Photosynthetic Light Reactions

Photosynthesis is the process in which plants use light to generate energy. The reactions are divided into two categories. Light reactions occur in the areas of the plant exposed to light, while dark reactions do not require light. The light reactions occur in the thylakoid of chloroplasts. The electron transport chain spans the thylakoid membrane. Within the chain, chlorophyll in Photosystems II and I absorbs light and loses high-energy electrons. Those electrons are used at the end of the chain to reduce NADP to NADPH. The electron transport chain also pumps protons into the lumen, or inside area, of the thylakoid. This creates a proton gradient across the membrane, which is used by ATP synthase. ATP synthase pumps protons from the lumen out into the stroma of the chloroplast (equivalent to the cytosol in human cells). It couples this with synthesizing ATP from ADP and inorganic phosphate. The final part of the process is the conversion of water to diatomic oxygen gas. High energy electrons are released and used to replenish the electrons lost by chlorophyll at the start of the process.

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Occurs in thylakoid membrane of chloroplasts
Occurring at Thigh-Liquor on Clover-Plate
The light reactions of photosynthesis in plants occur in chloroplasts. Within chloroplasts are membrane-bound compartments called thylakoids. The light reactions occur across the thylakoid membrane.

Chlorophylls absorb light and lose electrons
Clover-Phil with Light-Sponge losing an Electron
Chlorophylls are green pigments inside the thylakoid. When they are exposed to light, they absorb light and lose high-energy excited electrons.

Electron transport chain embedded in membrane
Electron Chain in the Membrane
The electrons lost by the chlorophyll are transferred through the electron transport chain, which is a series of protein complexes embedded in the thylakoid membrane. These protein complexes transfer electrons to the final electron acceptor.

Photosystems II and I transfer electrons
Photographer in (2) Tutu and Photographer with (1) Wand Transferring Electrons
Photosystem II is the first protein complex in the electron transport chain, and Photosystem I is one of the last protein complexes. Both of them contain chlorophyll, absorb light, and release high-energy electrons.

Electrons reduce NADP to NADPH
Electrons smoking NADP Cigarette with H+
The final part of the electron transport chain is a protein complex called ferredoxin-NADP reductase. It reduces NADP to NADPH with the electrons given off by the chlorophyll.

Electron transport chain creates H+ gradient by pumping protons
H+ Grater and Proton Pump in Electron Chain
The protein complexes in the electron transport chain also pump protons into the lumen of the thylakoid and create a proton gradient across the membrane. This proton gradient is used to fuel ATP production.

ATP Synthase Transports H+ Into the Stroma
ATP-battery Cent-face Transporting H+ to Straw-man
ATP synthase uses the proton gradient created by the electron transport chain to transport hydrogen ions from the thylakoid lumen into the chloroplast stroma. This process drives ATP production.

ATP Synthase Makes ATP From ADP and Phosphate
ATP-battery Cent-face Making ATP-battery with ADP and P
ATP synthase uses the proton gradient to make ATP from ADP and inorganic phosphate.

Water converted to O₂ to replenish electrons in chlorophylls

Water Pouring Into the O2-Tank spraying Electrons at Clover-Phil

Water is converted to diatomic oxygen gas in the chloroplast. In this process, it gives up high energy electrons that are used to replace those that the chlorophyll lost to the electron transport chain.