Important Word Roots

Auto	Throph	Photo	Hetero
• Self	• Feeding	• Light	• Other

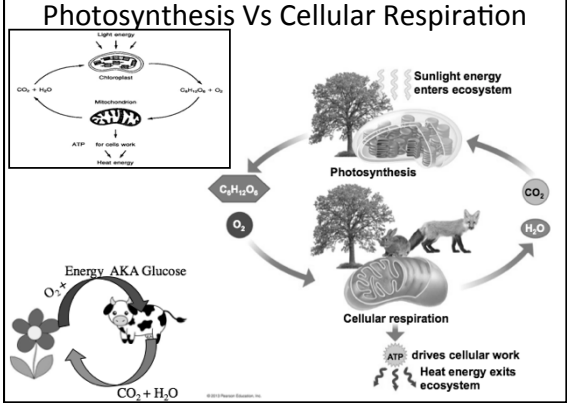
Photosynthesis

photosynthesis

photo syn thesis

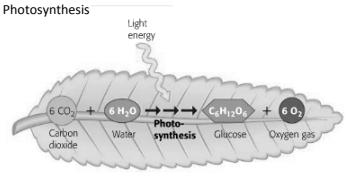
light together put

Photosynthesis Vs Cellular Respiration

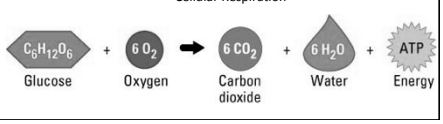


Photosynthesis Vs Cellular Respiration

Photosynthesis



Cellular Respiration



What do these two energy producing Organelle have in common?

_____

Anatomy of a Chloroplast

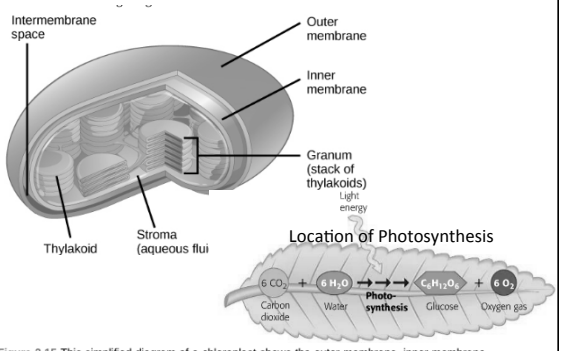
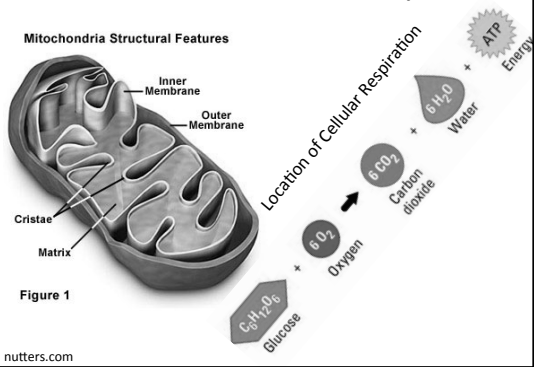
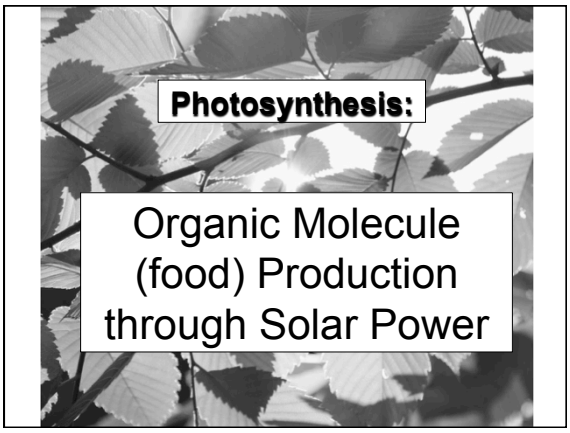
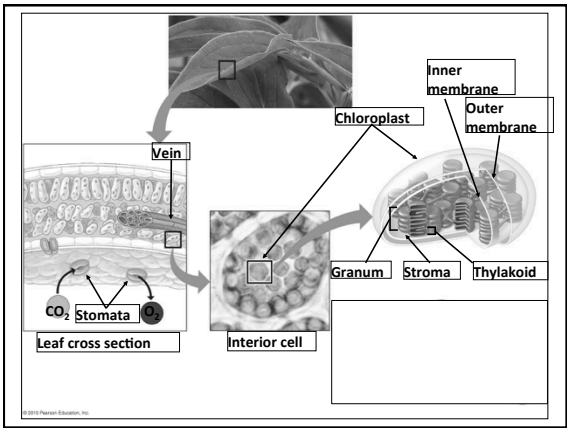


