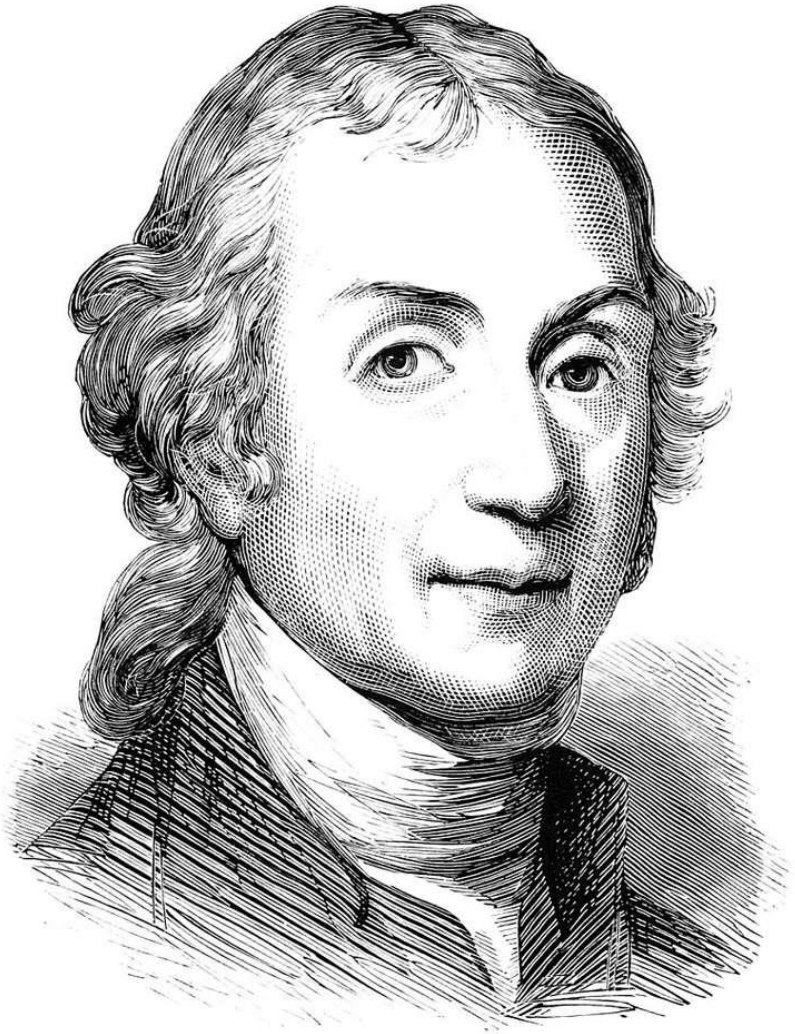

Photosynthesis

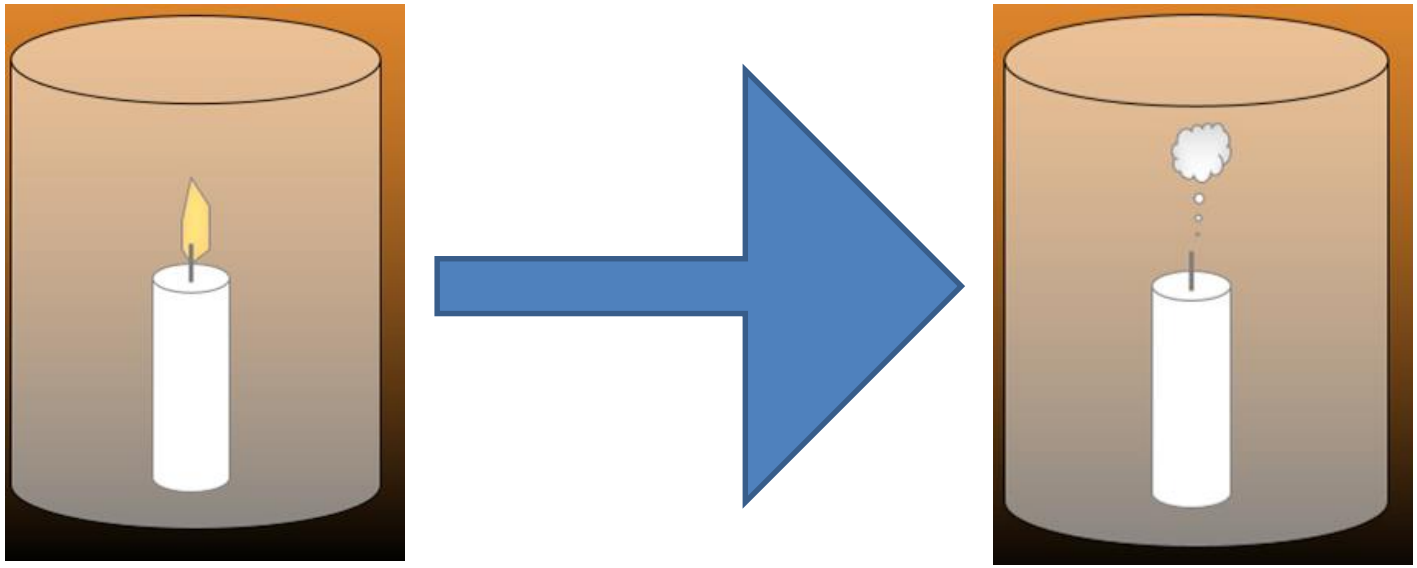
Joseph Priestley's Investigation

During the early 1770's, Joseph Priestley conducted a series of experiments using a bell jar. Record Priestley's observations and work with a partner to come up with a logical explanation for his observations.



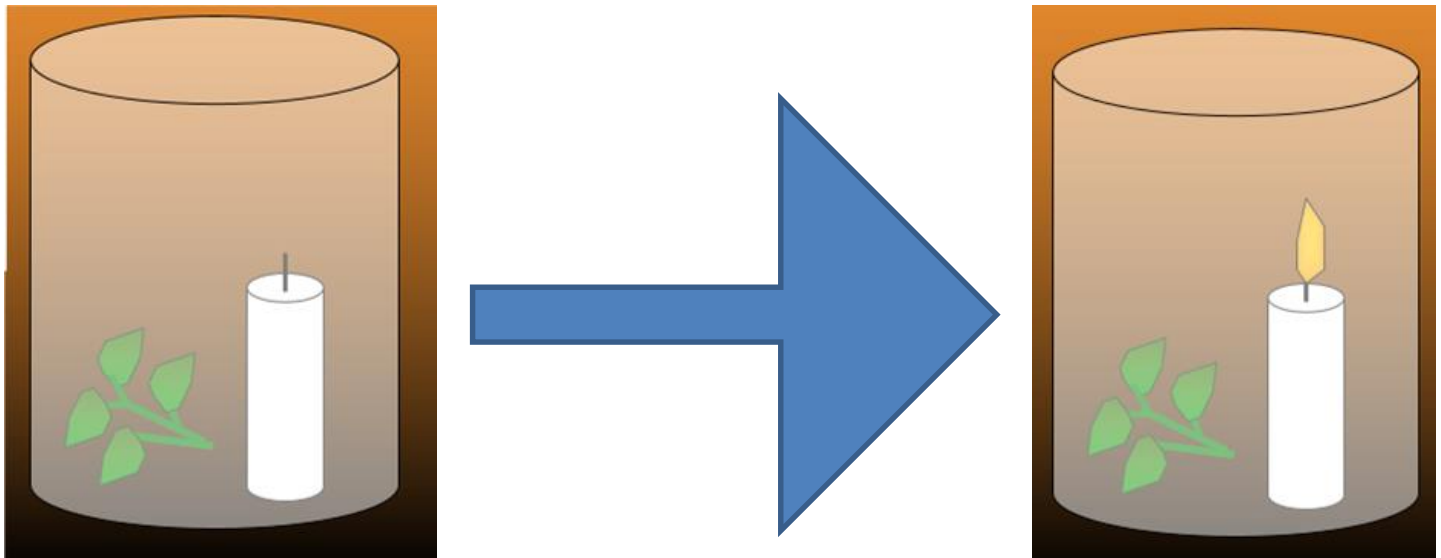
1) Priestley placed a lit candle in a sealed bell jar, and noticed that the candle would eventually burn out. It subsequently could not be relit while still in the jar.

What conclusion can be drawn from this observation?



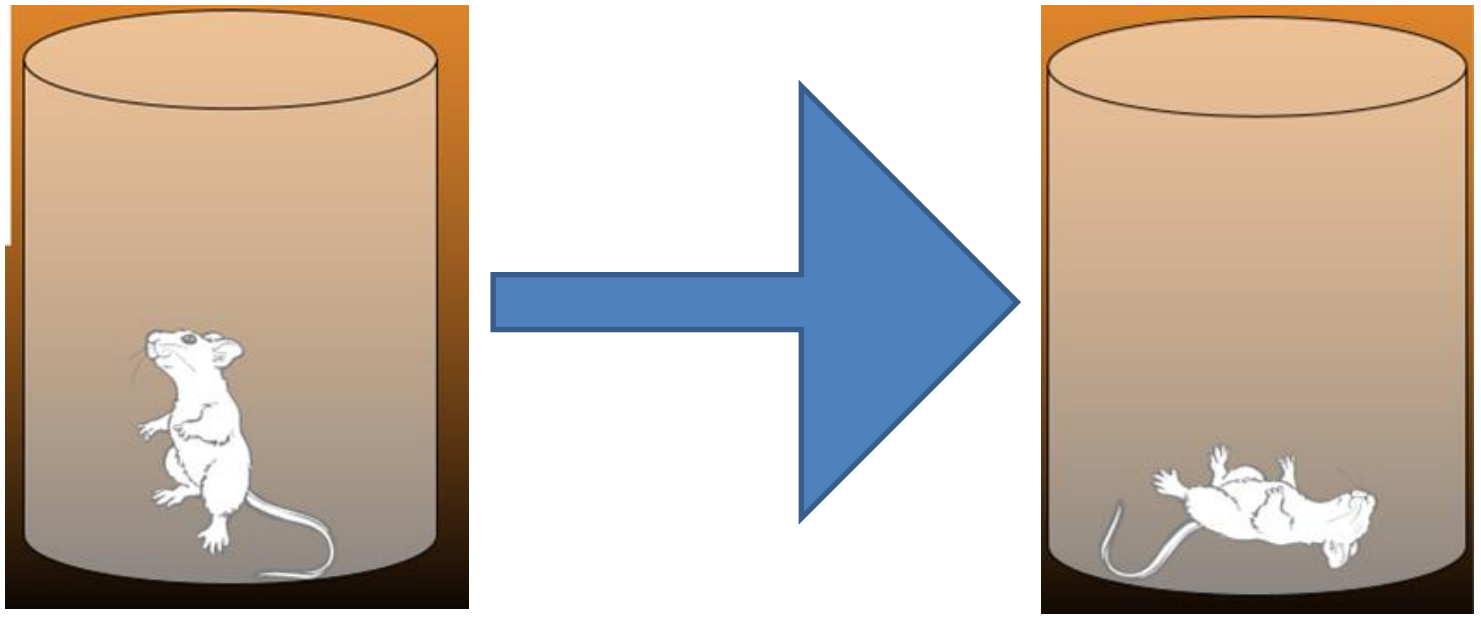
2) Priestley placed a mint plant into the jar with the burning candle. He observed that the candle went out as before. However, when he waited several days and tried again, the candle could be relit.

