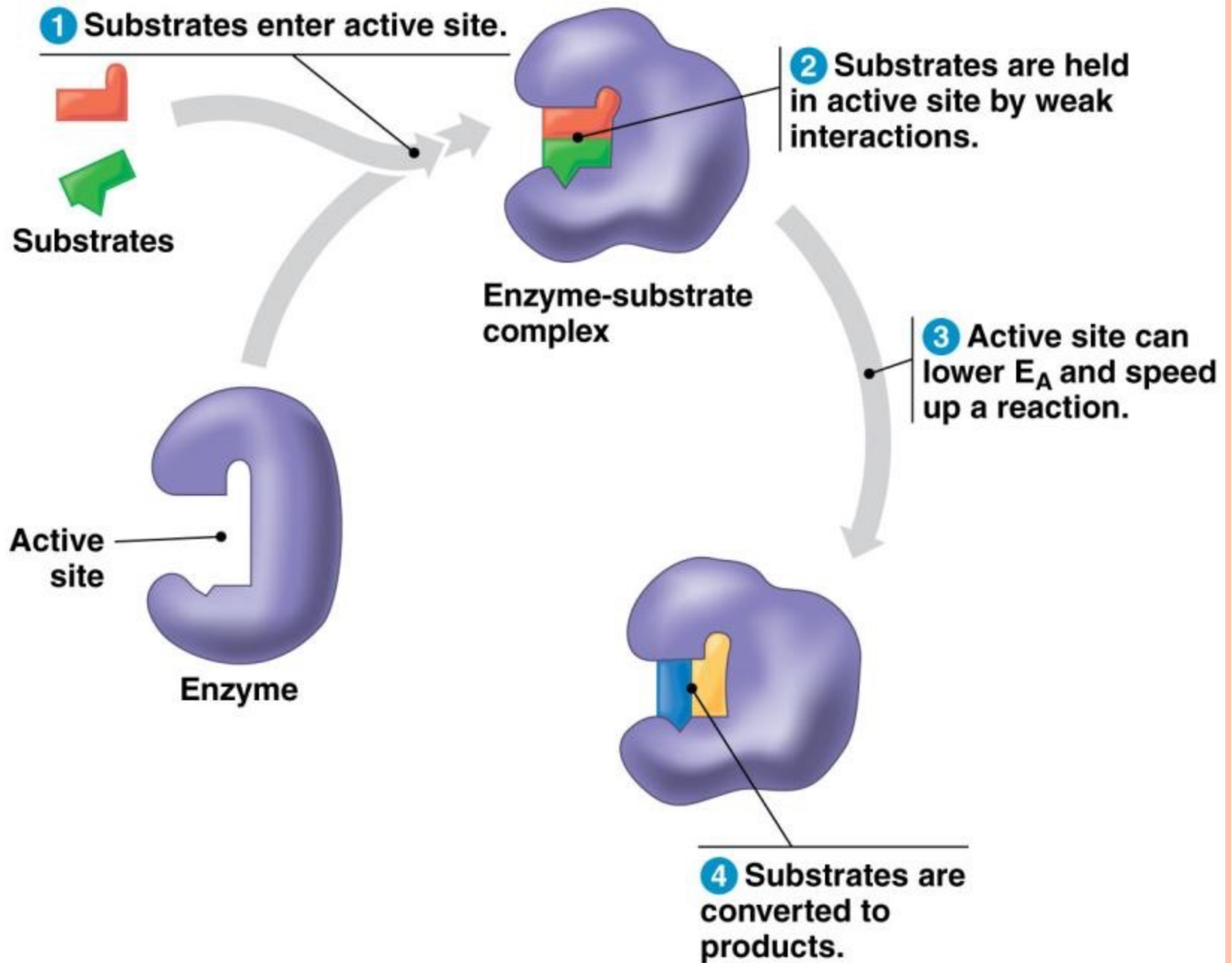
**1** Substrates enter active site.

