

Photosynthesis: A Star Wars Perspective

Energy is strong in the force....

In a plant far, far away, light energy from the sun is used, along with carbon dioxide and water, to make food; and so, because they make their own food plants are called **autotrophs**. **Heterotrophs** cannot absorb the sun's energy directly, so they need to obtain their food by another means, eating it!

Adenosine Triphosphate (ATP) is a compound cells use to store and release energy for the cells to function. ATP is the basic energy source at the cellular level and is “recharged” by the breakdown of glucose in cells. ATP is made up of an adenine, a sugar, and 3 phosphate groups.

Adenosine Diphosphate (ADP) is like ATP, so it contains an adenine, a sugar; however, it has only 2 phosphate groups.

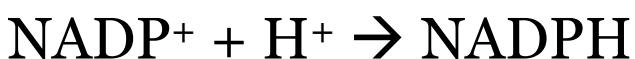


“Stored by cells, energy is when ADP becomes ATP. Hmm. Released, energy when ATP loses a phosphate and becomes ADP.”

Formula	Is energy stored? Or released?
A diagram showing the conversion of Adenosine Diphosphate (ADP) to Adenosine Triphosphate (ATP). An adenine ring is attached to a ribose sugar, which is attached to two phosphate groups. An arrow labeled "energy" points from the reaction to the third phosphate group being added to the ADP molecule, resulting in ATP.	
A diagram showing the conversion of Adenosine Triphosphate (ATP) back to Adenosine Diphosphate (ADP). An adenine ring is attached to a ribose sugar, which is attached to one phosphate group. An arrow labeled "energy" points from the reaction to the second phosphate group being released from the ATP molecule, resulting in ADP.	



*“Another way for energy to be carried to the dark side, there is. Yes, hmm. This is an **electron carrier**. The Dark side always steals this.”*



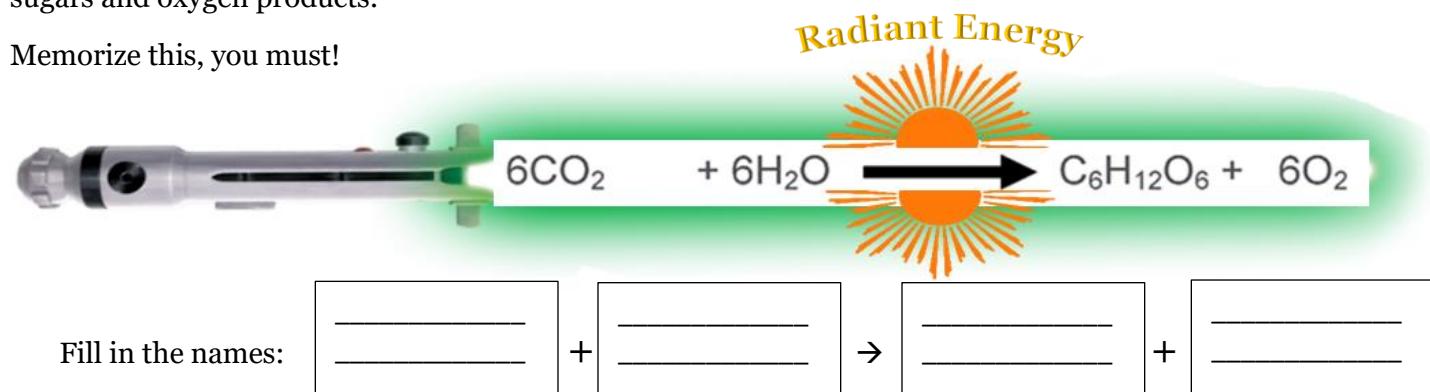
“Answer these questions before moving on in our training, you must. Yessss.”

1. How many phosphate groups are in one molecule of ATP? _____
2. How many phosphate groups are in one molecule of ADP? _____
3. What are the three parts of an ATP molecule? _____
4. Where does the hydrogen for NADPH come from? (hint: look at the reactants of photosynthesis)? _____

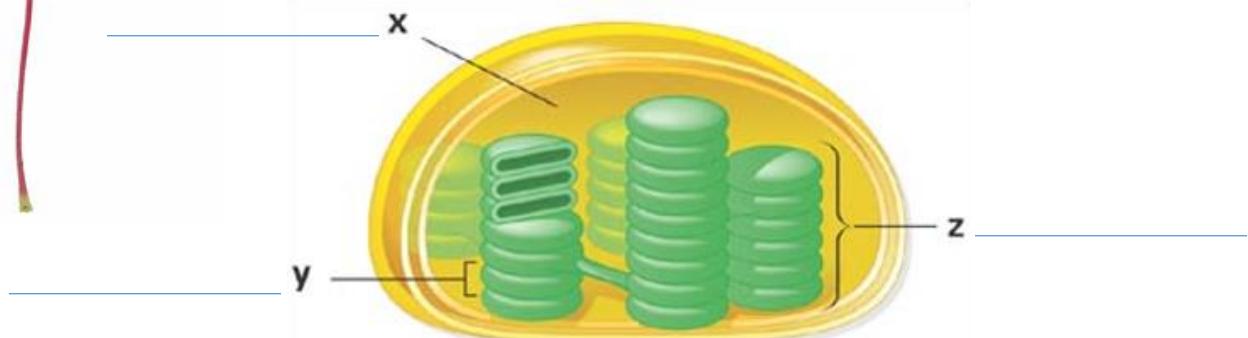
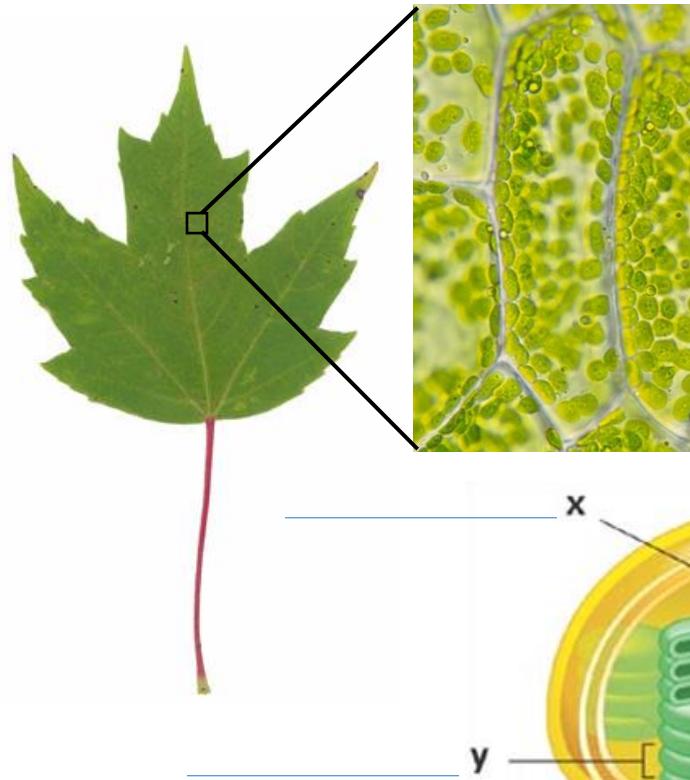
PHOTOSYNTHESIS

Photosynthesis uses the energy from the sun's rays to convert water and carbon dioxide into high-energy sugars and oxygen products.

Memorize this, you must!



THE CHLOROPLAST



Again, answer these questions before moving on, you must.

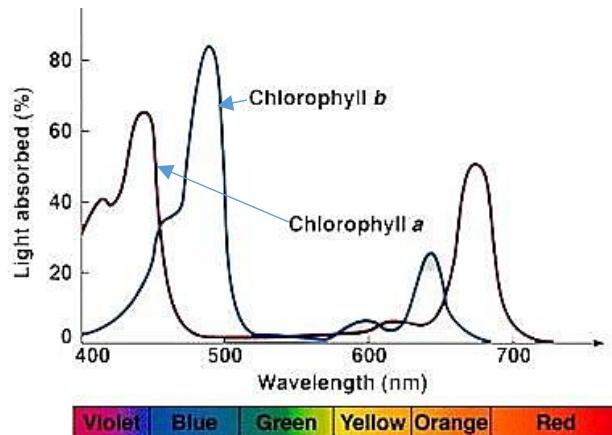
1. In what part of the chloroplast does the light-dependent reactions of photosynthesis take place?

2. In what part of the chloroplast does the Calvin cycle (Dark reaction) take place? _____



"Padawan, I ask plants green, why are?" _____

"Green I am. Hmmmm. Your final test before becoming a Jedi, this is. See the spectrum for how it truly is, only the pure of heart can. Hmmmm."



Chlorophyll absorbs the energy from the sunlight in what two color ranges? _____

Which color of light wavelength is absorbed the most? _____

What term do we use to describe chlorophyll? _____



CO₂ in.....
CO₂ out.....

THE DARK REACTION (AKA CALVIN CYCLE)

ATP and NADPH are made by the light-dependent side of photosynthesis. The Calvin (Dark) cycle, or light-independent reaction, takes and uses that energy to make high-energy sugars.

The CO₂ produced by Darth Vader with the stolen energy (ATP and NADPH) from the light-side forms high-energy sugars to be used by the Sith Lords.

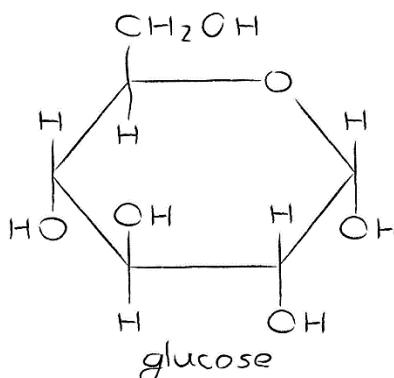
When the energy has been used up by the ruthless Siths on the Dark side, it is sent back as "energy-less" ADP and NADP⁺ back to Yoda and the light-side to be "recharged" so it can be used again and again.

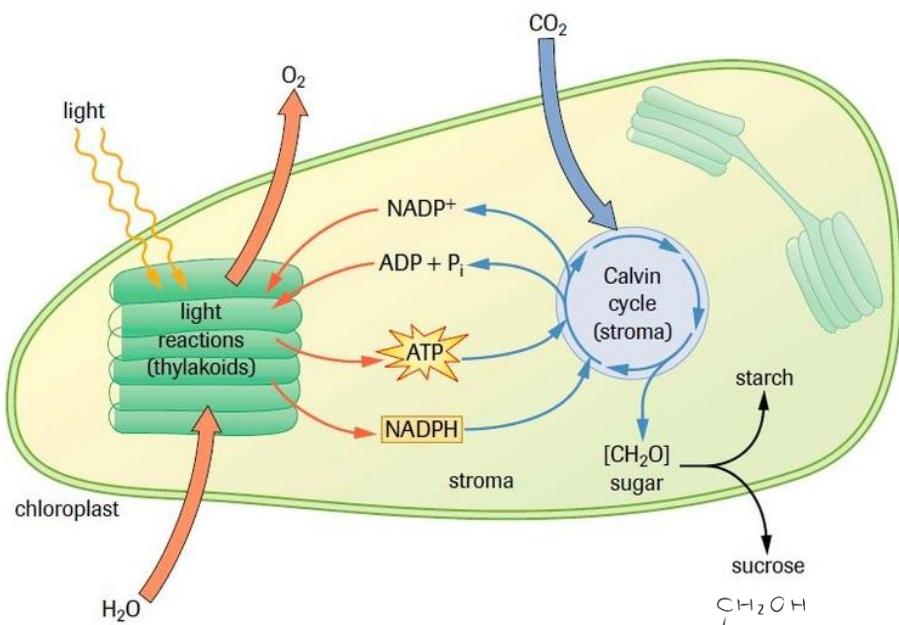
How many carbons are in a glucose molecule? _____

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How many carbons are in a glucose molecule? _____

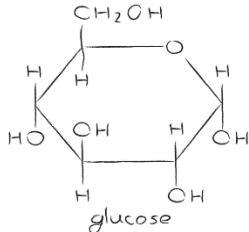
Write the full chemical formula for glucose below:





Predict you will: Light strikes the chloroplasts and the stacks of thylakoids, which also receive water from the root systems of plants. In this first part of photosynthesis (the light reaction) oxygen is released to the atmosphere. If the process is called “photolysis” what do you think that means? (remember your word roots...)

Predict you will: In the Dark reaction, CO₂ enters the stomata at night (mostly) and is broken down. Where do all carbons go? Specifically, where do every 6 carbons go?



Predict you will: Look closely at the energy molecules in the diagram above. Why do you think ATP and NADPH are handed off to the Dark reaction (which mainly happens at night)?

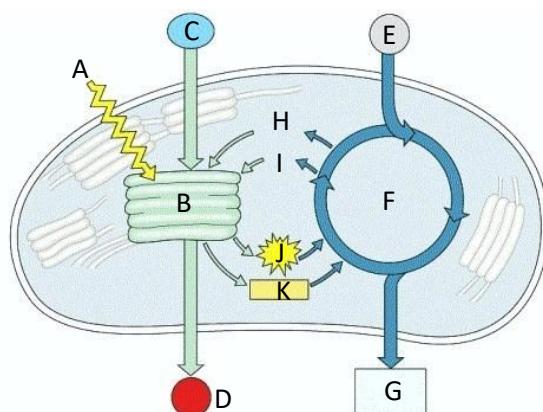
1. Write the equation for photosynthesis, both the formula (top) and name (bottom) for equation.

$$\text{_____} + \text{_____} + \text{_____} \rightarrow \text{_____} + \text{_____}$$

$$\text{_____} + \text{_____} + \text{_____} \rightarrow \text{_____} + \text{_____}$$

2. What is another name for the light-independent reactions? _____
3. What is made at the end of the Calvin cycle? _____
4. What 2 things are sent back to the light-side once the Calvin cycle is over? _____
5. What gas is needed by the Calvin cycle before it can start? _____

Jedi Photosynthesis Review (label all parts of the diagram)



- A. _____
- B. (process) _____
- C. _____
- D. _____
- E. _____
- F. (Process) _____
- G. _____
- H. _____
- I. _____
- J. _____
- K. _____