What conclusion can be drawn from this observation?



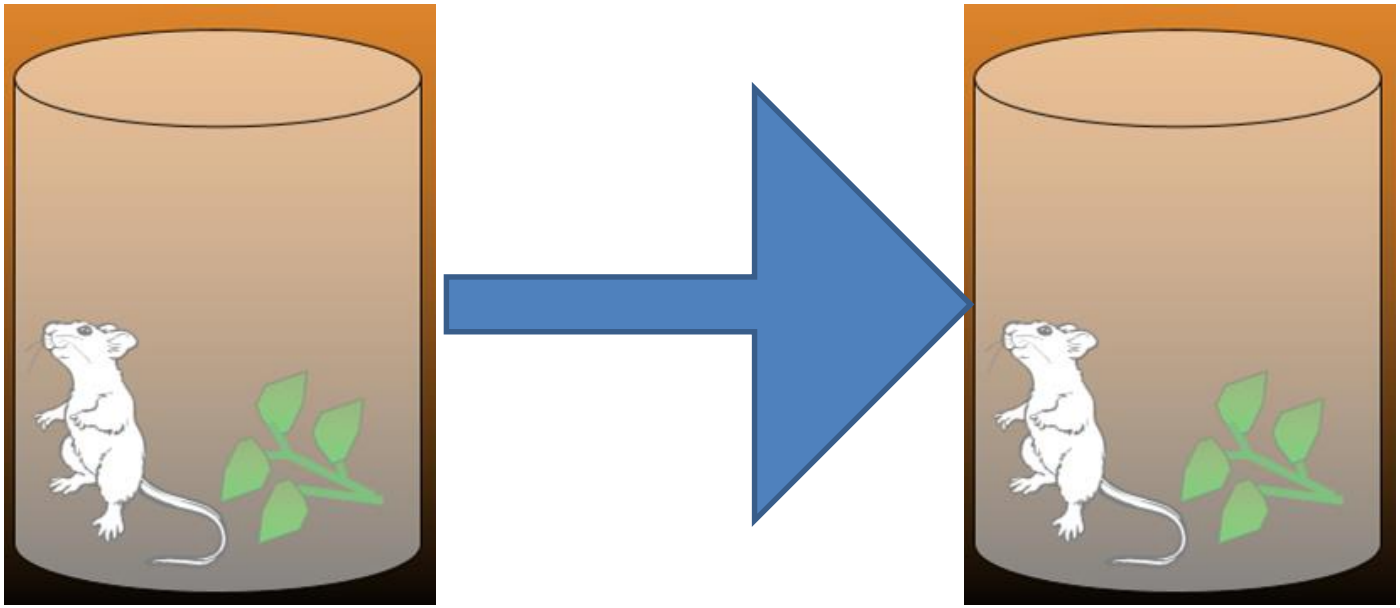
3) Priestley placed a live mouse inside the sealed jar and noticed that it eventually collapsed and died.

What conclusion can be drawn from this observation?



4) A mouse in a sealed jar with the mint plant survives for a longer period of time.

What conclusion can be drawn from this observation?



Analysis Questions:

1) What substance was consumed by the candle?

2) What important substance was produced by the plant that replenished the air?

3) What important substance was produced by the mouse?

Analysis Questions:

4) Why were both the plant and the mouse able to survive under the jar?

5) Suppose Priestley had put the plant and jar into a dark closet for a few days. Do you think the candle would have lit again? Why or why not?

What process was responsible for allowing the plant to “replenish” the air with oxygen?

PHOTOSYNTHESIS

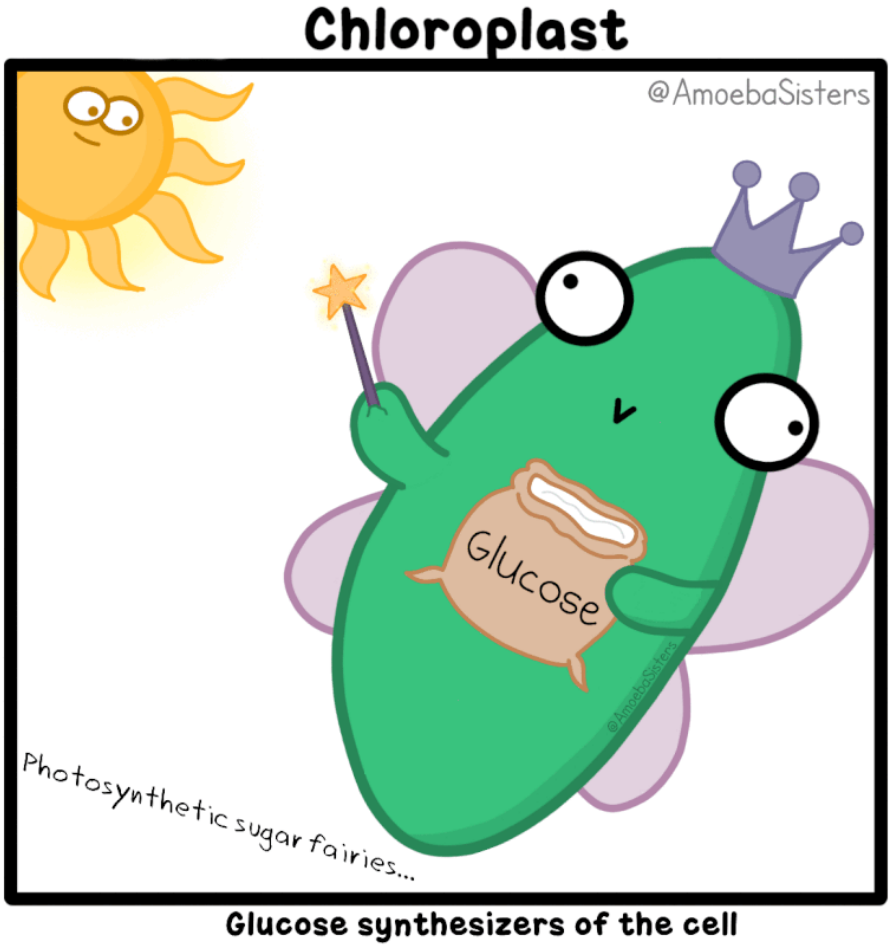
Photosynthesis also allows energy in the **sun** to be captured and used to make food that can later be broken down to provide an organism with energy.

Let’s take a deeper look at this process

PHOTOSYNTHESIS: What is it?

- It is the process by which **light energy** (from the sun) is converted to **chemical energy** stored in **glucose**.

- The glucose can then be used as a source of energy to fuel all life processes

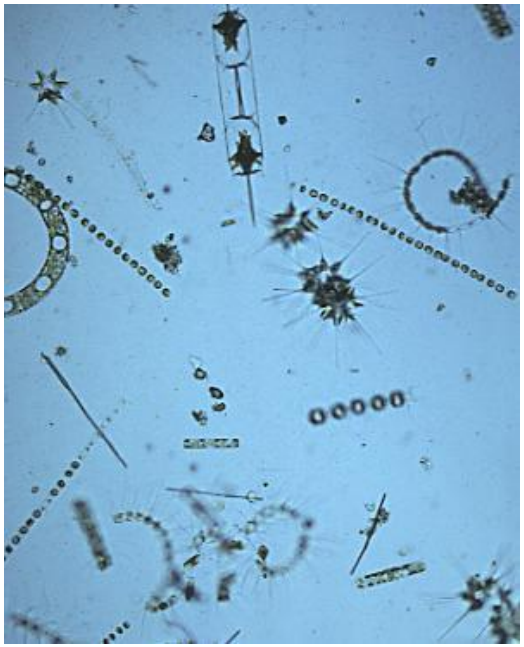


PHOTOSYNTHESIS: Who does it?

Autotrophs (aka: Producers)

- Organisms that make their own food

Examples: some bacteria, plants, algae, some plankton



PHOTOSYNTHESIS: Where does it take place?

In plant cells, photosynthesis takes place inside of the **chloroplast**.

*** Label your chloroplast with the following parts*

a) **Thylakoid:** Where light energy is absorbed, and ATP (cellular energy) is made.
b) **Granum (grana plural):** Stack of thylakoids.
c) **Stroma**: Fluid surrounding grana. Where glucose is made.

