

Photosynthesis

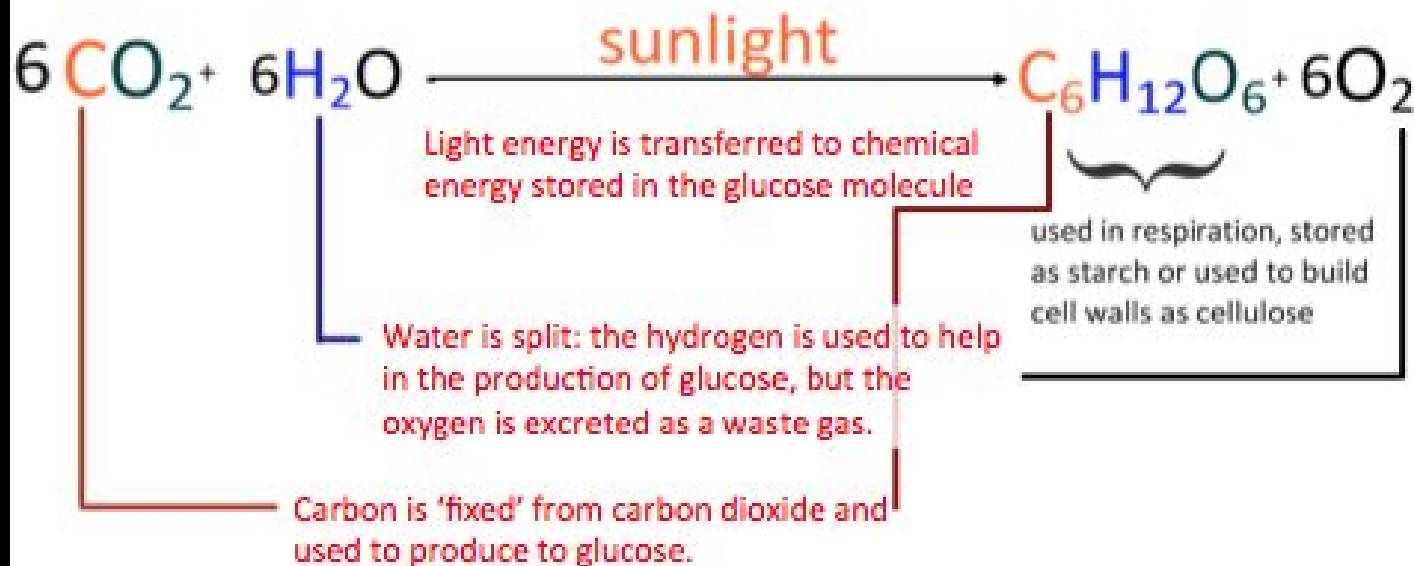
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(From SL) 2.9.U1 Photosynthesis is the production of carbon compounds in cells using light energy.

Photosynthesis

using light production

Photosynthesis is a metabolic pathway. Carbon dioxide and along with water is used to produce carbohydrates. Oxygen is released as a waste gas.



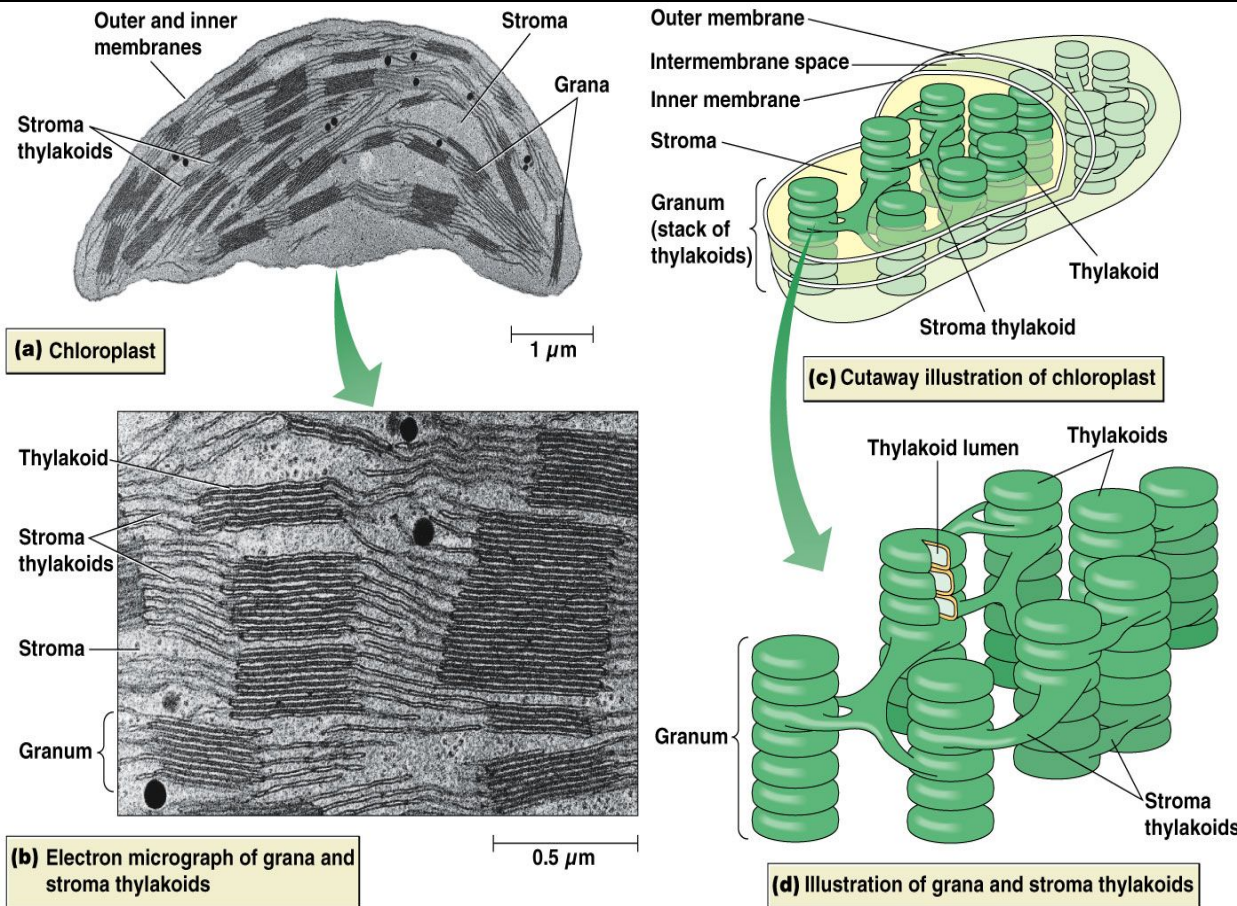
n.b. metabolic pathways are controlled by enzymes

