Photosynthesis - Lesson 3 - The Light Dependent Reactions - pgs 188-191

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How is solar energy absorbed?

- Within the chloroplasts, chlorophyll and other pigment molecules are found in clusters embedded in the **thylakoid membranes**

- The clusters are called **photosystems**

- There are two photosystems in photosynthesis, **photosystem I and II**

- the photosystems are responsible for capturing the light energy

- Solar energy is captured when an electron in a chlorophyll molecule absorbs a photon

- The electron gains energy from the photon and is now said to be **excited**

- the electron is now passed down the electron transport chain where its energy is used.

Where do the electrons come from?

- The electrons that gain the solar energy come from the **breakdown of water molecules**

- light energy is used to break apart water molecules into oxygen ($O_{2(g)}$), hydrogen ions (H^+), and electrons

- this process is called **photolysis**

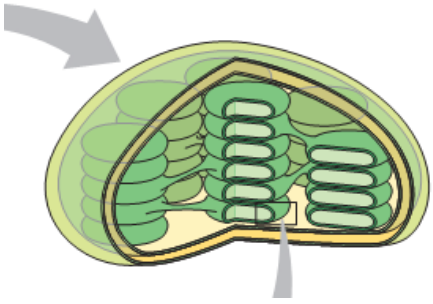
- photolysis occurs in the **thylakoid lumen**

↳ inside of the thylakoid

Two water molecules are consumed for every four electrons transferred to a photosystem.

$$2\,H_2O(l) + \text{energy} \rightarrow 4\,H^+ + 4\,e^- + O_2(g)$$

Where is the thylakoid lumen??



The Electron Transport Chain

- the electron transport chain (ETC) is a series of molecules that pass electrons along

- Key steps in electron transfer during the light-dependent reactions of photosynthesis are:

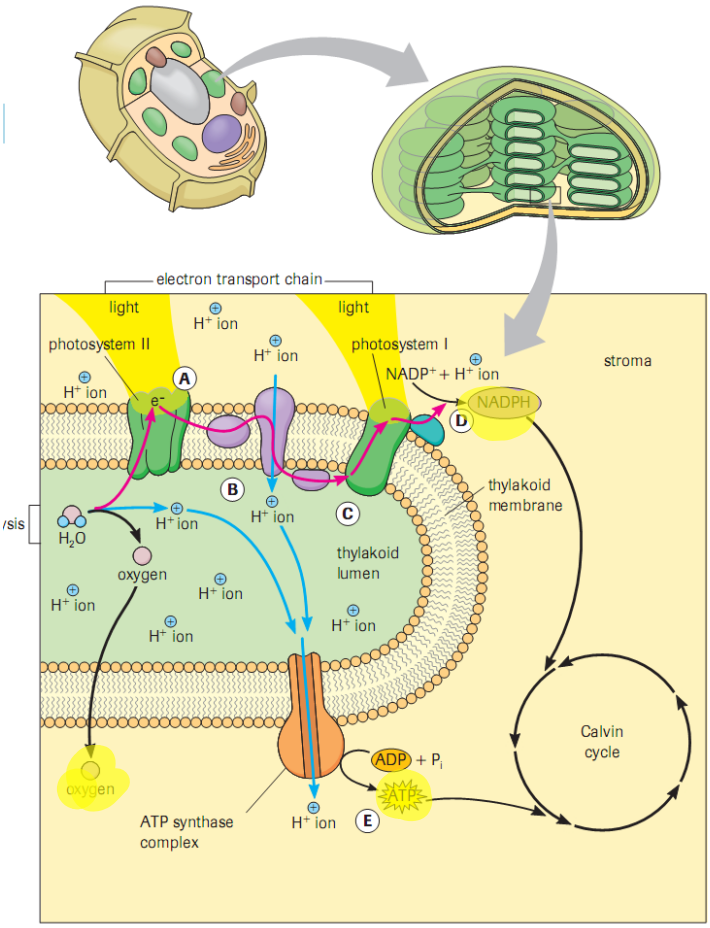
1. Electrons from **photosystem II** are transferred along an electron transport chain and across the thylakoid membrane to the inner surface of the membrane

2. Some of the electrons energy is used to pull H^+ ions across the membrane, **resulting in a build up of positive charge within the lumen**.

