BIOLOGY 2e

Chapter 6 METABOLISM

PowerPoint Image Slide Show

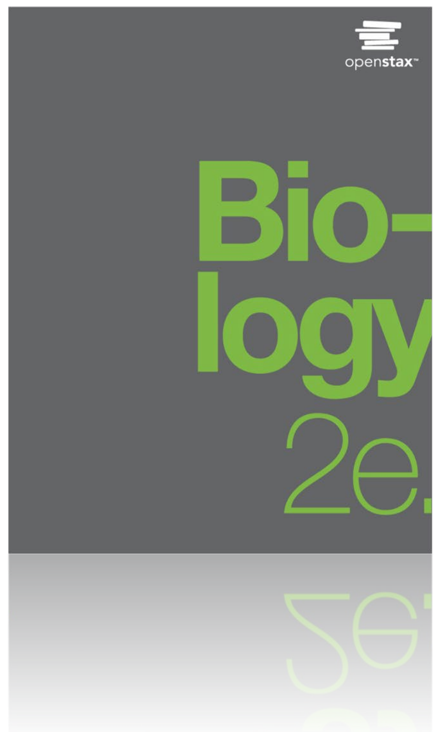
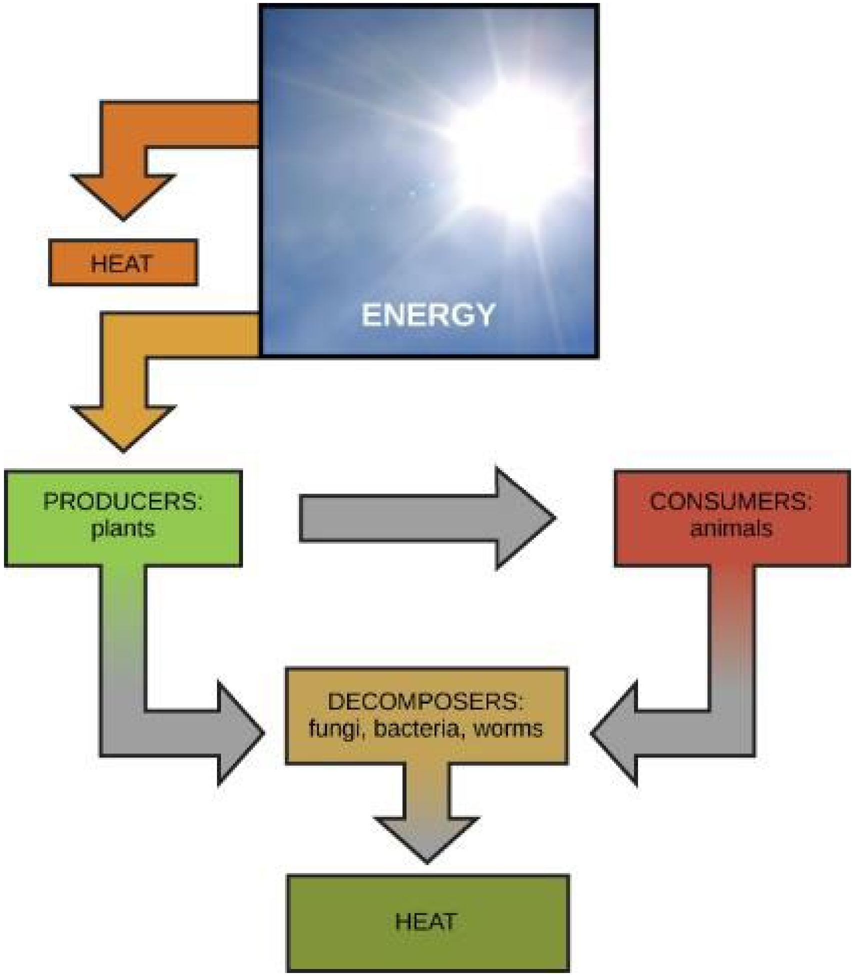


FIGURE 6.1

A hummingbird needs energy to maintain prolonged periods of flight. The bird obtains its energy from taking in food and transforming the nutrients into energy through a series of biochemical reactions. The flight muscles in birds are extremely efficient in energy production.

(credit: modification of work by Cory Zanker)

FIGURE 6.2



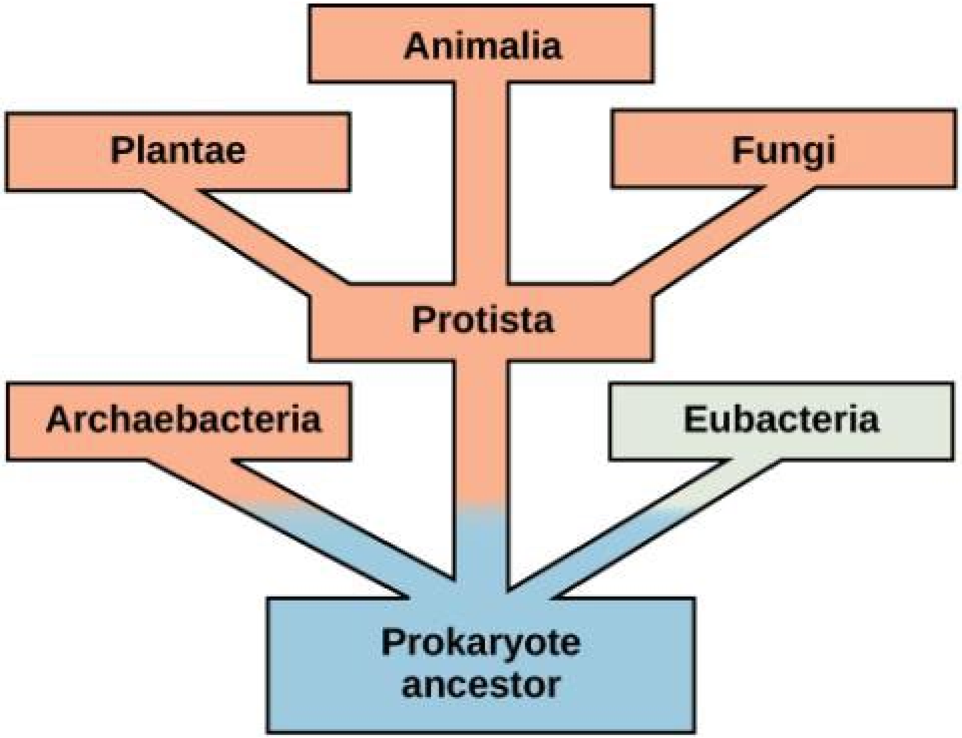
Most life forms on earth get their energy from the sun. Plants use photosynthesis to capture sunlight, and herbivores eat those plants to obtain energy. Carnivores eat the herbivores, and decomposers digest plant and animal matter.