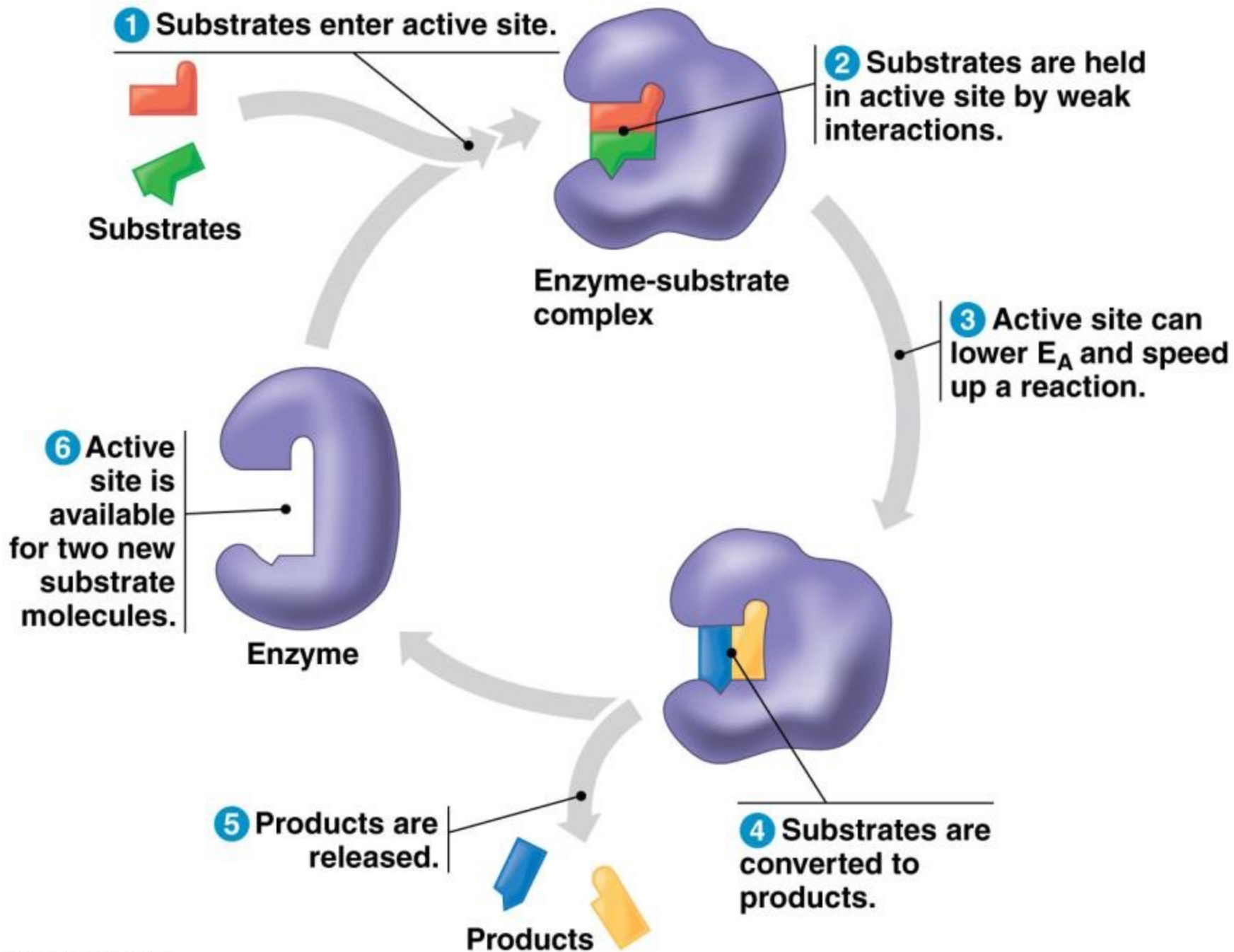


**2** Substrates are held in active site by weak interactions.

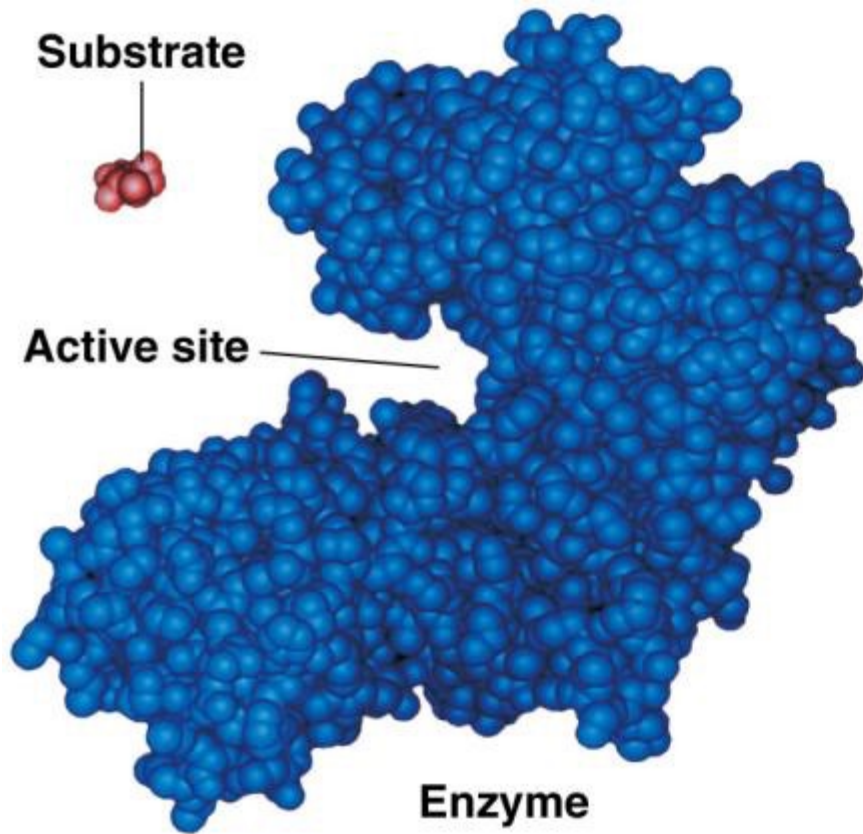