Photosynthesis: small picture

Understandings:

- Light-dependent reactions take place in the intermembrane space of the thylakoids
- Light-independent reactions take place in the stroma
- Reduced NADP and ATP are produced in the light-dependent reactions
- Absorption of light by photosystems generates excited electrons
- Photolysis of water generates electrons for use in the light-dependent reactions
- Transfer of excited electrons occurs between carriers in thylakoid membranes
- Excited electrons from Photosystem II are used to contribute to generate a proton gradient
- ATP synthase in thylakoids generates ATP using the proton gradient
- Excited electrons from Photosystem I are used to reduce NADP
- In the light-independent reactions a carboxylase catalyses the carboxylation of ribulose biphosphate
- Glycerate-3-phosphate is reduced to triose phosphate using reduced NADP and ATP
- Triose phosphate is used to regenerate RuBP and produce carbohydrates
- Ribulose biphosphate is reformed using ATP
- The structure of the chloroplast is adapted to its function in photosynthesis

8.3U 14 : Structure of chloroplast is adapted to function in photosynthesis

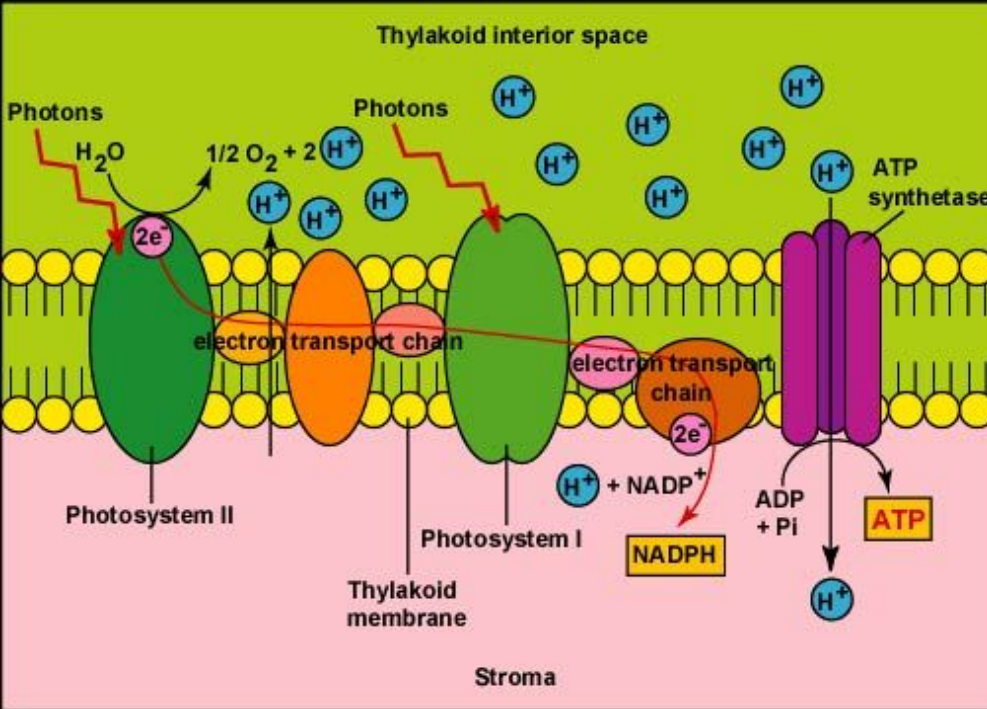


8.3U1 Light dependent rxn: intermembrane of thylakoids

8.3U3 Light independent rxn: stroma

1. Light Reaction: Big Picture

8.3U2 Light energy splits water to create a concentration gradient to drive ATP production.