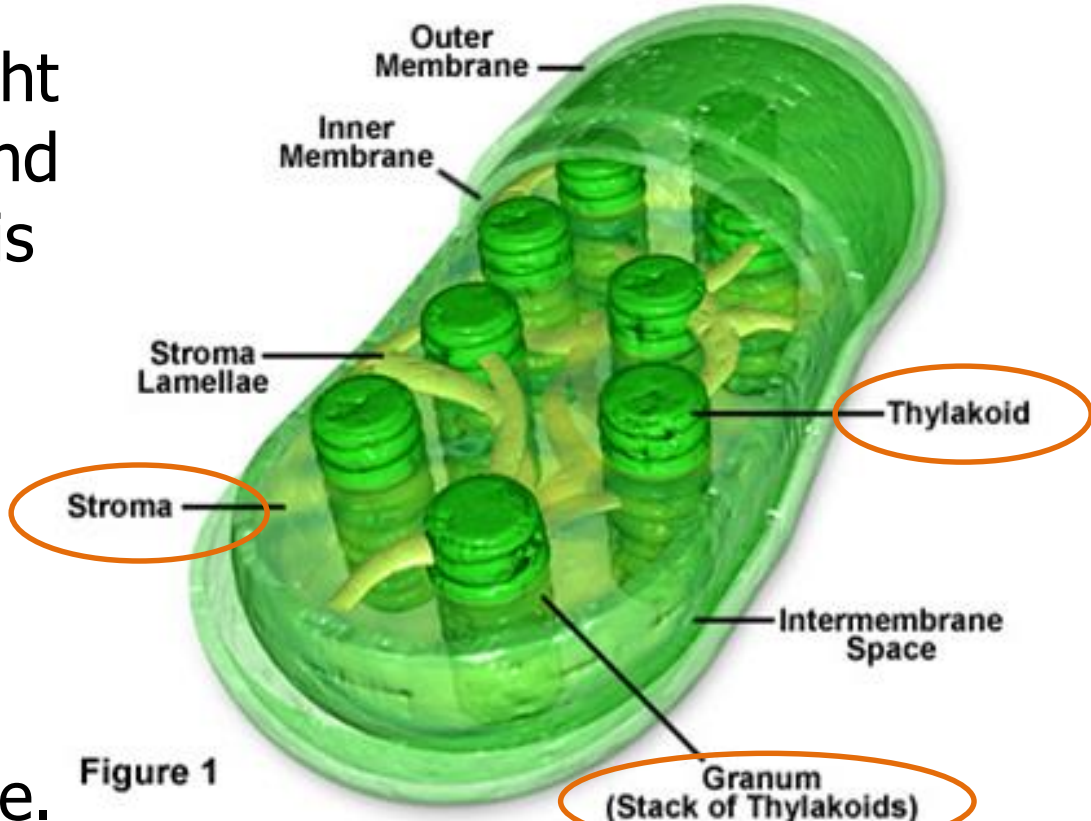
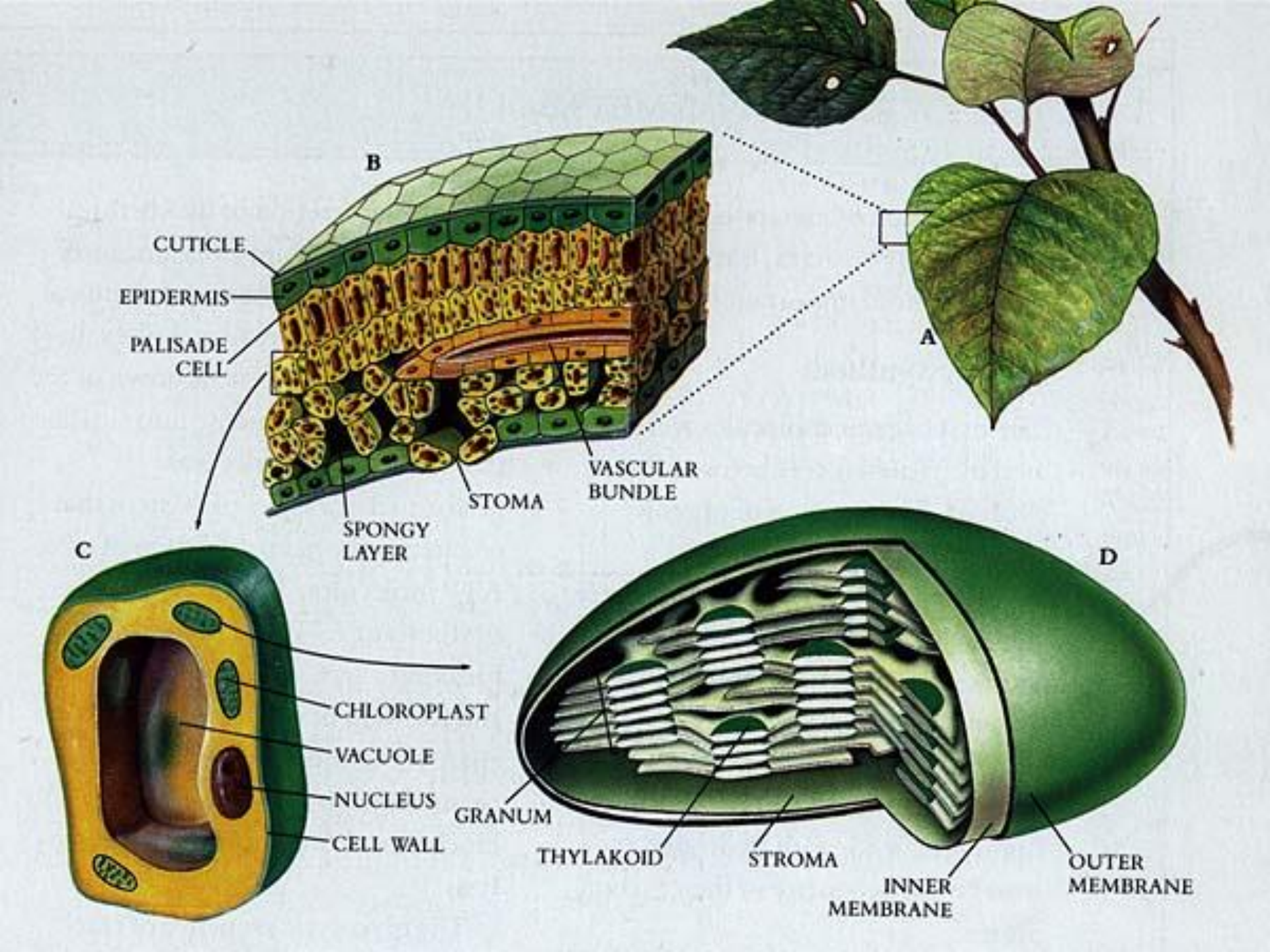
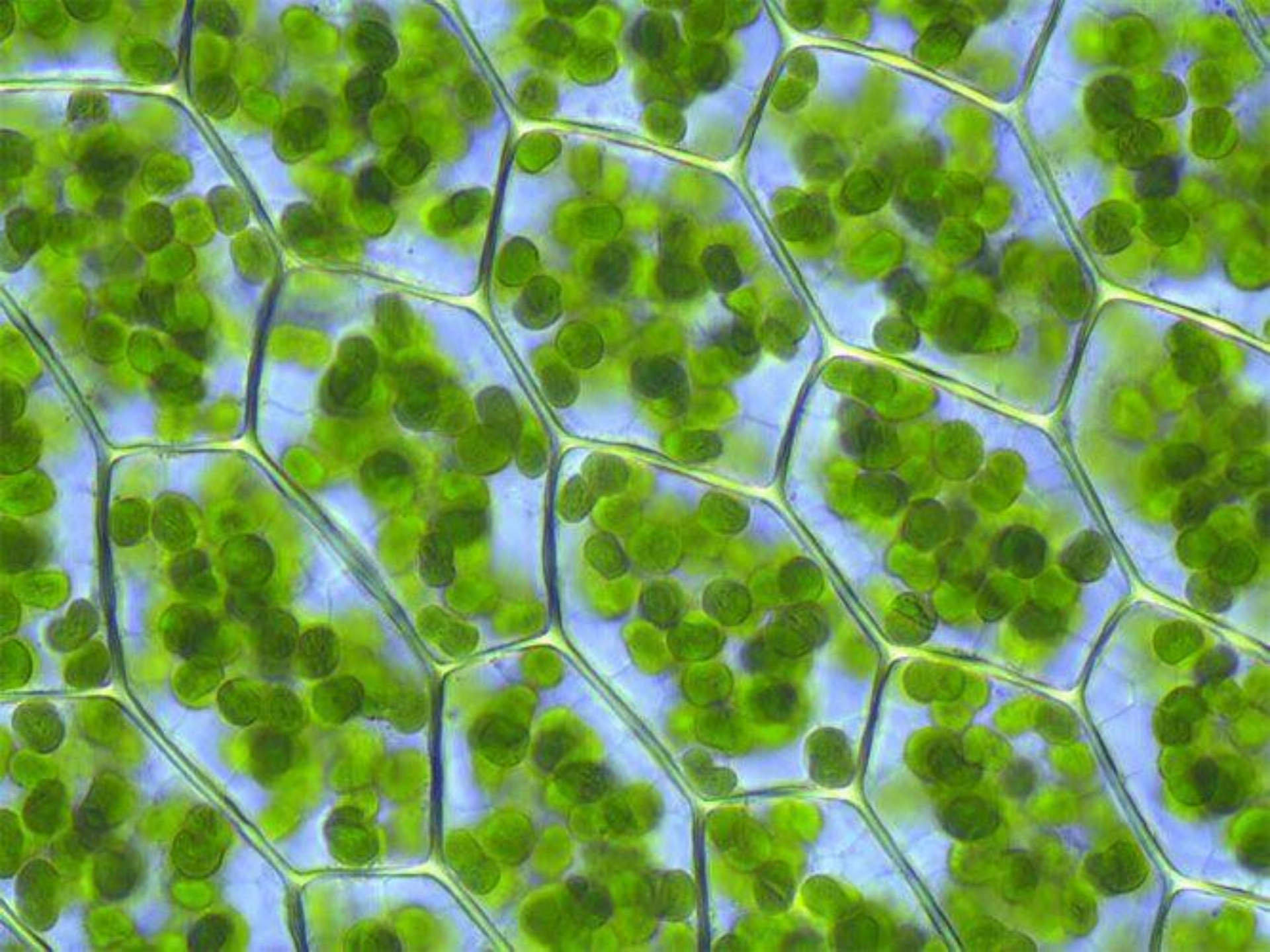
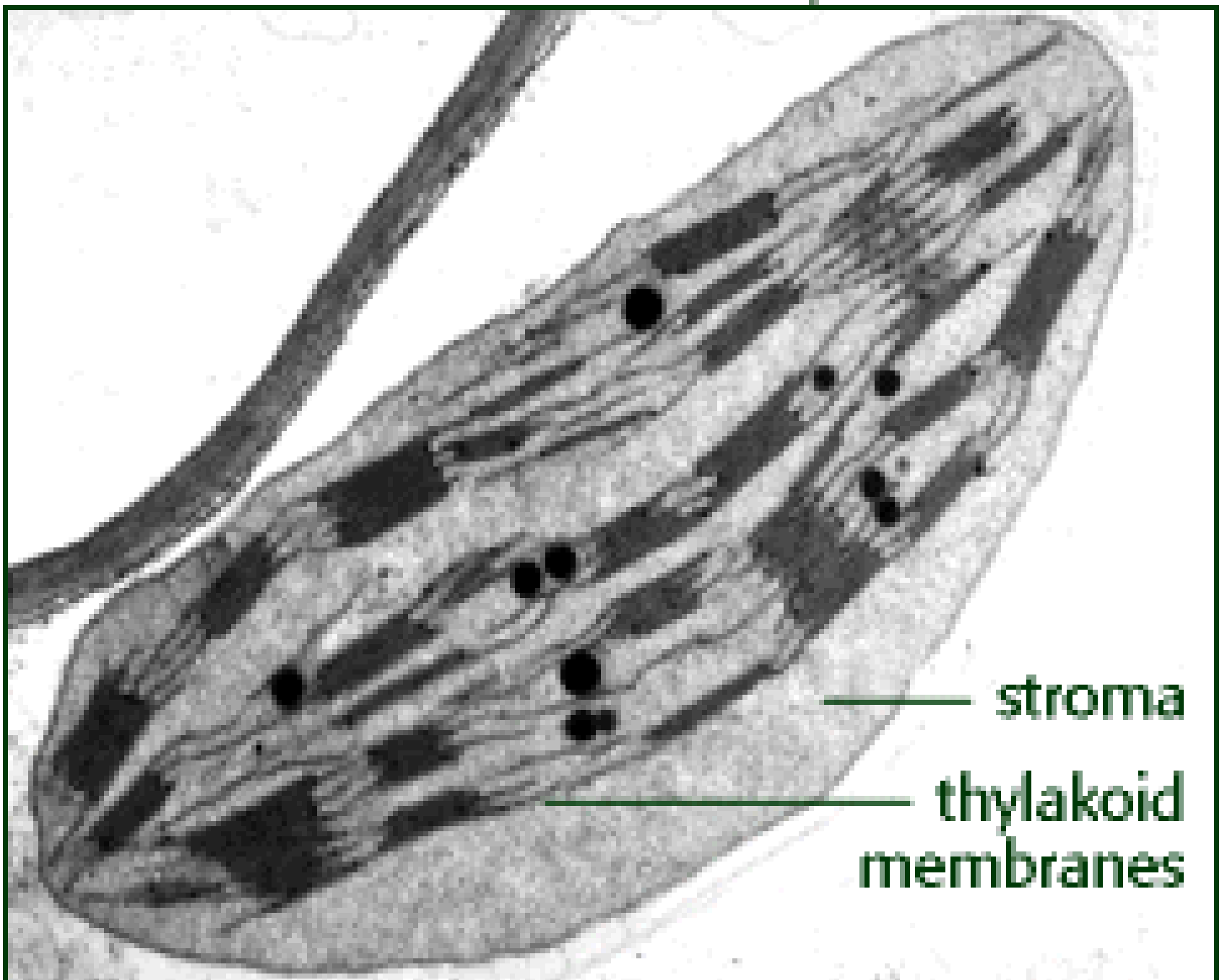


Figure 1


A
B
CUTICLE
EPIDERMIS
PALISADE CELL
SPONGY LAYER
STOMA
VASCULAR BUNDLE
C
CHLOROPLAST
VACUOLE
NUCLEUS
CELL WALL
D
GRANUM
THYLAKOID
STROMA
INNER MEMBRANE
OUTER MEMBRANE

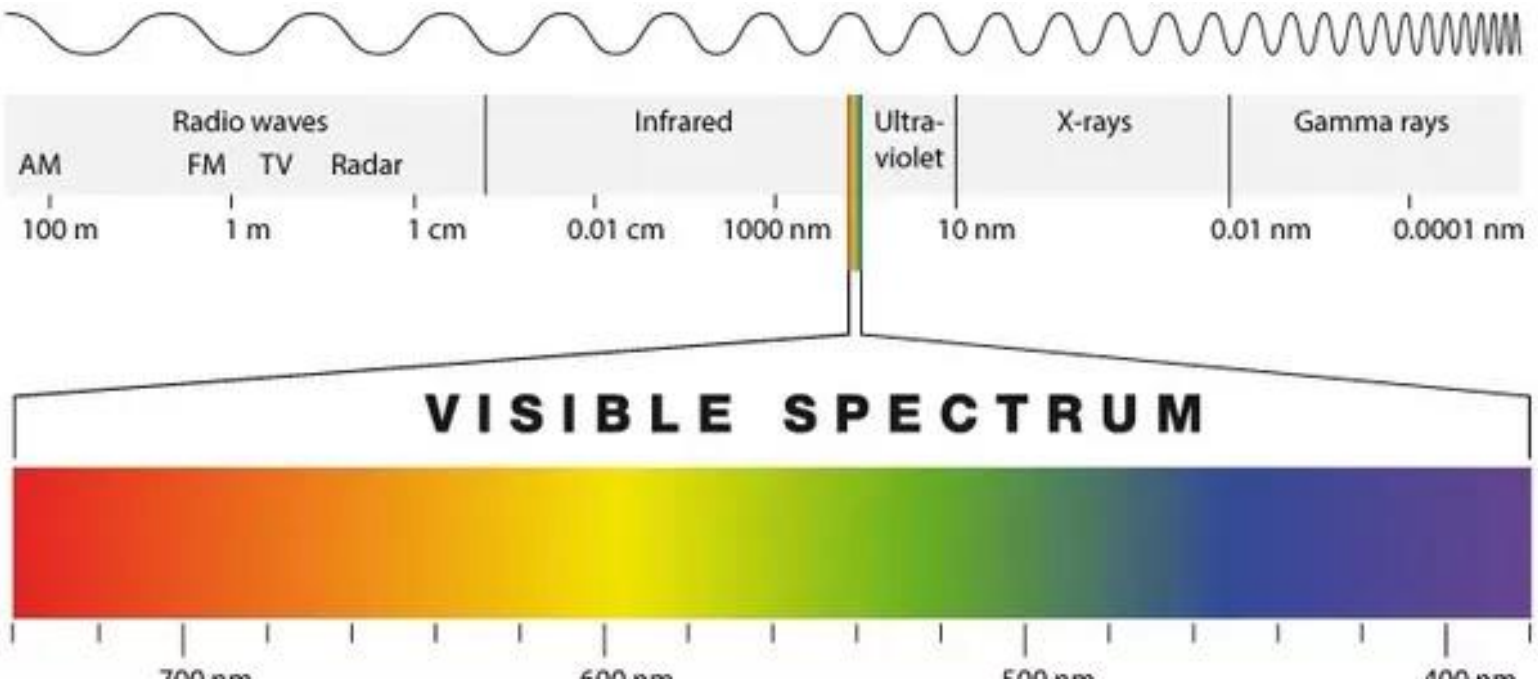


TEM of a chloroplast



First a little bit about Light

- Light from the sun is composed of many different wavelengths
- Different wavelengths lead to different colors
  - **Visible spectrum**



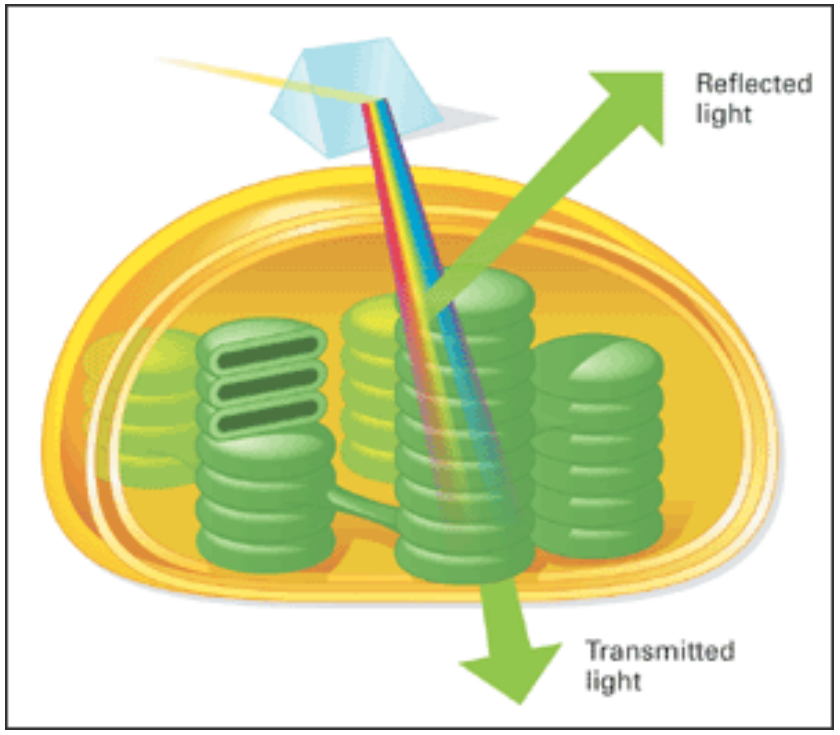
First a little bit about Light

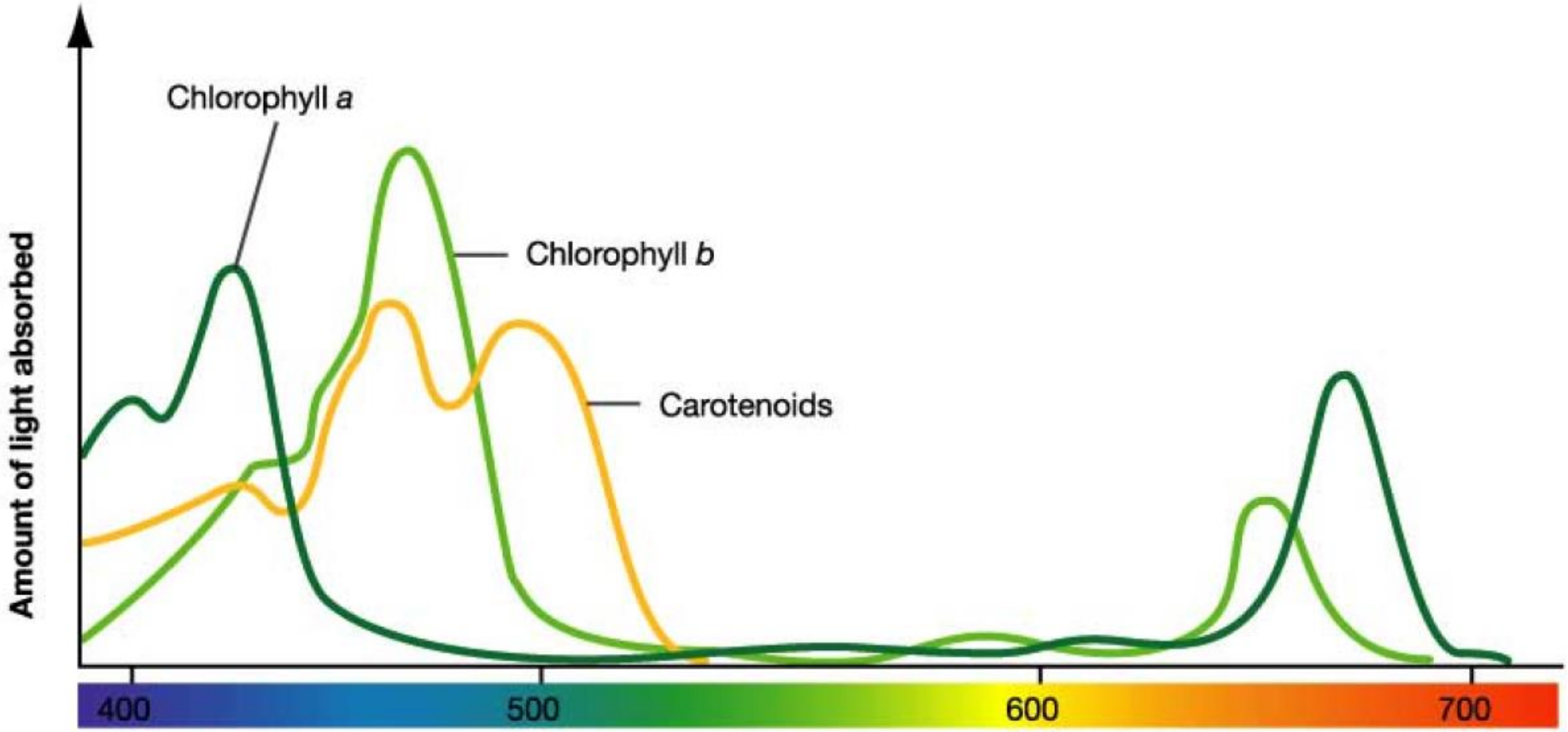
Pigments are chemicals that **absorb** light of various wavelengths.

In many plants, **chlorophyll** is the pigment that absorbs light energy.

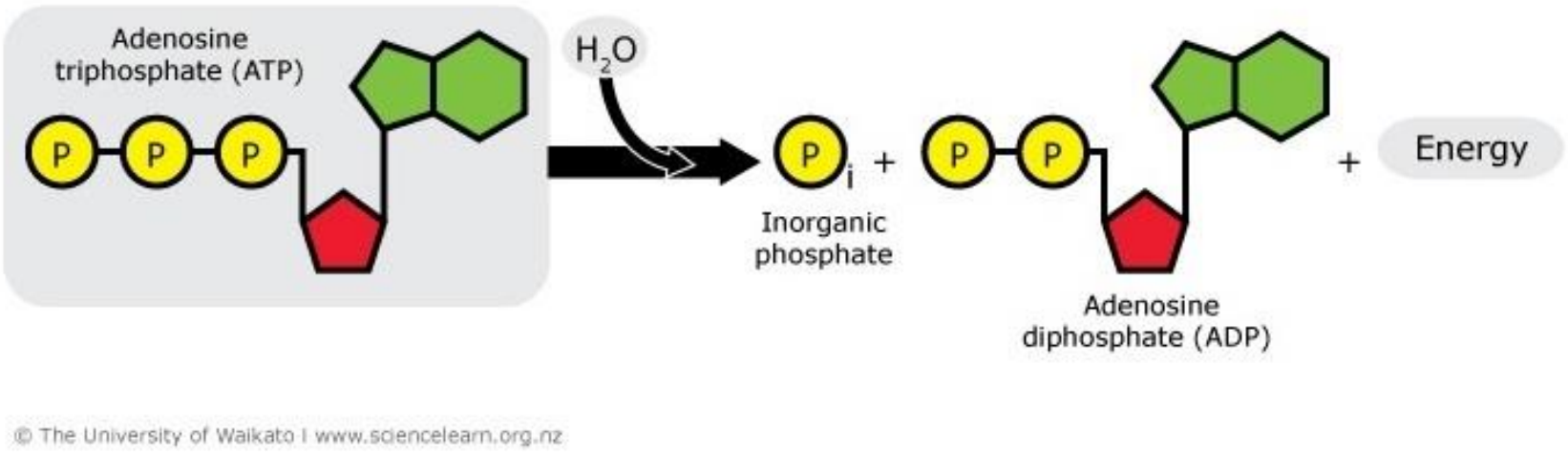
- found in the thylakoid of the chloroplast
- absorbs violet, blue, yellow, orange and red light.

Green light is **reflected,** so we see green plants




Chlorophyll *a*
Chlorophyll *b*
Carotenoids
Amount of light absorbed
400
500
600
700

Adenosine Triphosphate (ATP)



ATP is a molecule that cells use to **store energy**.

- **Chemical bonds** between atoms store energy.
- ATP has **3 phosphates** attached to it "(*tri-phosphate*)".
- When a phosphate is **broken off** through hydrolysis, the energy in the bond is **released**.

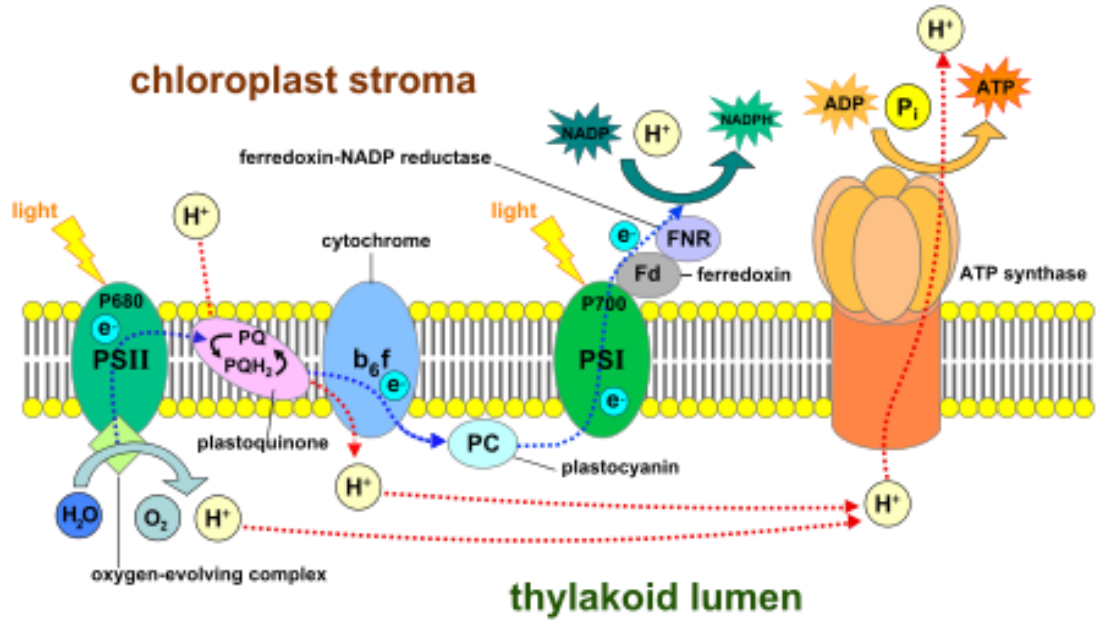
PHOTOSYNTHESIS:

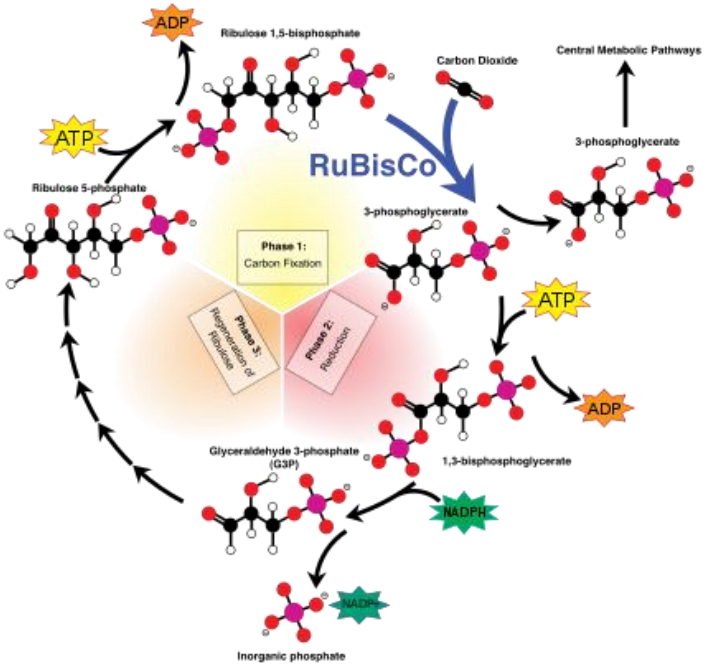
How does it happen?

Photosynthesis takes place in two stages:

1)Light Dependent Reaction

2)Light Independent Reaction (aka: Calvin Cycle)





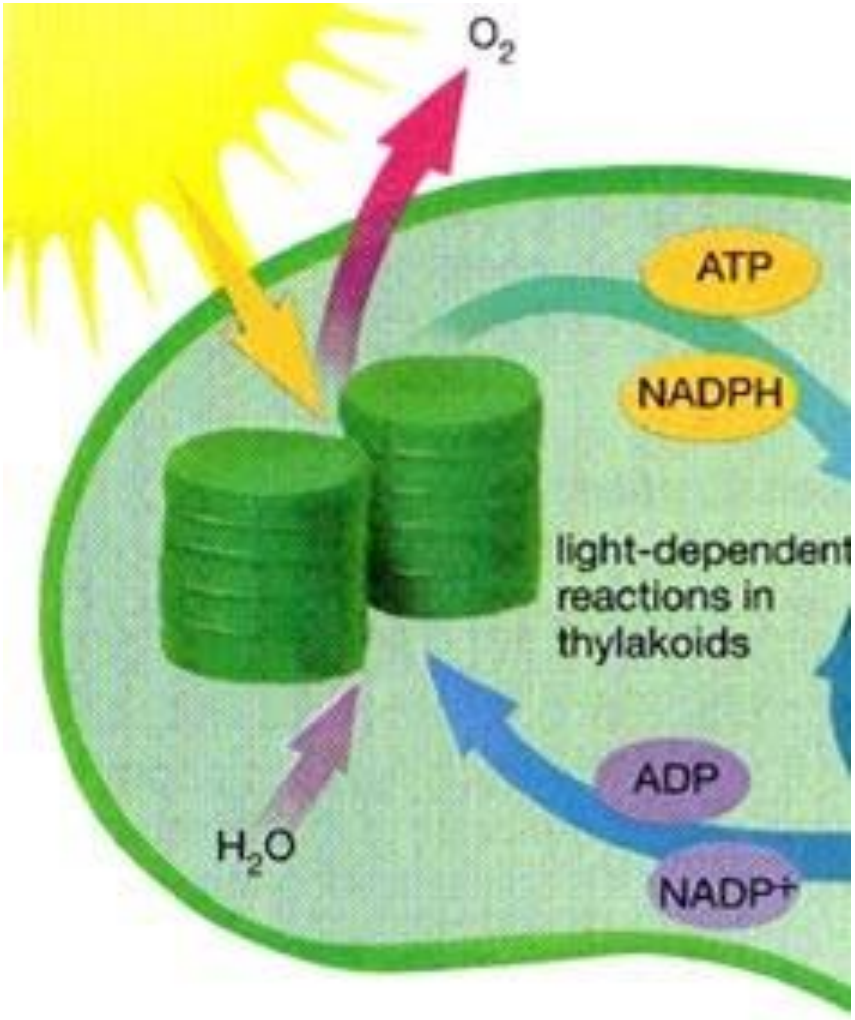
Stage 1: Light Dependent Reaction

Location: Thylakoid membrane

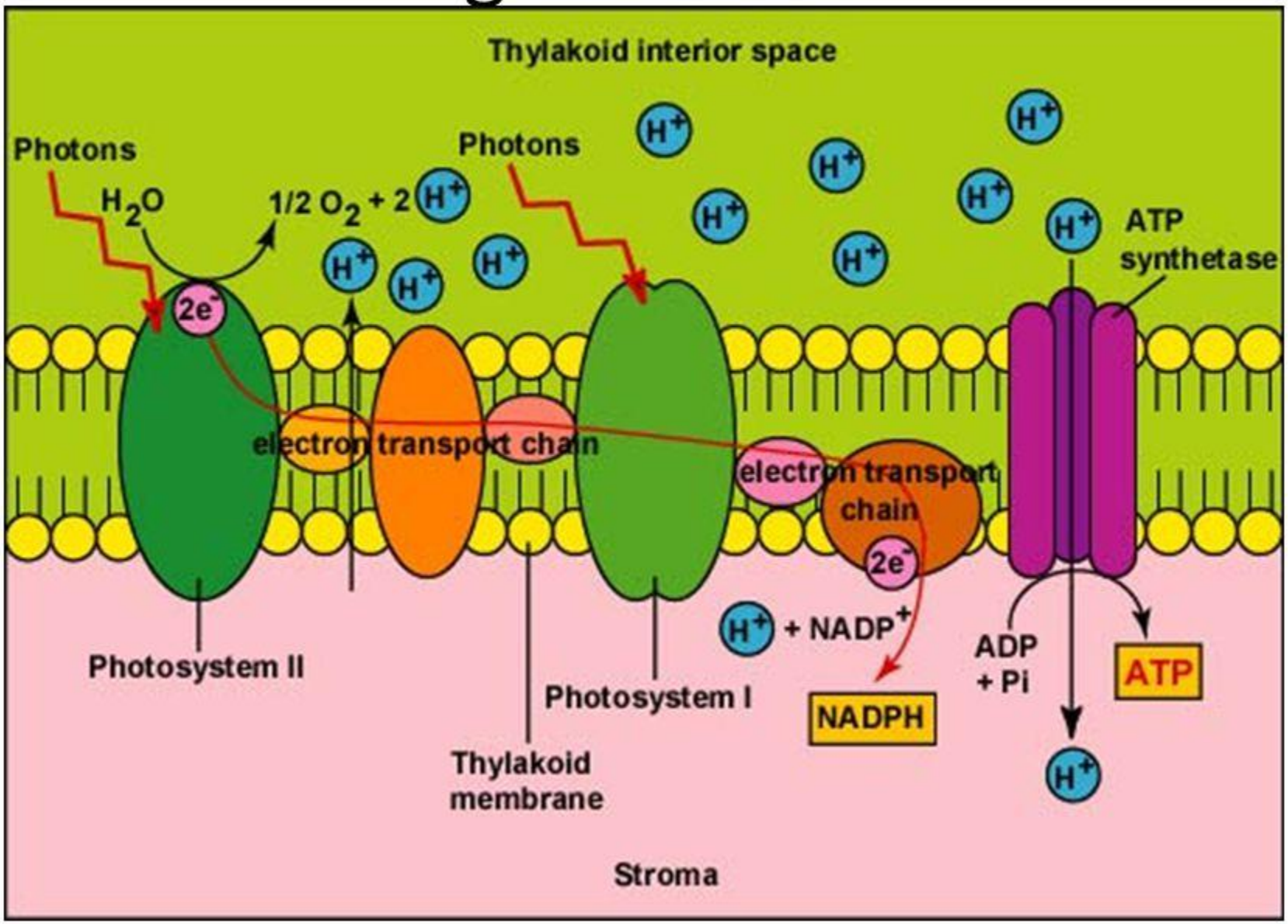
What goes in: Light energy (from sun) and water (from roots)