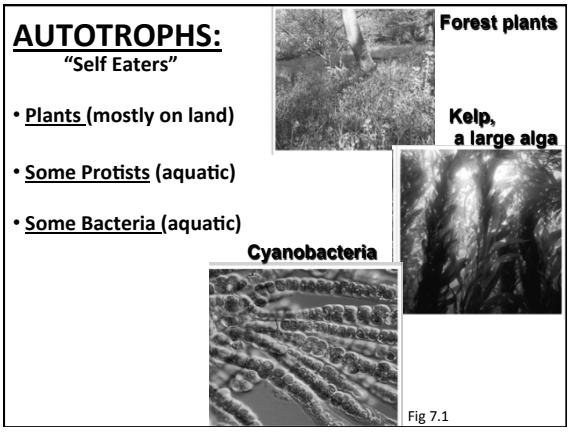
Figure 3.15 This simplified diagram of a chloroplast shows the outer membrane, inner membrane, thylakoids, grana, and stroma.

Mitochondrial Anatomy




Photosynthesis:
Organic Molecule (food) Production through Solar Power


Inner membrane
Chloroplast
Outer membrane
Vein
Granum
Stroma
Thylakoid
CO2
Stomata
O2
Leaf cross section
Interior cell


AUTOTROPHS:
"Self Eaters"
• Plants (mostly on land)
• Some Protists (aquatic)
• Some Bacteria (aquatic)
Forest plants
Kelp, a large alga
Cyanobacteria
Fig 7.1