Reactants: photons, water

Products: Reduced NADP and ATP

1. Photoactivation- light excites electrons
2. Photolysis- splits water
3. Electron Transport Chain- transfer of electrons between thylakoid membranes
4. ATP synthesis- driven by ETS
5. Photophosphorylation- Reduction of NADP

2. Photoactivation

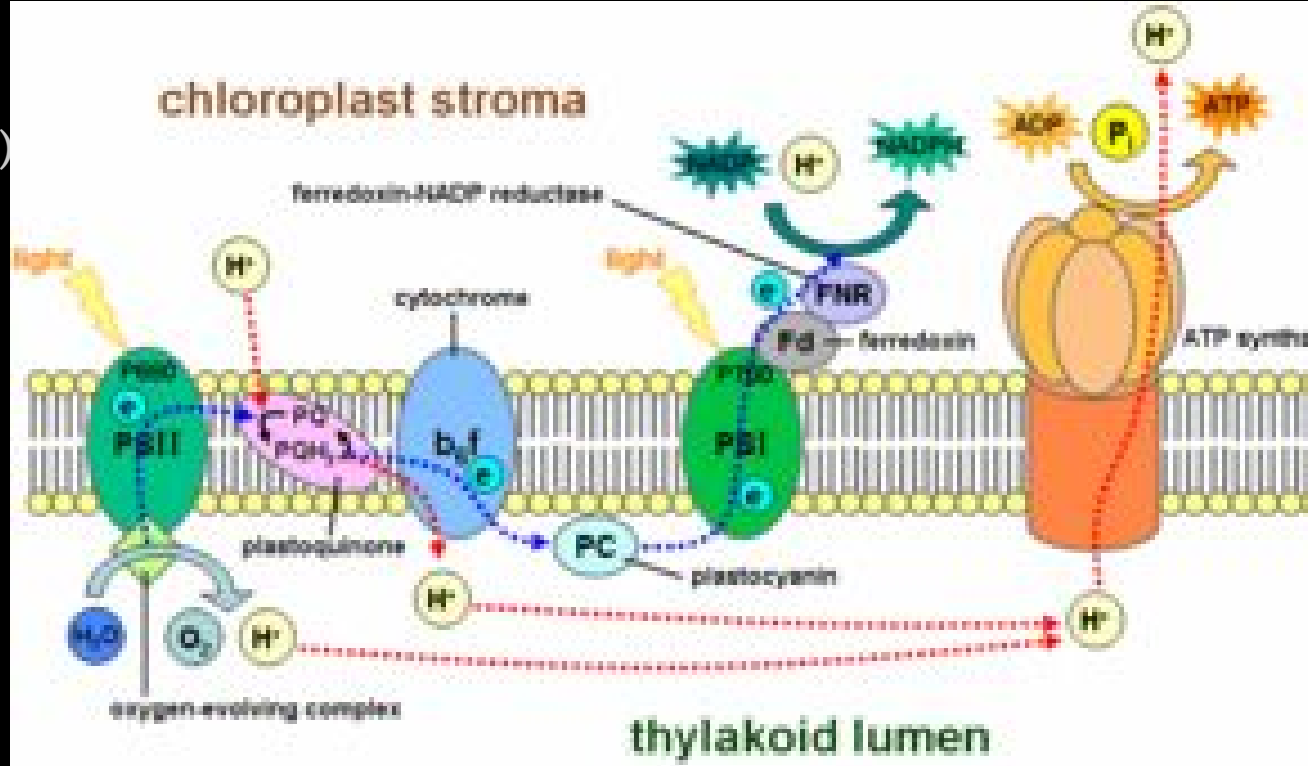
8.3U.4 Photons become concentrated in photosystem II and e^- becomes excited!

(2 times) Plastoquinone (Pq) carries $2e^-$ to photosystem I

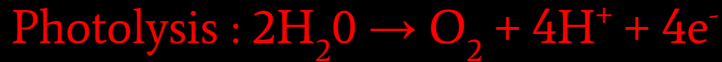
OUTCOME: chlorophyll is oxidized to drive photolysis

IN: photons

OUT: $4e^-$, 2 Pq



3. Photolysis = Light + Split

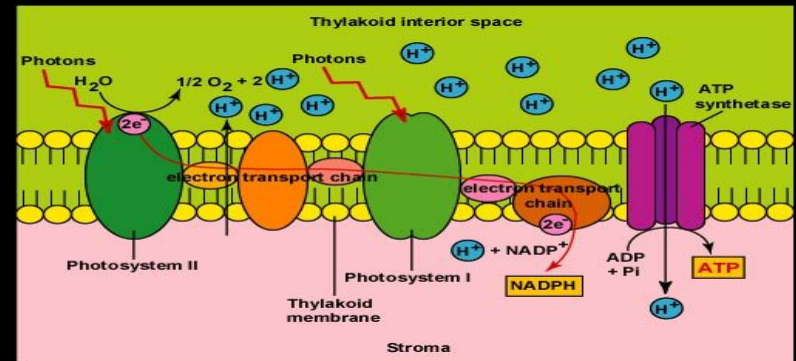
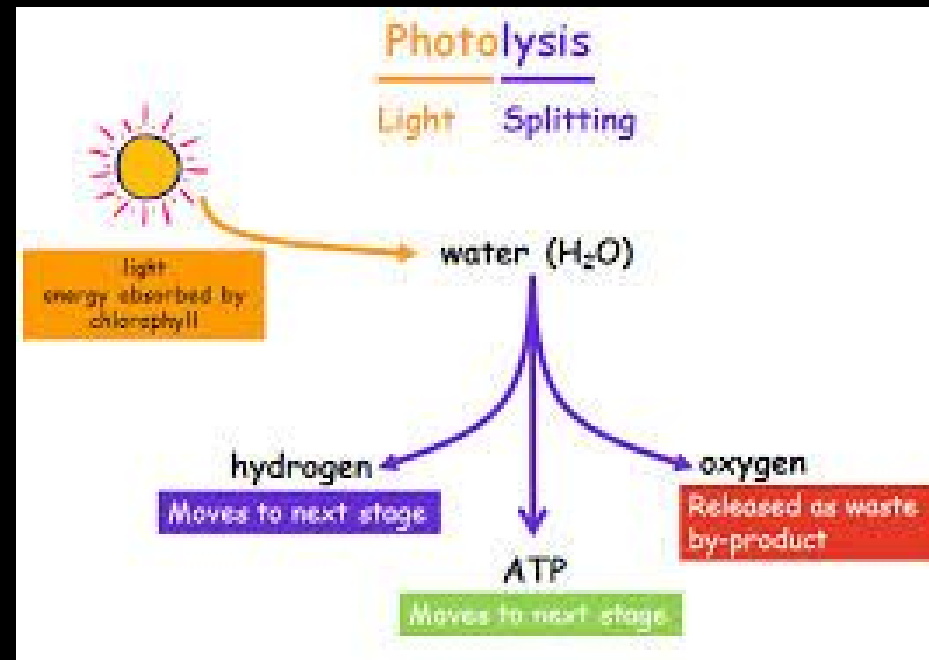


Oxygen is waste!

Location: fluid in thylakoids

Chlorophyll has replenished electrons and Pq can begin transporting again

8.3.U.5 Electrons from photolysis drives the rest of photosynthesis

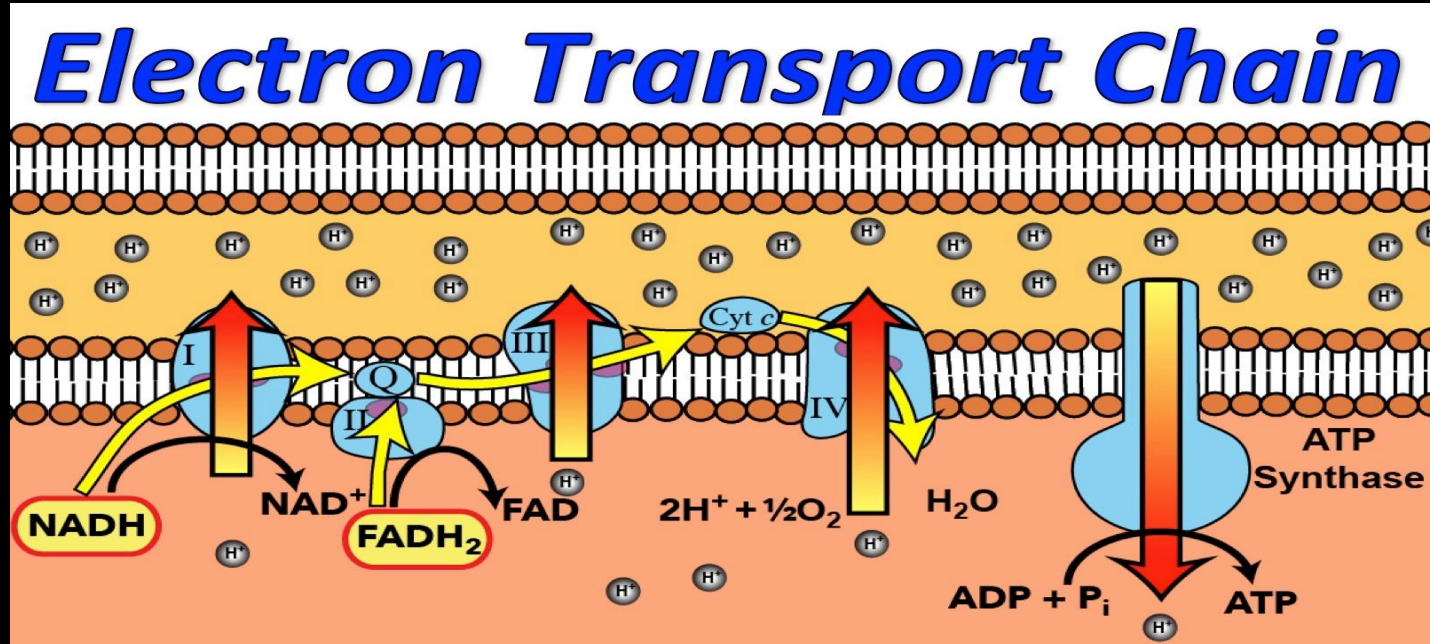


4. Electron Transport Chain (ETS)

http://www.mhhe.com/biosci/bio_animations/02_MH_Photosynthesis_Web/

8.3U.6 Location: thylakoid membranes

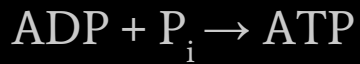
8.3.U.7 Electrons pass down the chain from PII, creating a proton (H^+) gradient \rightarrow potential energy