FIGURE 6.3

Plants, like this oak tree, use energy from sunlight to make sugar and other organic molecules. Both plants and animals, like this squirrel, use cellular respiration to derive energy from the organic molecules originally produced by plants.

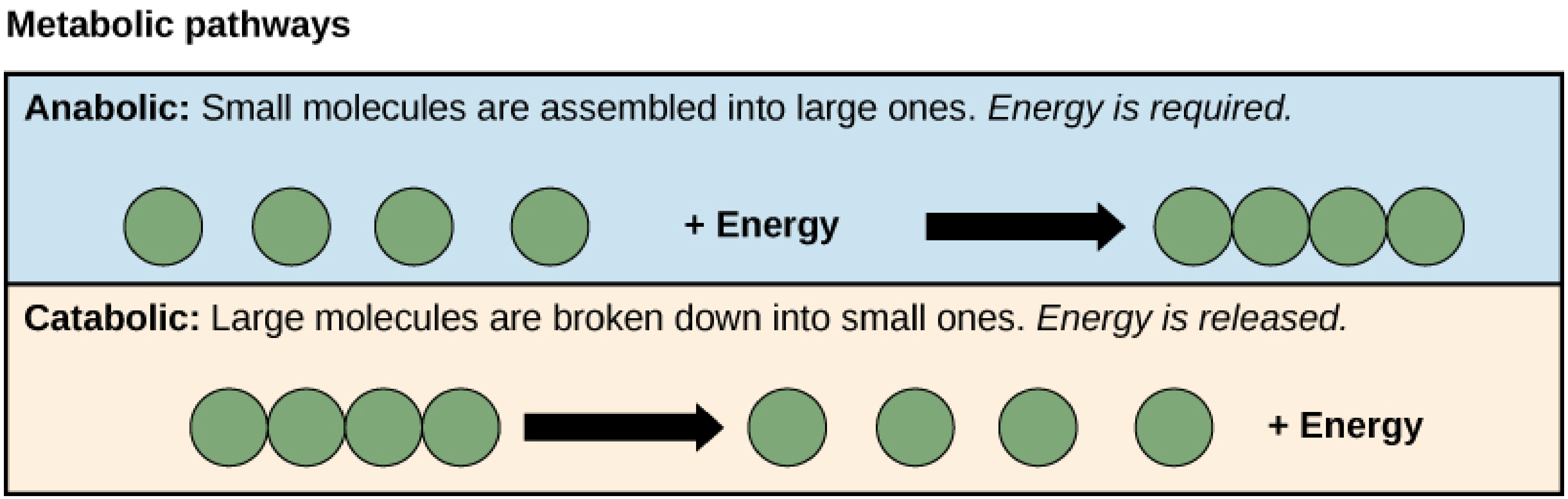
(credit “acorn”: modification of work by Noel Reynolds; credit “squirrel”: modification of work by Dawn Huczek)

FIGURE 6.4



This tree shows the evolution of the various branches of life. The vertical dimension is time. Early life forms, in blue, used anaerobic metabolism to obtain energy from their surroundings.

FIGURE 6.5



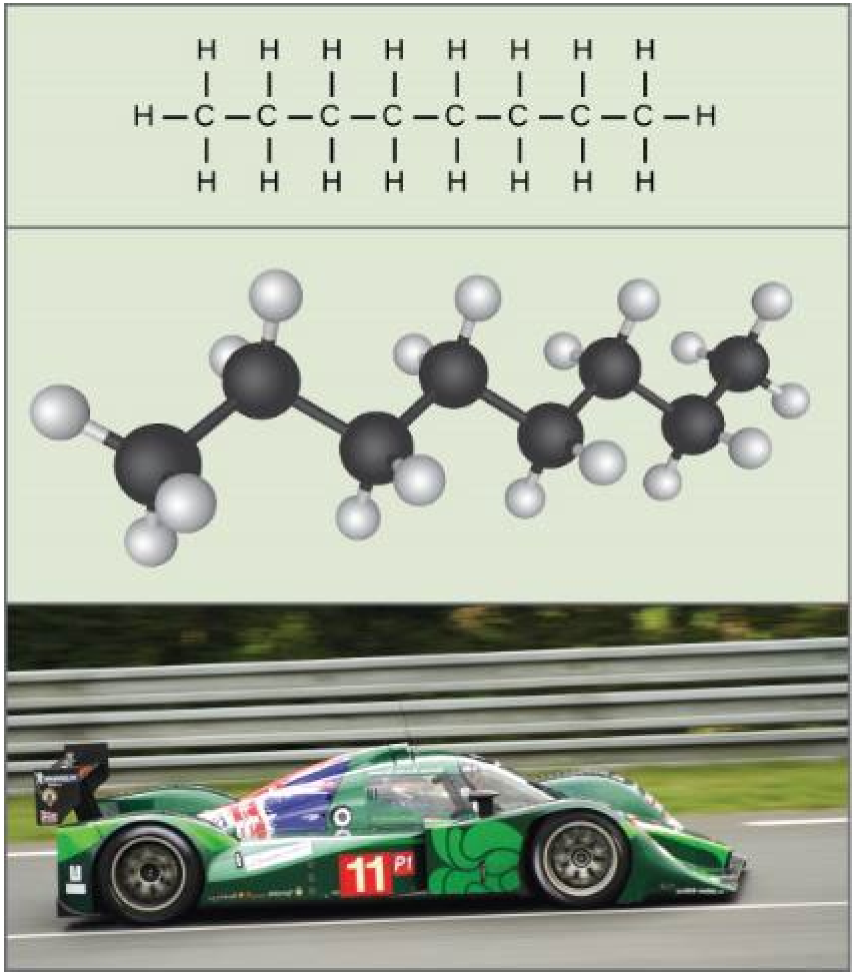
Anabolic pathways are those that require energy to synthesize larger molecules. Catabolic pathways are those that generate energy by breaking down larger molecules. Both types of pathways are required for maintaining the cell's energy balance.

FIGURE 6.6

Water behind a dam has potential energy. Moving water, such as in a waterfall or a rapidly flowing river, has kinetic energy.

