Photosynthesis Notes - Unit 2 General Biology

Objective 1: Explain the function and purpose of ATP

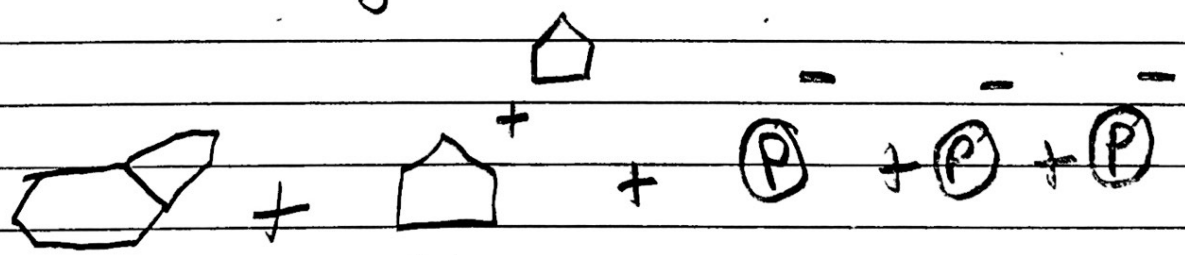
The function of ATP is to be a chemical energy storage molecule by storing energy in the bonds between phosphate groups.

The purpose of ATP is to be a molecule which can be used by cells to provide a source of chemical energy so the cell can complete cellular tasks.

What is ATP?

Adenosine Triphosphate

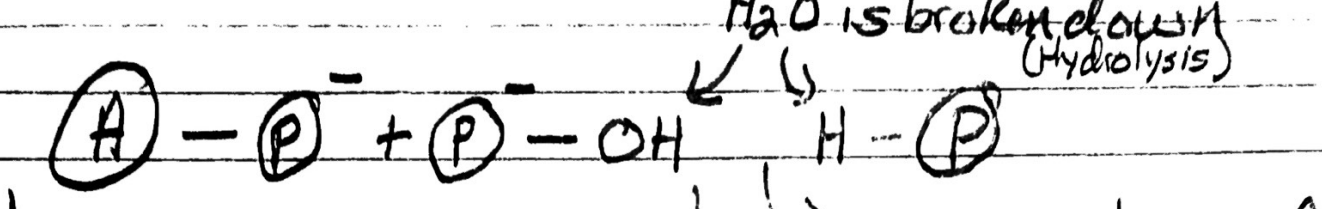
Adenosine is made of a Nitrogen base - Adenine and a sugar - Ribose



Adenosine + 3 phosphate groups

Where is the chemical energy stored? In the Bonds!

- ATP is unstable and exergonic when broken



ADP - Adenosine diphosphate

ADP can again add a phosphate group and recreate ATP. Energy is stored in the bonds between the phosphate groups. The most energy is stored between the 2nd + 3rd phosphate groups.

Objective 2: Describe the process of photosynthesis

The purpose of photosynthesis is to make sugar using solar energy.

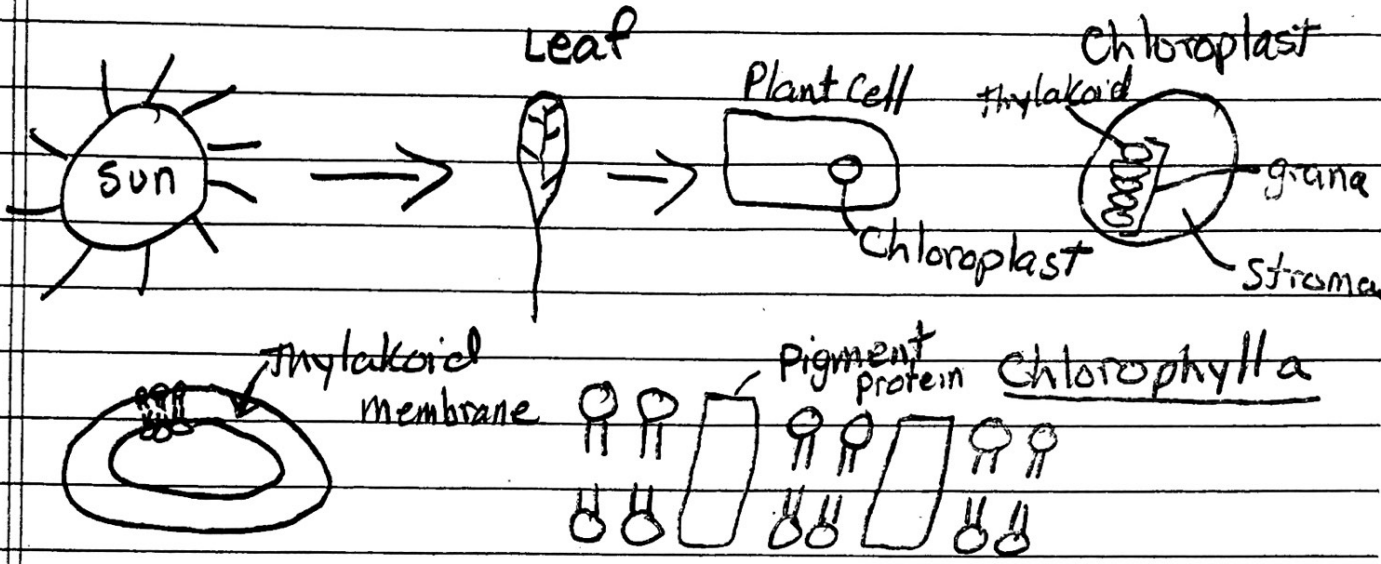
The function of photosynthesis is to use light (Solar energy), Carbon dioxide, and Water to make sugar and oxygen gas.

Where does photosynthesis occur?

Light Reactions (Rx)
- in the thylakoid membranes in Chloroplasts

Light Independent Rx
Stroma

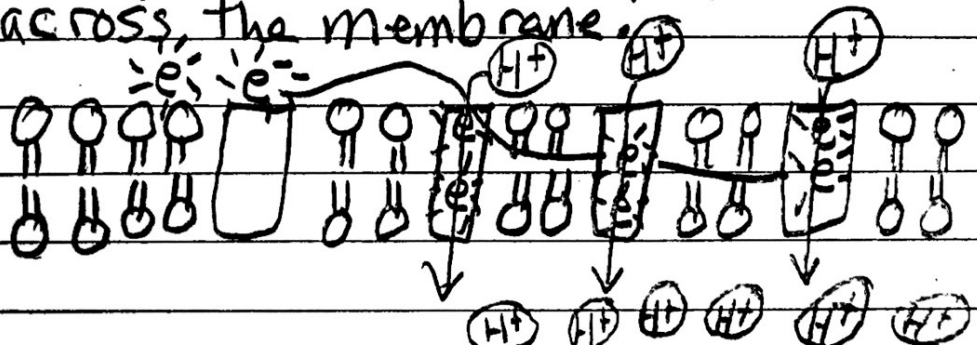
Light Dependent Rx



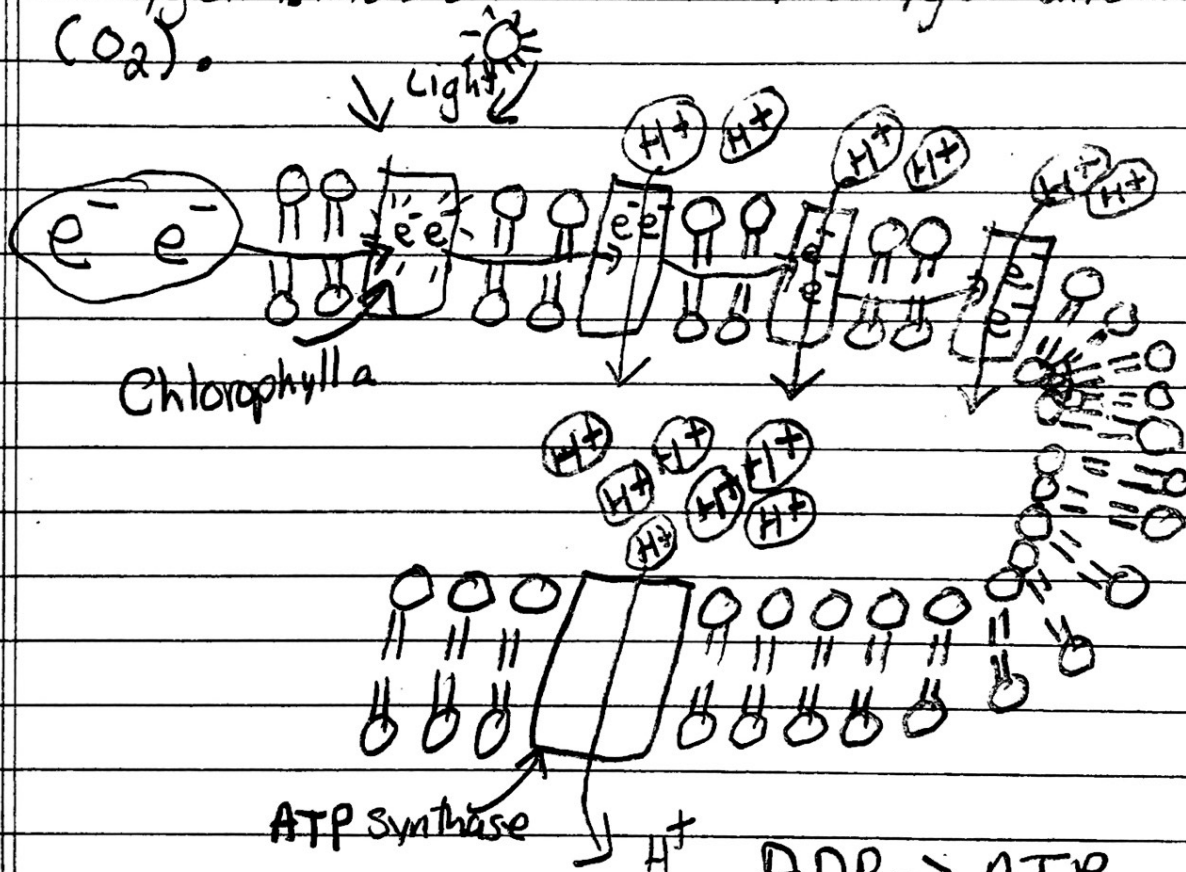
- **Photosystem II** (located in the membrane of the thylakoid in a chloroplast.)