Enzyme-substrate complex



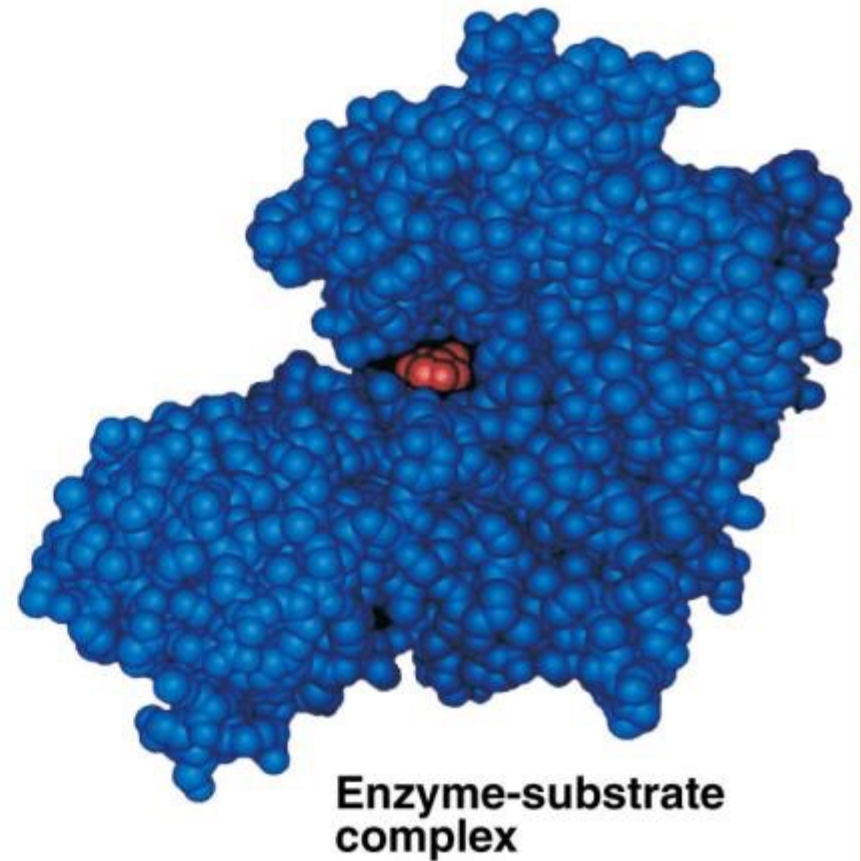




**INDUCED FIT**: ENZYME FITS SNUGLY AROUND  
SUBSTRATE -- “CLASPING HANDSHAKE”



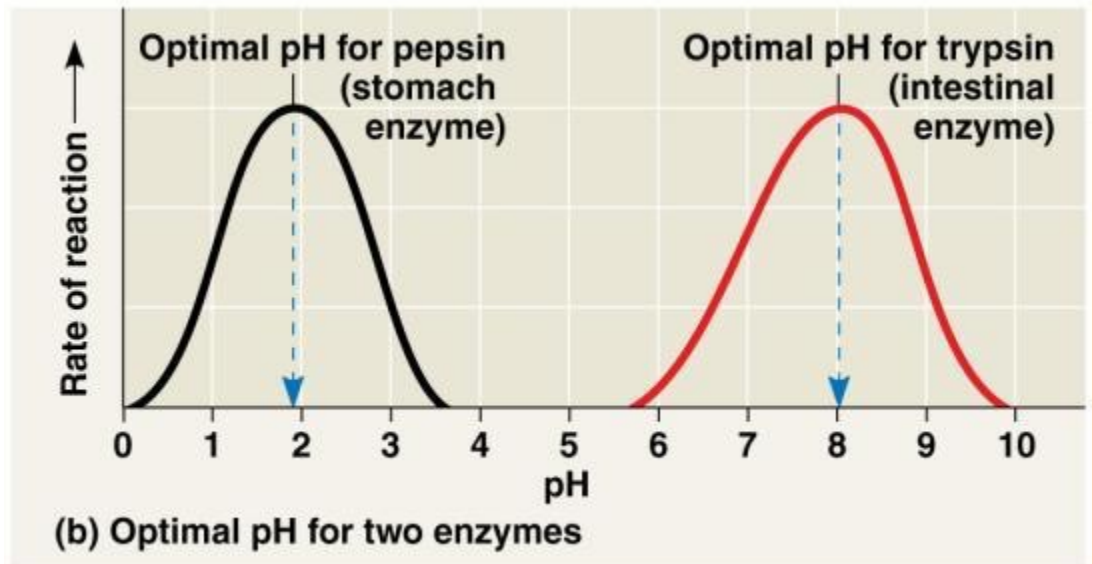
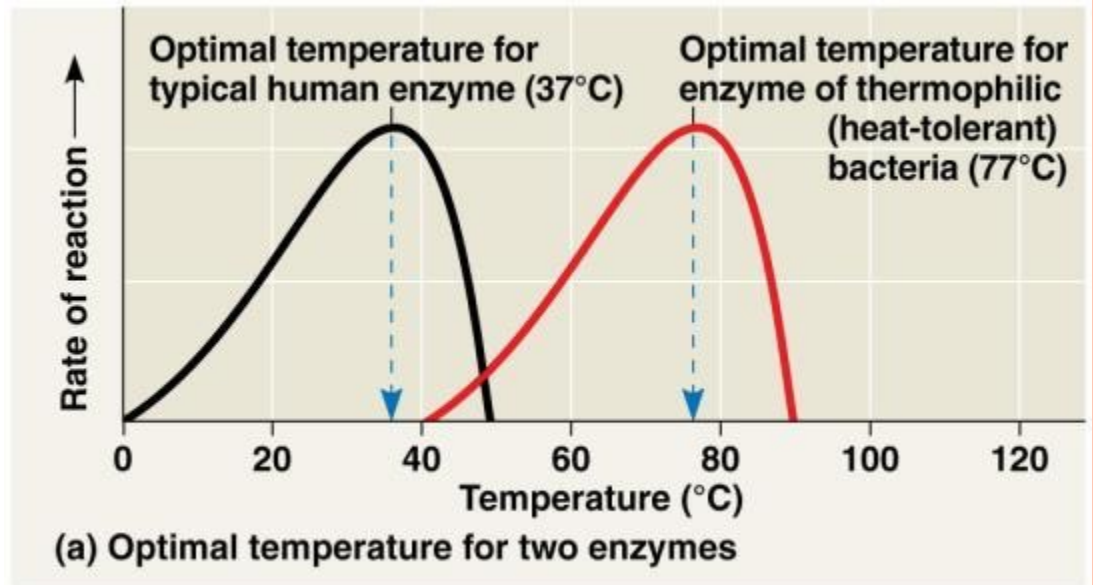
(a)



