- The Structure and Hydrolysis of ATP
  - **ATP (adenosine triphosphate)** is the cell's energy shuttle
  - ATP is composed of ribose (a sugar), adenine (a nitrogenous base), and three phosphate groups
  - This release of energy comes from the chemical change to a state of a lower free energy, not from the phosphate bonds themselves
- How the Hydrolysis of ATP Performs Work
  - The three types of cellular work (mechanical, transport, and chemical) are powered by the hydrolysis of ATP
  - In the cell, the energy from the exergonic reaction of ATP hydrolysis can be used to drive an endergonic reaction
  - ATP drives endergonic reactions by phosphorylation
  - The recipient molecule is now called a **phosphorylated intermediate**

- The regeneration of ATP
  - ATP is a renewable resource that is regenerated by addition of a phosphate group to adenosine diphosphate (ADP)
  - The energy to phosphorylate ADP comes and from catabolic reactions in the cell
  - The ATP cycle is a revolving door through which energy passes during its transfer from catabolic to anabolic pathways

8.4

- A **catalyst** is a chemical agent that speeds up a reaction without being consumed by the reaction
- An **enzyme** is a catalytic protein
- Hydrolysis of sucrose by the enzyme sucrase is an example of an enzyme-catalyzed reaction

- The Activation Energy Barrier
  - Every chemical reaction between molecules involves bond breaking and bond forming
  - The initial energy needed to start a chemical reaction is called the free energy of activation, or **activation energy**
  - Activation energy is often supplied in the form of thermal energy that the reactant molecules absorb from their surroundings
- How Enzymes Lower the Activation Energy Barrier
  - Enzymes catalyze reactions by lowering the activation energy barrier
  - **Enzymes do not affect** the change in free energy (**ΔG**); instead they hasten reaction would eventually occur

- 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
  - **Induced fit** of a substrate brings chemical groups of the active site into positions that enhance their ability to catalyze the reaction

- Catalysis in the Enzyme's Active Site
  - In an enzymatic reaction, the substrate binds to the active site of the enzyme
  - The active site can lower an activation energy barrier by: