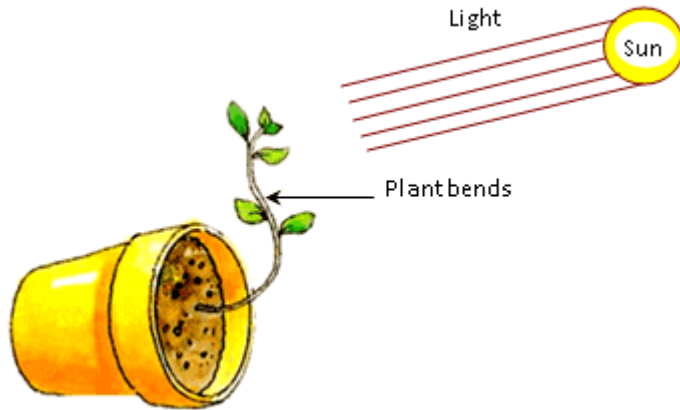


Identify two tropisms seen in this image.

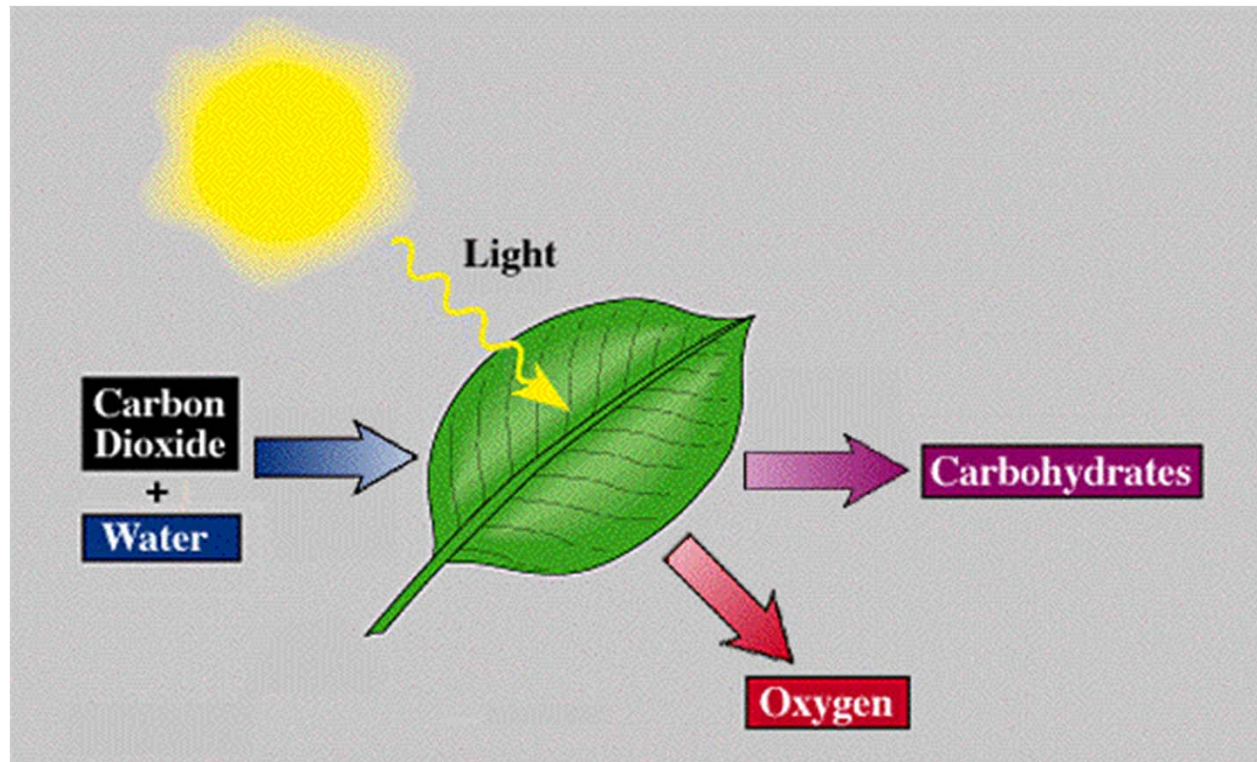


What three molecules enter and exit through the stomata in the leaves?

What is the main similarity between the Xylem and phloem?

Why do plants take in Inorganic ions through their roots?

PHOTOSYNTHESIS

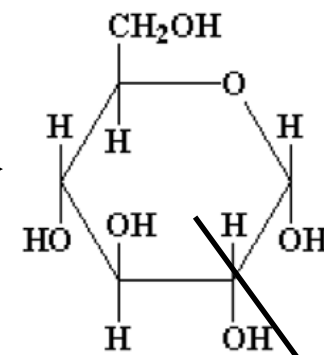
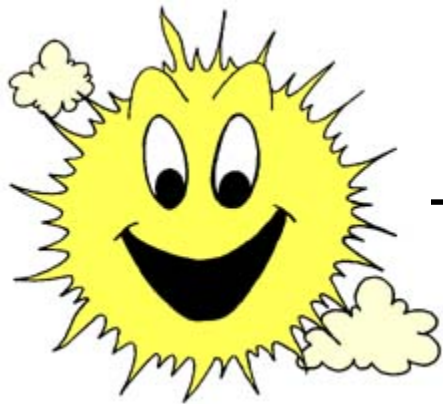


Overview: The Process That Feeds All Living Things

- **Photosynthesis**

(photo = light, synthesis = to make, put together)

- Overall Definition: the process that converts solar energy (photons) into chemical energy (glucose)



Glucose

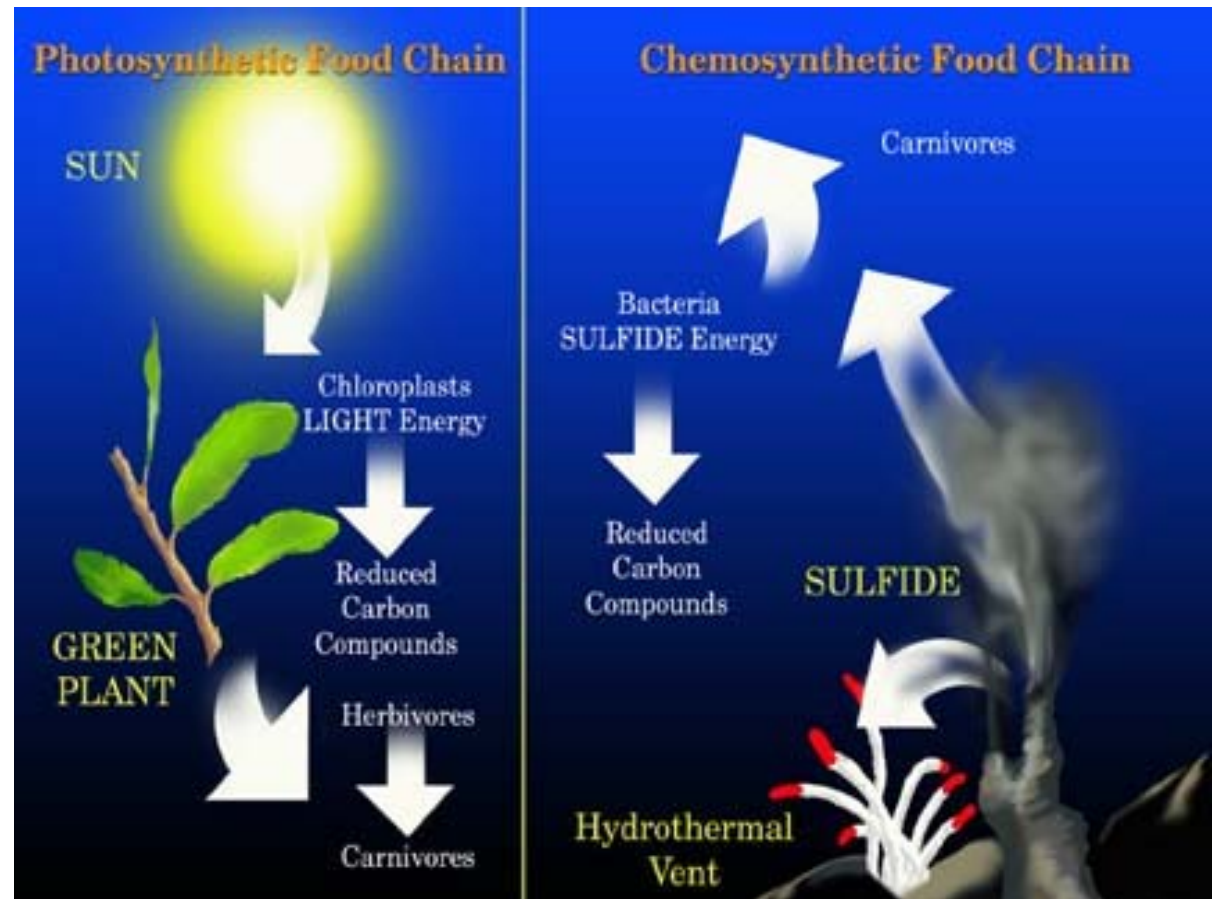
Remember Producers?