(credit “dam”: modification of work by "Pascal"/Flickr; credit “waterfall”: modification of work by Frank Gualtieri)

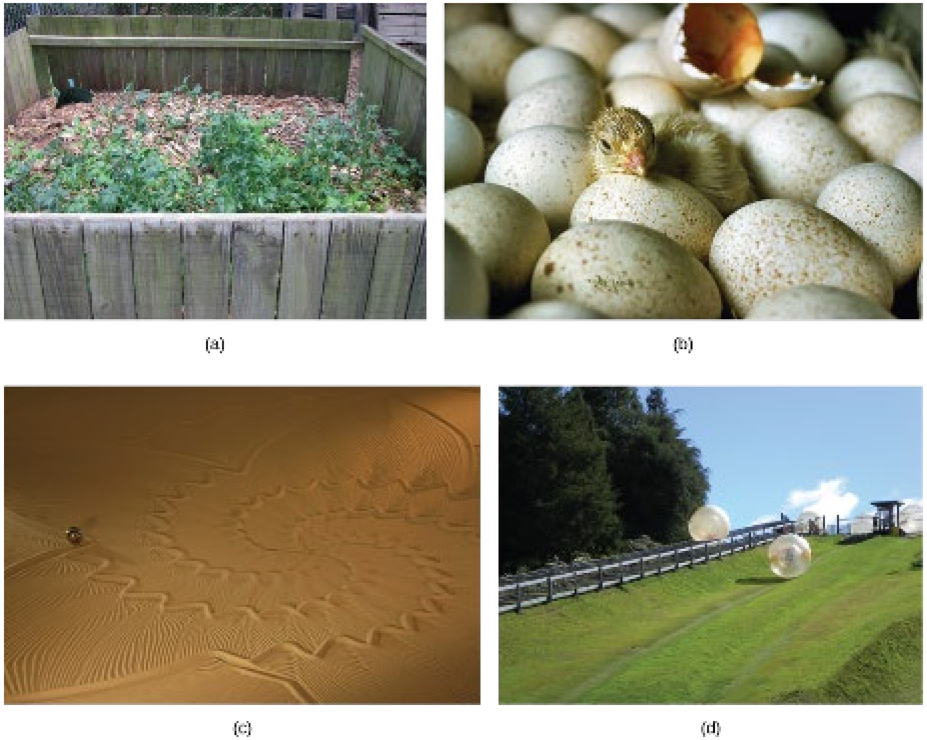
FIGURE 6.7



The molecules in gasoline (octane, the chemical formula shown) contain chemical energy within the chemical bonds. This energy is transformed into kinetic energy that allows a car to race on a racetrack.

(credit "car": modification of work by Russell Trow)

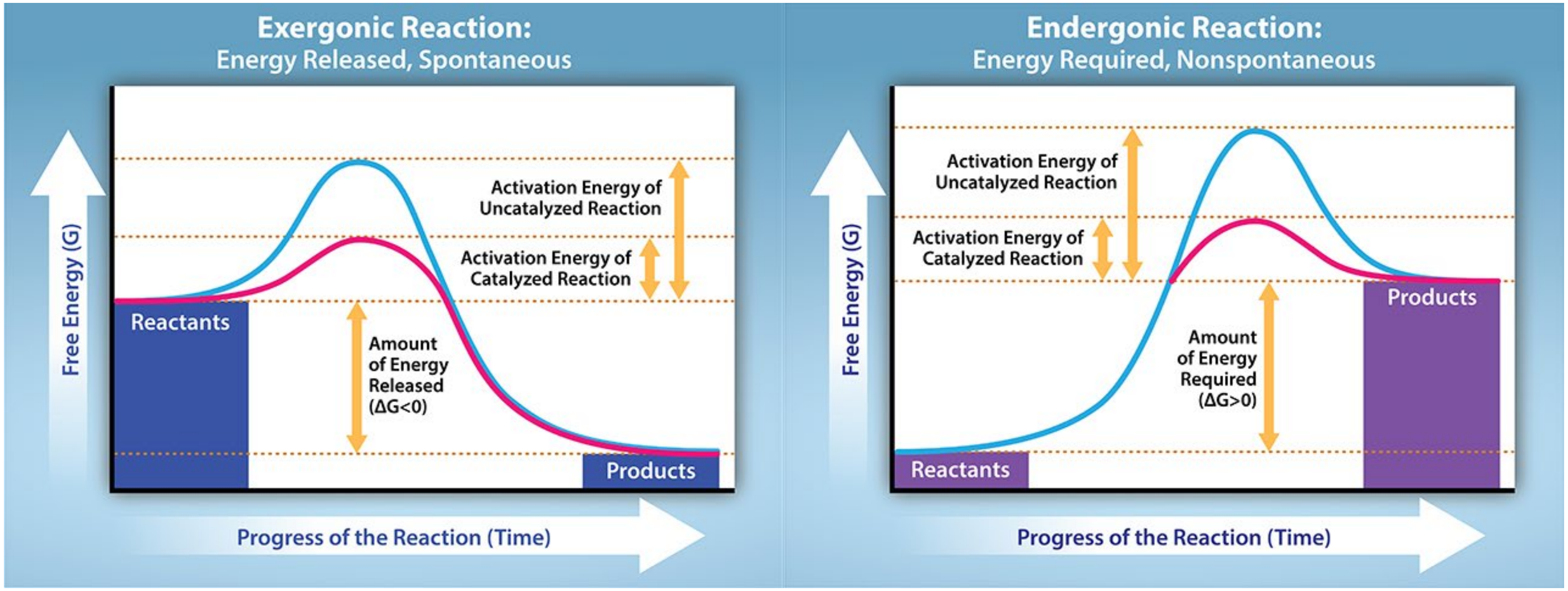
FIGURE 6.8



Shown are some examples of endergonic processes (ones that require energy) and exergonic processes (ones that release energy). These include (a) a compost pile decomposing, (b) a chick hatching from a fertilized egg, (c) sand art being destroyed, and (d) a ball rolling down a hill.

