

Lec 10. Plants provide the primary organic food for all living organisms.

Plants provide oxygen in the atmosphere, fossil fuel, fiber.



How do plants convert CO_2 and NO_3^- to organic food? Carbohydrates, proteins, lipids, secondary products (medicine)

Lec. 10. Photosynthesis I

I. **Overview of Photosynthesis:** 4 STAGES:

1. **Light Absorption:** Electrons are pulled from water, and O_2 is evolved. (LIGHT RX)
2. **Electron Transport :** NADPH is formed. (LIGHT RX)
3. **Generation of ATP.** (LIGHT RX)
4. **Conversion of CO_2 into Carbohydrates.** (DARK RX)

II. **Chloroplast & Pigments**

III. **Light Absorption by Pigments**

How is light absorbed? What does absorbed light do?

Light energy absorbed by pigments is transferred to a reaction center Chl a.

Rx center chl a gives up an electron. Photooxidation or photochemistry

Chl a pulls electrons from water generating oxygen.

This reaction is the key to photosynthesis. This reaction starts electron transport.

Overview of photosynthesis

1. **Light absorption**

water is split

2. **NADPH**

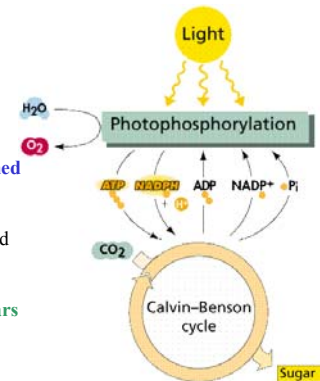
Reducing energy is formed

3. **ATP**

Chemical energy is formed

4. **$\text{CO}_2 \rightarrow \text{sugar}$**

CO_2 is converted to sugars



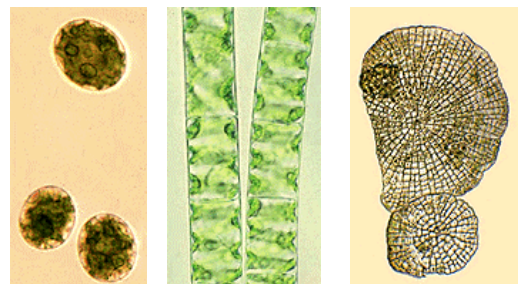
Discovery of PS

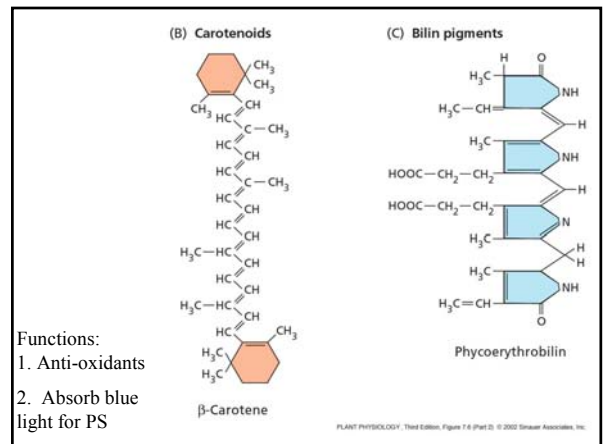
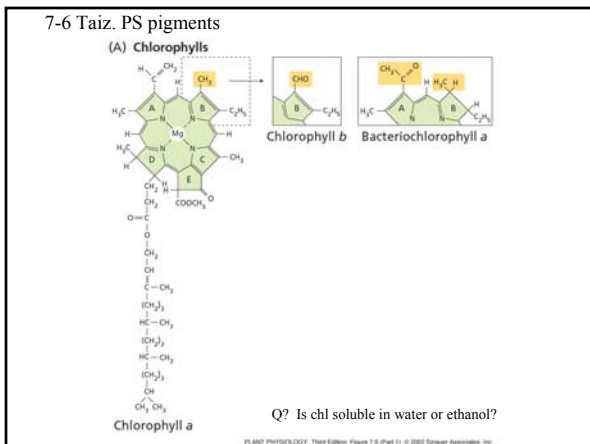
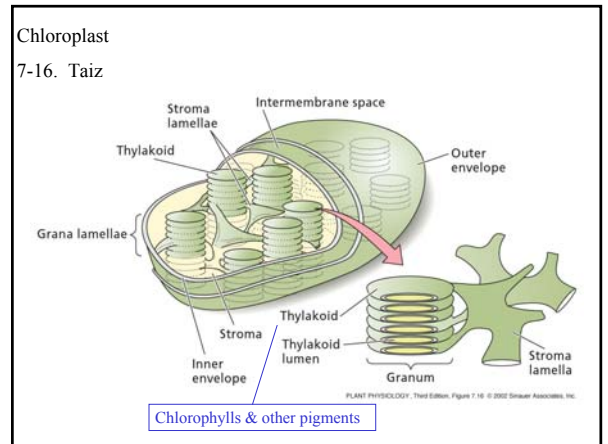
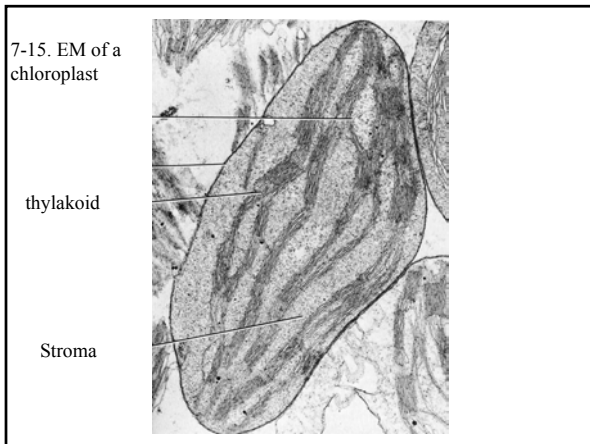
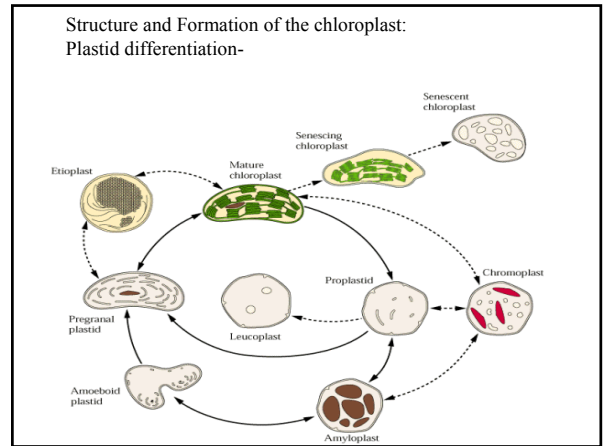
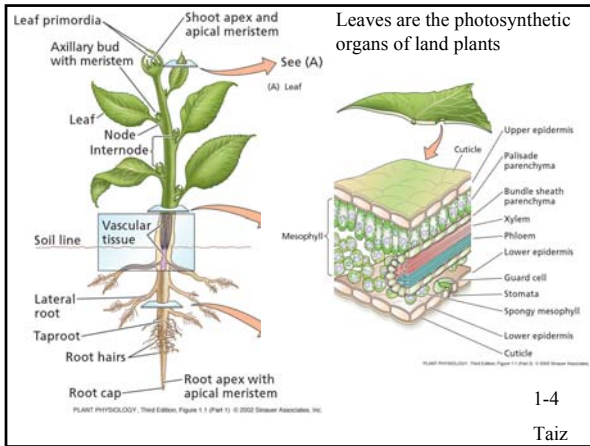
1. Van Helmont. Water was the main nutrient
2. Stephen Hales: Air supplied the nutrient
3. Priestley 1770s. Light caused plants to evolve something that supported a burning candle
4. Ingenhousz 1779. Plants evolved oxygen. Only green parts evolved O_2 .



