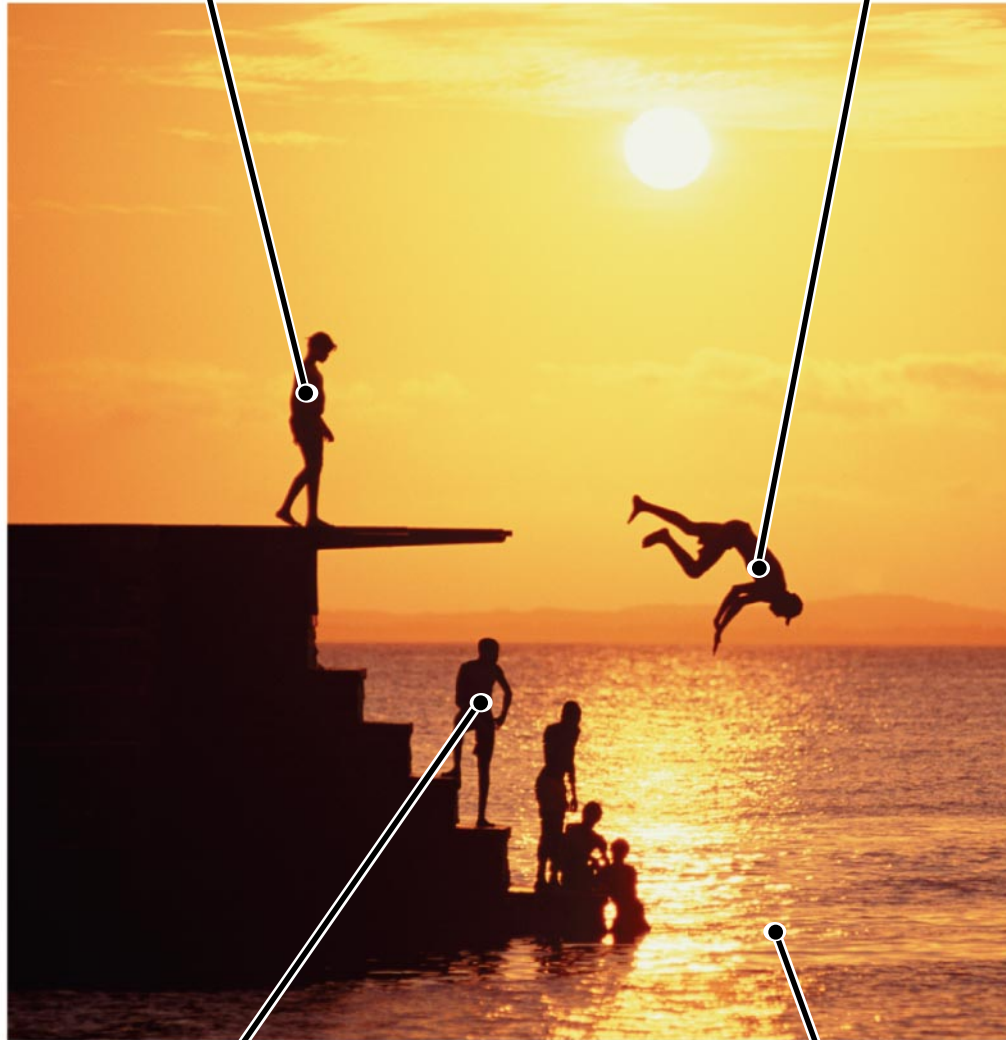


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**A diver has more potential energy on the platform than in the water.**

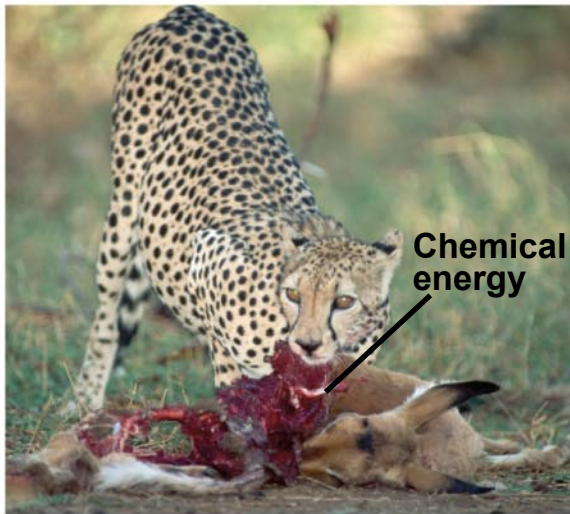
**Diving converts potential energy to kinetic energy.**



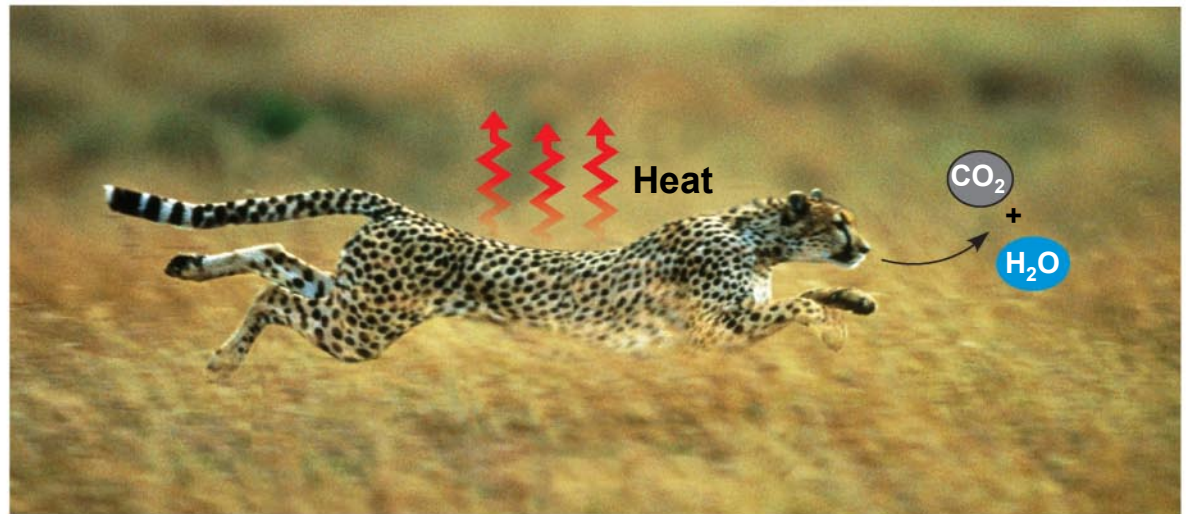
**Climbing up converts the kinetic energy of muscle movement to potential energy.**

**A diver has less potential energy in the water than on the platform.**

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**(a) First law of thermodynamics**



**(b) Second law of thermodynamics**

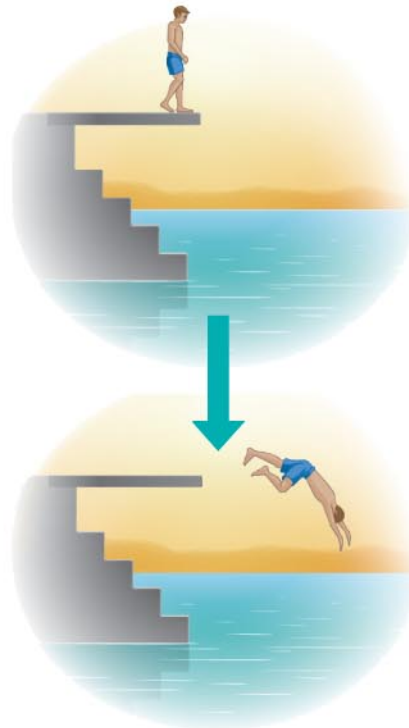
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- More free energy (higher  $G$ )
- Less stable
- Greater work capacity

In a spontaneous change

- The free energy of the system decreases ( $\Delta G < 0$ )
- The system becomes more stable
- The released free energy can be harnessed to do work