Light strikes the chlorophyll a pigments which transfer energy to existing electrons this raises the electrons to a higher energy level or state (Not ground state.)
(excites electrons)

Energized electrons move from one protein to the next protein in the thylakoid membrane. As energized electrons move, electrons "Lose" energy. That "lost" energy is used to pump protons (H^+) ions across the membrane.



Water is broken down to Produce protons (H^+) x 2 and electrons (e^-) x 2. H_2O has 2 hydrogen atoms. Each hydrogen is made of 1 proton and 1 electron. The protons are pumped through the membrane. The 2 electrons replace the 2 electrons used at the beginning of Photosystem II (PSII). Oxygen binds with another oxygen and is released (O_2).

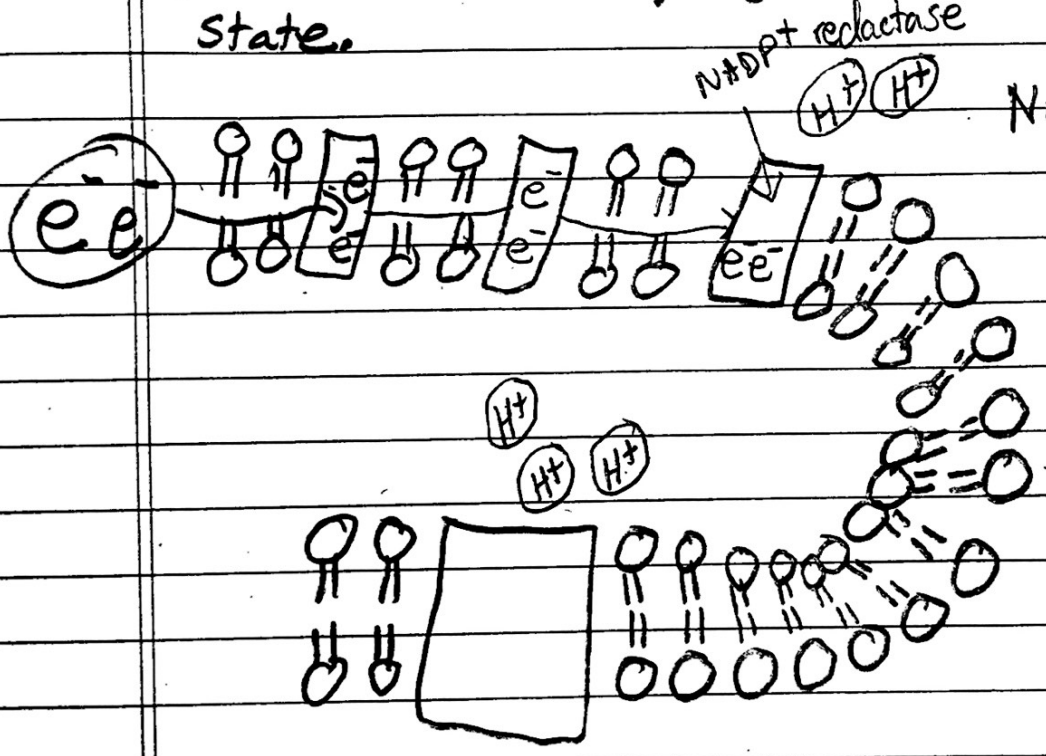


The protons move through a protein called ATP synthase, which makes ATP.

PSII makes ATP

- Photosystem I (PSI) Located in the membrane of a thylakoid in chloroplast

Electrons from PSII are again energized by sunlight. Chlorophyll b transfers energy to the 2 electrons, again raising their energy state.