(credit a: modification of work by Natalie Maynor; credit b: modification of work by USDA; credit c: modification of work by “Athlex”/Flickr; credit d: modification of work by Harry Malsch)

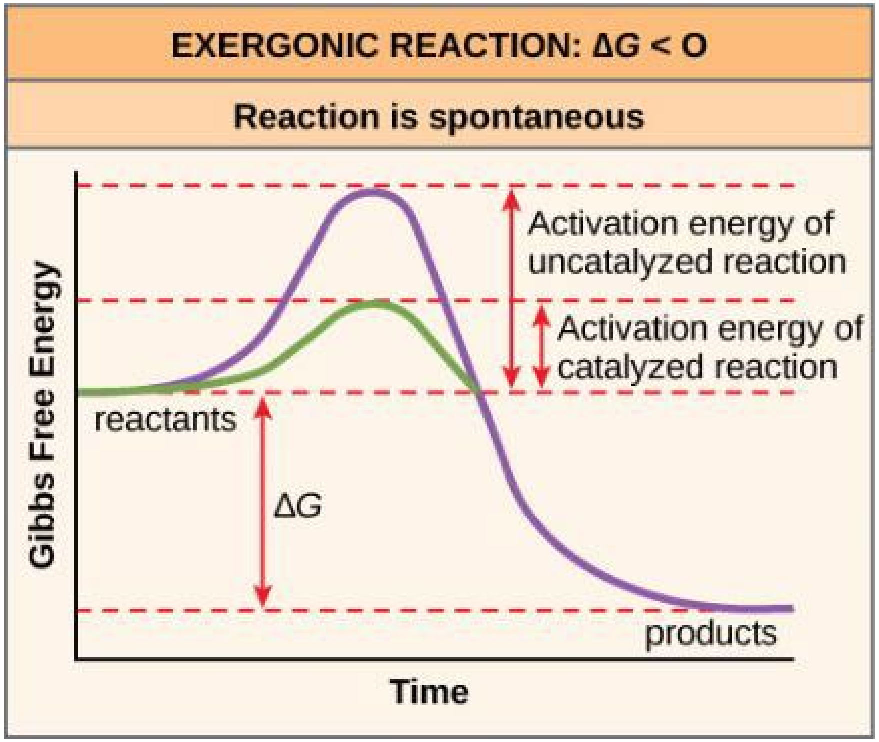
FIGURE 6.9



Exergonic and endergonic reactions result in changes in Gibbs free energy. Exergonic reactions release energy; endergonic reactions require energy to proceed.

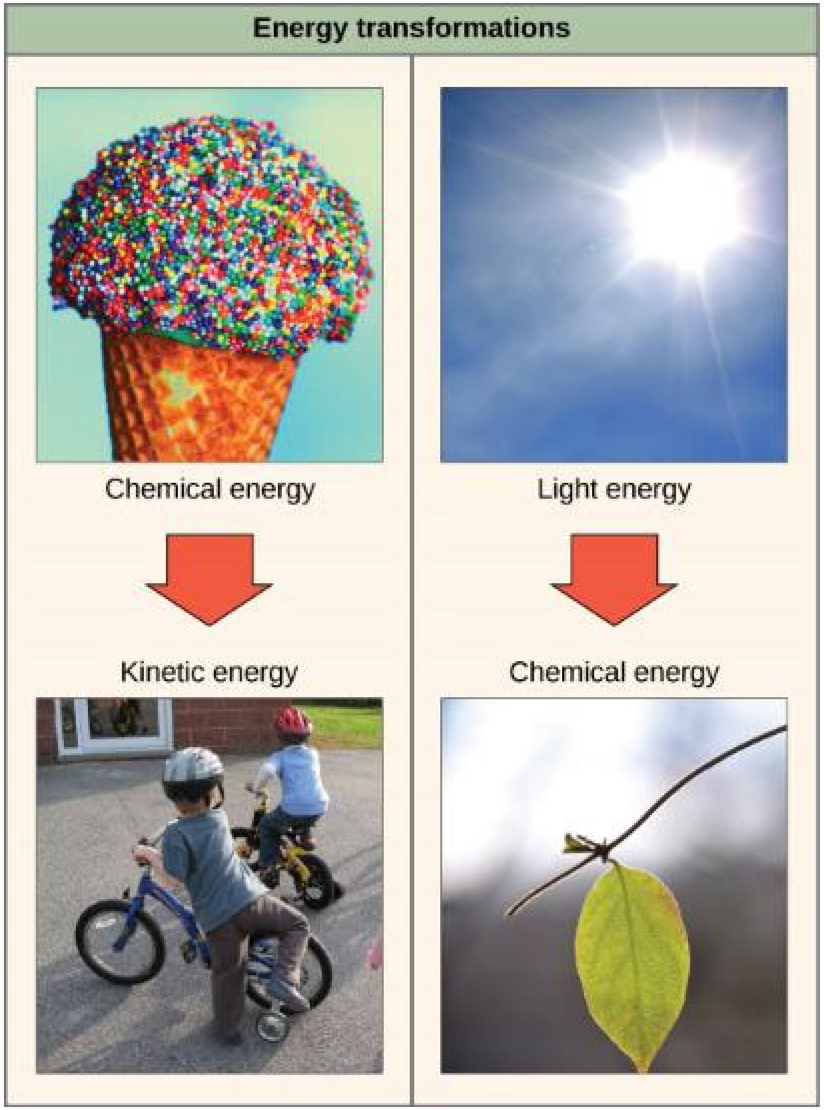
(credit: Tag, A., Rao, A., Fletcher, S. and Ryan, A. Department of Biology, Texas A&M University)

FIGURE 6.10



Activation energy is the energy required for a reaction to proceed, and it is lower if the reaction is catalyzed. The horizontal axis of this diagram describes the sequence of events in time.

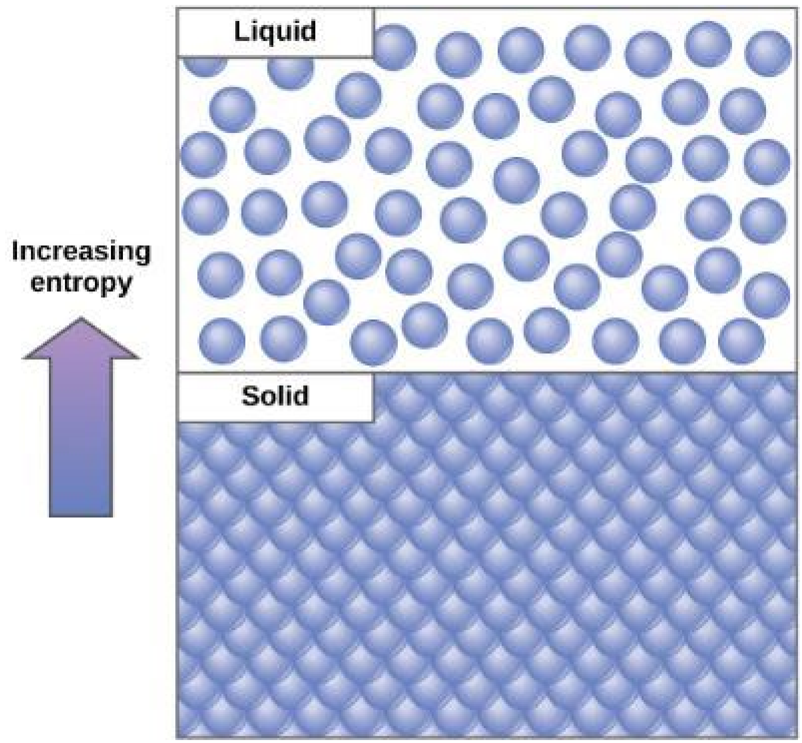
FIGURE 6.11



Shown are two examples of energy being transferred from one system to another and transformed from one form to another. Humans can convert the chemical energy in food, like this ice cream cone, into kinetic energy (the energy of movement to ride a bicycle). Plants can convert electromagnetic radiation (light energy) from the sun into chemical energy.

