CONCEPT: LIGHT DEPENDENT REACTIONS

Photosystem Structure

● **Photosystems** are two protein _____ where the light-dependent reactions take place

□ Photosystems are embedded in the thylakoid membrane

□ The **light harvesting center (antenna complex)** absorbs the light energy and turns it into electrical energy

- **Photoexcitation** is when light energy excites an electron

□ The **reaction center** accepts the electrical energy and transfers it to chemical energy

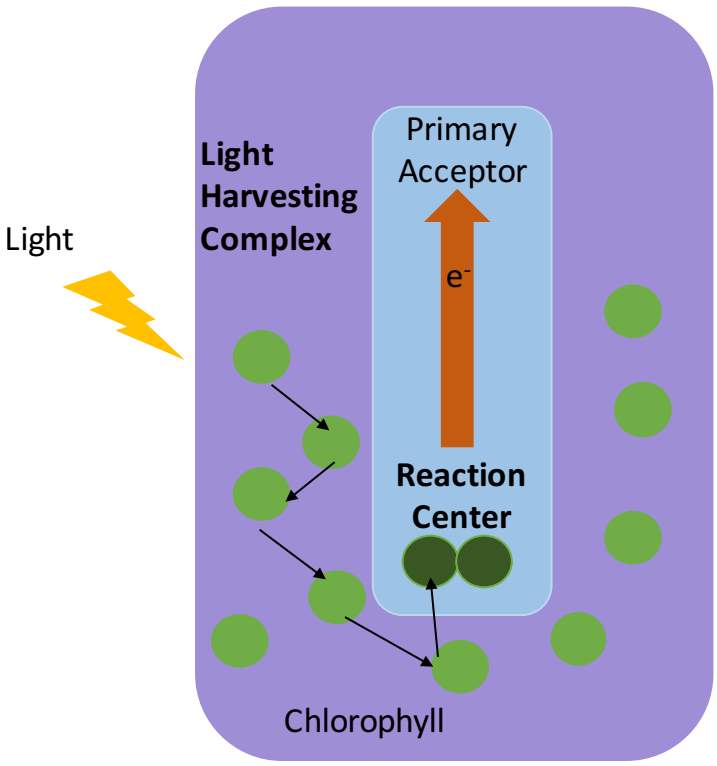
□ The photosynthetic pigment **chlorophyll** accepts light energy in the chloroplast

- Contains a light-absorbing ring (porphyrin ring) with easily _____ electrons

- Once electrons are excited they want to release the energy – can be converted to different energy forms

□ Electrons travel between photosystems and other protein complex through electron carriers

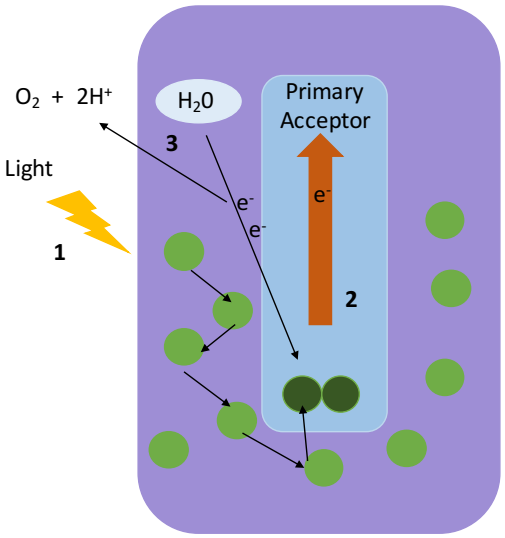
EXAMPLE: Overview of a photosystem



Light Dependent Reaction Steps

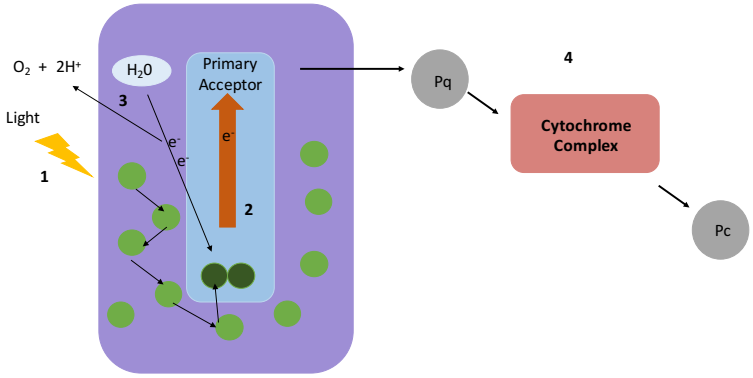
1. A light photon enters into the light harvesting center of **photosystem II** and hits a chlorophyll molecule
2. An electron in the chlorophyll pigment is excited, and that energy bounces around between many chlorophylls
    - Called **resonance energy transfer** when energy transfers between pigment molecules
3. Eventually this energy is transferred to a special pair of electrons (**P680)** and one electron is transferred to plastoquinoine (becomes reduced to plastoquinol)
    - The donated electron is replaced by splitting two H_2O (**phoyolysis)** molecules to form O_2
    - **Primary electron acceptor** is the molecule that accepts electrons from the reaction center