- Plants are autotrophs
 - They are the producers of ecosystems
 - Plants use energy from the sun to produce the food that feeds the ecosystem
 - Some bacteria (ex. blue-green algae) and some protists are also photosynthetic



Chemosynthesis

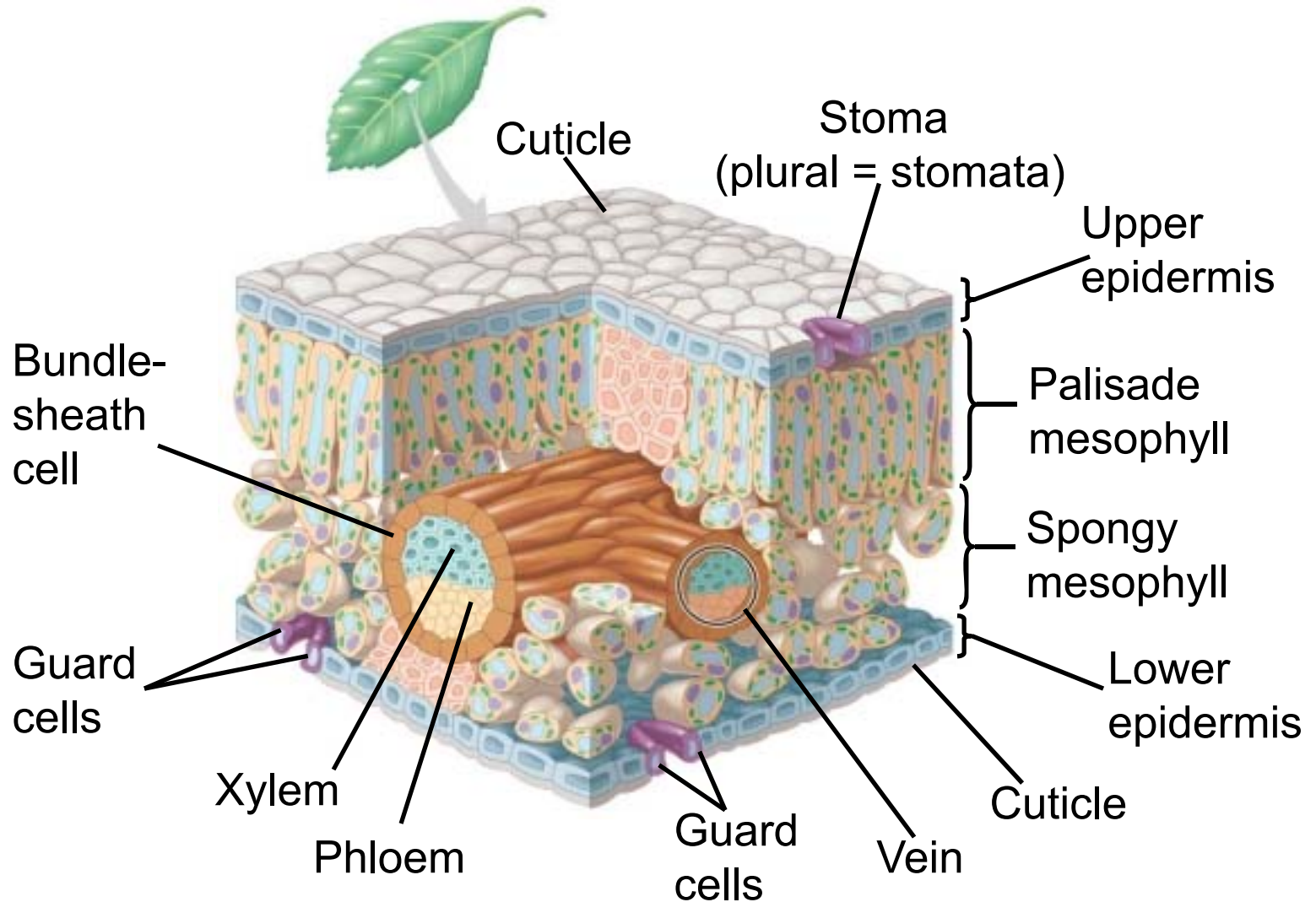
- Certain types of bacteria and fungi use energy from INORGANIC COMPOUNDS (such as hydrogen sulfide) instead of light energy to produce food.
- This process is called **CHEMO-SYNTHESIS**.



A comparison of photosynthesis and chemosynthesis.

Photosynthesis Occurs Within the Cells of Plant Leaves

Leaf anatomy



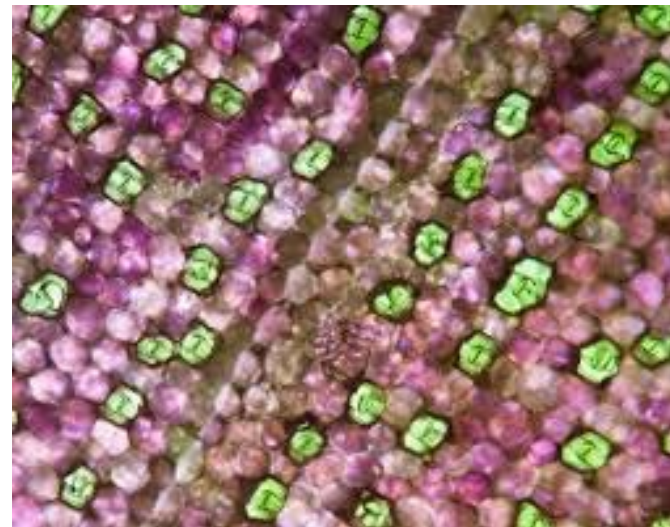
Transportation Of Needed Materials

- Nutrients and water, can get into and out of leaves:
 - **Xylem**: Carries water and dissolved minerals upward from roots into the stems and leaves
 - **Phloem**: Transports organic nutrients (ex. sugars) from where they are made to where they are needed
 - **Stoma (singular)**: allows CO₂, O₂, and H₂O (transpiration) to enter and leave the leaves.