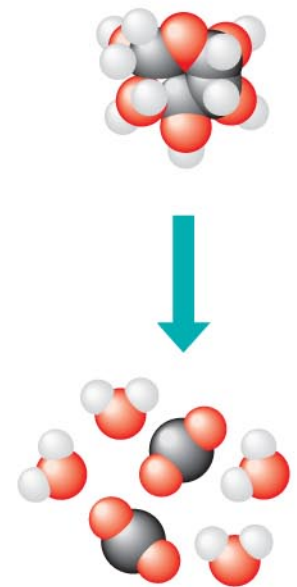
- Less free energy (lower  $G$ )
- More stable
- Less work capacity



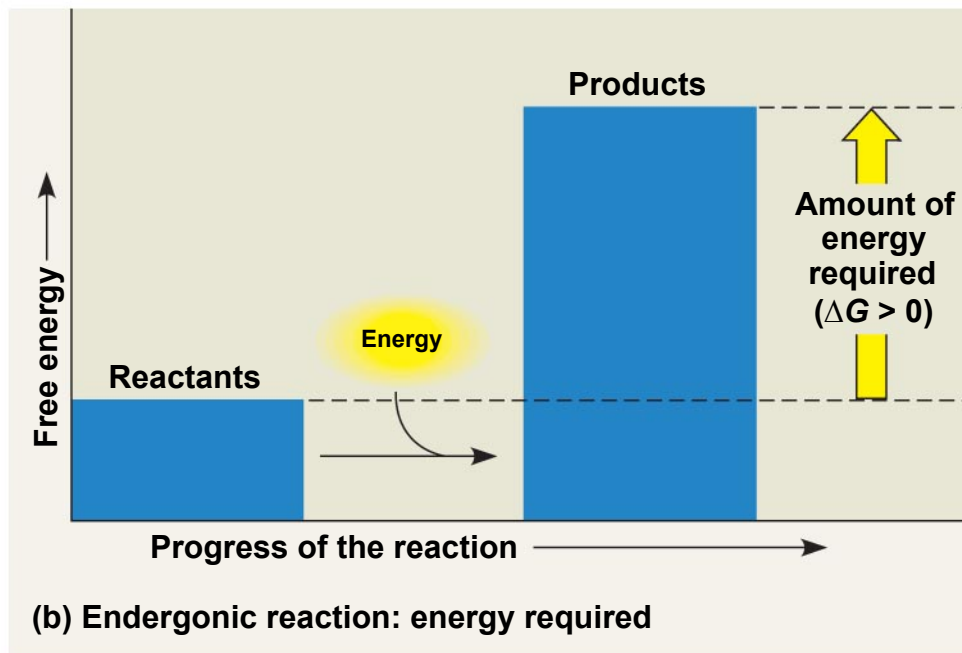
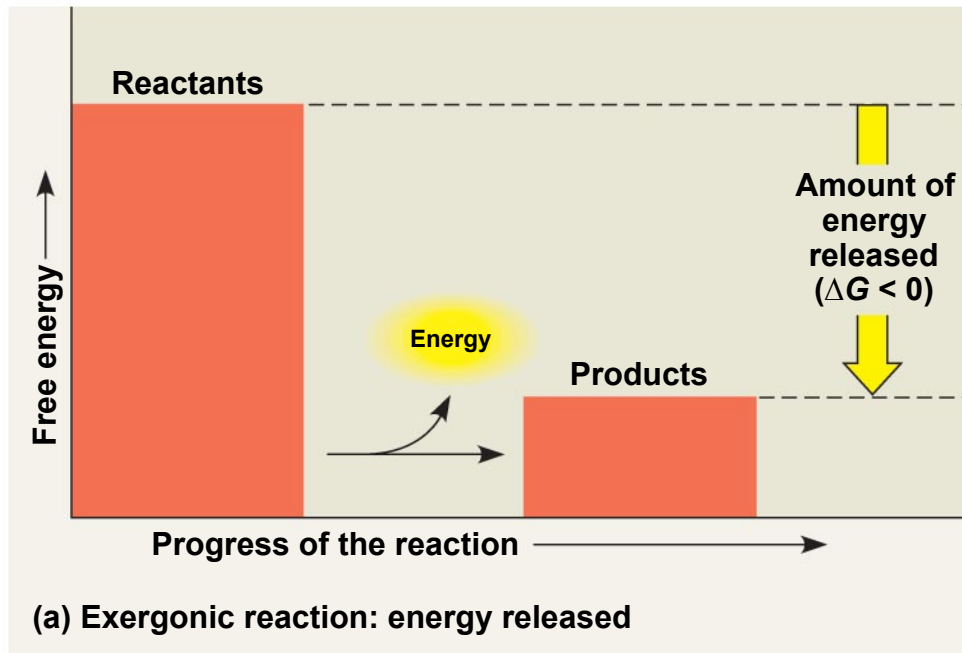
(a) Gravitational motion