EXAMPLE: First three light dependent steps in Photosystem II



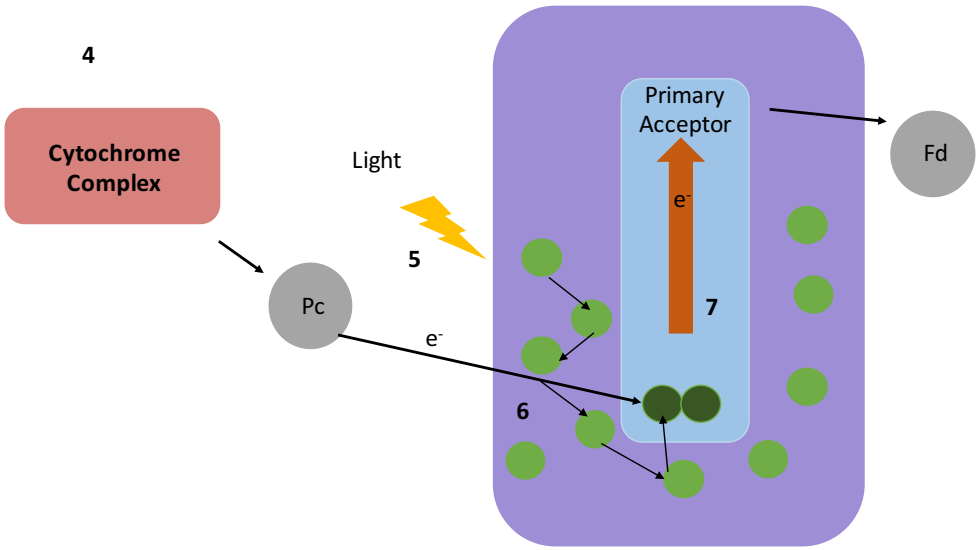
4. Plastoquinol transfers the electrons to an **electron transport system**
    - **Cytochrom B_6F complex** uses the energy from the electron to pump H^+ into thylakoid space
    - The electron is transferred to the electron carrier plastocyanin

EXAMPLE: Step 4 of light-dependent reactions shows electrons flow down the electron transport system



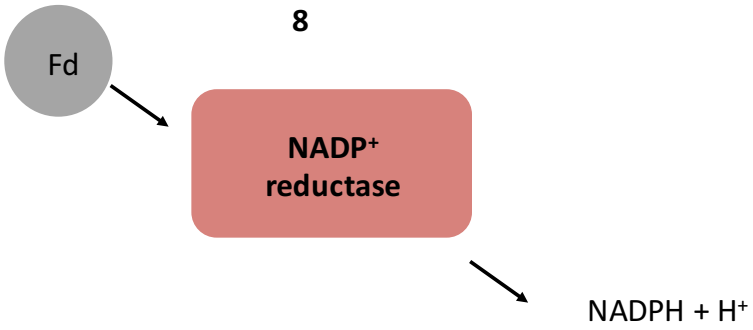
5. A light photon enters into the light harvesting center of **photosystem I** and hits a chlorophyll molecule
6. An electron in the chlorophyll pigment is excited, and that energy bounces around between many chlorophylls
7. This energy is transferred to a special pair of electrons (**P700)** and one electron is transferred to ferrodoxin
    - The donated electron is replaced by the electron from photosystem II