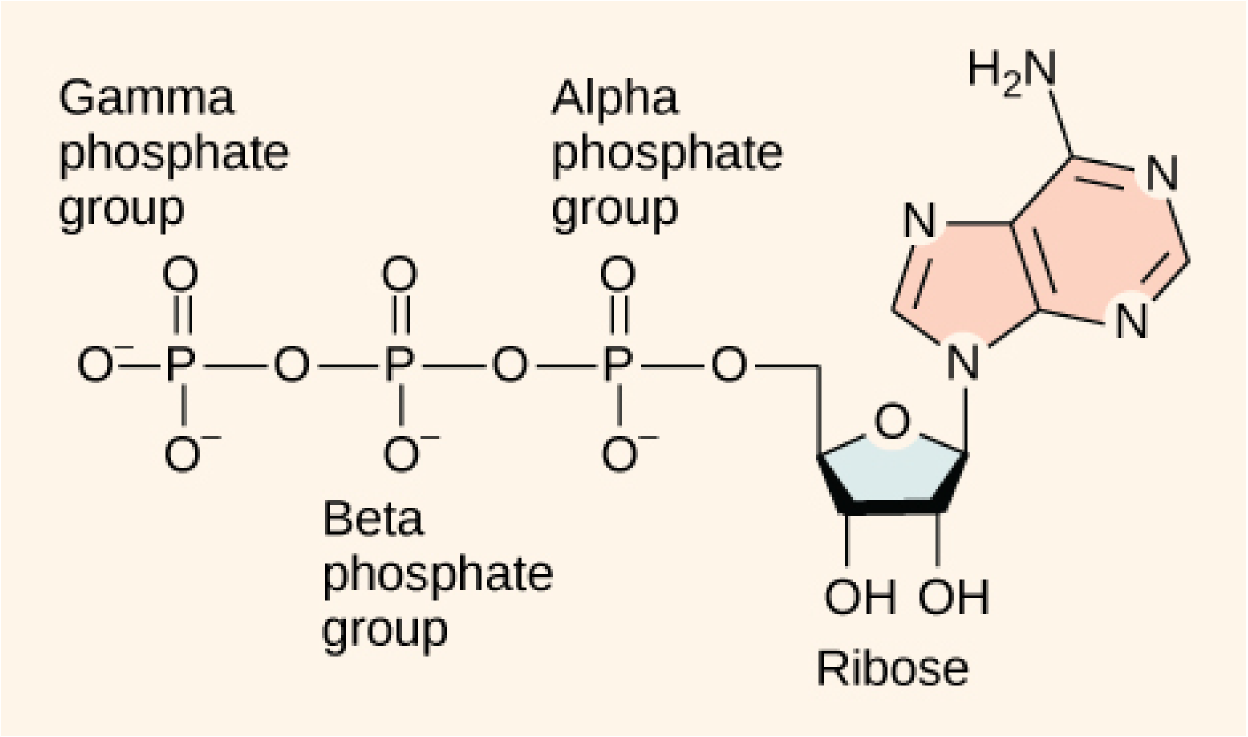
(credit “ice cream”: modification of work by D. Sharon Pruitt; credit “kids on bikes”: modification of work by Michelle Riggen-Ransom; credit “leaf”: modification of work by Cory Zanker)

FIGURE 6.12



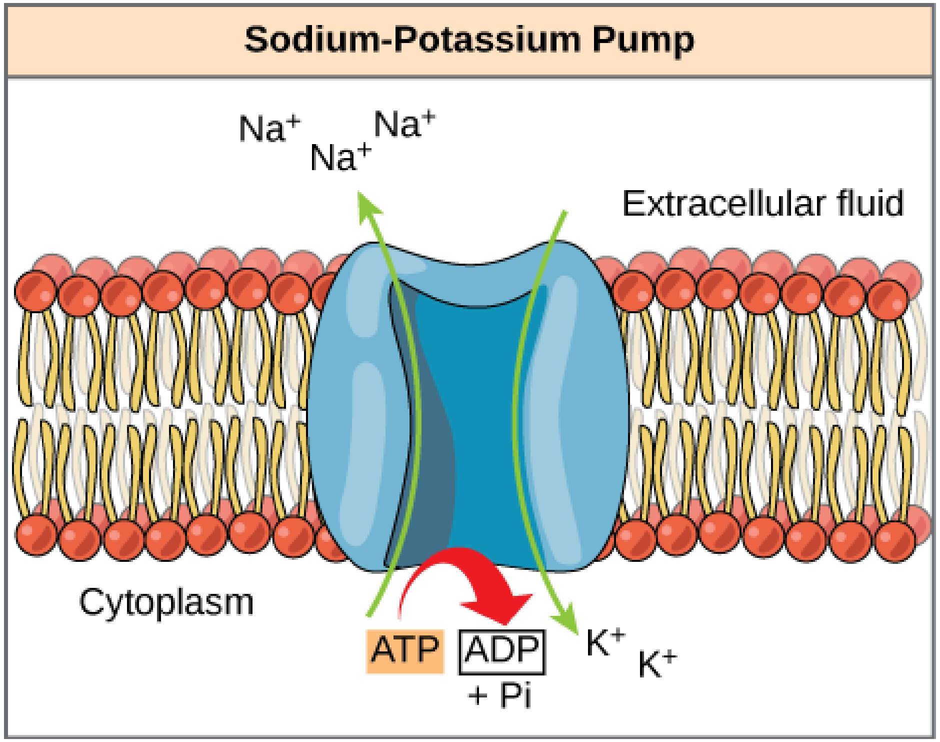
Entropy is a measure of randomness or disorder in a system. Gases have higher entropy than liquids, and liquids have higher entropy than solids.

FIGURE 6.13



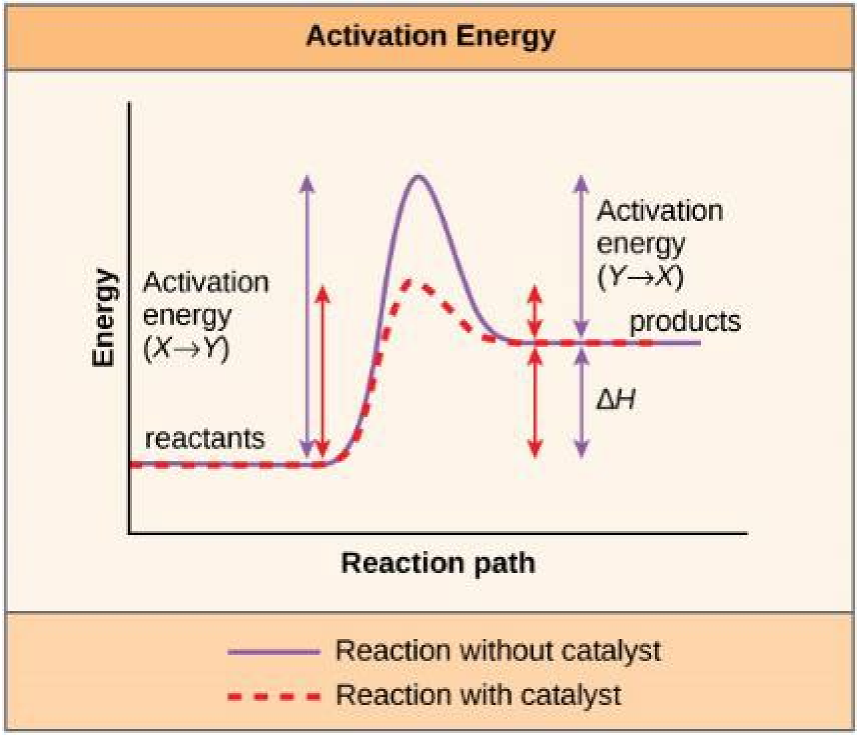
ATP is the primary energy currency of the cell. It has an adenosine backbone with three phosphate groups attached.

FIGURE 6.14



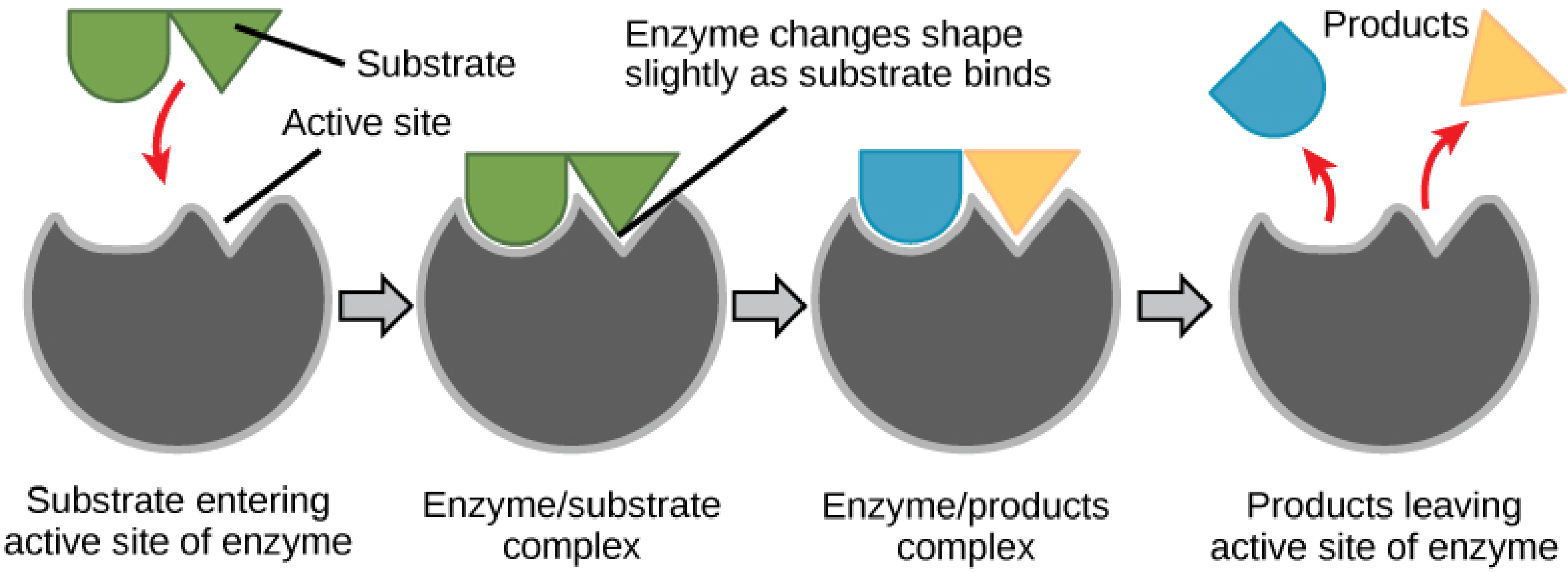
The sodium-potassium pump is an example of energy coupling. The energy derived from exergonic ATP hydrolysis is used to pump sodium and potassium ions across the cell membrane.