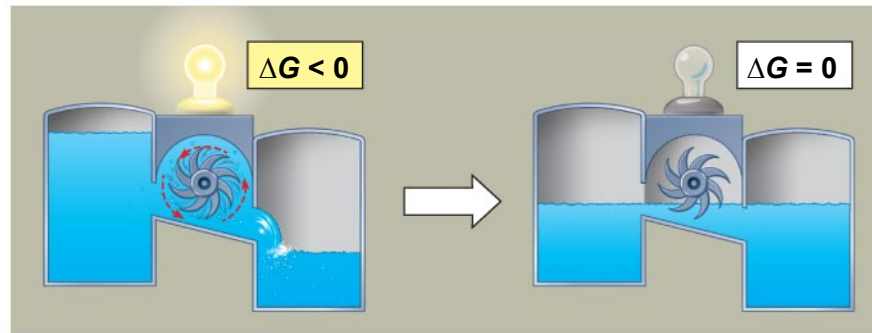


(b) Diffusion

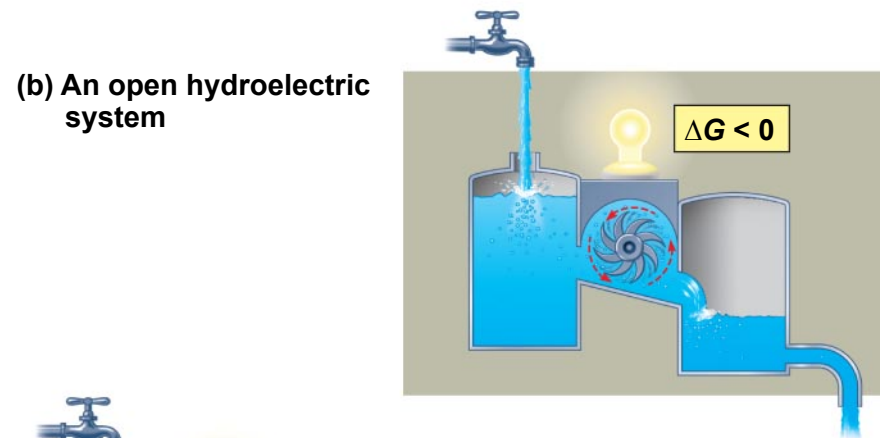


(c) Chemical reaction

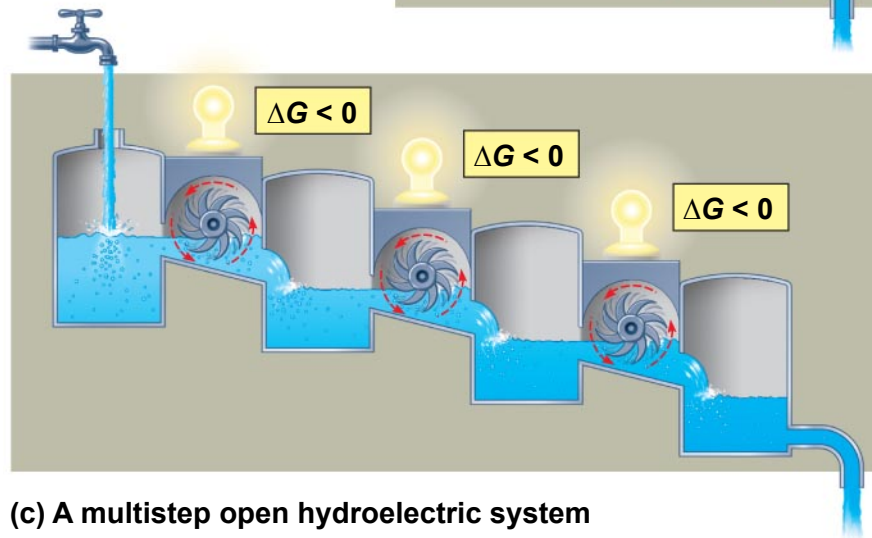




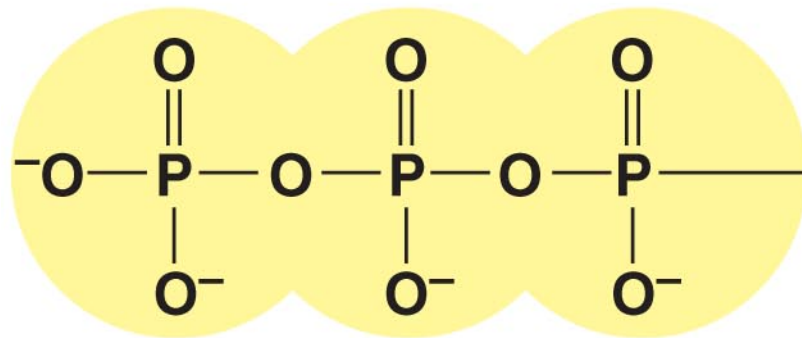
(a) An isolated hydroelectric system



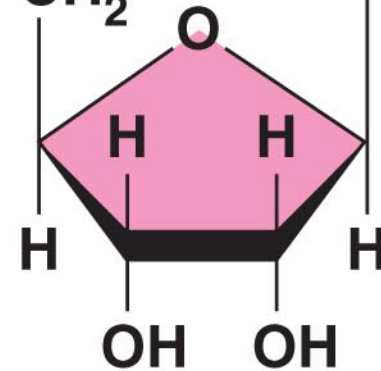
(b) An open hydroelectric system



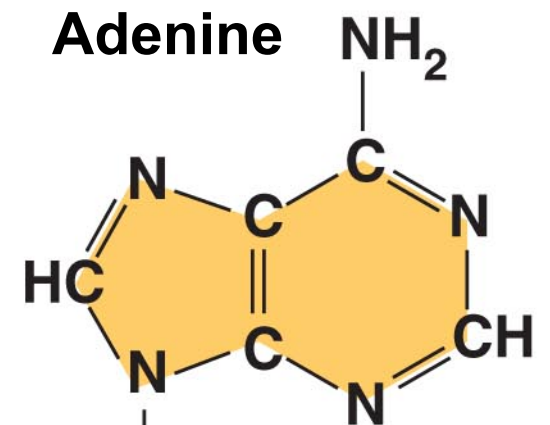
(c) A multistep open hydroelectric system



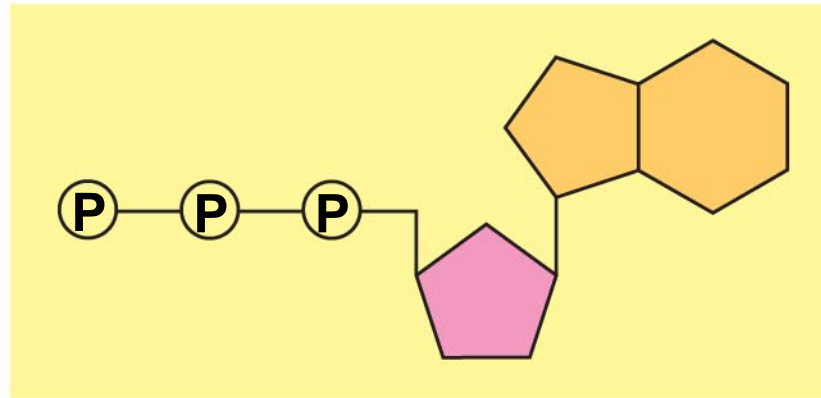
**Phosphate groups**



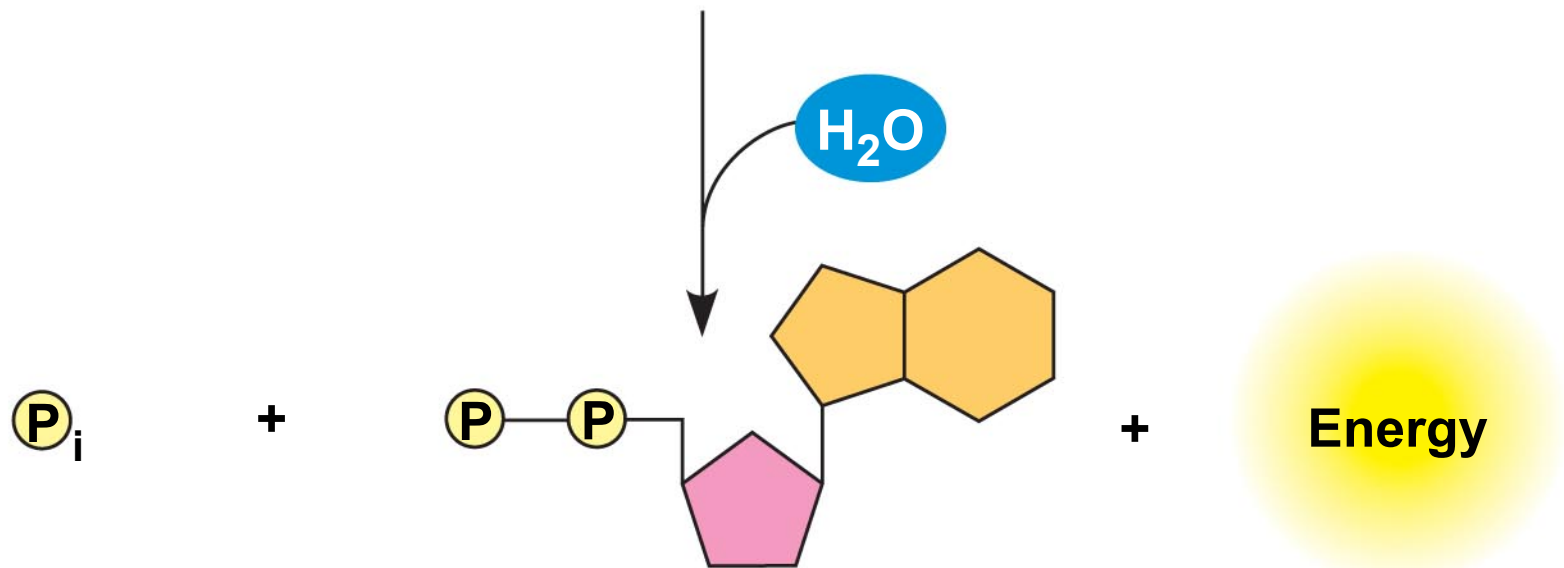
**Ribose**



**Adenine**



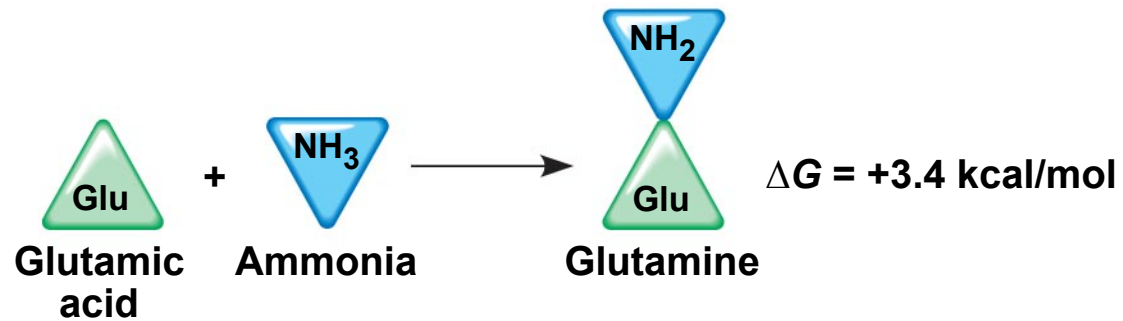
**Adenosine triphosphate (ATP)**



**Inorganic phosphate**

**Adenosine diphosphate (ADP)**

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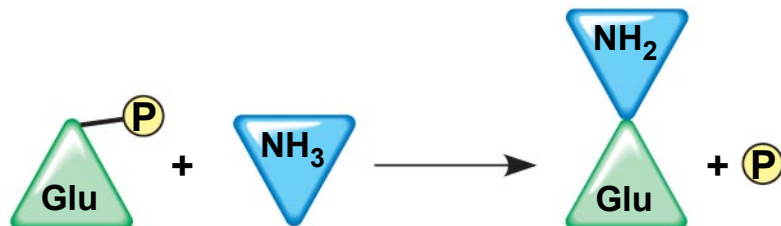


(a) Endergonic reaction

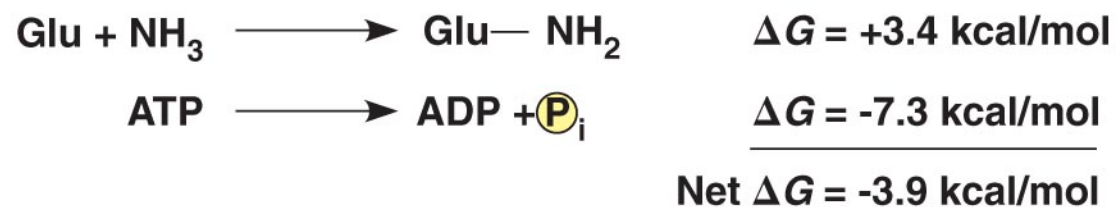
- 1 ATP phosphorylates glutamic acid, making the amino acid less stable.



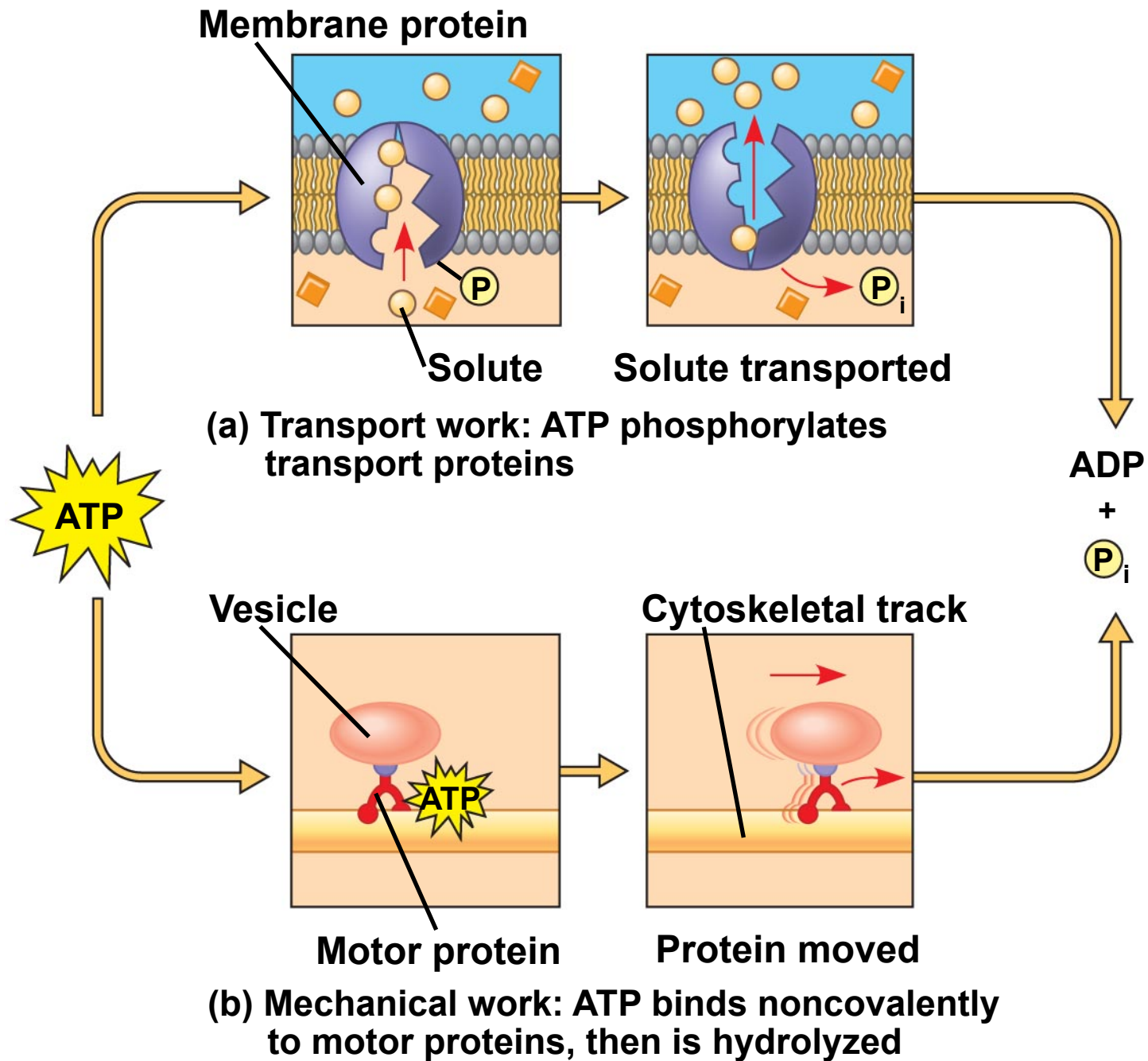
- 2 Ammonia displaces the phosphate group, forming glutamine.