(b)

An enzyme's activity can be affected by:

- temperature
- pH
- chemicals





# COFACTORS

- Cofactors are **nonprotein enzyme** helpers such as minerals (eg. Zn, Fe, Cu)
- Coenzymes are **organic cofactors** (eg. vitamins)

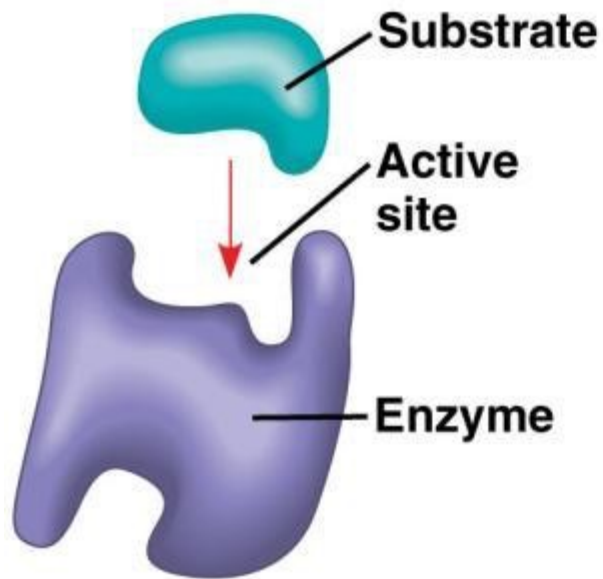
## *Enzyme Inhibitors*

- Competitive inhibitor: binds to the *active site* of an enzyme, competes with substrate
- Noncompetitive inhibitor: binds to *another part* of an enzyme → enzyme changes shape → active site is **nonfunctional**