Plural = Stomata

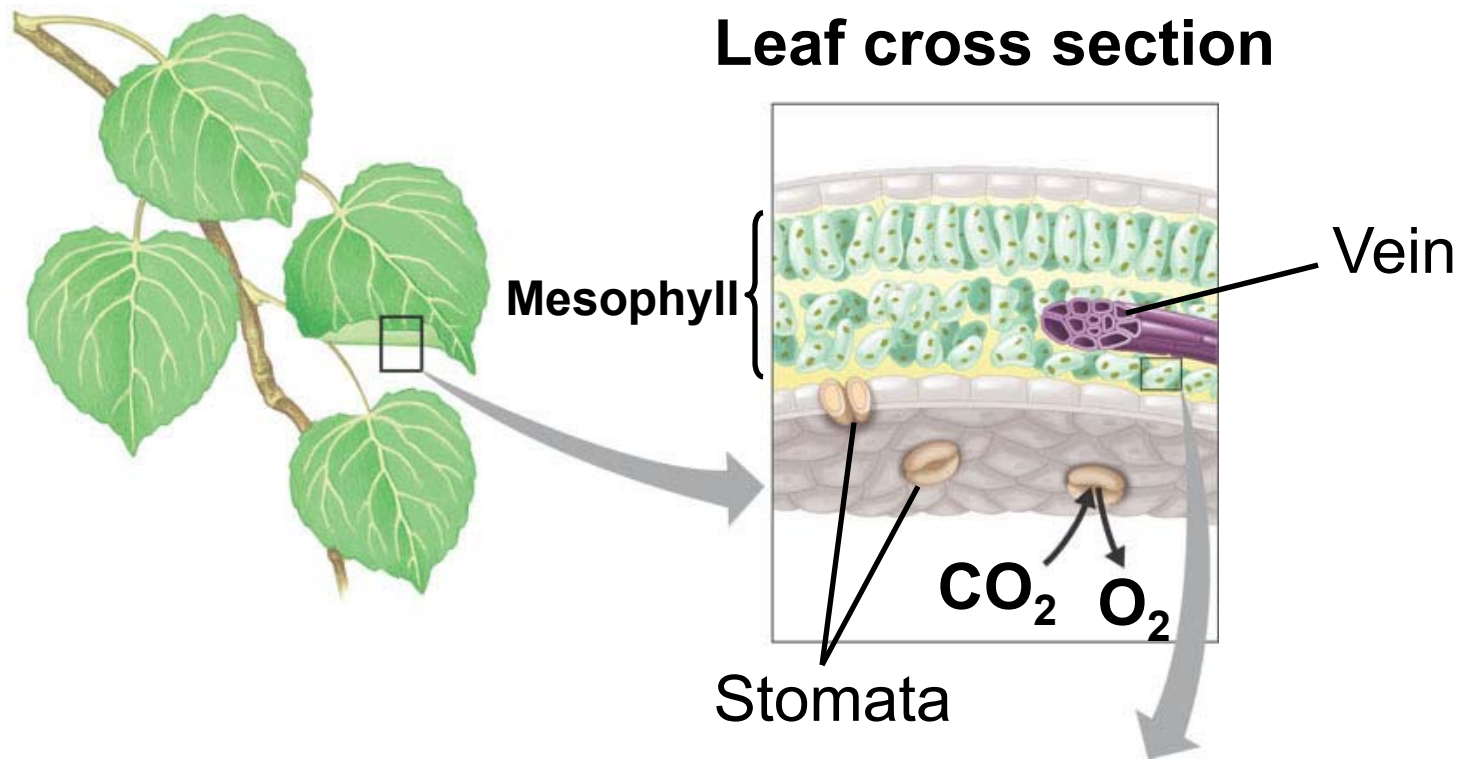


Purple Zebrina
(Wandering Jew Plant)
As seen under a
microscope



Photosynthesis converts light energy to the chemical energy of food

- The leaves of plants are the major sites of photosynthesis



Chloroplasts: The Sites of Photosynthesis

- What type of cells have chloroplasts? Think back to our CELL unit

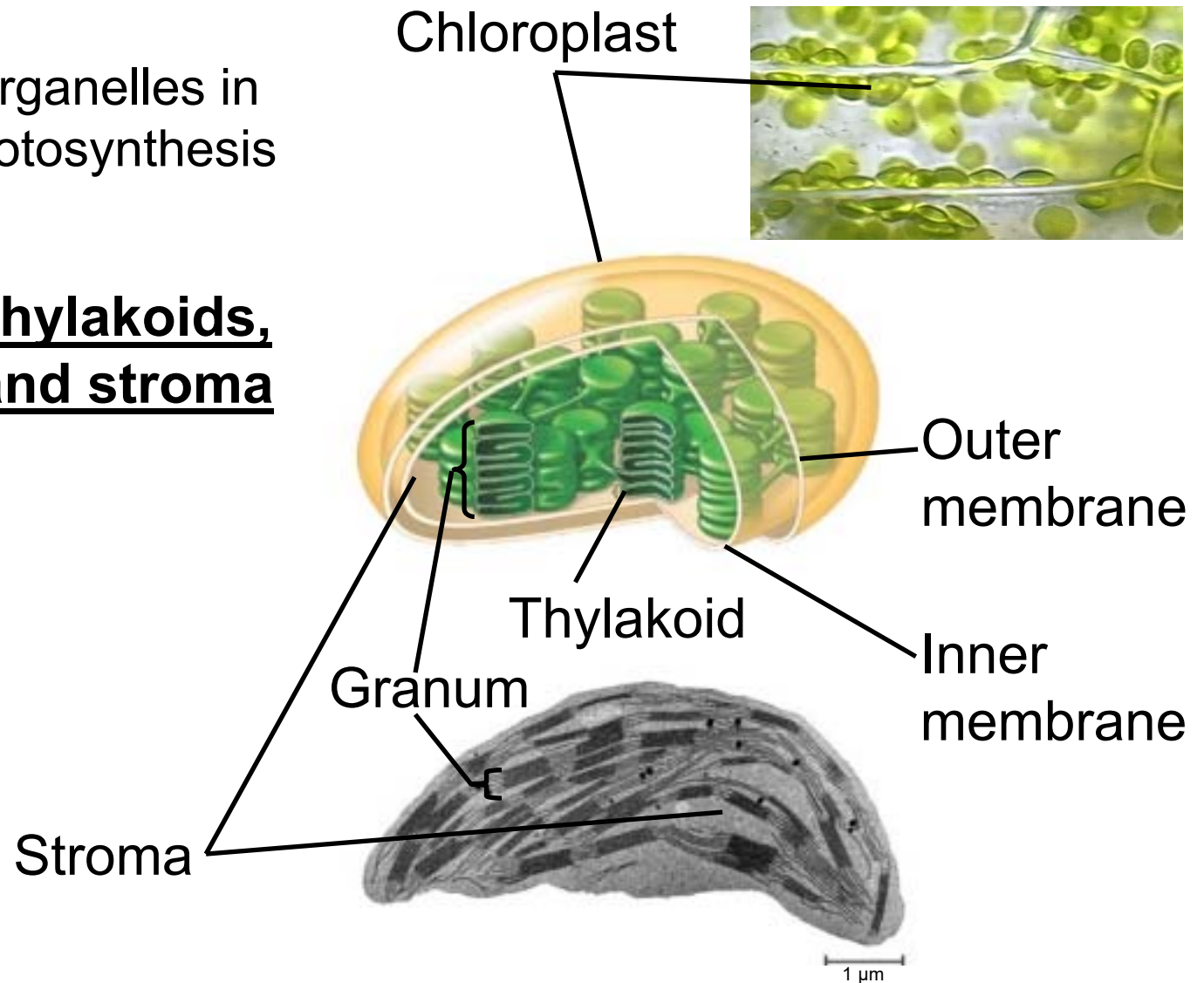


Chloroplasts

Cell Walls

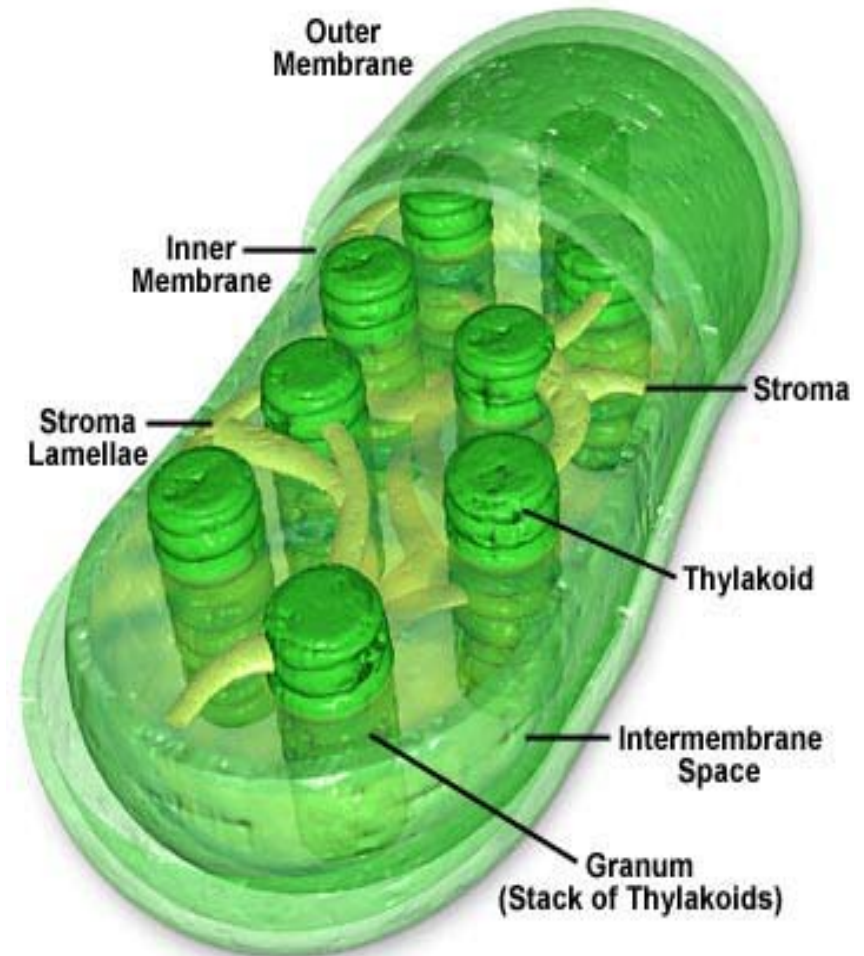
Chloroplasts: The Site of Photosynthesis

- Chloroplasts
 - Are the organelles in which photosynthesis occurs