5. ATP Synthesis

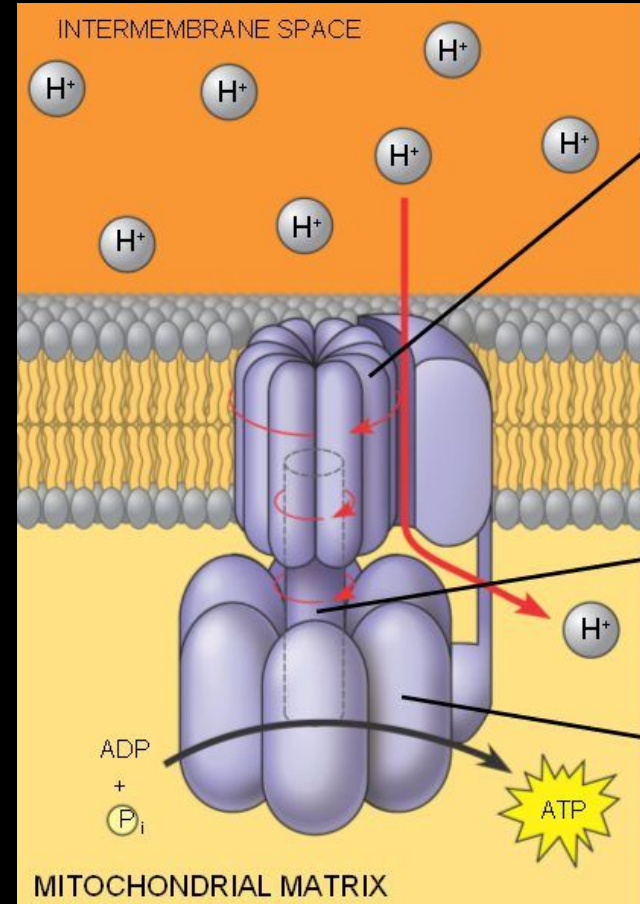
8.3U8. **ATP Synthase** - enzyme that uses protons travelling down concentration gradient to synthesize ATP.

Electron carriers: Used to transfer electrons from one protein to another and create a concentration gradient



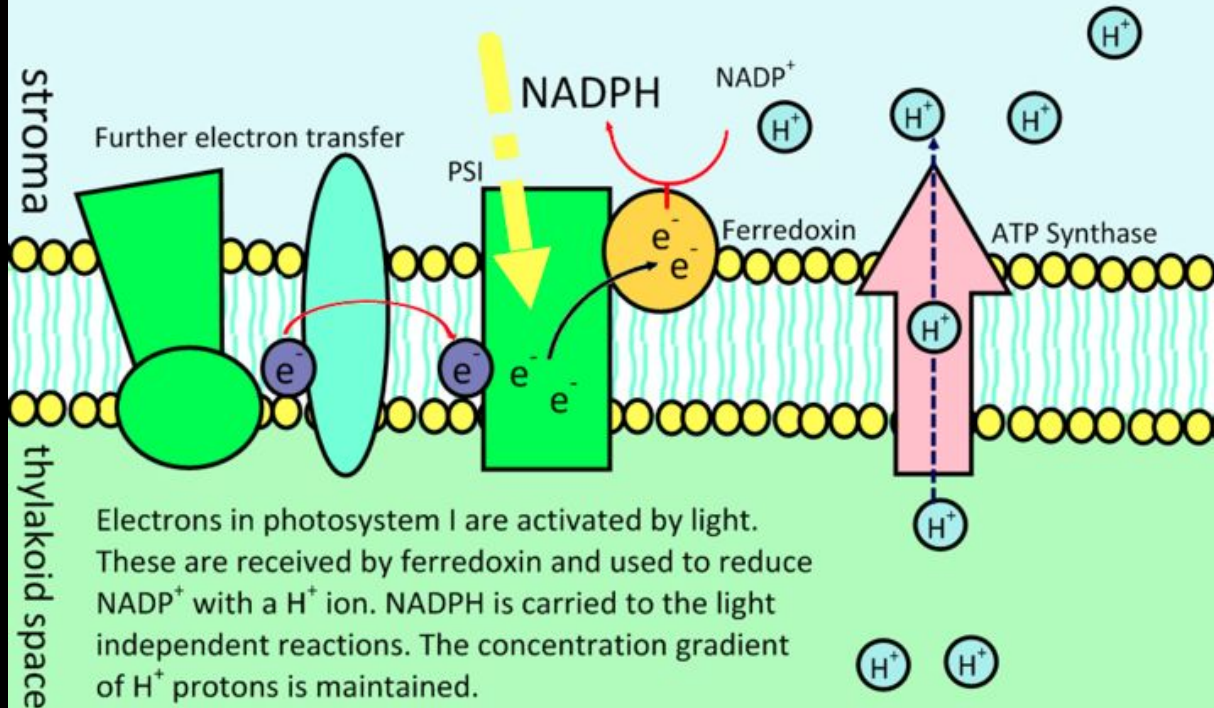
Chemiosmosis- Flow of ions through a membrane

<http://www.sigmaaldrich.com/life-science/metabolomics/learning-center/metabolic-pathways/atp-synthase/atp-animation.html>



6. Reduction of NADP

NADP⁺ is reduced to NADPH



- PI gets photoactivated activated
- Pass e⁻ to ferredoxin
- NADP gets reduced → NADPH
- NADPH is necessary for light independent reactions

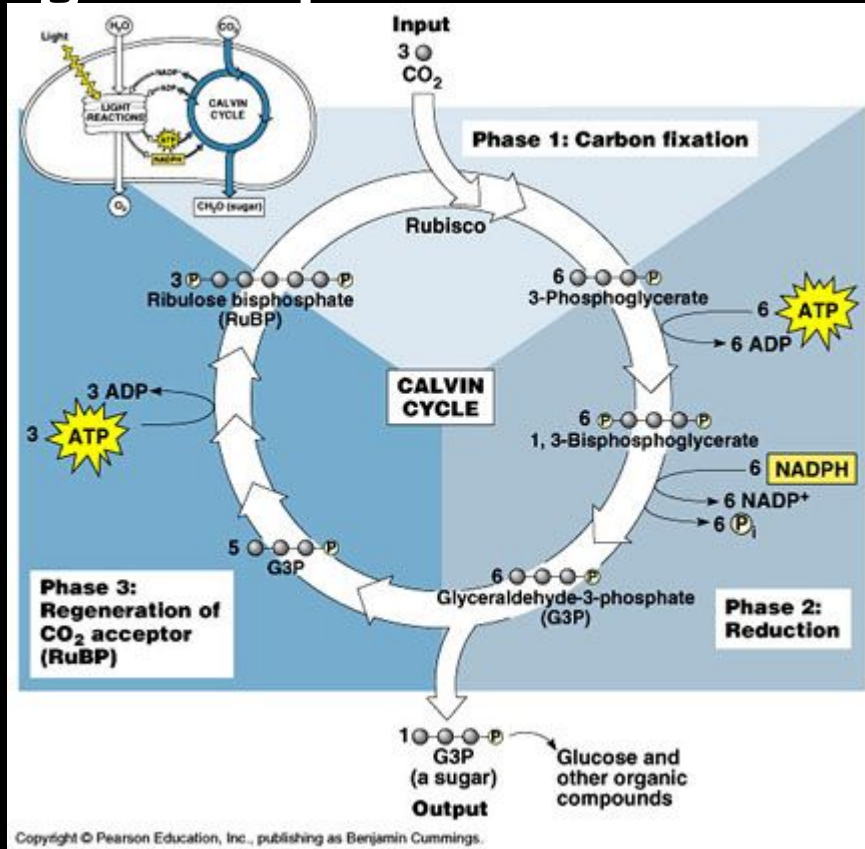
What are the reactants and products in the light dependent reaction?

Where does it take place?

What are all the moving parts?

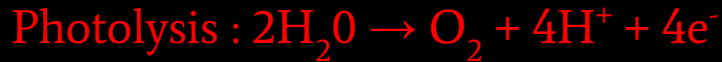
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Light Independent Reaction



1. Carbon Fixation
2. Reduction
3. Regeneration of RuBP

3. Photolysis = Light + Split

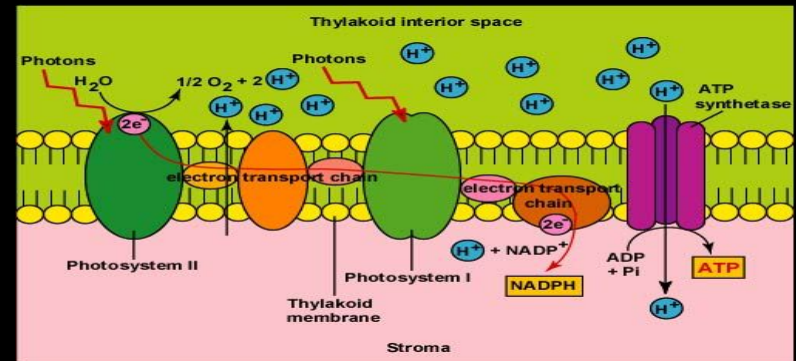
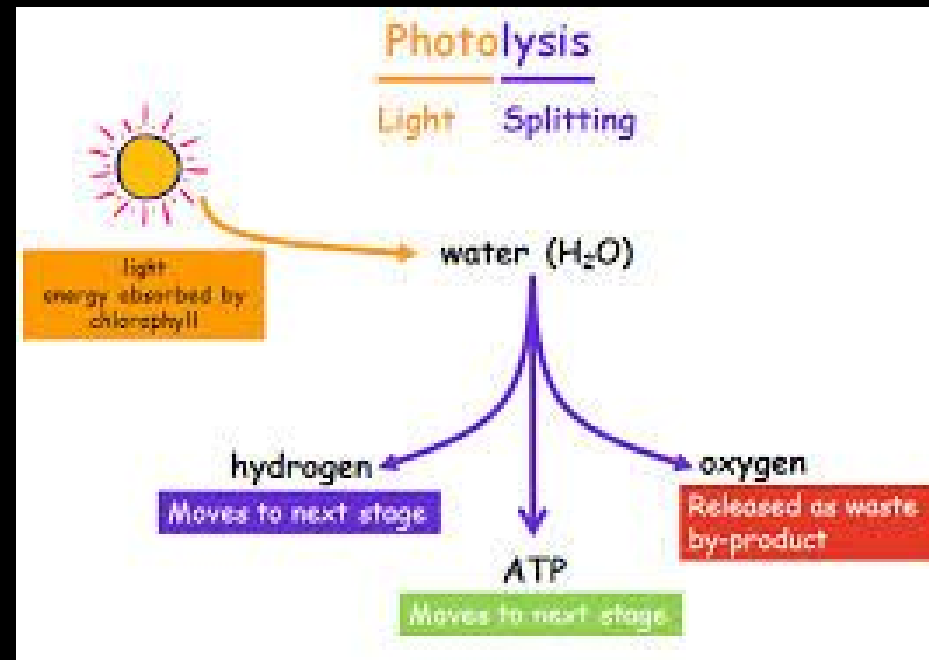


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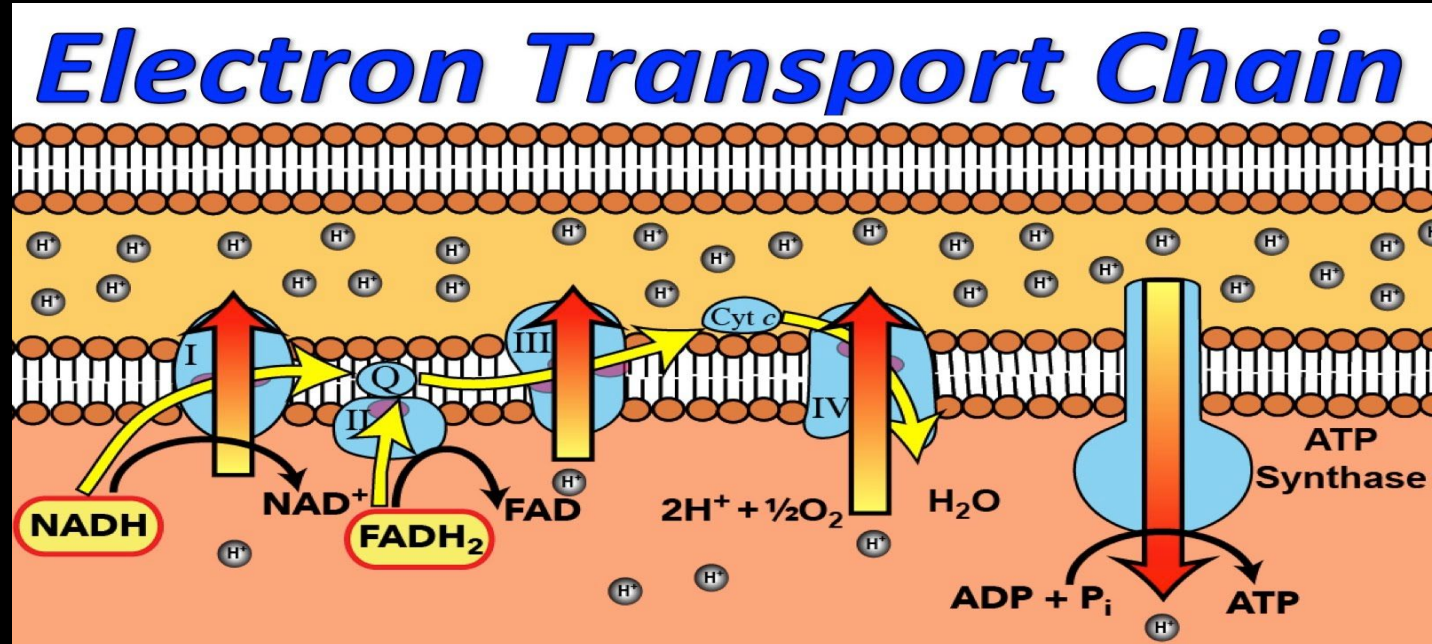


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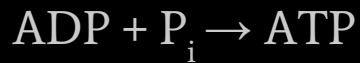
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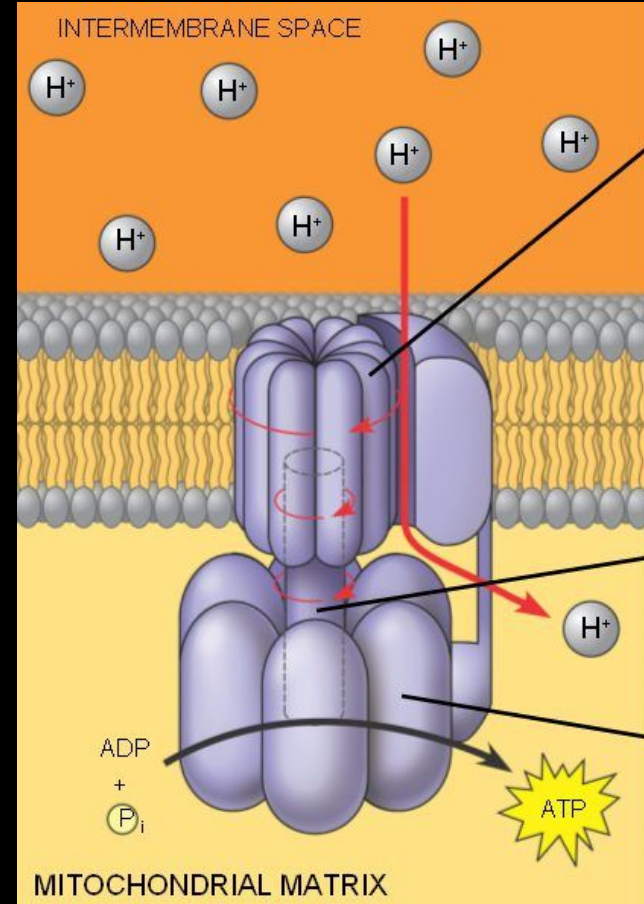
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Electron carriers: Used to transfer electrons from one protein to another and create a concentration gradient

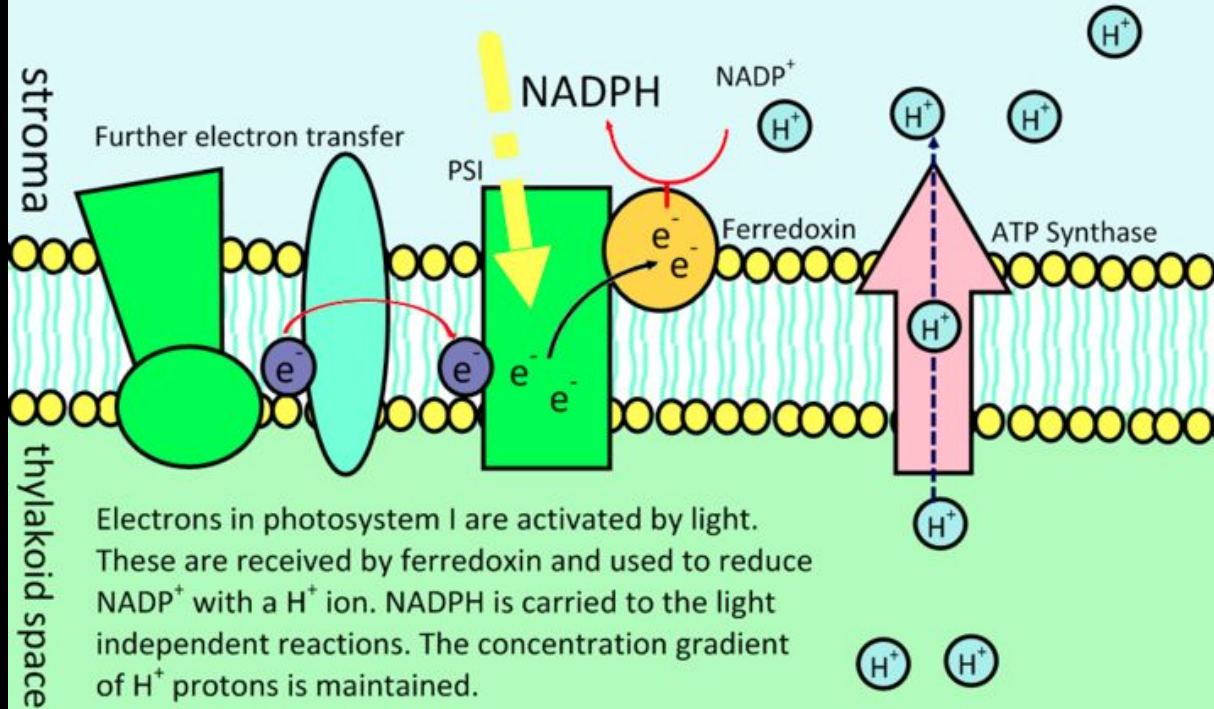


Chemiosmosis- Flow of ions through a membrane



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- Pass e⁻ to ferredoxin
- NADP gets reduced → NADPH

- NADPH is necessary for light independent

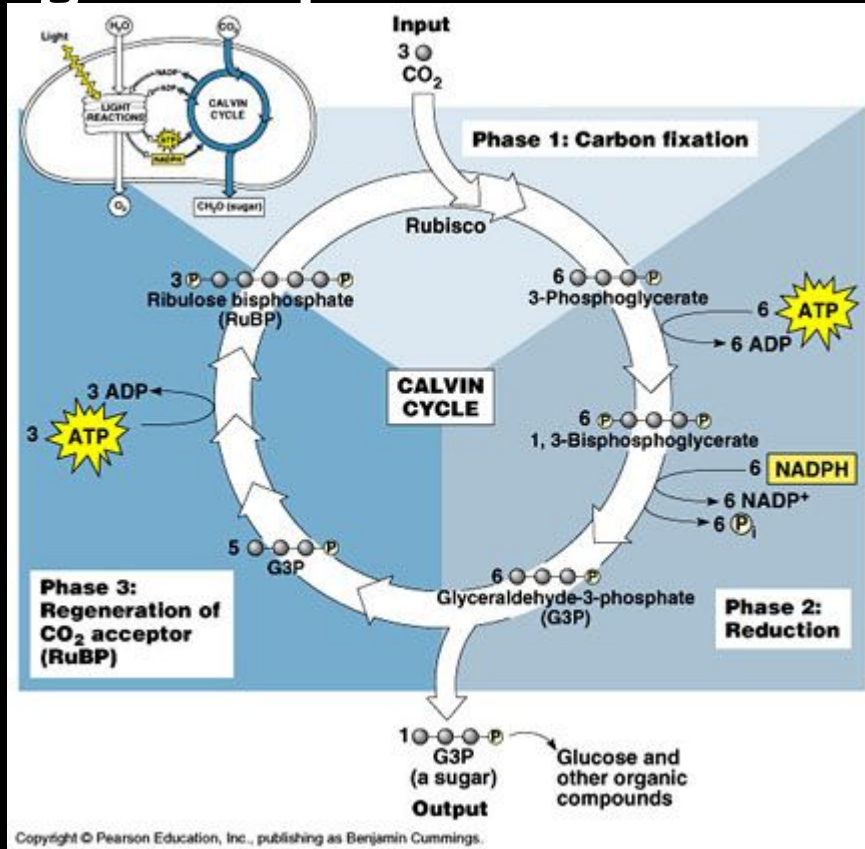
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