EXAMPLE: Steps 5-7 of the light-dependent reactions involving photosystem I



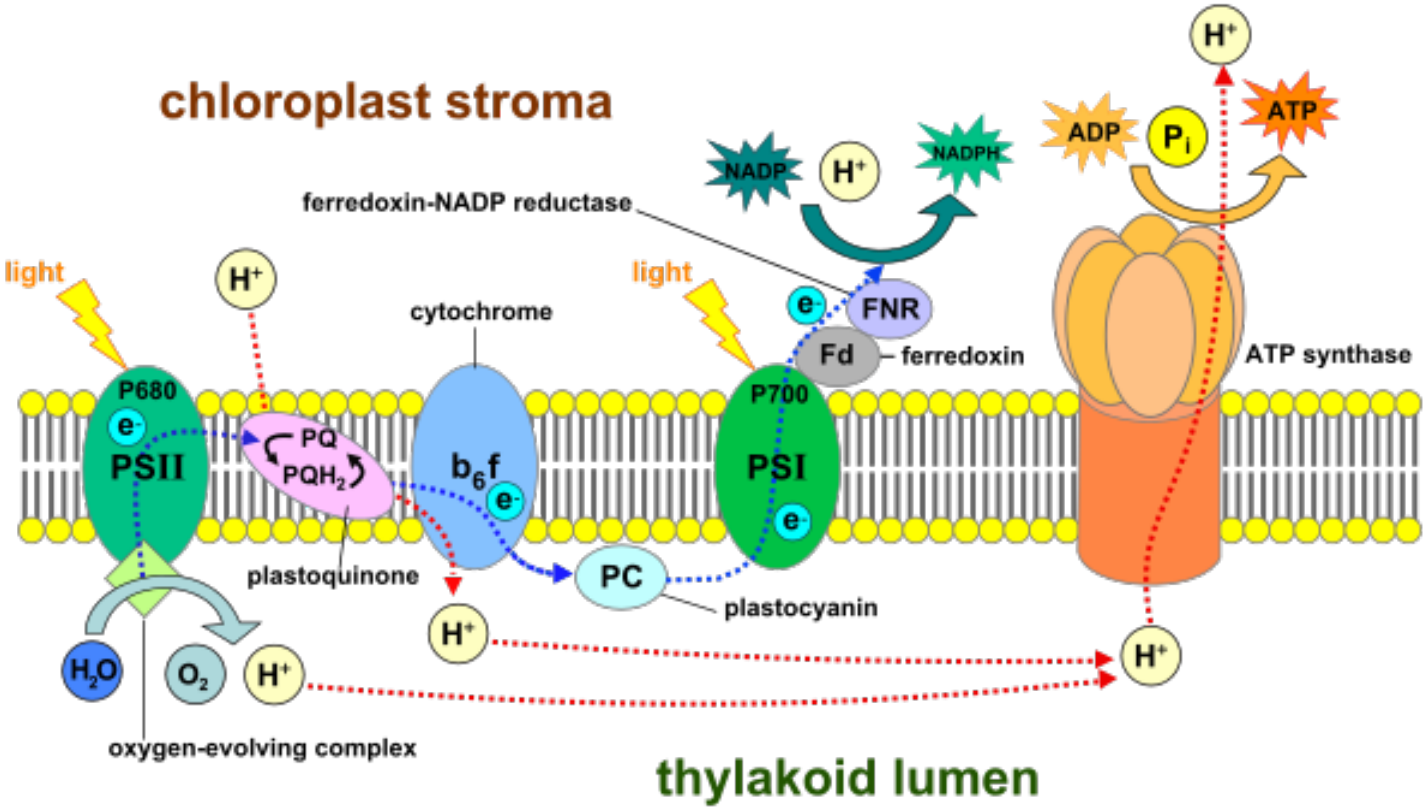
8. Ferrodoxin carries the electron to **NADP⁺ reductase** to form NADPH in the stoma (used in the light independent reaction)

EXAMPLE: NADP⁺ reductase forming NADPH in stroma



9. The H⁺ gradient is funneled through ATP synthase to form ATP

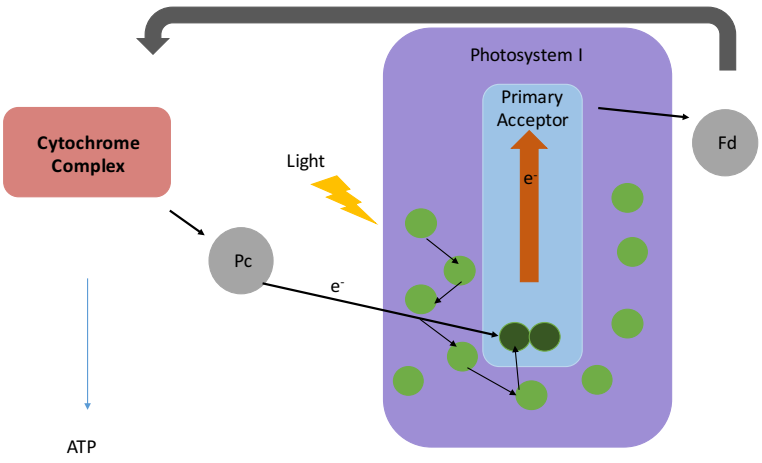
EXAMPLE: Overview of photosynthesis



Cyclic Light Dependent Reactions (Cyclic Photophosphorylation)

- In cyclic light dependent reactions the process _____ ATP but not NADPH
  - □ Photosystem II works the same as in the linear pathways
  - □ Photosystem I works in reverse and transports an electron to the electron transport center
    - Creates more ATP instead of NADPH

EXAMPLE: Cyclic light dependent reactions



PRACTICE:

1. Which part of the photosystem is responsible for accepting a light photon?
    a. Chlorophyll
    b. Reaction Center
    c. Primary Acceptor
    d. Cytochrome

2. Oxygen is formed by a reaction occurring where?
    a. Photosystem I
    b. Photosystem II
    c. Cytochrome B_6F complex
    d. $NADP^+$ reductase

3. Where in the chloroplast is NADPH synthesized?
    a. Thylakoid membrane
    b. Grana
    c. Thylaoid lumen
    d. Stroma

4. Cyclic photophosphorylation is different than photosynthesis in what way?
    a. Photosystem II reverses and generates CO_2
    b. Photosystem I reverses and transports and electron to the electron transport center
    c. The entire process generates more NADPH than ATP
    d. Photolysis doesn't occur