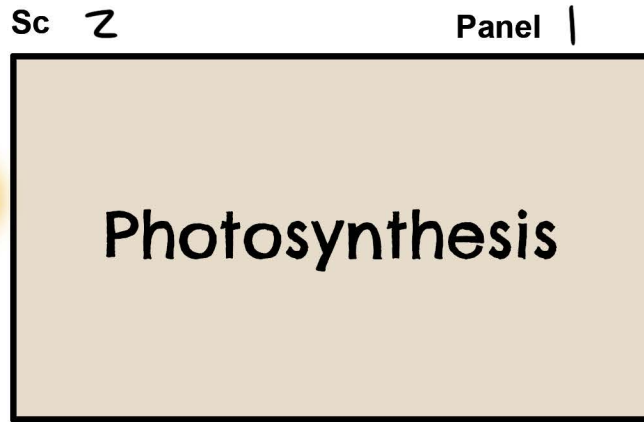
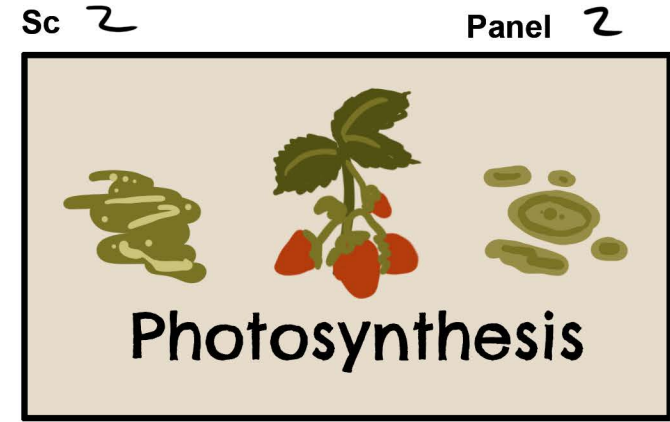


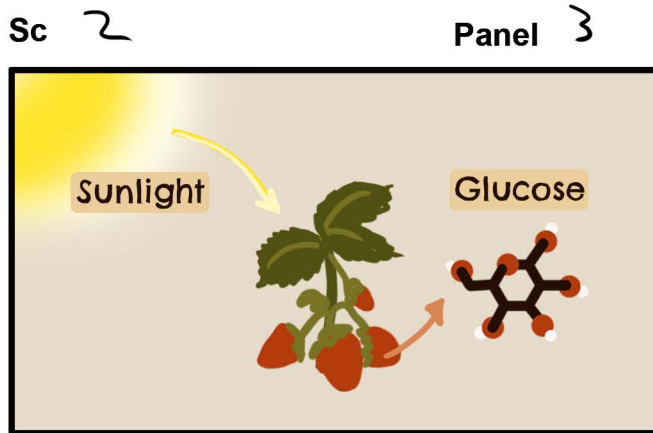
"All right, if cellular respiration is how we use..."
 (conveyor belt visual of glucose molecules going in and ATP coming out)



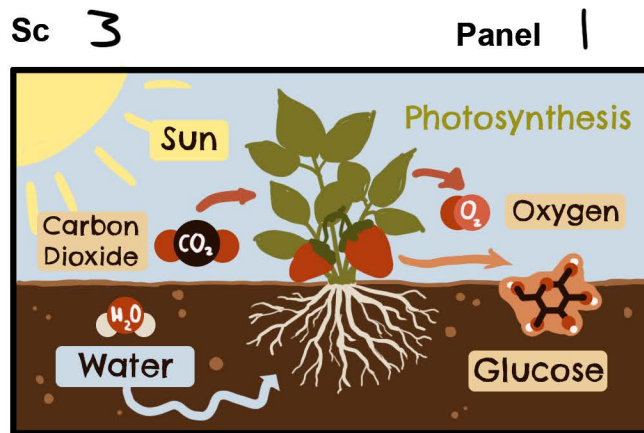
"The answer is Photosynthesis, the process"



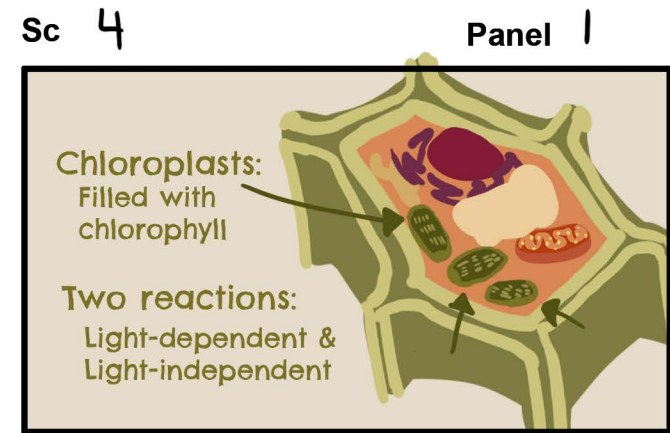
"that allows plants, algae, and some bacteria..."
 (pop up the images as they're said)



"to transform light energy from the sun into chemical..."



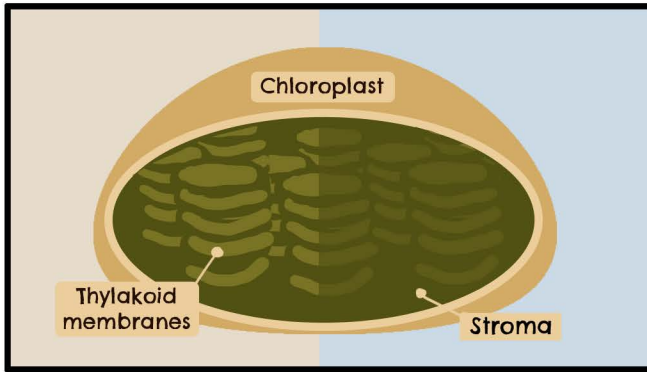
"Here is the overall big picture of photosynthesis."



"Photosynthesis happens inside chloroplasts..."

Sc 5

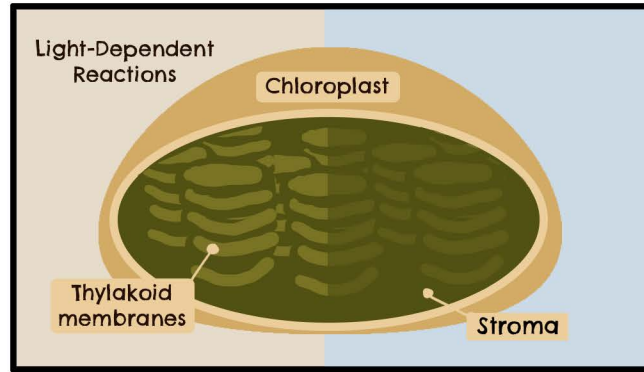
Panel 1



"Inside the chloroplasts, photosynthesis happens in two main stages."

Sc 5

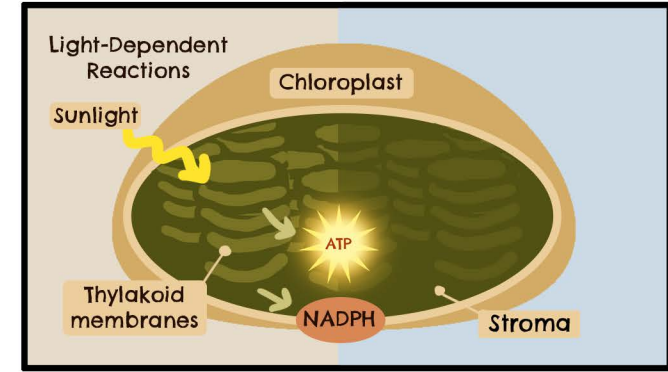
Panel 2



"The first one are the light-dependent reactions,"

Sc 5

Panel 3

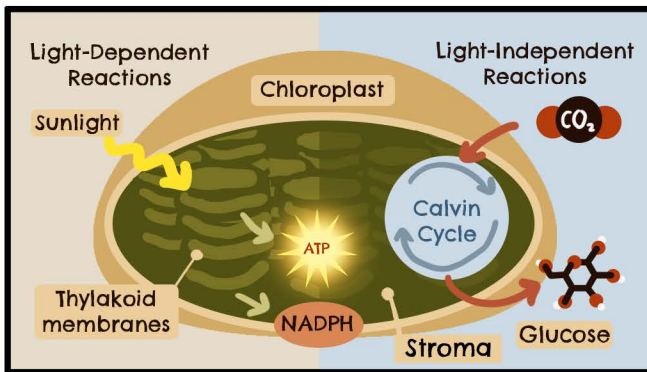


"Which capture sunlight and make the energy molecules ATP and an electron carrier known as NADPH."

(pop up each element as discussed)

Sc 5

Panel 4

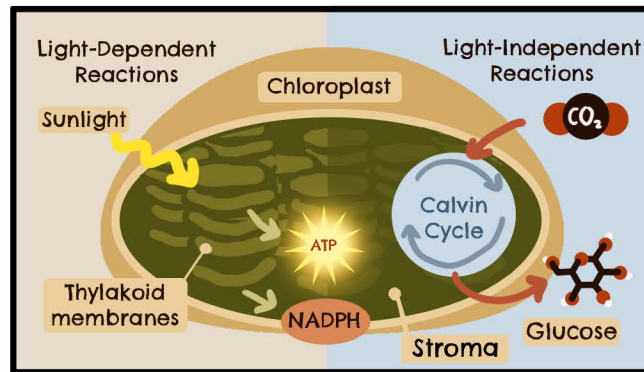


"The second part is the light-independent reactions..."

(pop up each element as discussed)

Sc 5

Panel 5

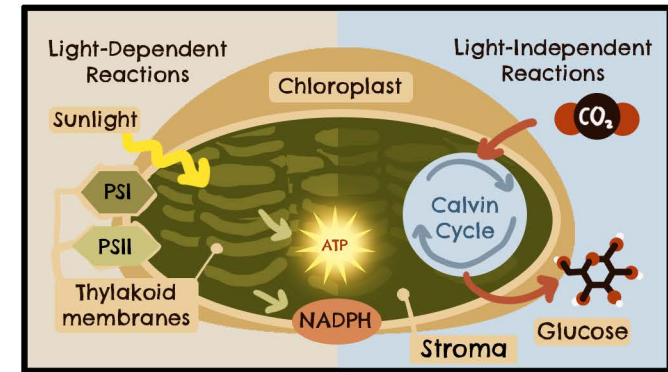


"The light-dependent reactions take place in the thylakoid membranes..."

(pop up each element as discussed, Thylakoid membranes label grows and shrinks)

Sc 5

Panel 6

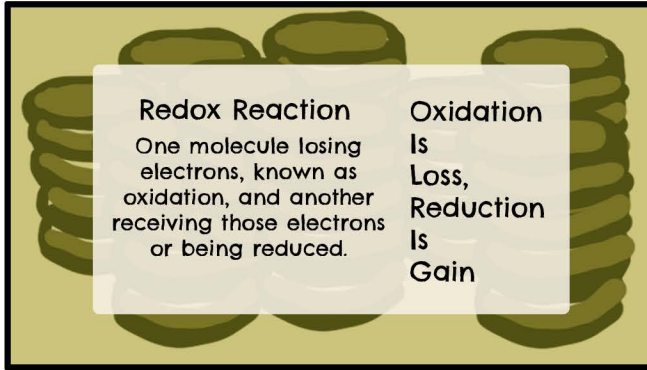


"two special protein complexes that work together, photosystem II and photosystem I..."

(pop up each element as discussed)

Sc 6

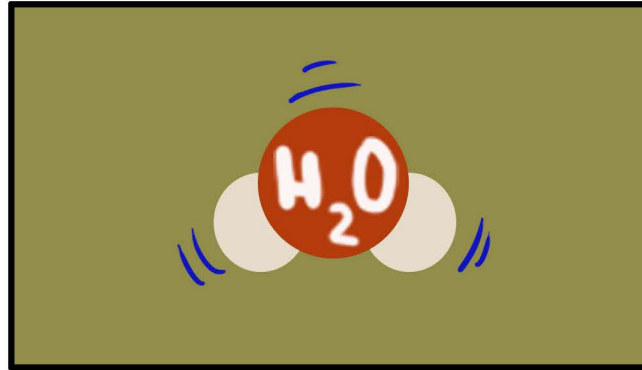
Panel 1



"A redox reaction, as a reminder, involves..."
(pop up each element as discussed)

Sc 7

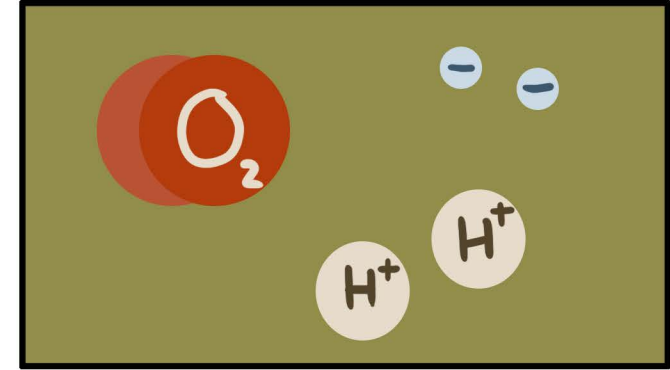
Panel 1



"In photosynthesis, water is oxidized."
(H2O starts vibrating as it's about to split)

Sc 7

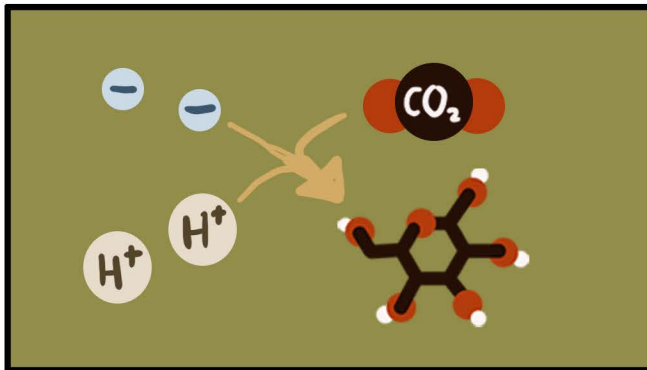
Panel 2



"It loses electrons when it's split, and carbon dioxide..."
(Splits into all its parts and they drift for a sec)

Sc 7

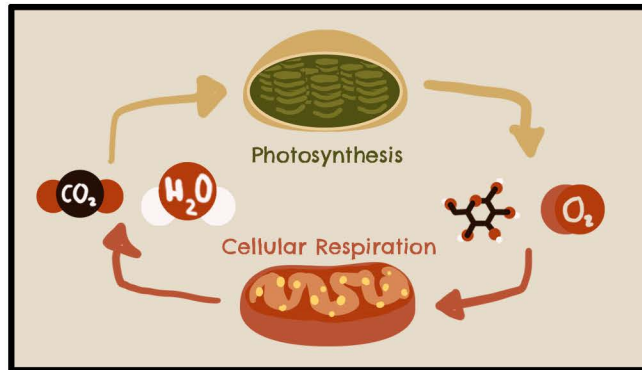
Panel 3



"It gains electrons to become glucose. Every time an electron is transferred, energy moves with it."

Sc 8

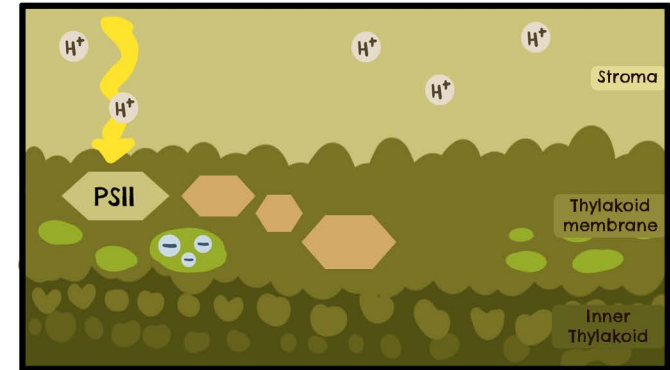
Panel 1



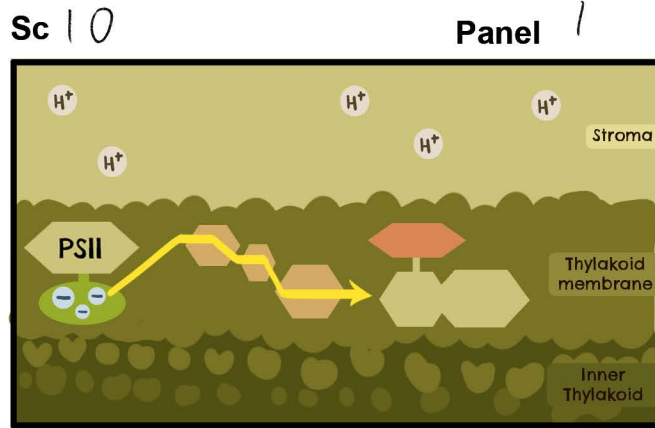
"The flow of electrons..."

Sc 9

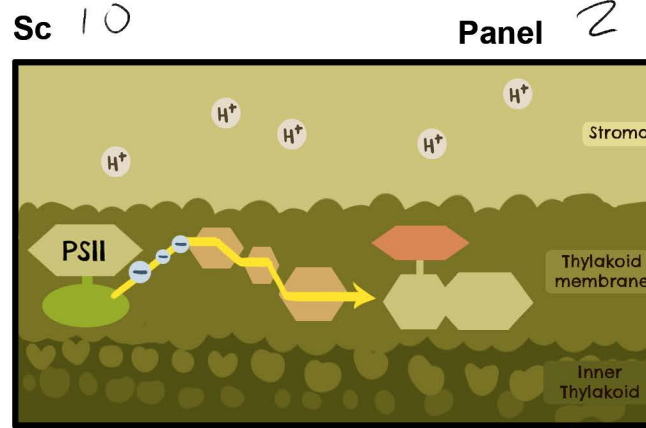
Panel 1



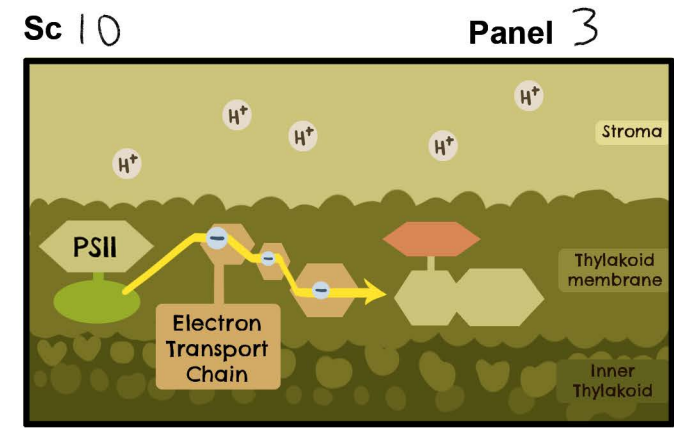
"When sunlight hits photosystem II, or PSII"



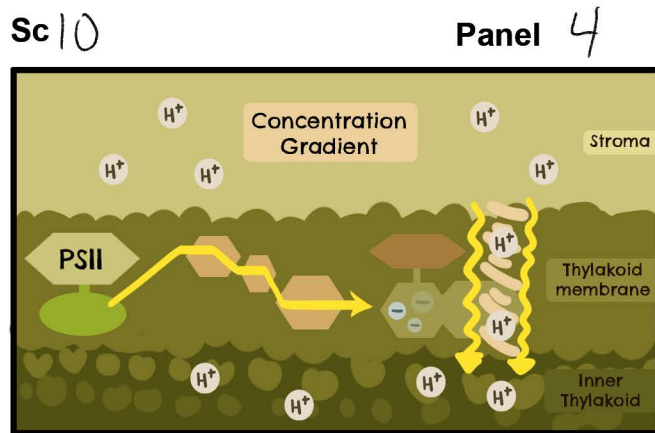
"The light energy excites electrons in the chlorophyll molecules, like sunlight jolting them awake."
 (Wiggle around the electrons and make them glow, and they move up to the top of the 'slide'. Also the hydrogens are lazily drifting)



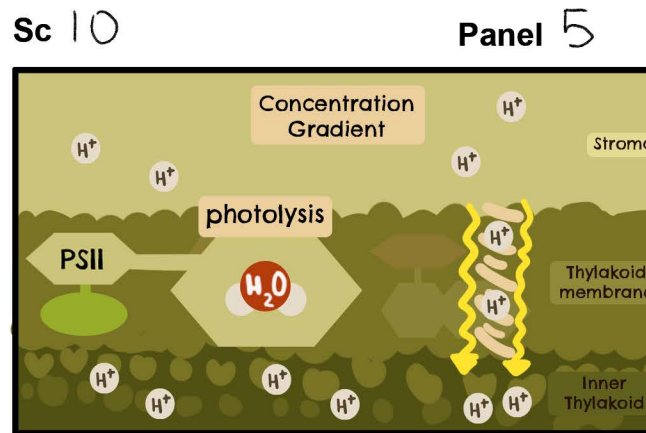
"These high-energy electrons are boosted up to a higher energy level, like being pushed to the top of a slide."
 (Wiggly, excited electrons go down the slide, vibrating less as they go to the bottom)



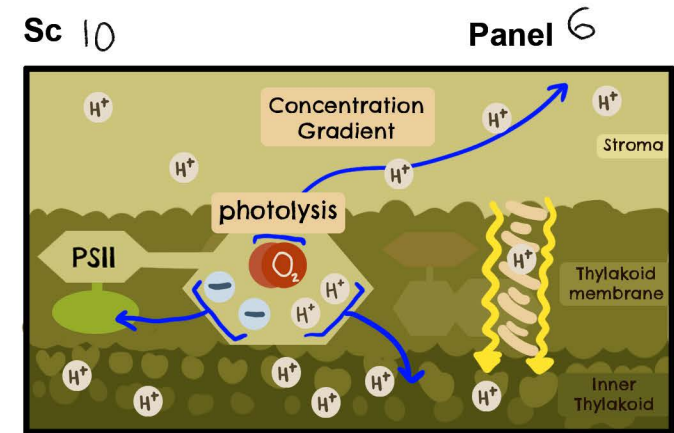
"Those excited electrons leave the chlorophyll molecule and are passed down an electron transport chain, a series of proteins embedded in the thylakoid membrane."
 (Wiggly, excited electrons go down the slide, vibrating less as they go to the bottom)



"That released energy is used to pump hydrogen ions from the stroma into the thylakoid space, building up a concentration gradient, like we saw with cellular respiration. The electrons that left chlorophyll must be replaced."
 (Electrons go into PSI node and fade out, H+ ions go down into the membrane)



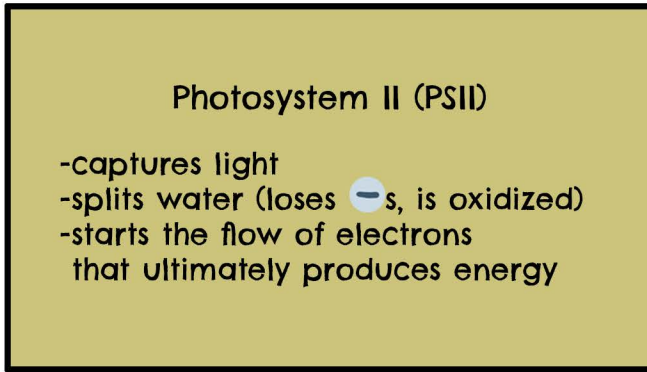
"To get new electrons, PSII splits water molecules, a process called photolysis."
 (H2O splitting)



"Each water molecule splits into two electrons, which refill the chlorophyll; two hydrogen atoms, which add to the gradient, and oxygen, which is released as a gas."
 (Animate each element moving to the appropriate place in time with the description)

Sc 12

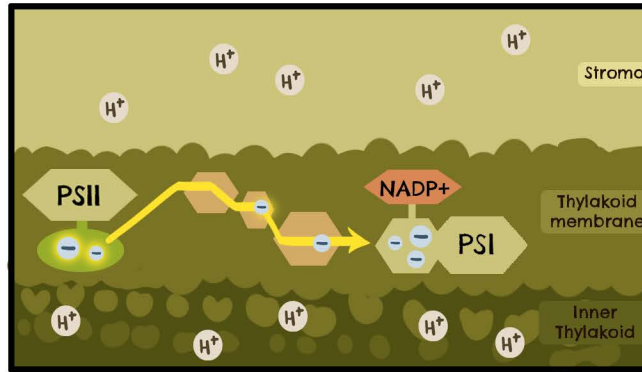
Panel 1



"So photosystem II captures..."

Sc 13

Panel 1

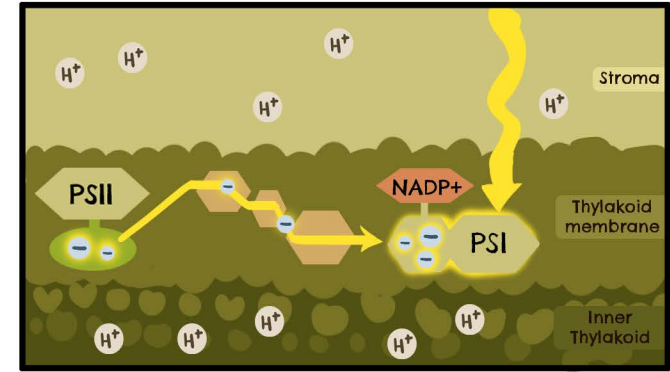


"Next up, those electrons travel down the electron transport chain to photosystem I, or PSI. By the time they arrive, the electrons have lost some energy."

(Vibrating electrons start in the chloroplast, shot up and go down the slide, slowing down as they reach the end)

Sc 13

Panel 2

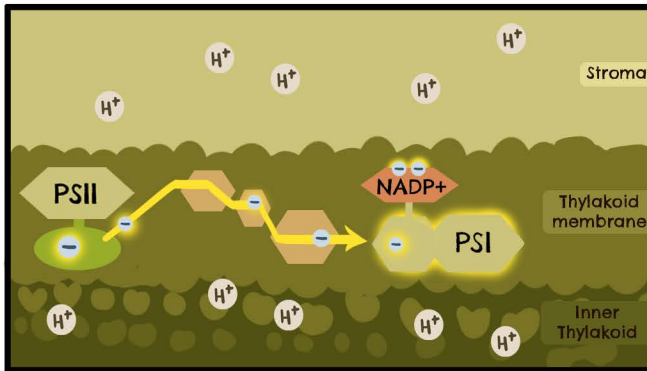


"PSI uses a second photon of light to reenergize electrons, boosting their energy levels again."

(Sunlight arrow comes down and makes the electrons glow and vibrate a lot again)

Sc 13

Panel 3

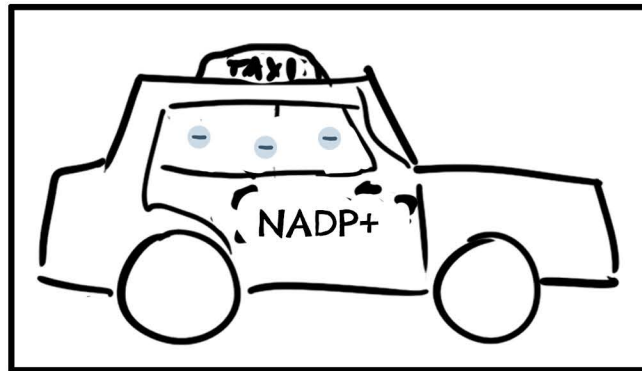


"These newly energized electrons are then transferred to a molecule called NADP+."

(Glowing, vibrating electrons move to NADP+)

Sc 14

Panel 1

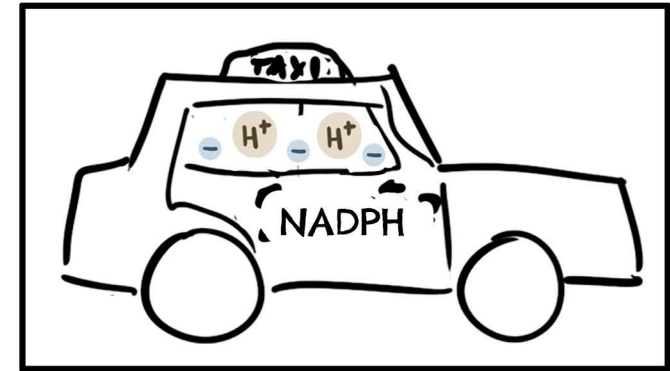


"NADP+ acts like the NAD+ electron taxi we saw..."

(Refer to Cellular Respiration taxi scene and asset)

Sc 14

Panel 2

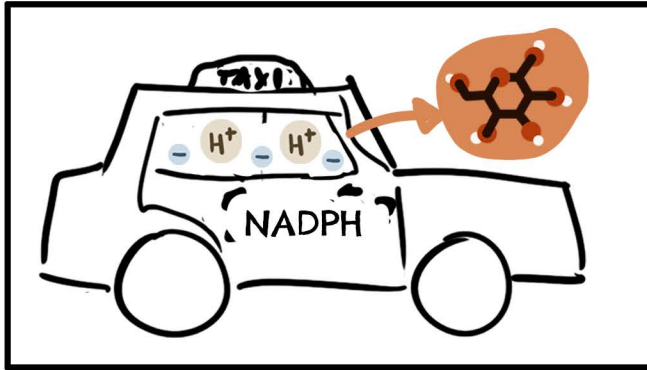


"along with hydrogen ions, forming NADPH"

(The hydrogens pop in and the + turns into H)

Sc 14

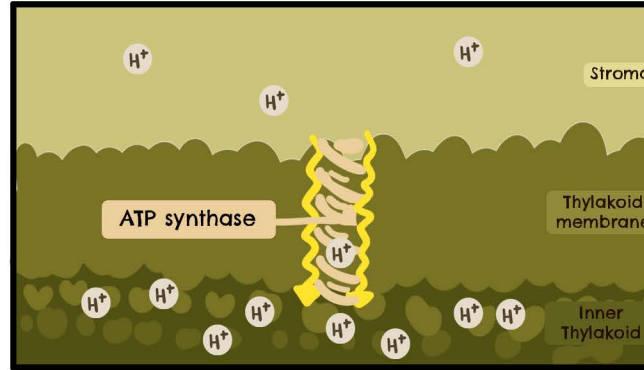
Panel 3



"where they will be used to help build glucose."

Sc 15

Panel 1

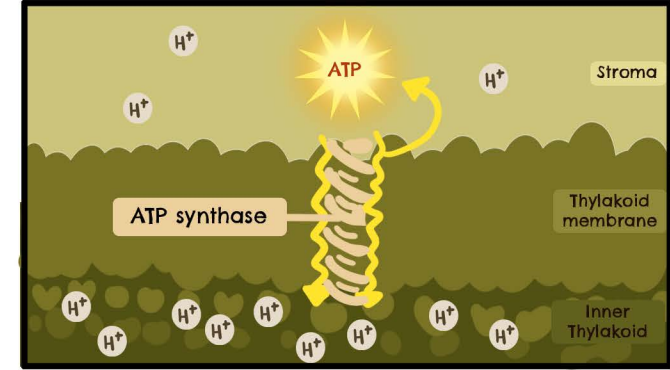


"Meanwhile, we will look back at all those hydrogen..."

(The hydrogens should continue to float around, with one occasionally going down the synthase. If we can make the ATP synthase look like it's spinning like a turbine that would be cool too.)

Sc 15

Panel 2

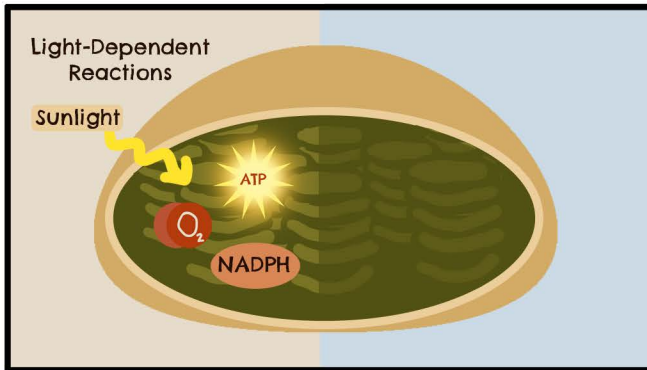


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Sc 16

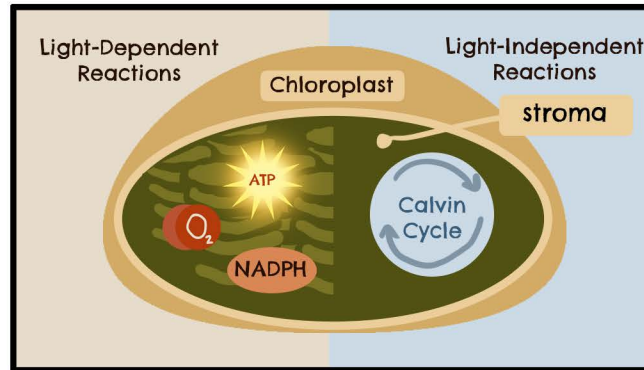
Panel 1



"So, by the end of the light reaction, sunlight..."

Sc 16

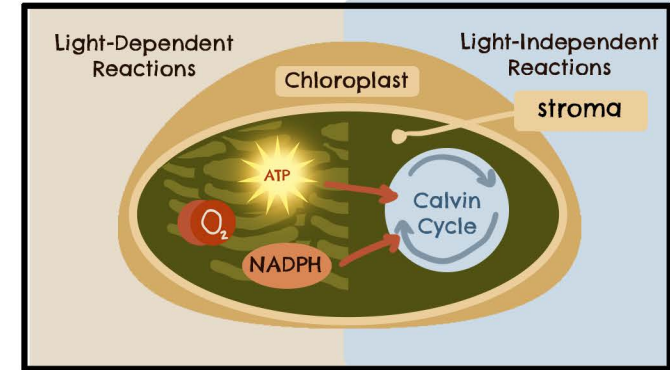
Panel 2



"We will now move on to the light-independent..."

Sc 16

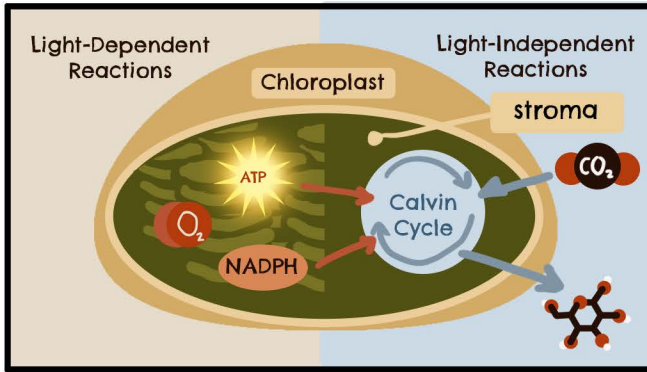
Panel 3



"This stage doesn't require light directly, but..."

Sc 16

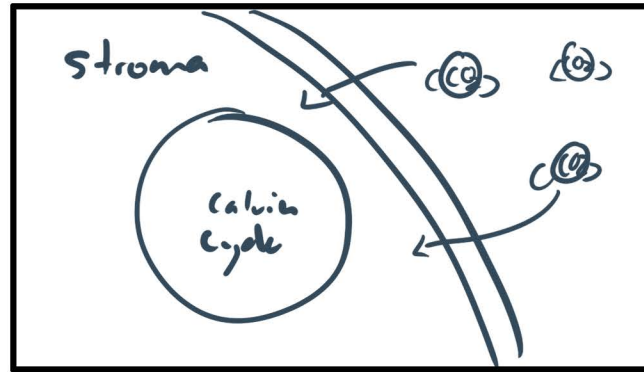
Panel 4



"The Calvin cycle goal is to fix carbon, or to take carbon atoms from CO₂ and turn them into a stable, high-energy molecule like glucose."

Sc 16

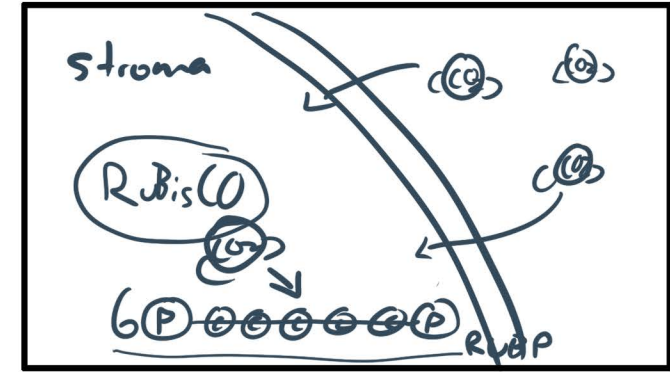
Panel 5



"Now we will follow the carbons like we did in cellular respiration. Carbon dioxide enters the stroma from the atmosphere. Each carbon dioxide molecule contains one carbon, which will become the backbone of glucose."

Sc 16

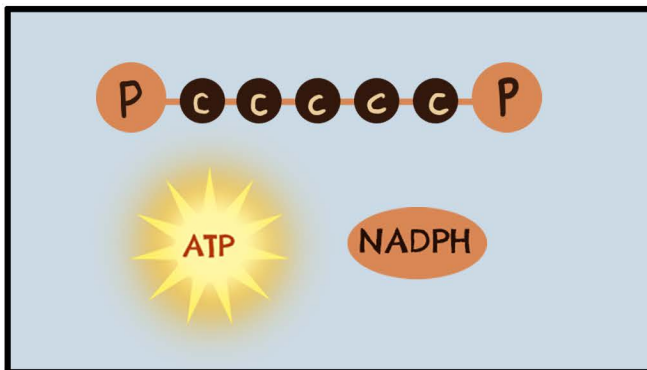
Panel 6



"An enzyme known as RuBisCO, one of the most abundant proteins on Earth, captures carbon dioxide and attaches it to a five-carbon molecule called RuBP."

Sc 17

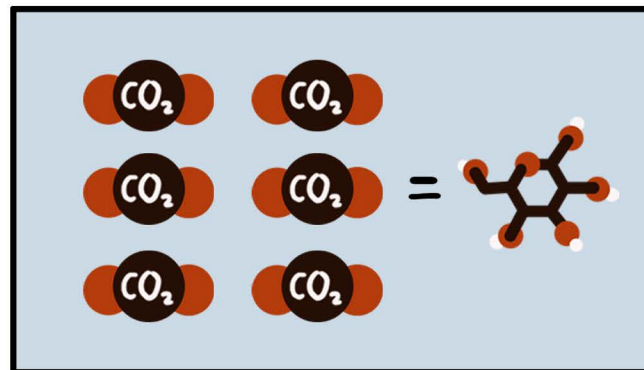
Panel 1



"This molecule goes through a series of reactions powered by ATP for the energy and NADPH for the high energy electrons to convert the CO₂ molecules into glucose."

Sc 18

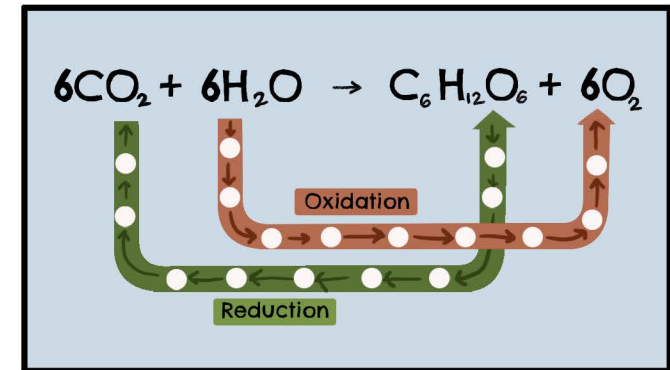
Panel 1



"It takes 6 CO₂ molecules to eventually produce one glucose."

Sc 18

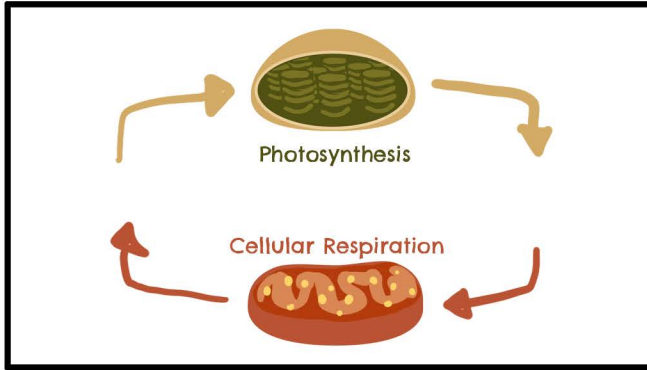
Panel 2



"By the end of the Calvin Cycle, the carbons from CO₂ have been fixed into organic molecules, primarily in the form of glucose. The electrons from NADPH have been stored in the bonds of the organic molecules, and the ATP energy has been used up to power those transformations. Overall, water is oxidized to form oxygen, and carbon dioxide is reduced to form glucose."

Sc 19

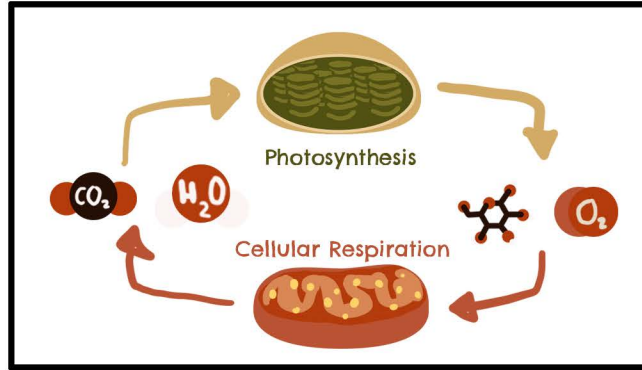
Panel 1



"Let's go back and connect the dots between photosynthesis and cellular respiration. Photosynthesis and cellular respiration are mirror images of one another."

Sc 19

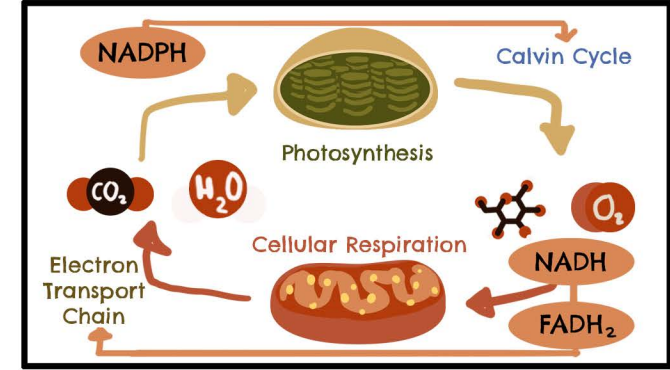
Panel 2



"In photosynthesis, light energy is captured and stored in carbon dioxide molecules to form glucose, and water is split, releasing oxygen. In cellular respiration, the stored energy is released from glucose to make carbon dioxide and ATP, and oxygen will become water."

Sc 19

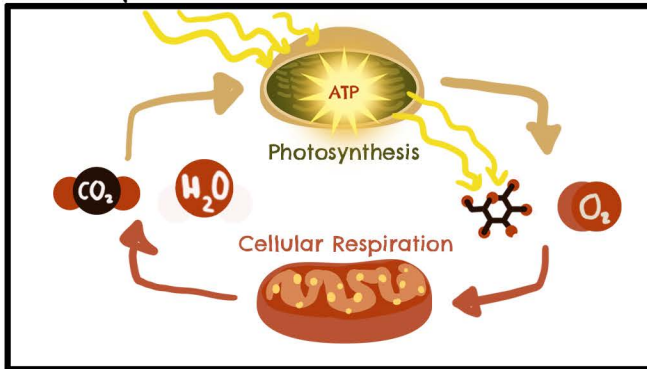
Panel 3



"Just like in respiration, electron carriers play a vital role. In photosynthesis, NADPH carries electrons from the light reactions to the light-independent reactions known as the Calvin cycle. In cellular respiration, NADH and FADH2 carry electrons to the electron transport chain."

Sc 19

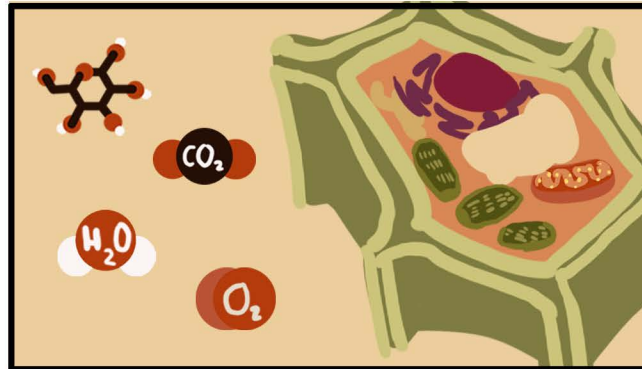
Panel 4



"In photosynthesis, energy moves one way, from sunlight to ATP to glucose. But when you add cellular respiration, the matter keeps cycling."

Sc 20

Panel 1



"The making and breaking of glucose, carbon dioxide, water, and oxygen keeps electrons flowing to power the cell's activities."

Fade to black

Sc

Panel