Products: Oxygen gas and ATP (cellular energy)

Description: Sunlight is absorbed by chlorophyll (pigment absorbing molecule in chloroplast). Water is split to release oxygen gas.



Light Reaction



Why leaves change color:

When the weather gets colder, and there is less sun- some trees lose their leaves to conserve energy.

Nutrients are kept in the trunk and not taken to the leaves.

Chlorophyll is no longer formed, and the chlorophyll that remains starts to break down.

As it breaks down it begins to absorb green wavelengths and reflect orange/red.

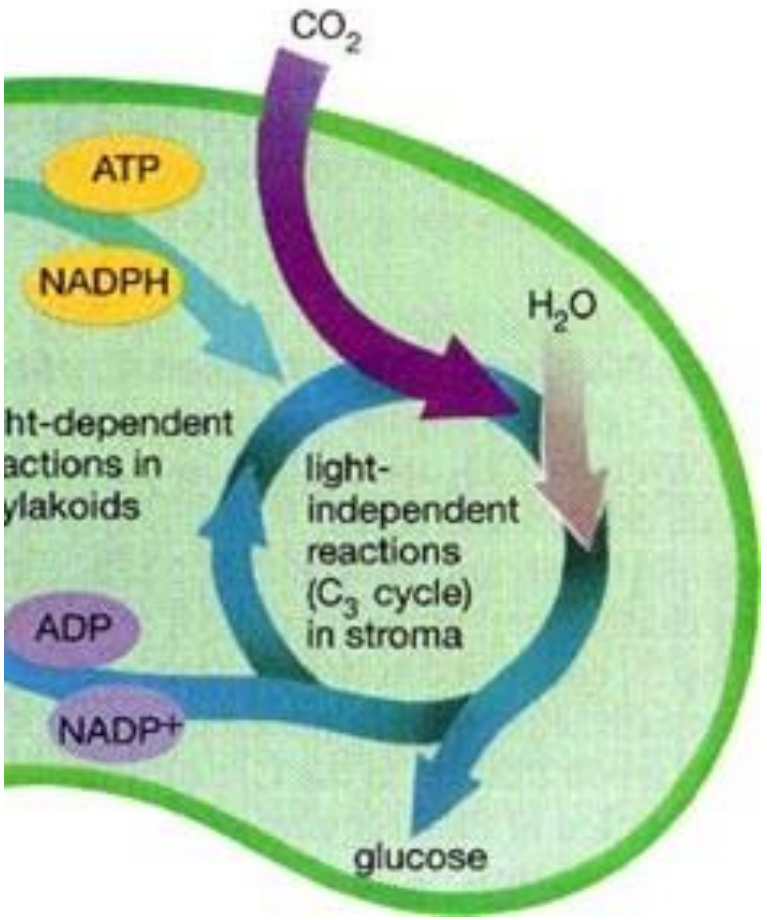
Stage 2: Light Independent Reaction (Calvin Cycle)

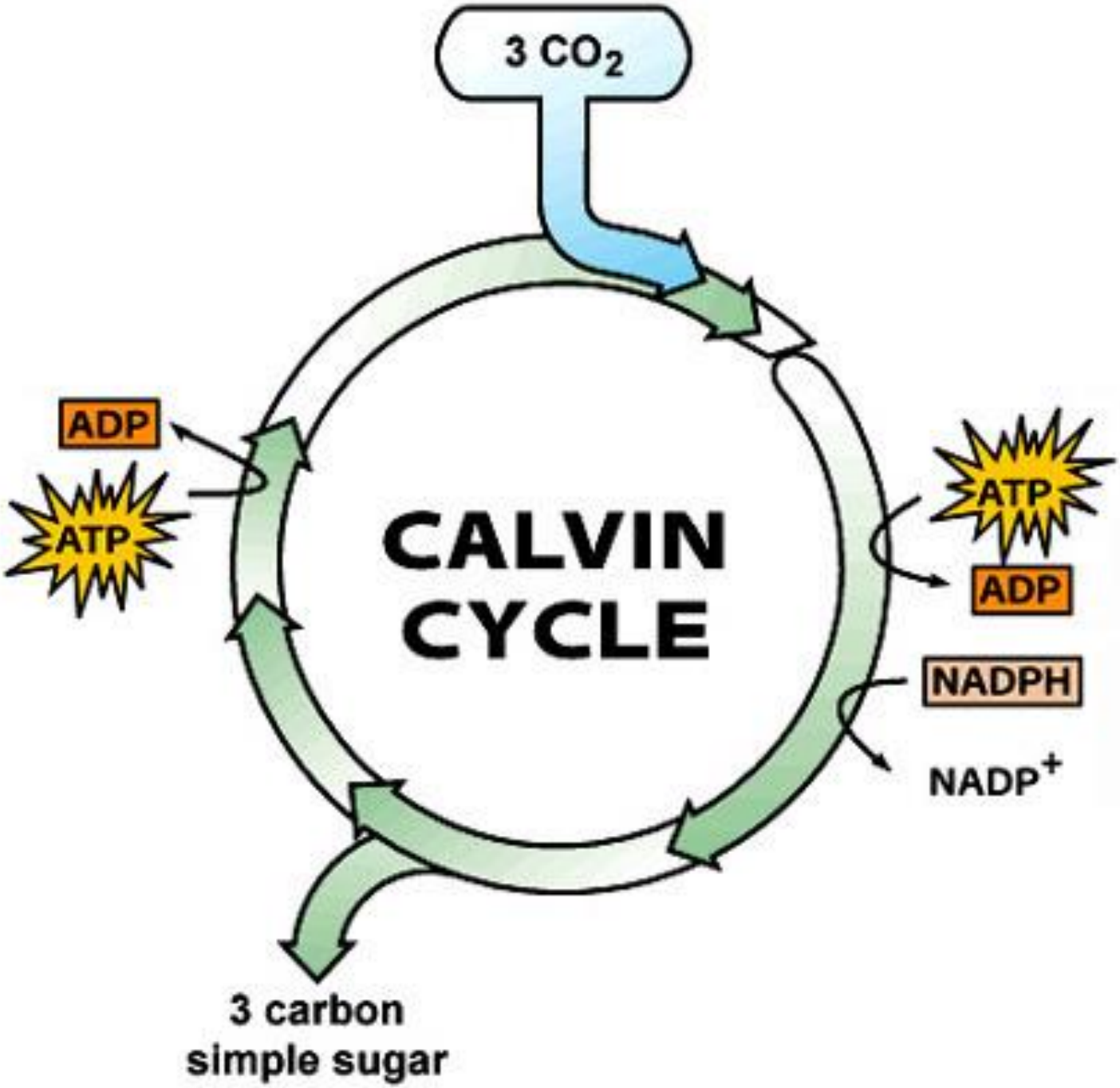
Location: Stroma

What is needed: CO_2 (from air) and ATP (from light dependent reactions)

Products: Glucose

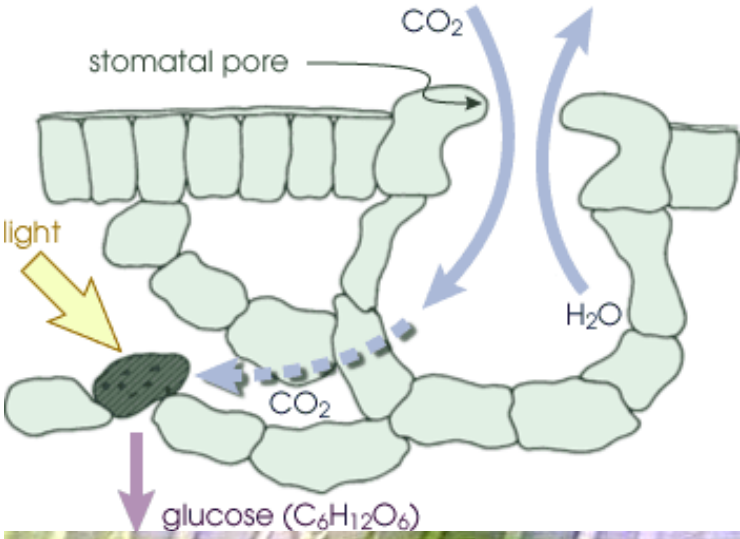
Description: Energy in ATP bonds is used to make glucose from CO_2. Some of the energy from sun is stored in the bonds of glucose.

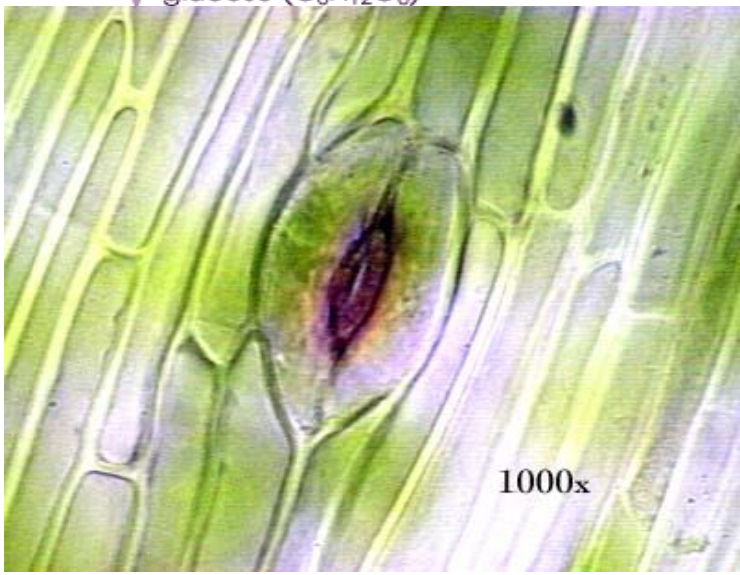



3 CO_2
ADP
ATP
CALVIN CYCLE
ATP
ADP
NADPH
$NADP^+$
3 carbon simple sugar

Stage 2: Light Independent Reaction
Additional Details

CO_2 enters the leaf through the **stomata**, which are small **pores** located on the underside of a leaf.