 - Contain **thylakoids, grana, and stroma**



Structures of the Chloroplast

- Thylakoid = disk-shaped sac in the stroma of a chloroplast
- Grana = layers or stacks of thylakoids
- Stroma = the thick fluid contained in the inner membrane of a chloroplast; made of water and enzymes



Chlorophyll: The Green Pigment Inside Chloroplasts

Chlorophyll is a pigment.

A pigment is any substance that absorbs light.

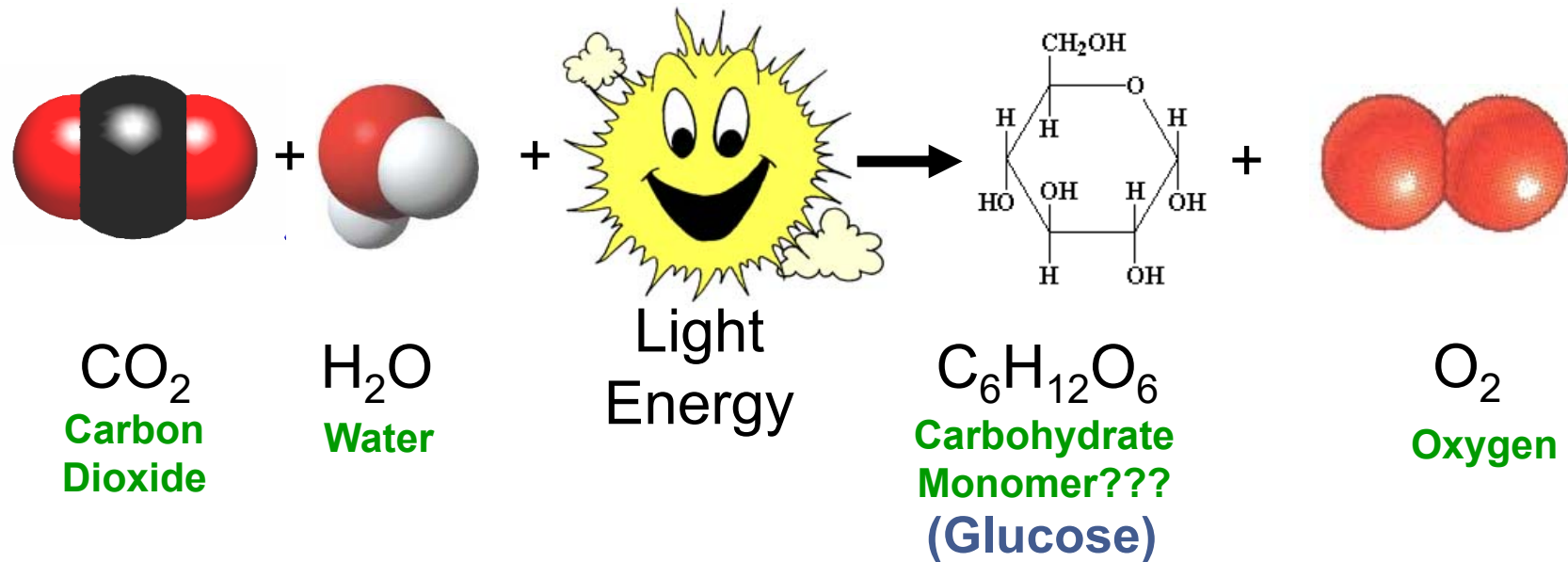
The color of the pigment comes from the colors of light reflected (in other words, those not absorbed).