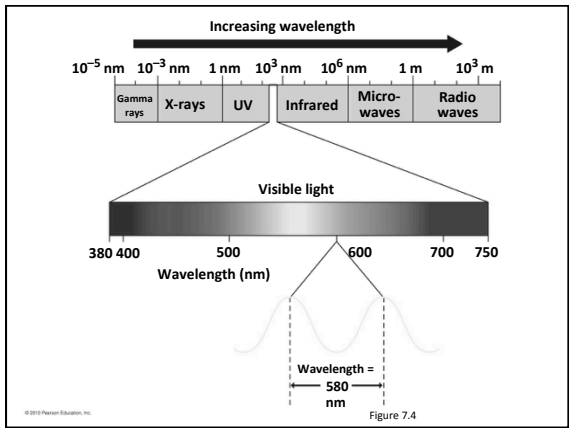


Figure 7.4

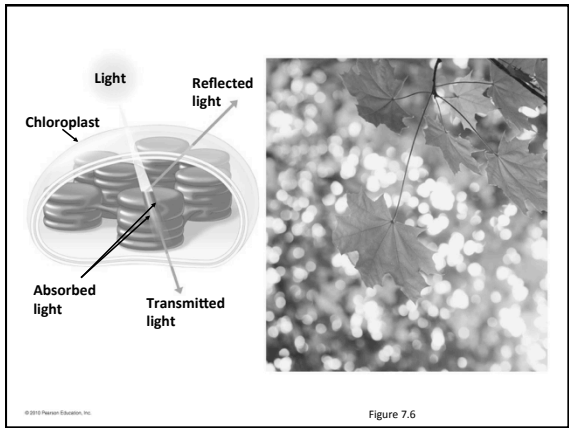


Figure 7.6

Lots of different Pigments are capable of photosynthesis

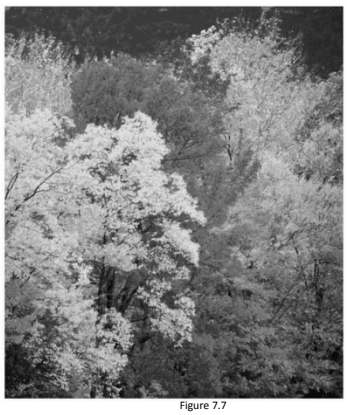
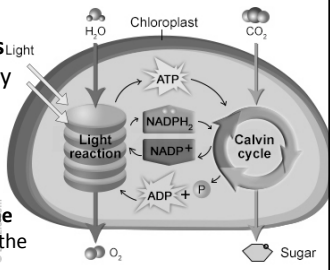


Figure 7.7

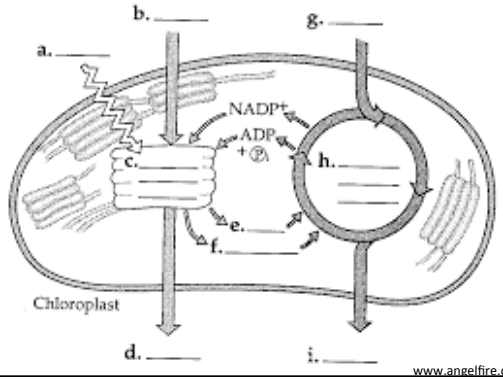
Photosynthesis Overview

Two stages:

1. The **Light Reactions** convert solar energy to chemical energy
   - **Where**: Thylakoid Membrane
2. The **Calvin cycle (Sometimes called the dark Reaction)** uses the products of the light reactions to make sugar from carbon dioxide
   - **Where**: Stroma (liquid)



Practice Photosynthesis Steps



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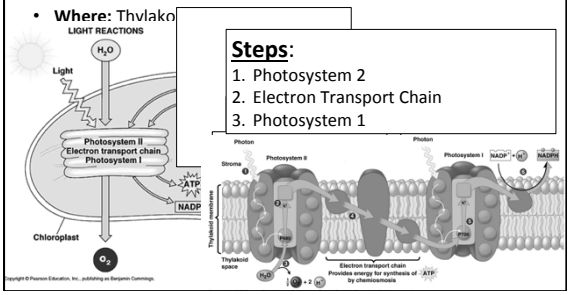
1. Light Dependent Reaction

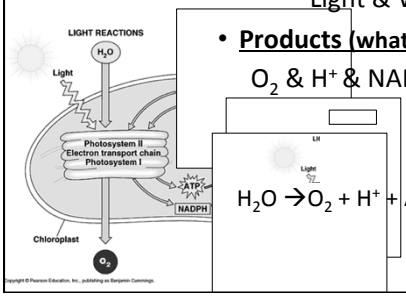
- **Goal**: Convert light energy into chemical energy. This chemical energy will be used by the Calvin cycle to fuel the assembly of sugar molecules.
  - **Where:** Thylako

Steps:
1. Photosystem 2
2. Electron Transport Chain
3. Photosystem 1



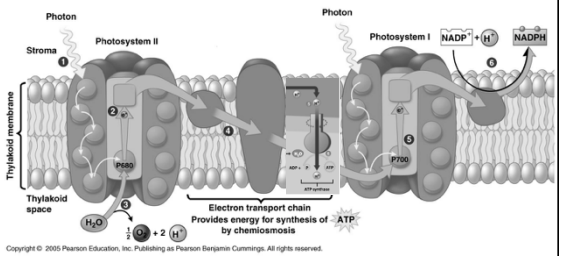
1. Light Dependent Reaction

- **Reactants (what goes in)**: Light & Water
- **Products (what comes out)**: O_2 & H^+ & NADPH & ATP



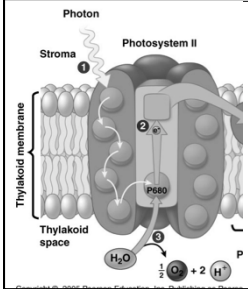
$H_2O \rightarrow O_2 + H^+ + ATP + NADPH$

1. Light Dependent Reaction



1. Light Dependent Reaction

- **Step 1:** Photosystem 2 - a grouping of pigment molecules and proteins called a photosystem.
- Goal: Excite an electron

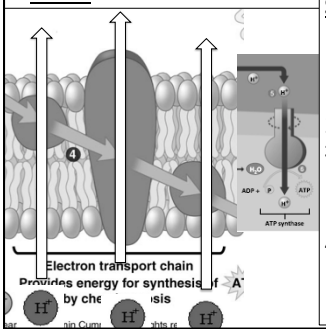


Steps:

1. Photon hits pigment of Chlorophyll (packet of light energy)
2. Electrons of Chlorophyll become excited and break free
3. To replace the electron, water is split, creating O_2 & H^+

1. Light Dependent Reaction

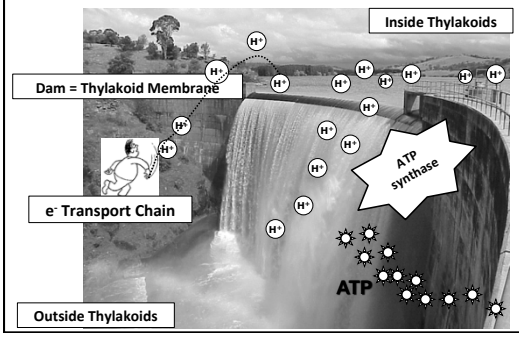
- **Step 2: Electron Transport Chain**
- **Goal:** Make ATP



Steps:
1. Electron falls through membrane proteins
2. Pumps H^+ into Stoma
3. **Result**: A high concentration of H^+ ions that want to flow back into the thylakoid membrane
4. Flow through ATP synthase

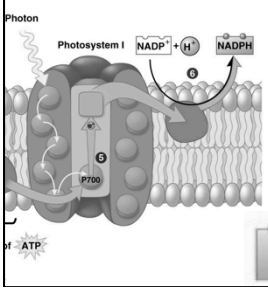
ADP+P→ATP

Electron Transport Chains Works like a Dam



1. Light Dependent Reaction

- **Step 3:** Photosystem 1 - a grouping of pigment molecules and proteins called a photosystem,
- **Goal:** Accept the electron from the ETC, Store it in NADPH



Steps:
1. Electron arrives from ETC
2. Another photon of light hits it and energizes it

$NADP^+$ + Electron→ NADPH

Compare NADH to NADPH

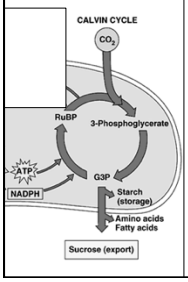
Cellular Respiration
Electron Transporter

Photosynthesis
Electron Transporter

Both Carry Electron safely to the next step so they don't zip away and we lose the power that they hold

2. Calvin Cycle (AKA Dark Reaction, AKA Light Independent Reaction)

- **Goal**: Build food in the form of Glucose molecules from the Carbon in CO_2 and Hydrogen in H_2O



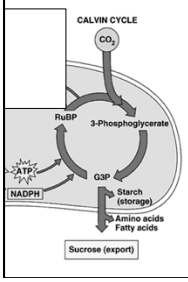
Steps:

- CO2 enters through the stomata and diffuses into Stroma

1. Fixation
2. Reduction
3. Regeneration

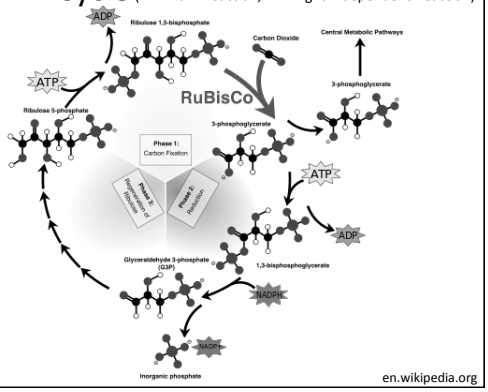
2. Calvin Cycle (AKA Dark Reaction, AKA Light Independent Reaction)

- **Reactants (what goes in)**:
  CO_2, NADPH and ATP
- **Products (what comes out)**:
  Glucose ($C_6H_{12}O_6$)



CO_2 +NADPH + ATP → $C_6H_{12}O_6$

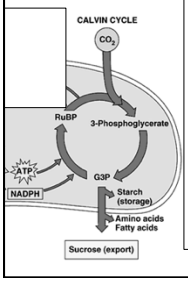
2. Calvin Cycle (AKA Dark Reaction, AKA Light Independent Reaction)



en.wikipedia.org

2. Calvin Cycle (AKA Dark Reaction, AKA Light Independent Reaction)

- **<u>Step 1</u>**: **<u>Fixation</u>**-
  CO_2 → C-C-C-C-C-C → C-C-C + C-C-C

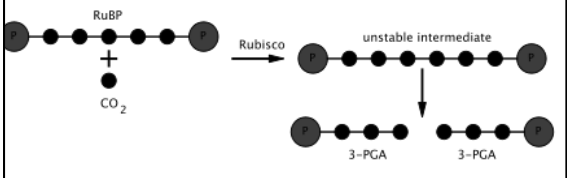


<u>Steps</u>:

1. Enzyme RuBisCO catalyzes
   - $CO_{2\ into}$ 6-Carbon structure:
     C-C-C-C-C-C
   - And then into:
     C-C-C + C-C-C

2. Calvin Cycle (AKA Dark Reaction, AKA Light Independent Reaction)

- **<u>Step 1</u>**: **<u>Fixation</u>**-
  CO_2 → C-C-C-C-C-C → C-C-C + C-C-C



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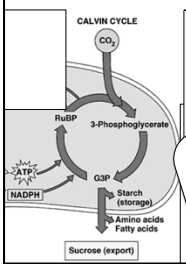
2. Calvin Cycle (AKA Dark Reaction, AKA Light Independent Reaction)

- **Step 2**: **Reduction**-
  ATP and NADPH energy make:
  3-PGA: C-C-C & C-C-C →G3P: C-C-C & C-C-C But with **electrons**

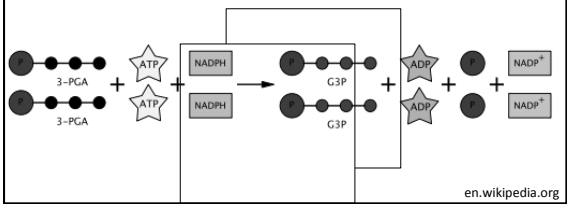


Steps:
1. ATP and NADPH use their stored energy to convert the C-C-C, 3-PGA, into another C-C-C compound called G3P.

I don't need you to know PGA and G3P, just that we go from C-C-C to C-C-C (With more **energy/electrons**)

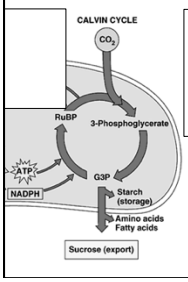
2. Calvin Cycle (AKA Dark Reaction, AKA Light Independent Reaction)

- **Step 2**: **Reduction**-
  ATP and NADPH energy make:
  3-PGA: C-C-C & C-C-C →G3P: C-C-C & C-C-C But with **electrons**



2. Calvin Cycle (AKA Dark Reaction, AKA Light Independent Reaction)

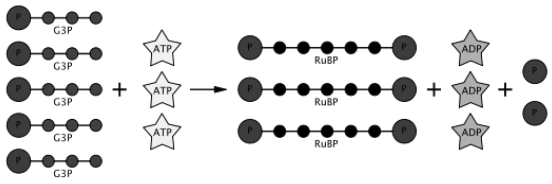
- **Step 3**: **Regeneration:** 1 G3p: C-C-C leaves to make glucose and 1 G3P: C-C-C Recharges the RuBp.