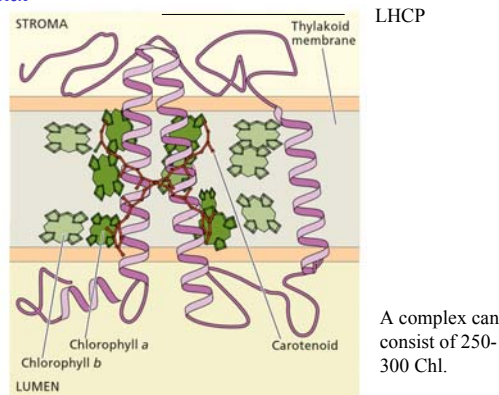
Green algae

Spirogyra

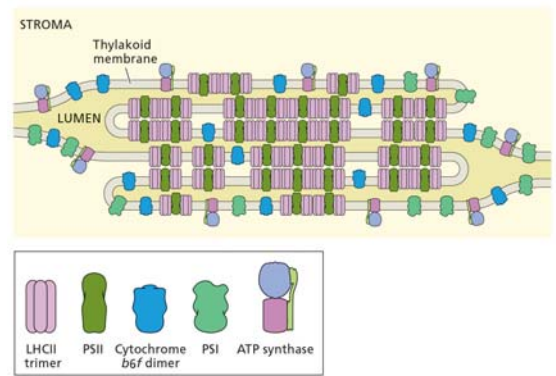




7-20 Taiz: Pigments bind to protein to form a Light Harvesting Complex

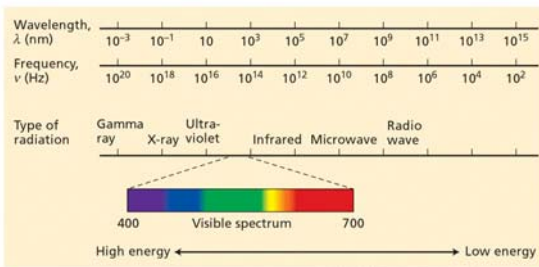


7-18 Taiz. Protein complexes on the thylakoid membrane

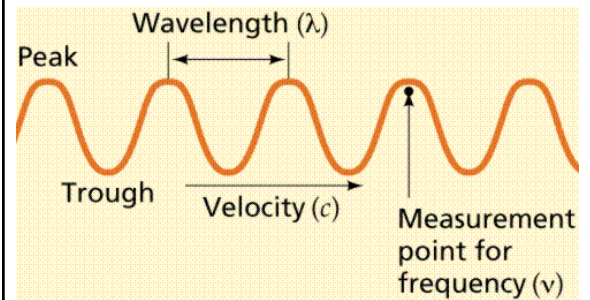


How is light absorbed and used for photochemistry?

Plants use the energy of visible light



13. Farabee. Light has properties of a Wave and a particle.



$$E = h \nu$$

Chlorophyll absorbs in the blue and red

Basic Concepts about Light

1. Amount of energy is dependent on the wavelength of light.
Light has properties of a wave and a particle (photon).
Quantum (energy of a photon) = $h\nu = hc/\lambda$
2. Plants contain pigments that absorb the energy of photons.
When molecules absorb light, they change their electronic state

1. Principle of Goethaus-Draper

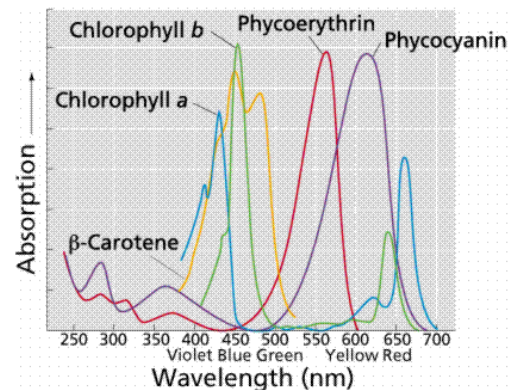
Only light that is absorbed can be active in a photochemical reaction.

2. Einstein-Stark Law.

A single photon can excite only one electron.

13. Farabee. Absorption spectra of pigments

7-7. Taiz



Chlorophyll can absorb a photon,
-get excited and
-give up a high energy electron

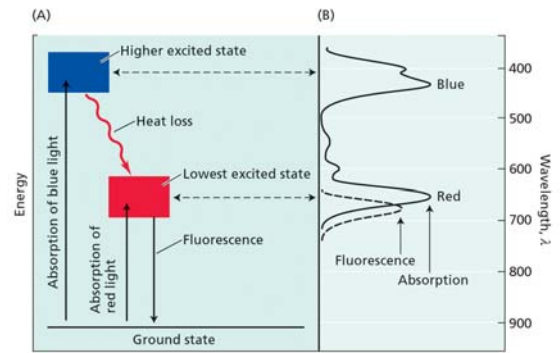
What is light absorbed used for?

a) excitation energy transfer

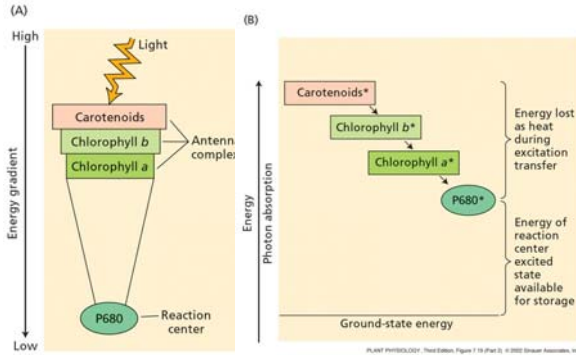
b) photochemistry or photo-oxidation

This is the beginning of photosynthesis

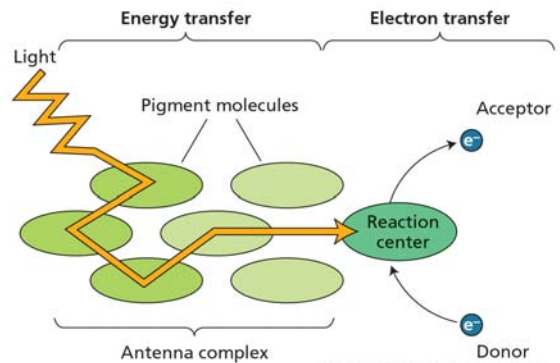
7-5 Taiz. Light absorption and emission by chlorophyll



7-19 Light-harvesting antenna: energy is funneled to the reaction center chl. Bulk of Chl are antenna chl.



7-10. Taiz. Energy transfer



Summary:

Chl and accessory pigments absorb light energy.

Energy absorbed is funneled by excitation energy transfer to a special chl a pair (Reaction Center pigment)

At RC, chl a is oxidized

Oxidation results in chl a pulling e^- from H_2O generating oxygen.

?? Rx ?

7-9. Concept of Action Spectrum

What wavelength of light is effective in O_2 evolution?

Experiment:

