CHAPTER 8 BIOLOGY – *The Working Cell: Energy from Sunlight*

- **Photosynthesis uses light energy to make food.**
- **Chloroplasts:** cellular organelles where photosynthesis takes place
  - **Chlorophyll =** pigment that gives a plant its color but also is able to "catch" the sun's energy so it can be used in photosynthesis.
  - Photosynthesis happens mainly in the leaves of plants, since this is where chloroplasts are found in highest concentration (also since leaves are closest to the sun).
  - **Stomata** = tiny holes/pores on the surface of the leaf; these holes allow for CO_2 entry and O_2 exits.
  - **Structure of a chloroplast:**
    - **Inner membrane =** has a thick fluid called stroma
    - **Thylakoid =** disc like sac
    - **Grana =** stacks of thylakoids

- **PHOTOSYNTHESIS:**
  - $CO_2 + H_2O \rightarrow C_6H_{12}O_6$ (glucose) + O_2
  - Electrons stored in water are "excited" when sun hits the leaf.
  - The chloroplast then uses the energy from these excited electrons to rearrange carbon dioxide and water to make glucose.

- **TWO MAIN STEPS OF PHOTOSYNTHESIS:**
  - **Light reaction**
    - Basically, energy from sunlight converted into chemical energy:
      - Chlorophyll molecules in the thylakoid membranes capture light energy.
      - Chloroplasts use this captured energy to remove electrons from water.
      - Removal of electrons from water splits water into oxygen and hydrogen.
      - Oxygen is a waste product and escapes thought the stomata.
      - Chloroplasts use the electrons and hydrogen to make NADPH.
      - Chloroplasts use the captured light energy to make ATP.
      - *Summary: Light energy is converted to chemical energy (stored in NADPH and ATP). This chemical energy will be used in the Calvin cycle to make glucose from carbon dioxide.*
      - *See p. 166, fig. 8-10, for picture description.*
  - **Calvin Cycle ("Dark Cycle")**
    - Basically, sugar is formed from the atoms in CO2 and the hydrogen ions and electrons carried by NADPH.
    - Takes place in the stroma.
    - ATP and NADPH from the light reactions provide the energy and the electrons needed to convert CO2 to glucose! Once ATP and

NADPH are used in the Calvin Cycle, ADP and NADP+ are returned to the light reactions.
    - The Calvin Cycle does not require light to begin and so is also called the "Light-Independent Reaction" or the "Dark Cycle".
    - *See p. 169, fig. 8-13, for picture description.*

- **Summary of Photosynthesis:**
    - $6\ CO_2 + 6H_2O \rightarrow\ C_6H_{12}O_6 + 6O_2$
    - Light reaction: takes place in the thylakoid membrane; light energy is converted to chemical energy in the form of ATP and NADPH.
    - Calvin Cycle: takes place in the stroma, uses the energy stored in ATP and NADPH to make sugar from carbon dioxide.

- Photosynthesis has a global impact.
    - The carbon cycle – process by which carbon moves from inorganic to organic compounds and back again. (see p. 172)
    - Photosynthesis and the global climate:
        - Carbon dioxide levels have been steadily increasing. Any carbon dioxide not used in photosynthesis is used to trap heat from the sun. Increase carbon dioxide means more heat is trapped, making Earth warmer than it was before (Greenhouse effect).