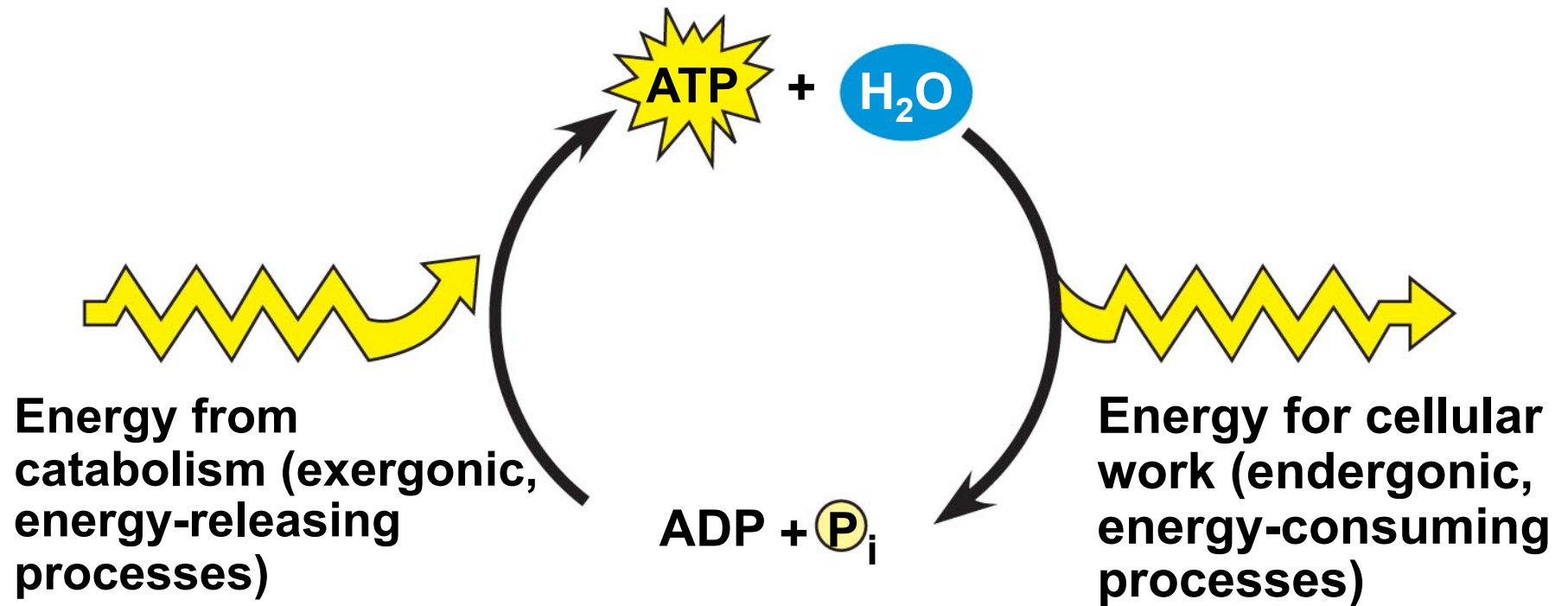


(b) Coupled with ATP hydrolysis, an exergonic reaction

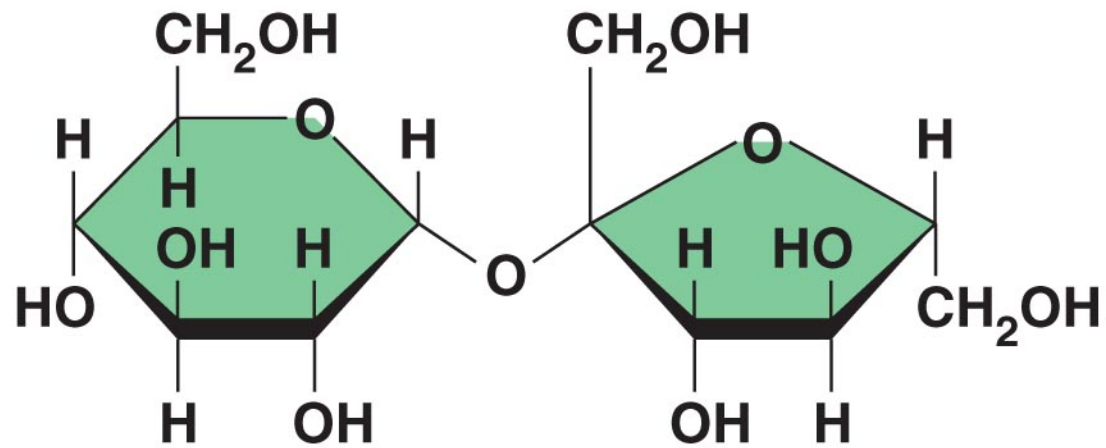


(c) Overall free-energy change

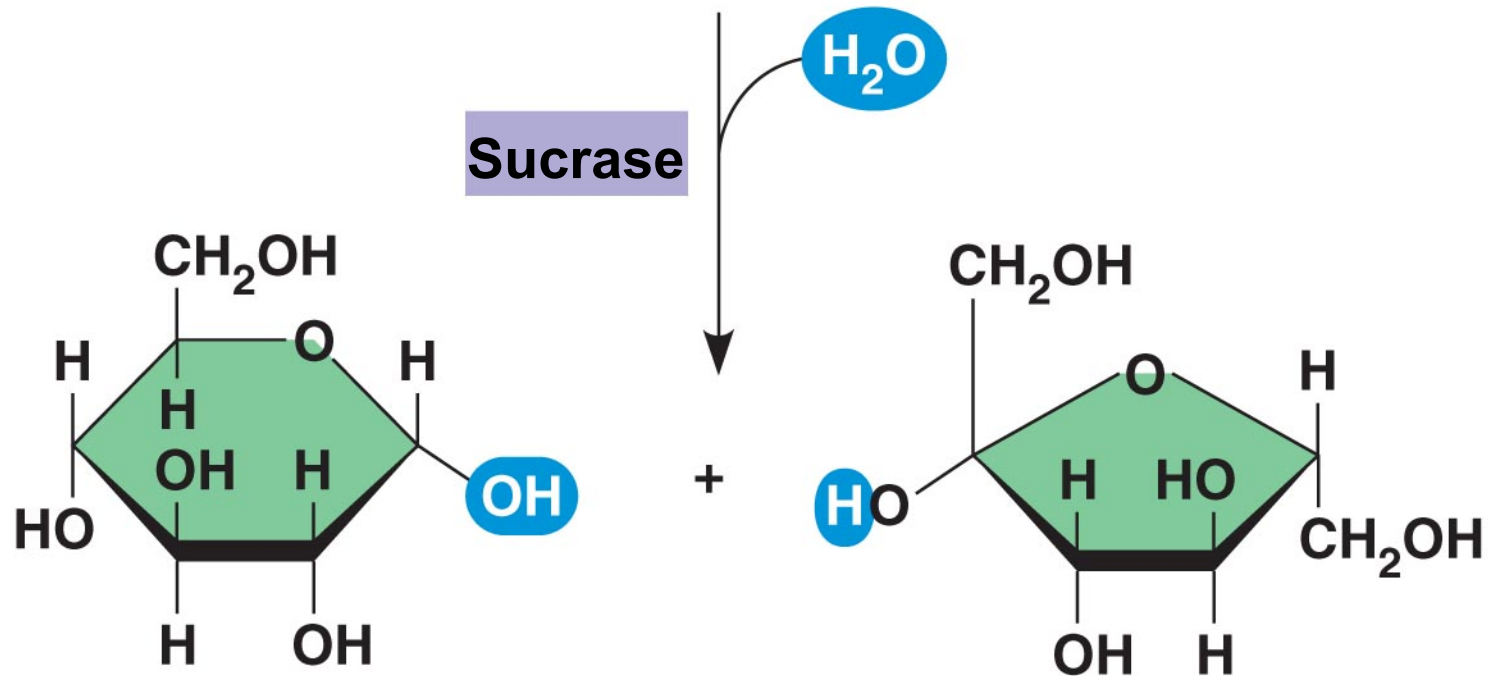




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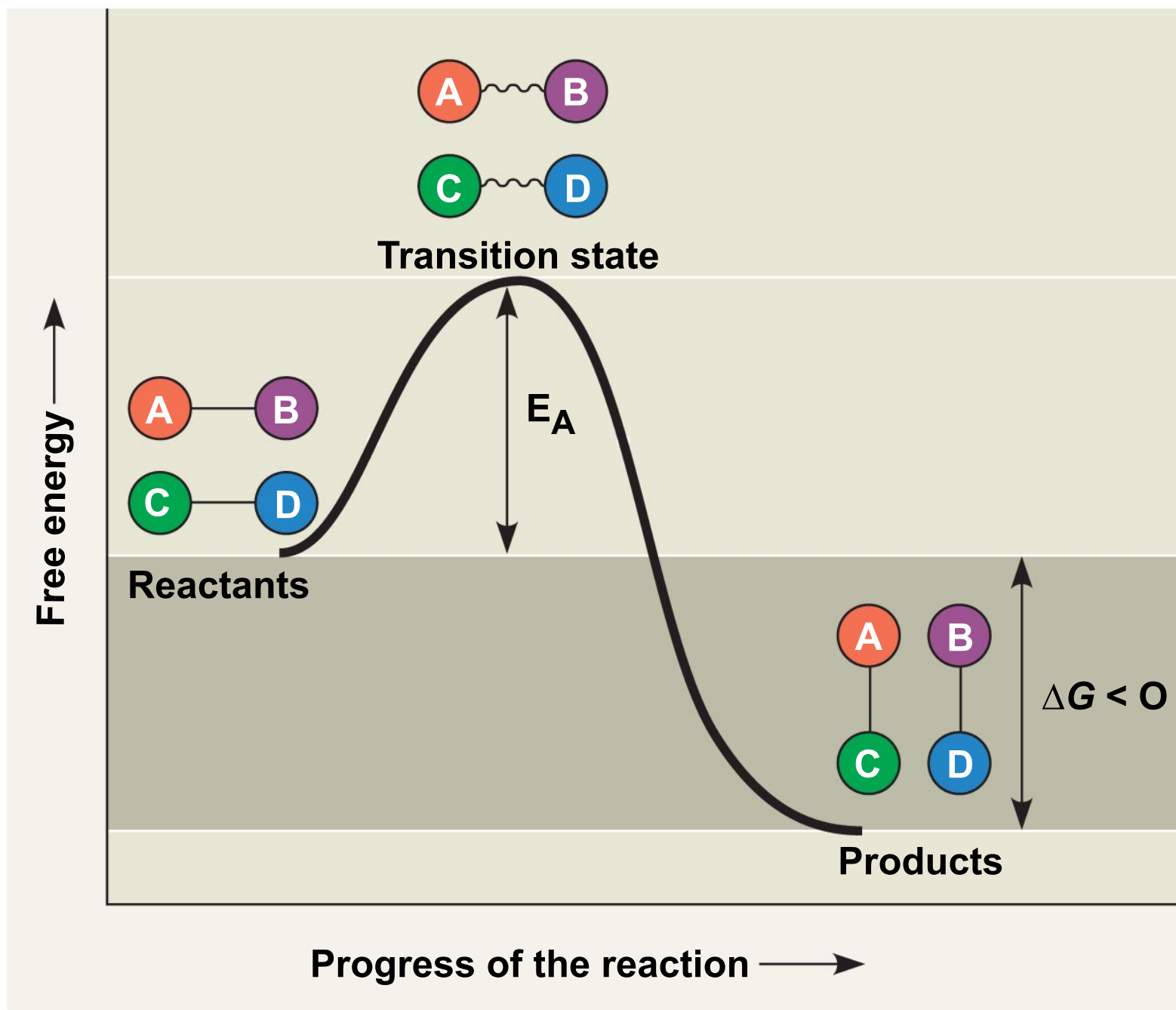


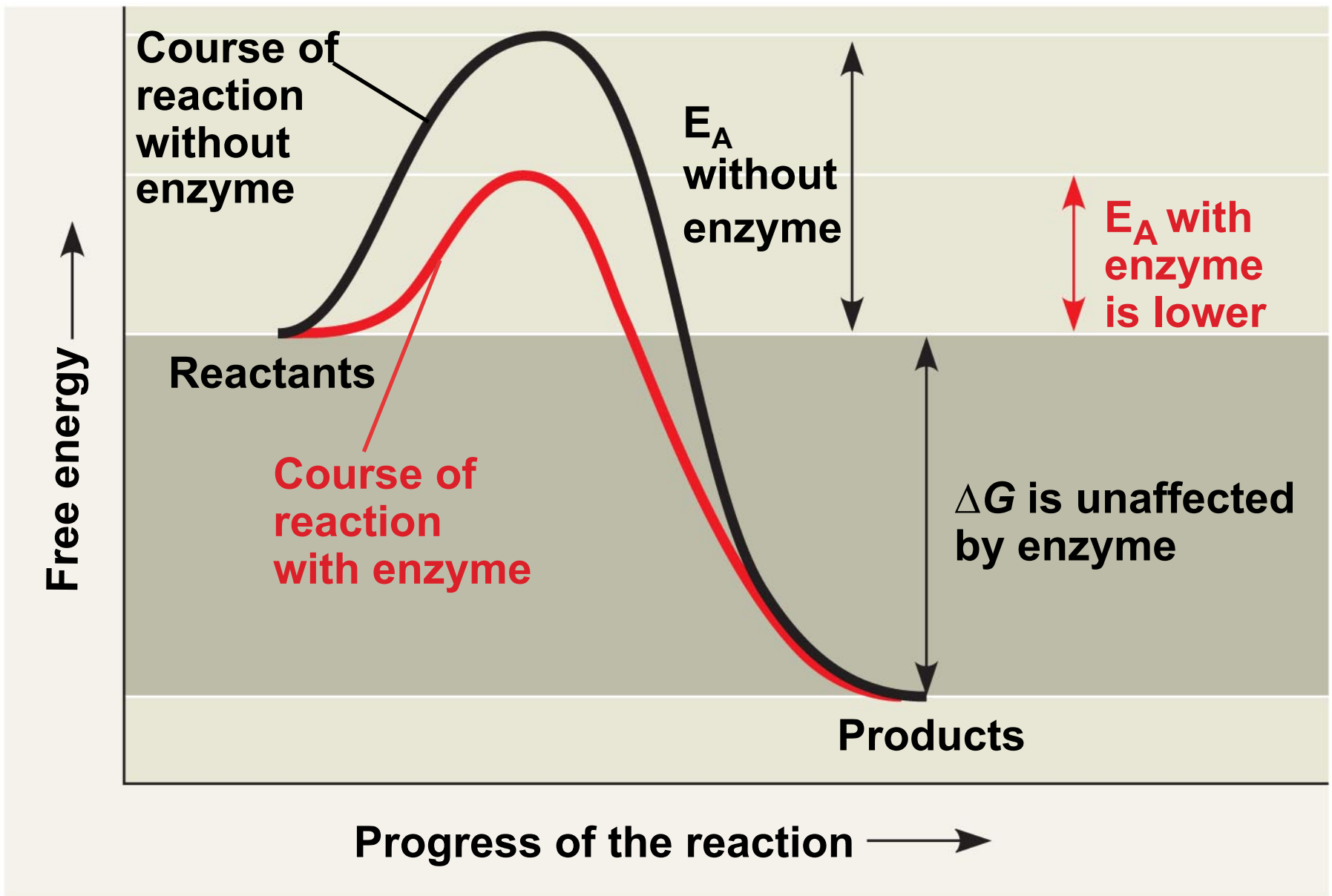
**Sucrose ( $C_{12}H_{22}O_{11}$ )**

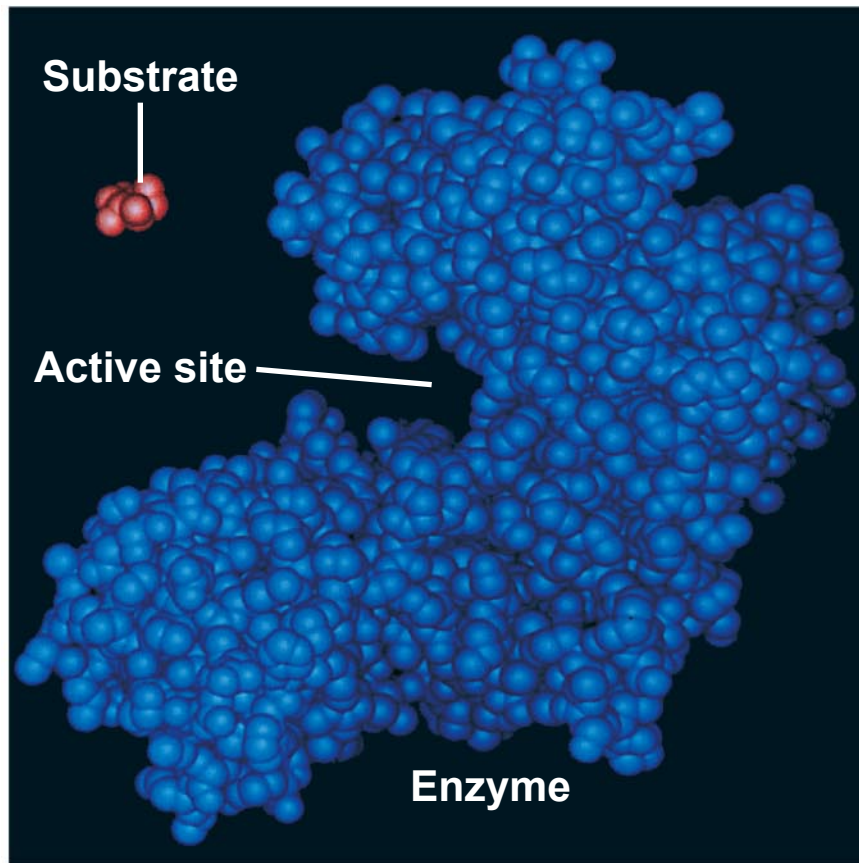


**Glucose ( $C_6H_{12}O_6$ )**

**Fructose ( $C_6H_{12}O_6$ )**

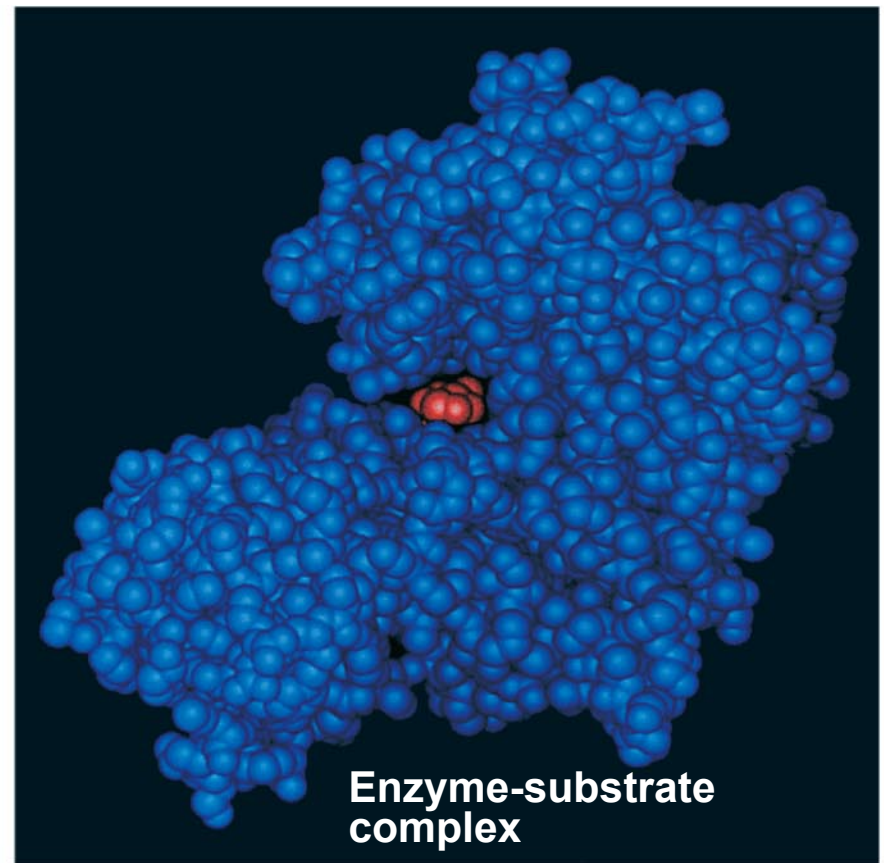




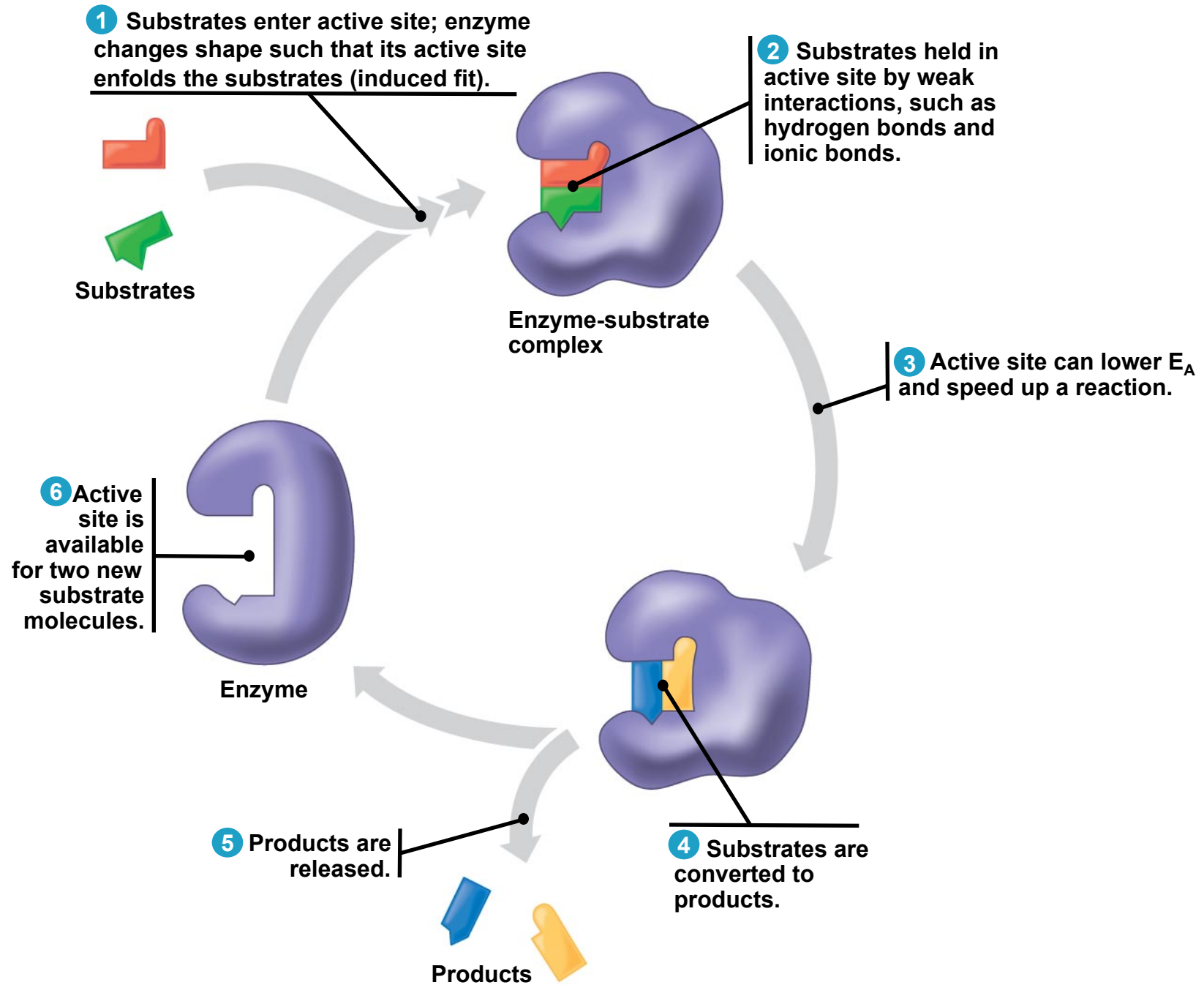


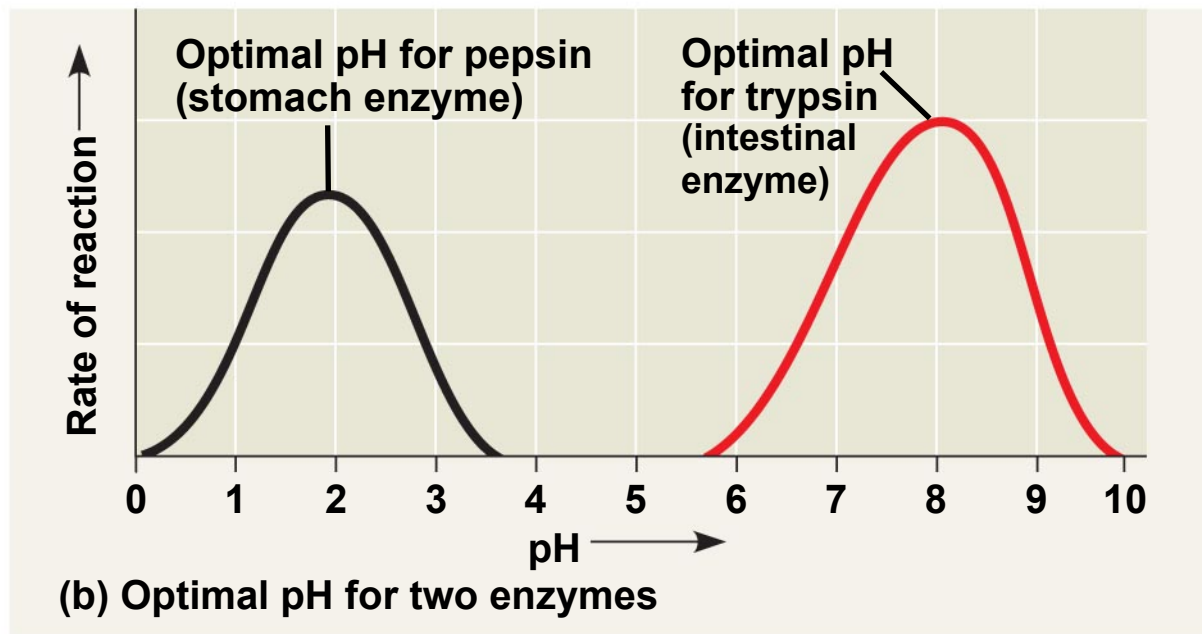
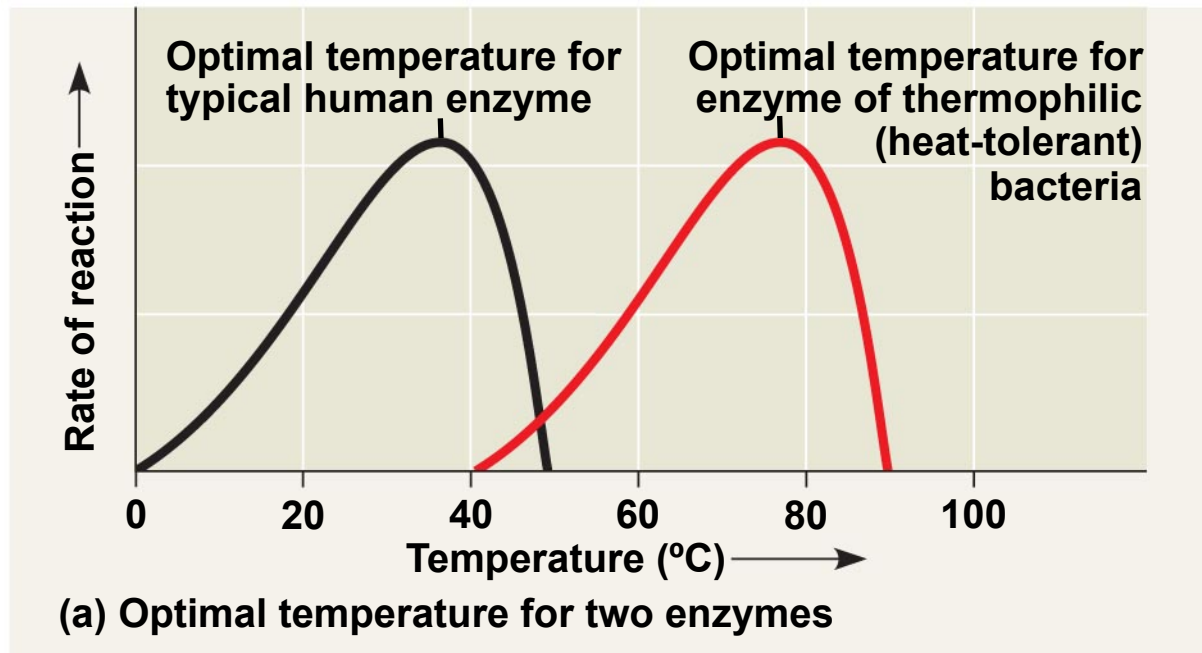
(a)

