# TEACHER'S NOTES LESSON 16

Present these key points and questions to the students during the *Activities* section of Lesson 16, as your lecture/discussion.

**Chloroplasts and Photosynthesis**
Show images of the following aspects of chloroplasts and photosynthesis. Some beautiful images of chloroplasts, chlorophyll, photosystem I and II, and more are found on the Biology web site:
http://gened.emc.maricopa.edu/Bio/BIO181/BIOBK/BioBookPS.html

1. Sunlight is made of various wavelengths of light, only, a few of which are in the visible range. Sunlight is captured in the harvesting complexes in the thylakoid membrane. They are made of pigments, which absorb wavelengths of light useful for photosynthesis. The energy here travels from one pigment to another until it reaches the reaction center, which can release electrons for photosynthesis. These excited electrons then travel through the electron transport chain leaving a positive "hole" where it used to be (in the chlorophyll). (This is like a person (electron) learning about some new exciting project (sunlight energy) who then leaves home and travels down a new path (electron transport system) leaving an empty space behind (hole).
2. Water is split into oxygen, electrons and protons ($H^+$). The electrons released fill in the holes in the chlorophyll that has been created by the absorption of the photon of light, which caused the electron to pass through the electron transport chain. [In other words, another person (another electron) replaces the person ($1^{st}$ electron) who left]. The released protons from the splitting of water in the thylakoid space create a proton and electric gradient. (The protons are the positive people and there are more on one side of the wall then the other). The protons move down their concentration gradient through the ATP synthase to form ATP in the stroma (matrix) (The positive people living in the crowded area move to the other side to try and make it a more positive place and by doing so create energy). The electrons move through the carrier proteins in the thylakoid membrane by oxidation/reduction reactions causing more $H^+$ to pass through the membrane and increase the proton and electric gradient. In the end these electrons join with the protons to form NADPH. This is essentially the dance of the partners I mentioned in the mitochondrial portion. The products are oxygen, ATP and NADPH.
3. The ATP and NADPH are used for the Calvin cycle and the oxygen passes outside the cell.
4. The Calvin cycle takes the ATP and NADPH from the light reactions and $CO_2$ to form sugars. In this way the energy from the sun is stored in the chemical bonds of the sugars. That's where we our energy comes from when we eat sugars.
5. Show summary slide or overhead of light-dependent and light-independent reactions such as figure 6.14 on p. 105 of Starr's textbook Biology concepts and applications. Write up the overall equation for photosynthesis and point out the molecules in the diagram.

$$12H_2O + 6CO_2 \rightarrow 6O_2 + C_6H_{12}O_6 + 6H_2O$$