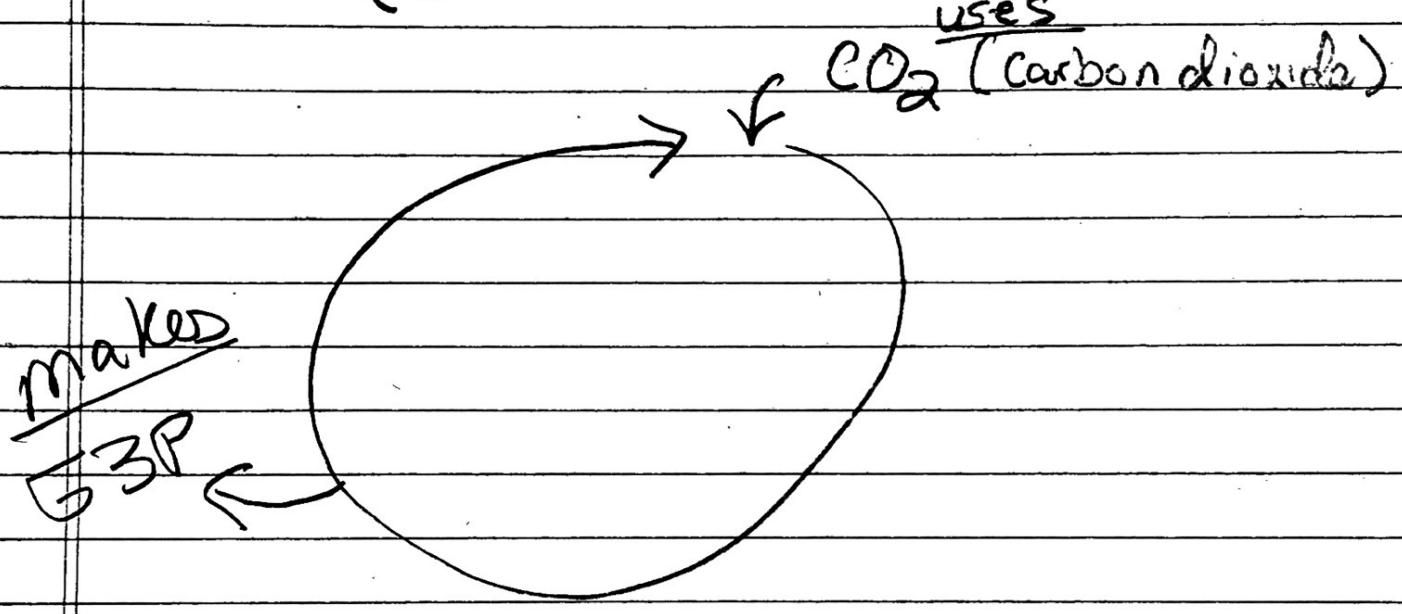
$NADP^+ + H^+ + e^- + e^-$ makes NADPH

NADPH is an electron carrier (in the Hydrogen atom)

Photosystem I makes NADPH molecules

18 ATP + 12 NADPH are used in the Calvin cycle (Light Independent Rx)

Light Independent Reactions (Calvin Cycle)



G3P is a building block to make a sugar. 2 G3P molecules forms a sugar called glucose. G3P can also be used as a building block to make Proteins, Lipids, Nucleic Acids, and other Carbohydrates

- Proteins → Amino Acids
- Lipids → fats, waxes
- Nucleic Acids → DNA + RNA
- Carbohydrates → Fructose

Objective 3: molecules used + Produced in photosynthesis

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

- $6CO_2$ → Calvin Cycle
- $6H_2O$ → Light Dep (PSII)
- $C_6H_{12}O_6$ → Calvin cycle
- $6O_2$ → Calvin cycle + PSII

Calvin Cycle + Light Dep (PSII) = reactants (used)

Calvin cycle + PSII = Products (made)

Objective 4: Explain what molecules are used and produced in the process of Photosynthesis

Summary:

- Light dependent Rx - PS II + PS I

  make: ATP
  NADPH
  O_2 - oxygen gas
  (Products)

  Uses: H_2O

Light Independent Rx - Calvin Cycle

make: G3P (sugar) x 2 = glucose
(G3P = product)

uses: ATP
NADPH
CO_2

The products of photosynthesis are ATP, NADPH, O_2 and G3P (½ glucose). ATP and NADPH are used in the Calvin cycle. Extra ATP are used by cells for cellular activities. O_2 (oxygen gas) is used for cellular respiration in our cells. G3P can be used to make sugar.

G3P is a building block which can be used in many ways. It can be:

- used with a second G3P to make glucose (sugar)
- used with other molecules to make other sugars, lipids, nucleic acids, and proteins.