FIGURE 6.15



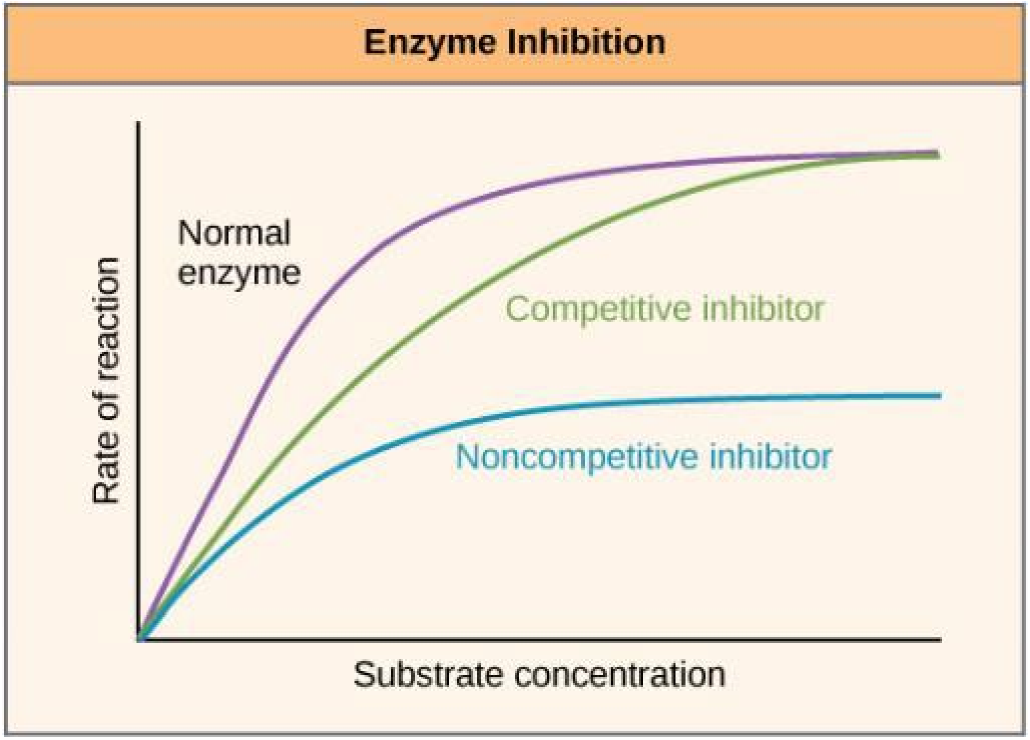
Enzymes lower the activation energy of the reaction but do not change the free energy of the reaction.

FIGURE 6.16



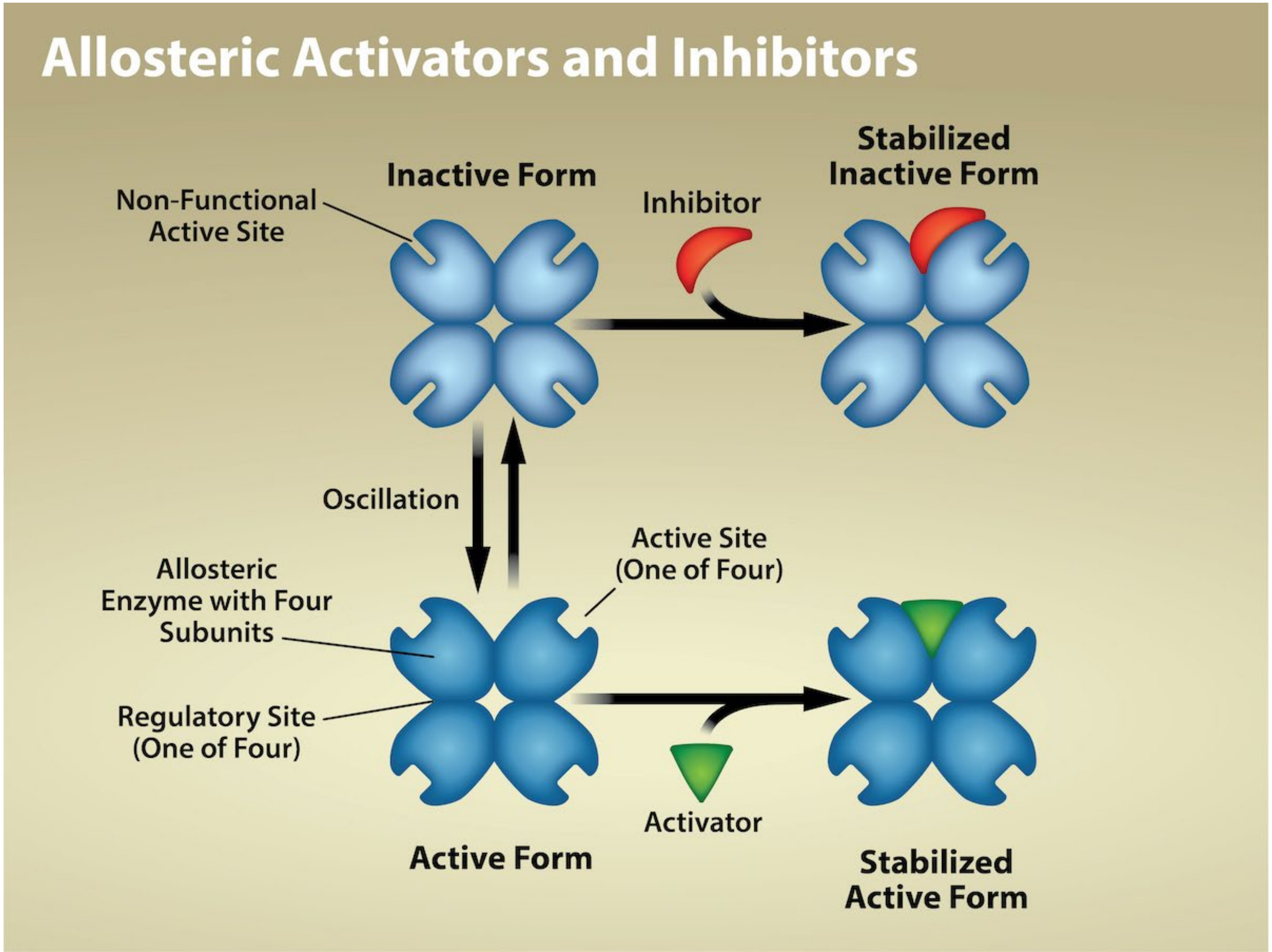
According to the induced-fit model, both enzyme and substrate undergo dynamic conformational changes upon binding. The enzyme contorts the substrate into its transition state, thereby increasing the rate of the reaction.

FIGURE 6.17



Competitive and noncompetitive inhibition affect the rate of reaction differently. Competitive inhibitors affect the initial rate but do not affect the maximal rate, whereas noncompetitive inhibitors affect the maximal rate.

FIGURE 6.18



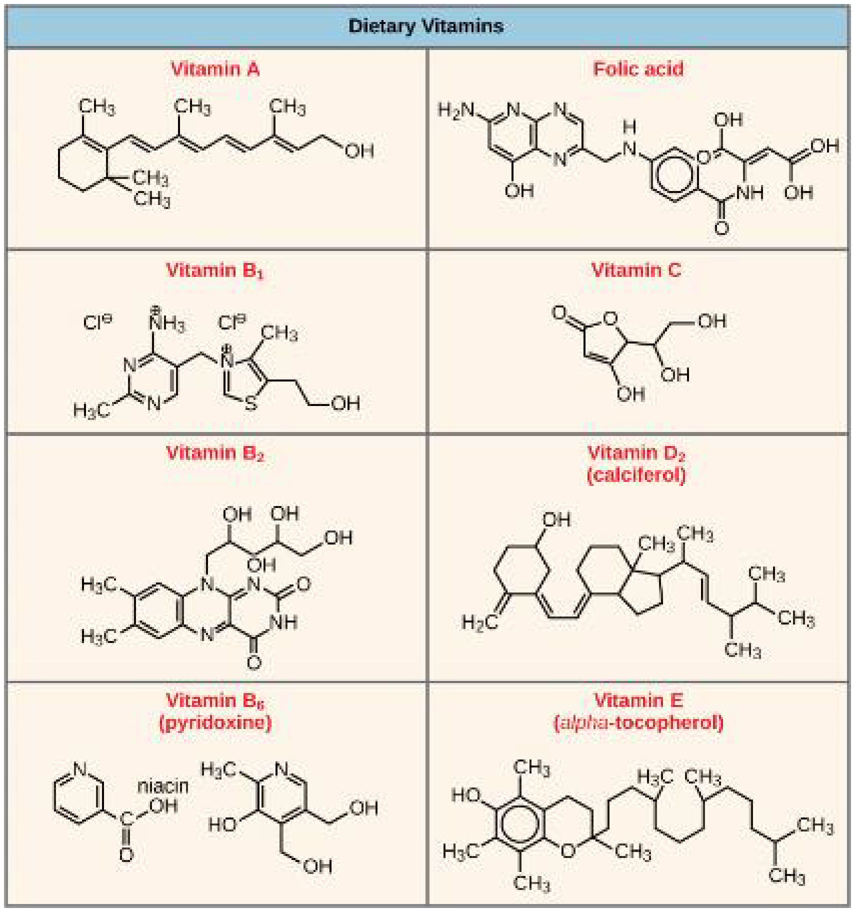
(credit: Rao, A., Hawkins, A., Fletcher, S. and Tag, A. Department of Biology, Texas A&M University)

FIGURE 6.19

Have you ever wondered how pharmaceutical drugs are developed?

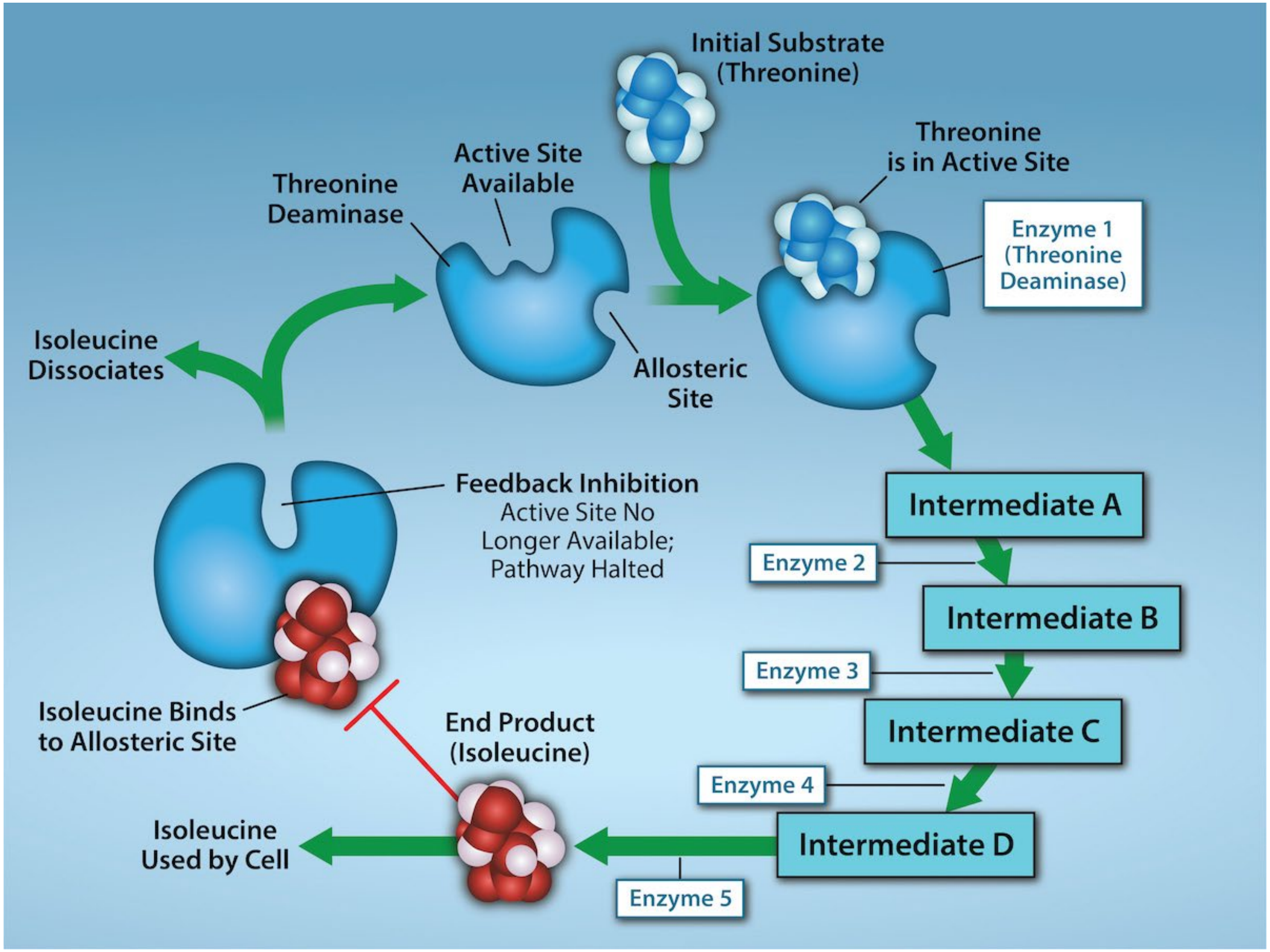
(credit: Deborah Austin)

FIGURE 6.20



Vitamins are important coenzymes or precursors of coenzymes, and are required for enzymes to function properly. Multivitamin capsules usually contain mixtures of all the vitamins at different percentages.

FIGURE 6.21



(credit: Rao, A., Ryan, K., Tag, A., Hawkins, A. and Fletcher S. Department of Biology, Texas A&M University)