Stage 2: Light Independent Reaction

Additional Details

When stomata open, water vapor evaporates out.

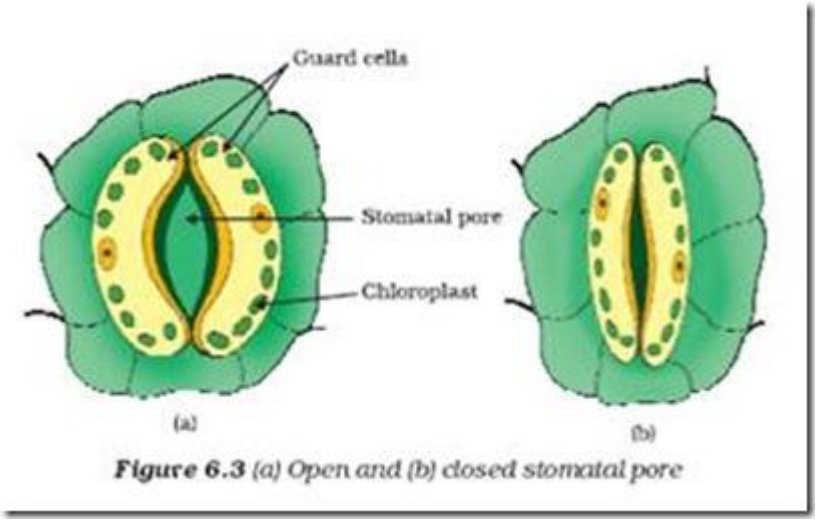
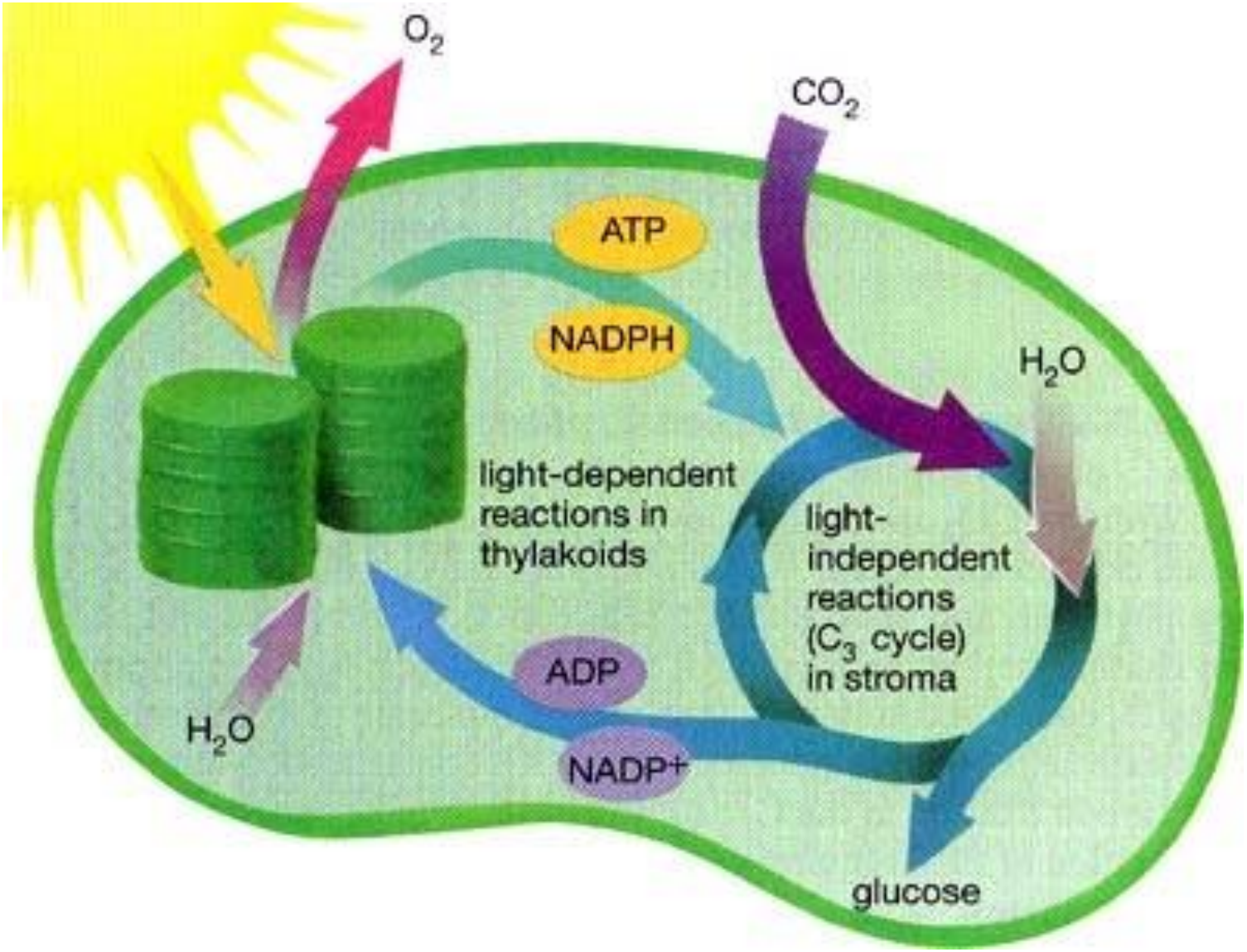


Figure 6.3 *(a) Open and (b) closed stomatal pore*

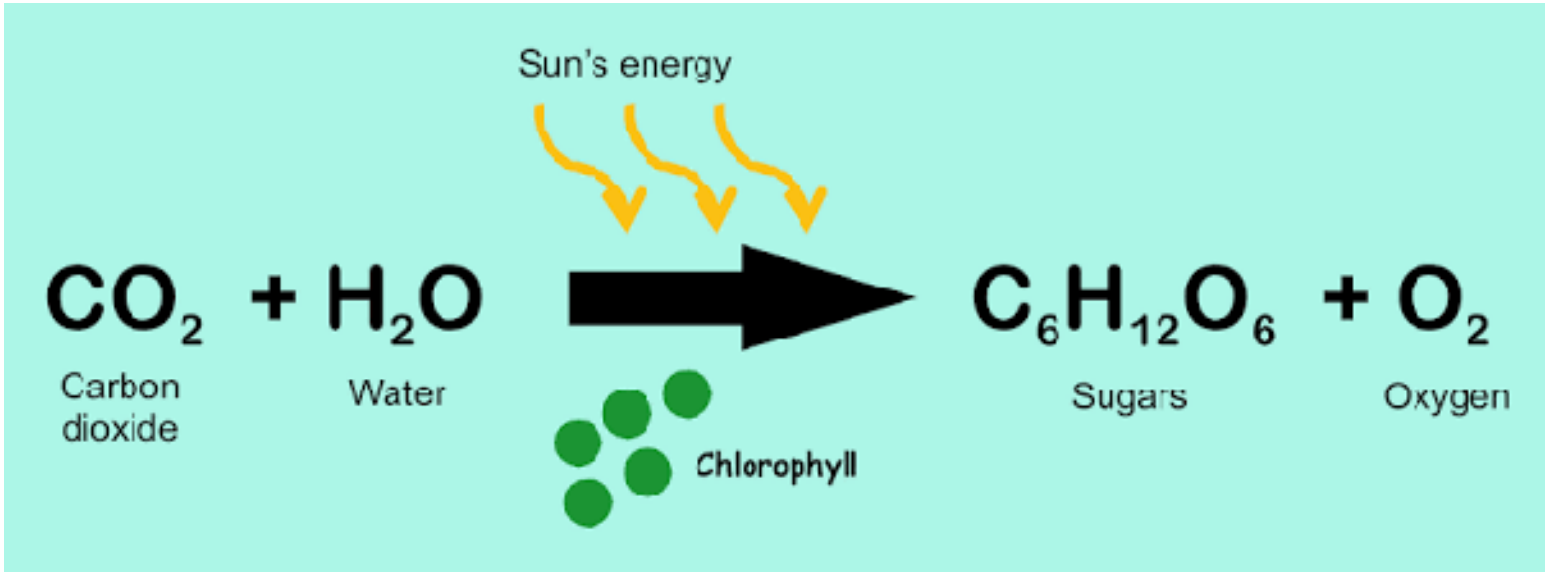
To conserve water, in hot and dry environments: stomata open at dusk and at dawn.

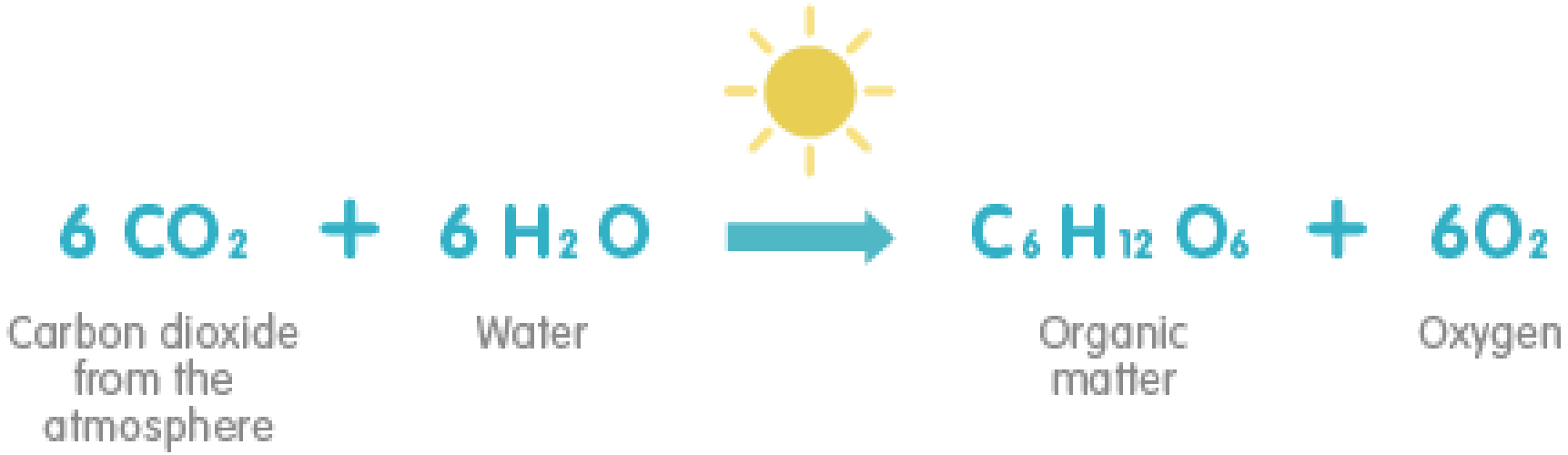
In wet environments, they will open and close as needed.