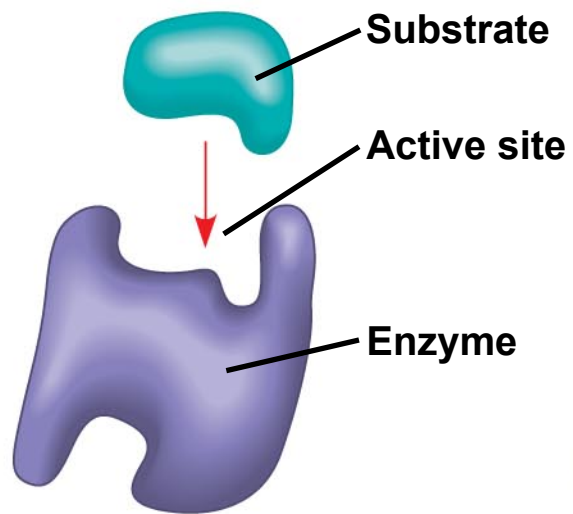
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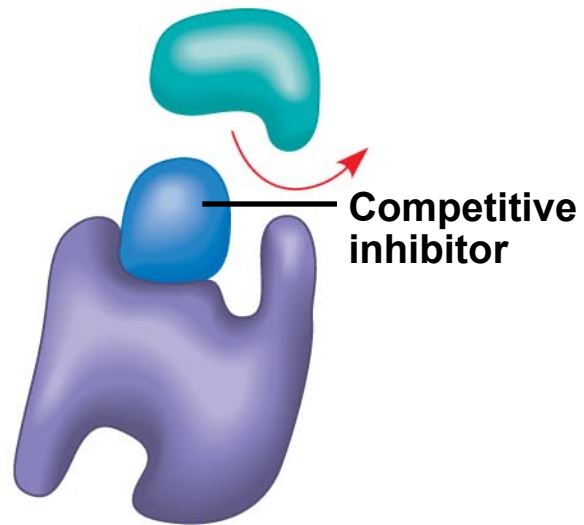
(b)



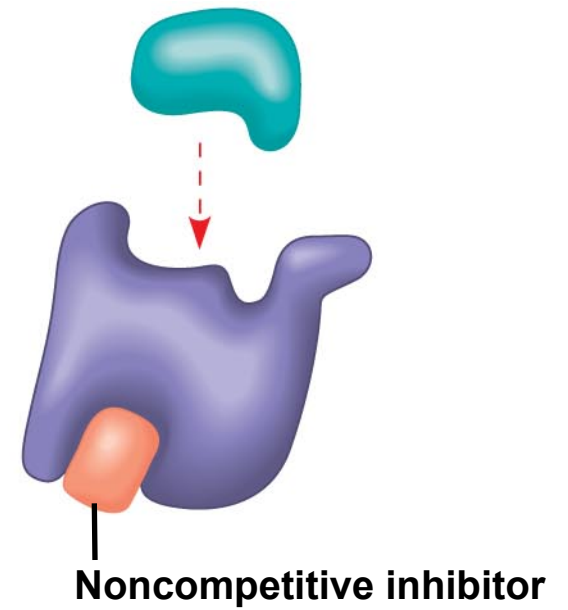




**(a) Normal binding**

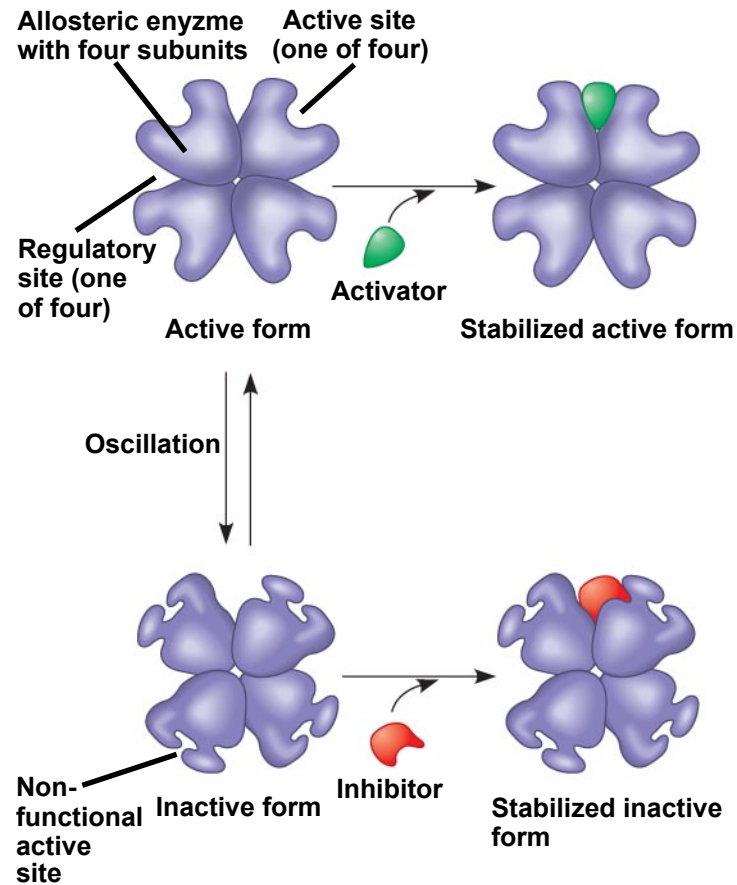


**(b) Competitive inhibition**

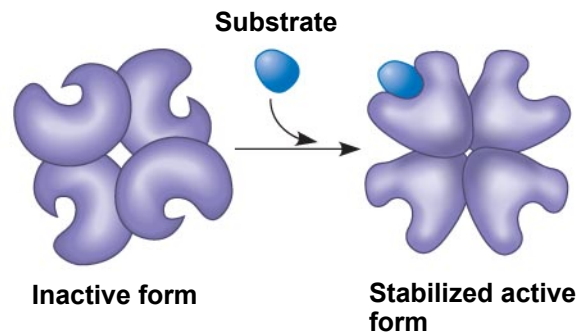


**(c) Noncompetitive inhibition**

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(a) Allosteric activators and inhibitors



(b) Cooperativity: another type of allosteric activation

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