Chlorophyll is green because it reflects green light.



The Chemical Reaction of Photosynthesis

- Photosynthesis is summarized by the following chemical reaction:

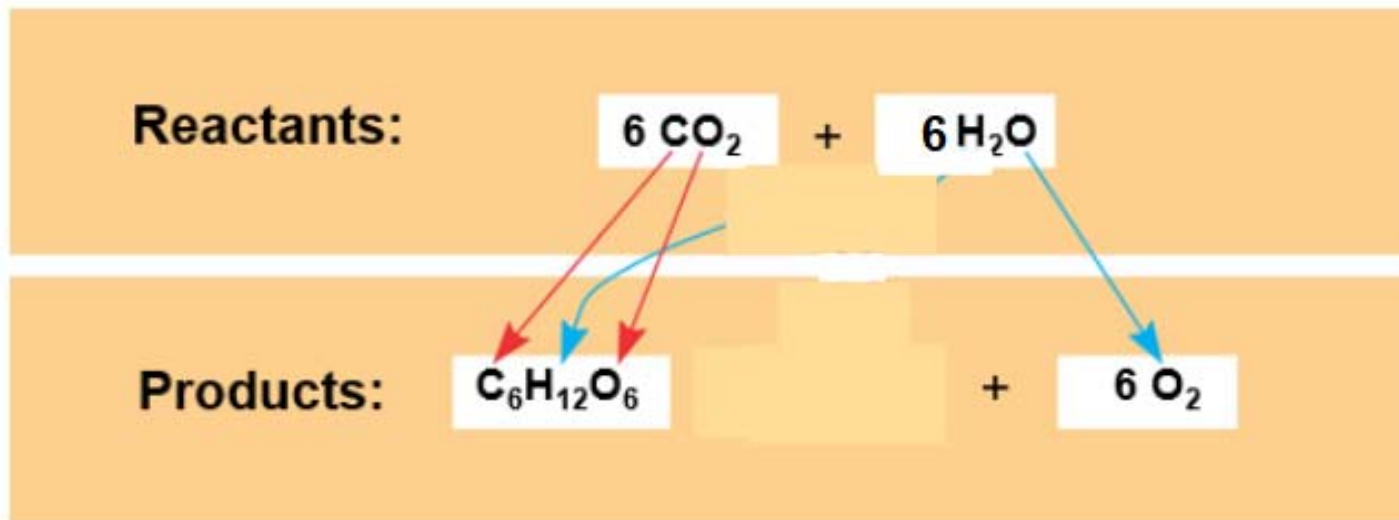


The Balanced Chemical Equation:



Tracking The Atoms Through Photosynthesis

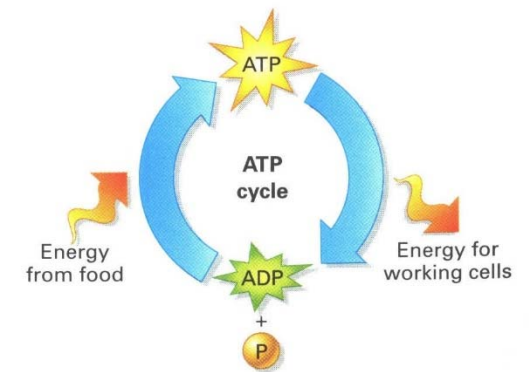
- Chloroplasts split carbon dioxide and water
 - To make sugar molecules and oxygen