3. The electrons, having lost much of their original energy, are then transferred to chlorophyll molecules in the **photosystem I** complex, where they again absorb solar energy and reach an excited state.

4. High-energy electrons from photosystem I are transferred to $NADP^+$ to form NADPH.

$$NADP^+ + 2e^- + H^+ \rightarrow NADPH$$



- A reaction in which electrons are **gained** is called a **reduction** reaction

$$NADP^+ + 2e^- + H^+ \rightarrow NADPH$$

- A reaction in which electrons are **lost** is called an **oxidation** reaction

$$2\,H_2O(l) + \text{energy} \rightarrow 4\,H^+ + 4\,e^- + O_2(g)$$

Chemiosmosis

- the last step in the light-dependent reactions is **the production of ATP**

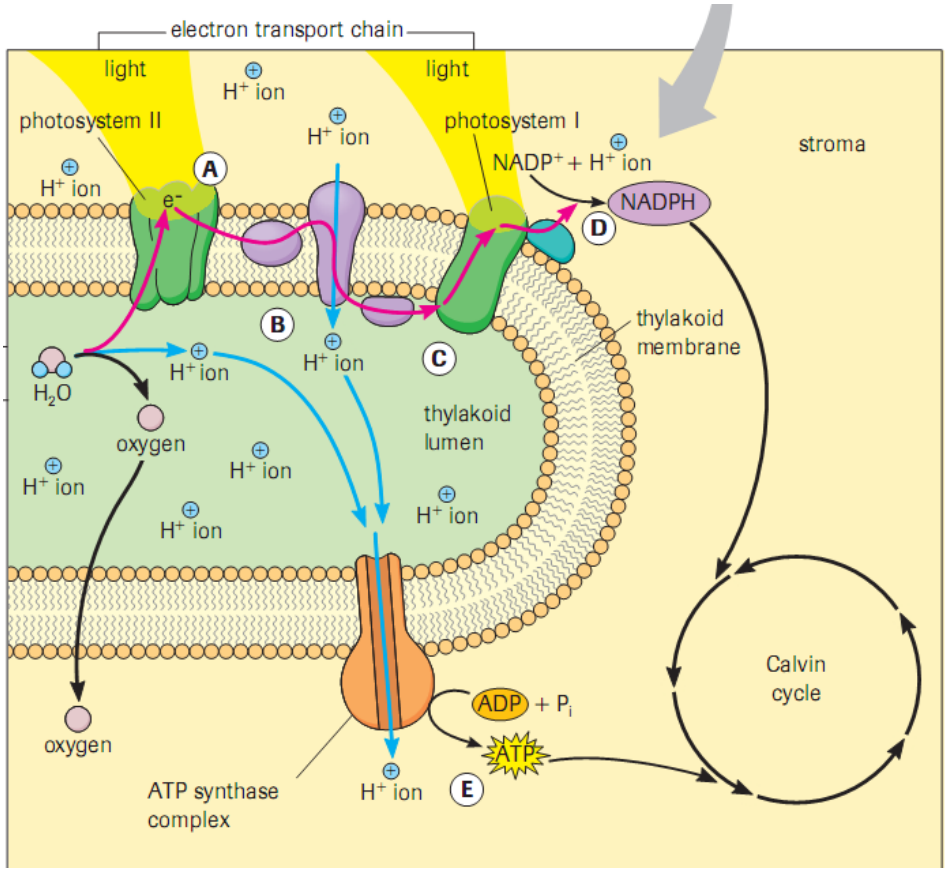
- Recall that H^+ ions were pumped into the thylakoid membrane using energy from the electron transport chain

- H^+ ions have now built up a large positive charge in the lumen and want to get out

- the only way out is through specialized protein complexes embedded in the membrane, named **ATP synthase complexes**

- The complexes are able to use some of the energy released by H^+ ions travelling through the complex to combine ADP with P_i

ADP + P + energy --> ATP



Results of Light-Dependent Reactions

1. Oxygen is produced as a result of **photolysis**

2. High energy molecule NADPH is created from **electron transport chain**

3. High energy molecule ATP is created from **chemiosmosis**

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http://www.wwnorton.com/college/biology/discoverbio4/_core/ch/08/animations.aspx

SUMMARY OF LESSON

http://www.nelson.com/ABbio20-30/teacher/protect/otr/Bio2030OTR/attachments/i_AnimationSimulation/noncyclic_v3.html