Steps:
1. 1 C-C-C leaves to make glucose
2. 1 C-C-C reenters the Calvin Cycle to recharge it.

2. Calvin Cycle (AKA Dark Reaction, AKA Light Independent Reaction)

- **Step 3**: **Regeneration:** 1 G3p: C-C-C leaves to make glucose and 1 G3P: C-C-C Recharges the RuBp.



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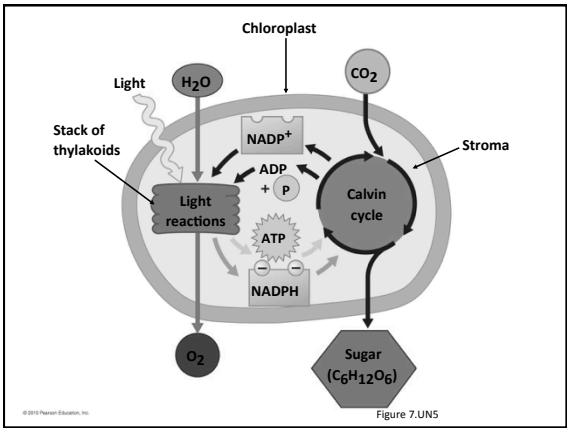


Figure 7.UN5

Figure 7. Summary: Calvin cycle

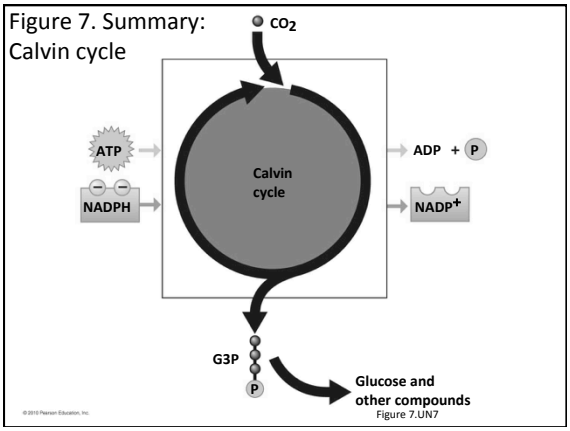
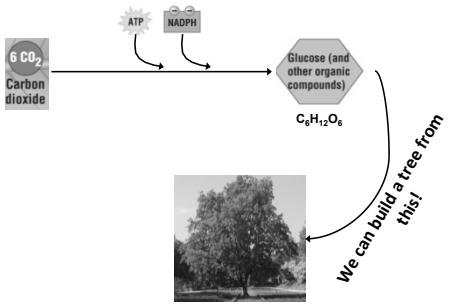


Figure 7.UN7

2. Light-Independent Reactions: Calvin Cycle



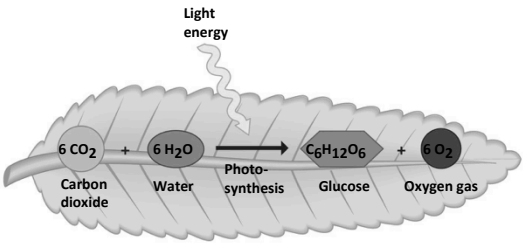


Figure 7.UN1

Get out a blank piece of paper and put your name on it:

1. Tell me everything you can about photosynthesis

_____

2. Add whatever else you now can

_____

3. Add whatever else you can