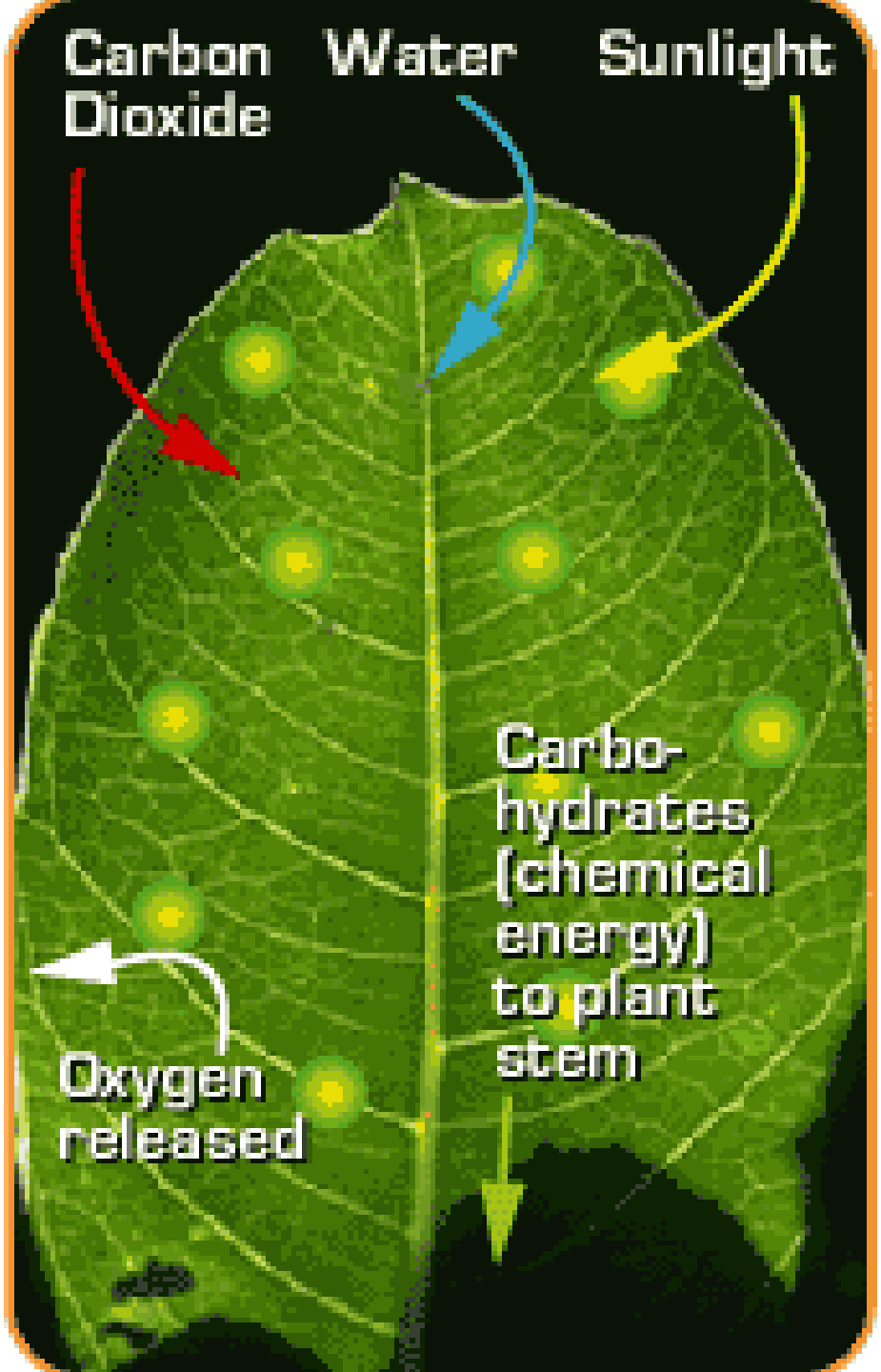
PUTTING IT ALL TOGETHER!

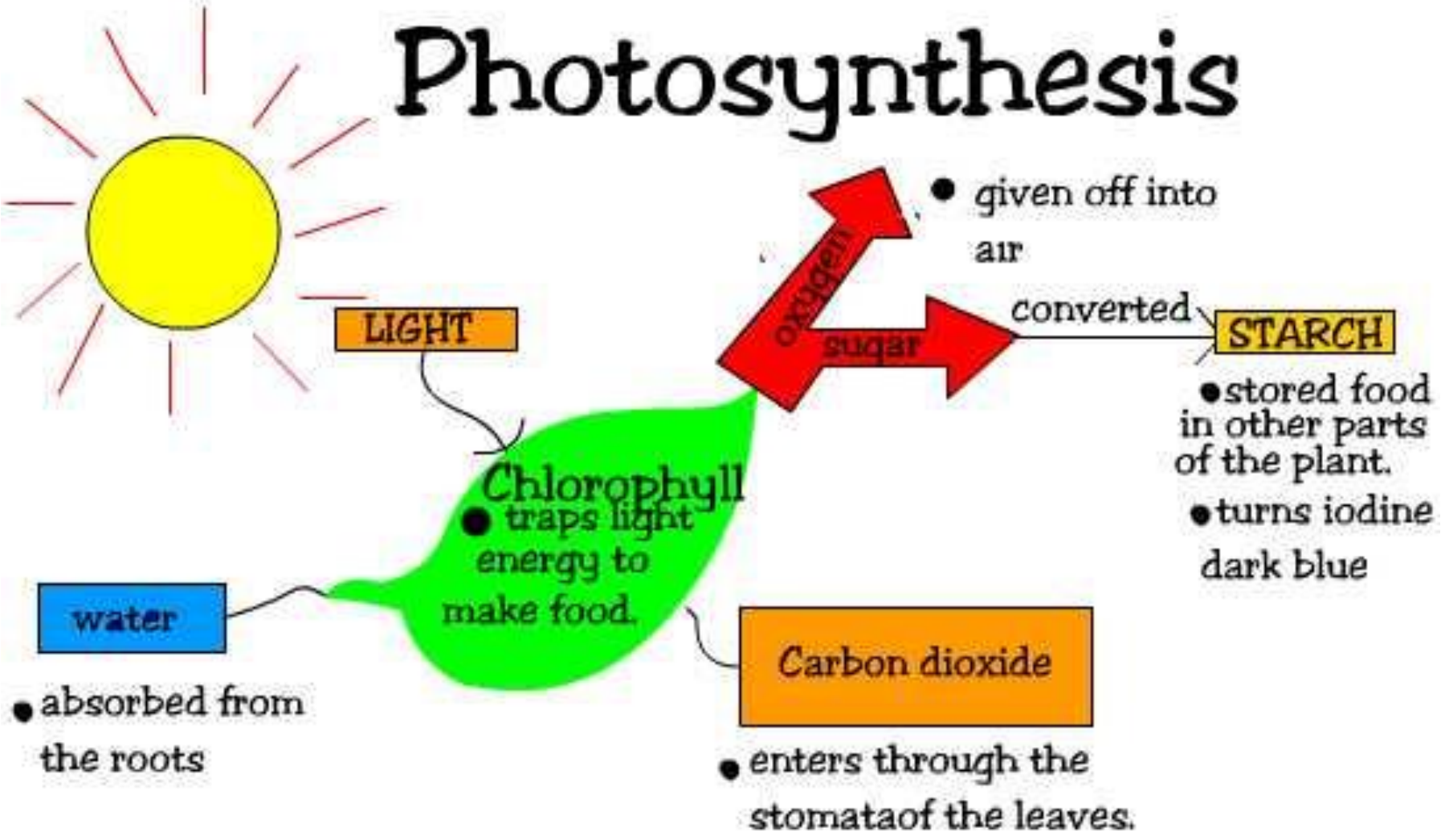


The chemical equation for photosynthesis

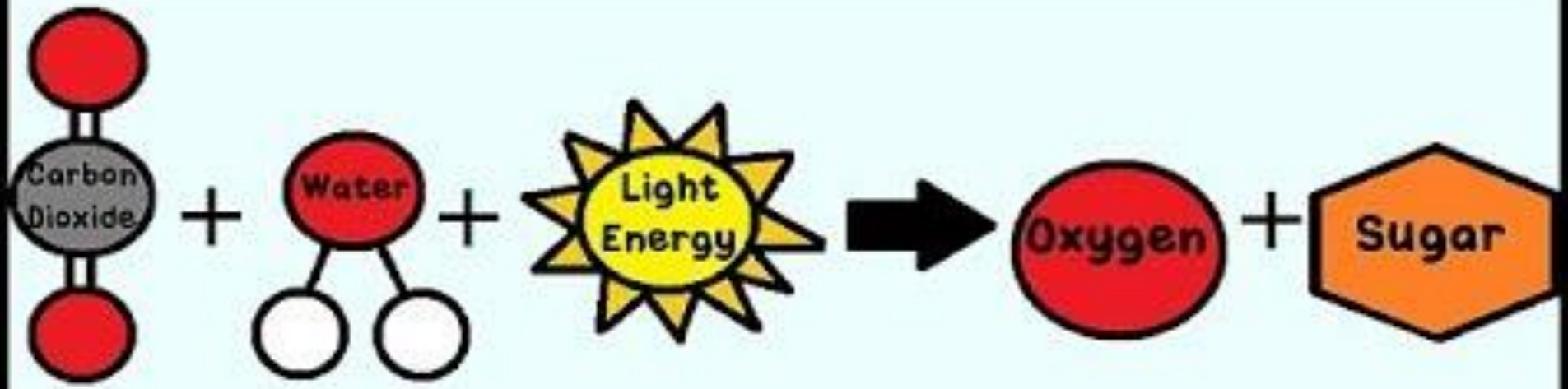





Carbon Dioxide
Water
Sunlight
Carbo-hydrates (chemical energy) to plant stem
Oxygen released

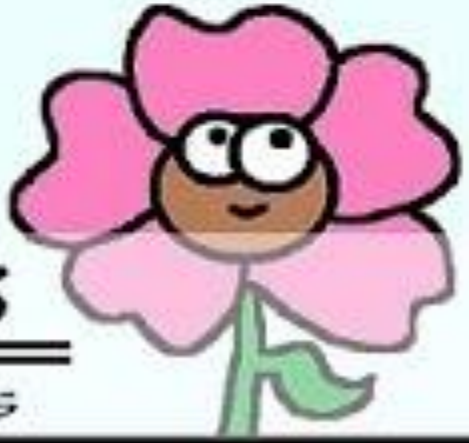


http://www.biologycorner.com/resources/photosynthesis.jpg



Photosynthesis

With the Amoeba Sisters



Recipe for Photosynthesis

Take a little Carbon Dioxide present in the air,
Add a bit of water that's found everywhere.
If the plant has chlorophyll then add a dash of light,
And you'll know the recipe for photosynthesis will turn out all right.

Green plants get their energy from the sun,
And form the base of food chains for everyone.

Plants make glucose the fuel that we need,
When we eat this sugar, energy is freed.
As if this isn't enough for the green plants to do,
They release oxygen to the atmosphere too.

Plants bring beauty to the world that we see,
We get many products from the trees.
Even if you're a carnivore and eat a plant you can't.
Just remember that meat's energy begin with a plant.