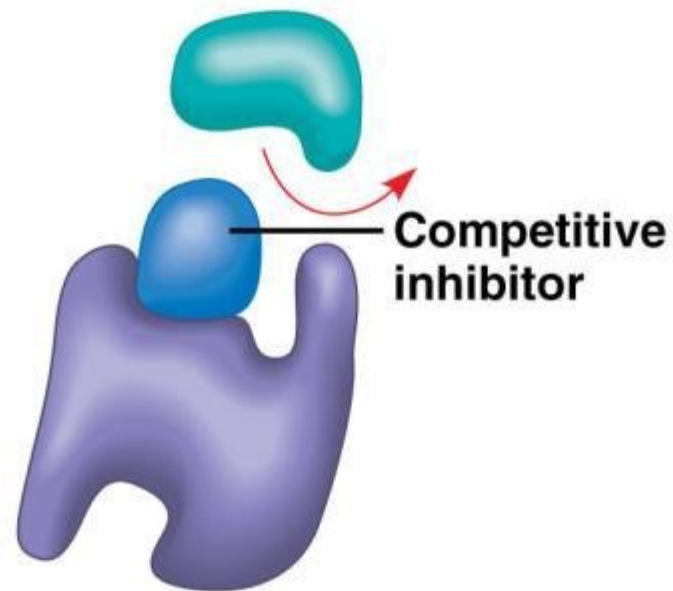


# INHIBITION OF ENZYME ACTIVITY

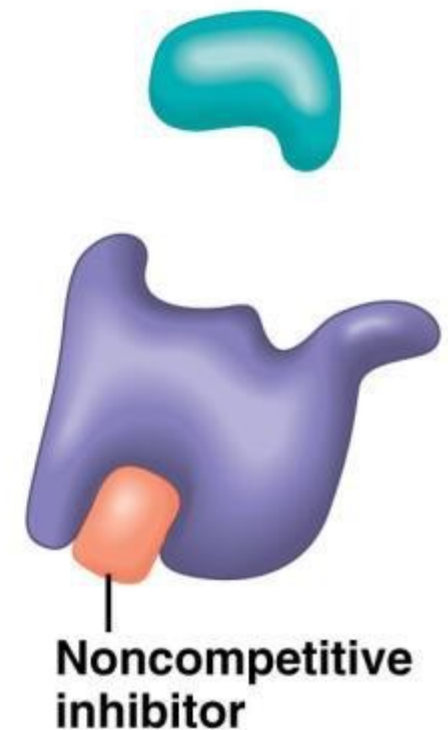
(a) Normal binding




(b) Competitive inhibition



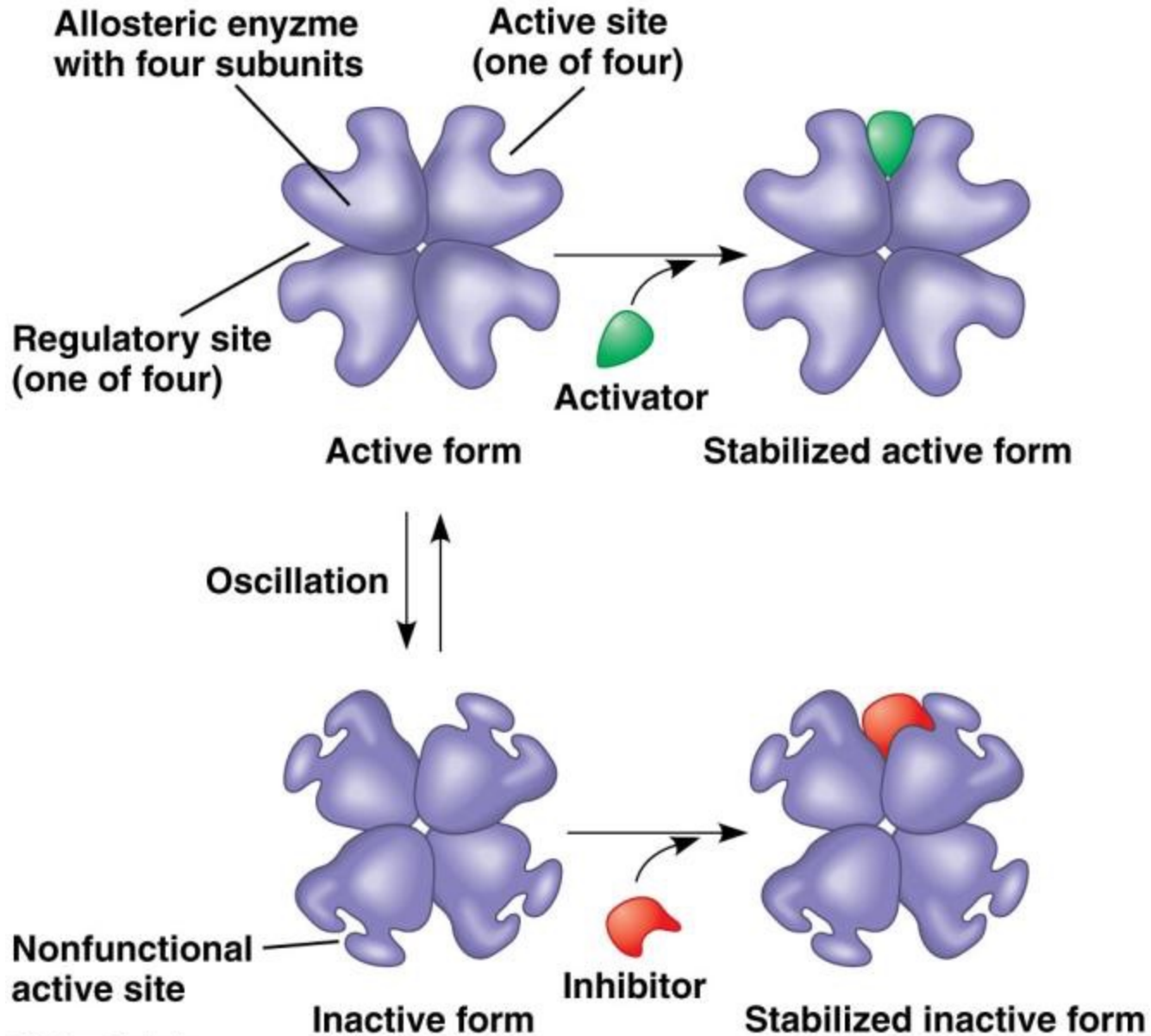
(c) Noncompetitive inhibition



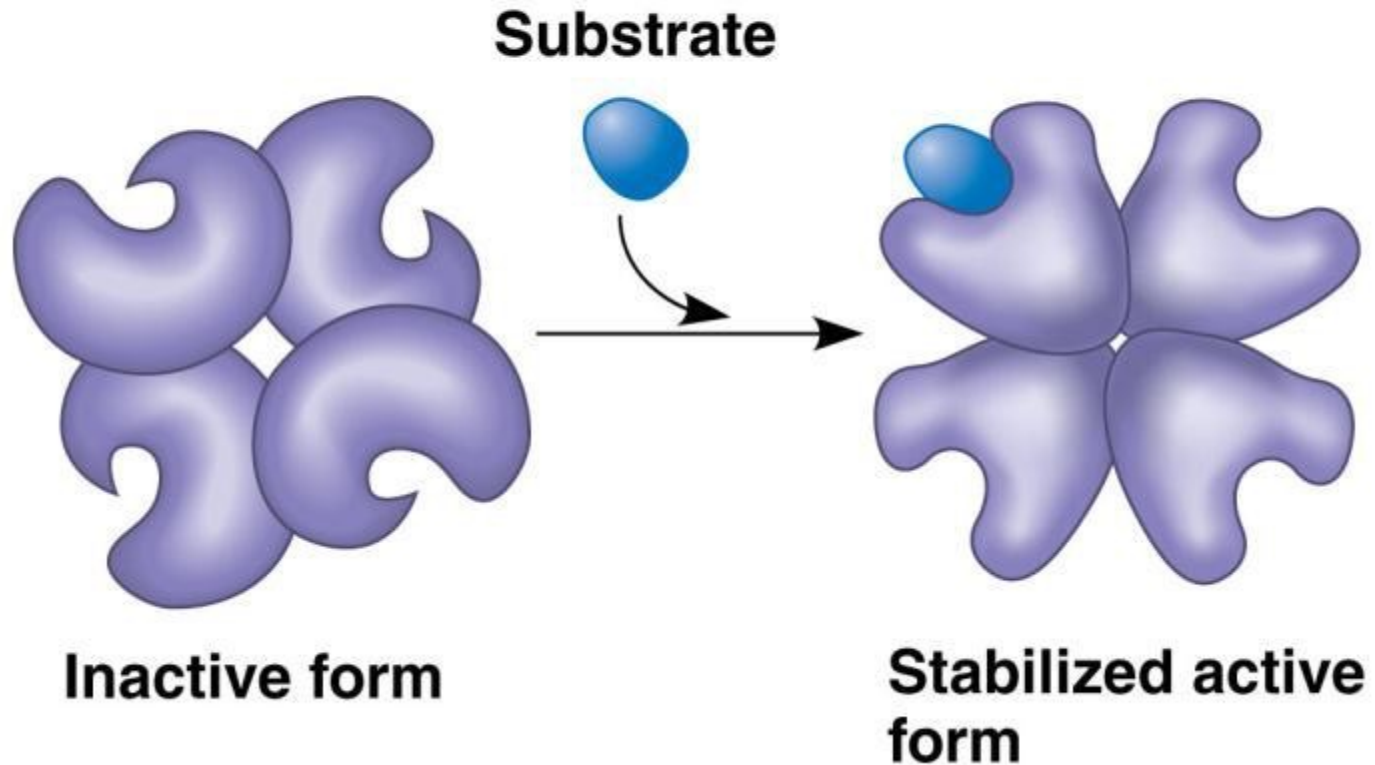
# REGULATION OF ENZYME ACTIVITY

- To regulate metabolic pathways, the cell switches on/off the genes that encode specific enzymes
  - **Allosteric regulation**: protein's function at one site is affected by binding of a **regulatory molecule** to a separate site (allosteric site)
    - **Activator** – stabilizes active site
    - **Inhibitor** – stabilizes inactive form
    - **Cooperativity** – one substrate triggers shape change in other active sites → increase catalytic activity
- 

### (a) Allosteric activators and inhibitors



**(b) Cooperativity: another type of allosteric activation**



# *FEEDBACK INHIBITION*

- End product of a metabolic pathway shuts down pathway by binding to the allosteric site of an enzyme
- Prevent wasting chemical resources, increase efficiency of cell



# FEEDBACK INHIBITION