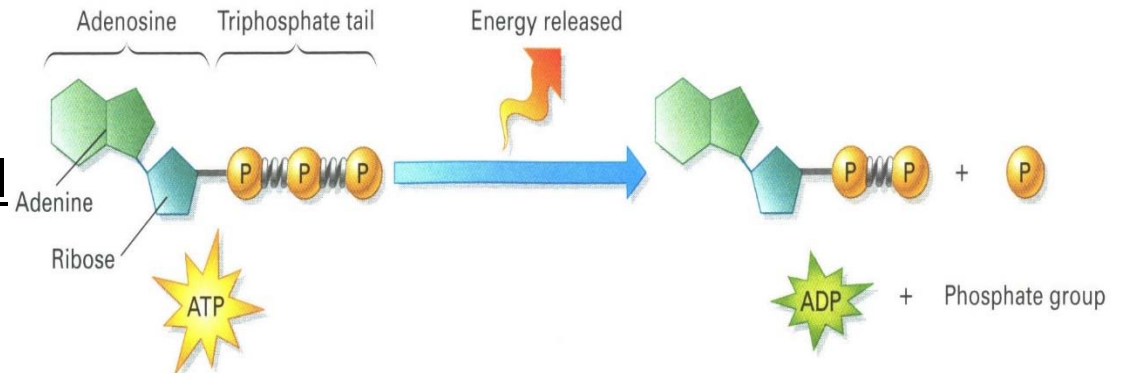
- The oxygen we breath comes from H_2O
- The carbon in our food, comes from CO_2

Adenosine Triphosphate

- ATP is the main energy source for cell processes
 - Energy is released when ATP is converted to ADP (Adenosine Diphosphate)
 - Tri = 3 Di = 2
 - ADP can be converted into ATP again using energy from food to reform bonds.
 - ATP is made of three components



- Adenine
- Ribose
- Triphosphate tail

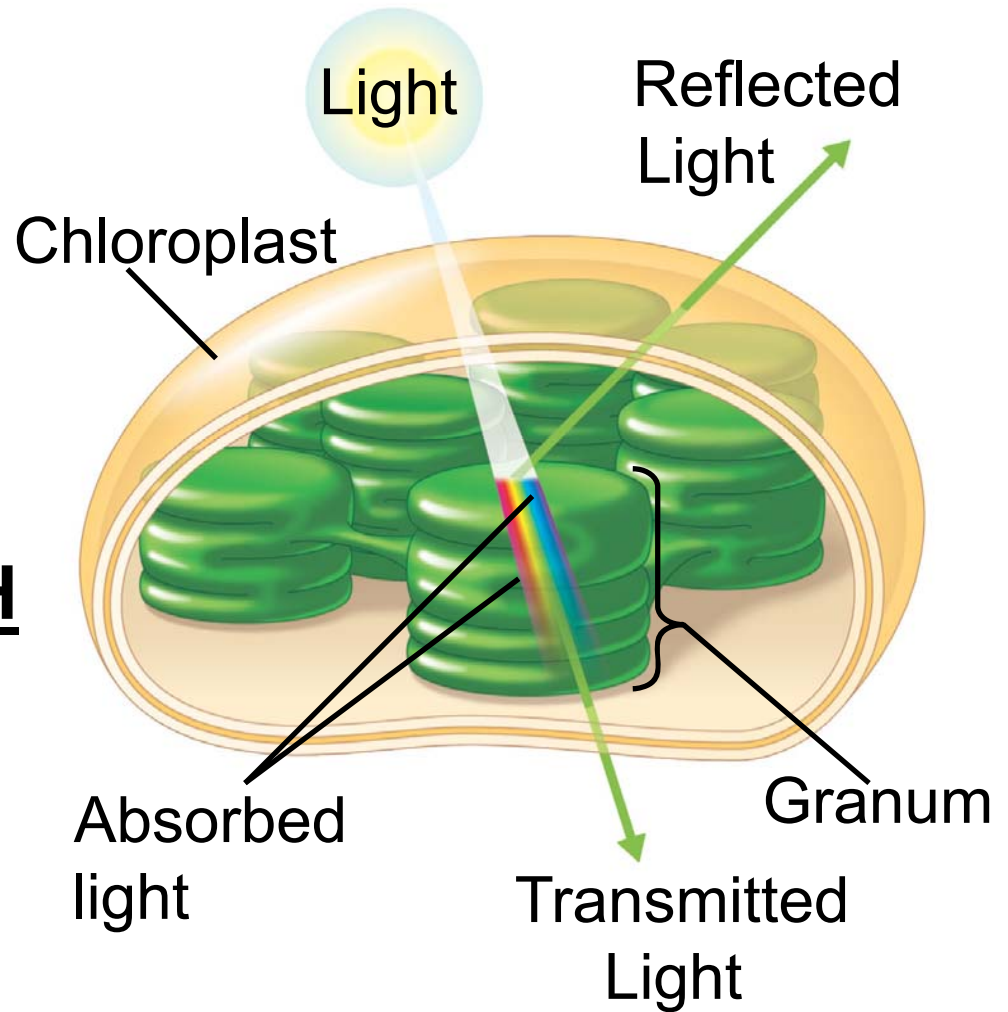


The Two Stages of Photosynthesis

- Photosynthesis consists of two processes
 - The light (dependent) reactions
 - The dark (light-independent) reactions; also called the Calvin cycle

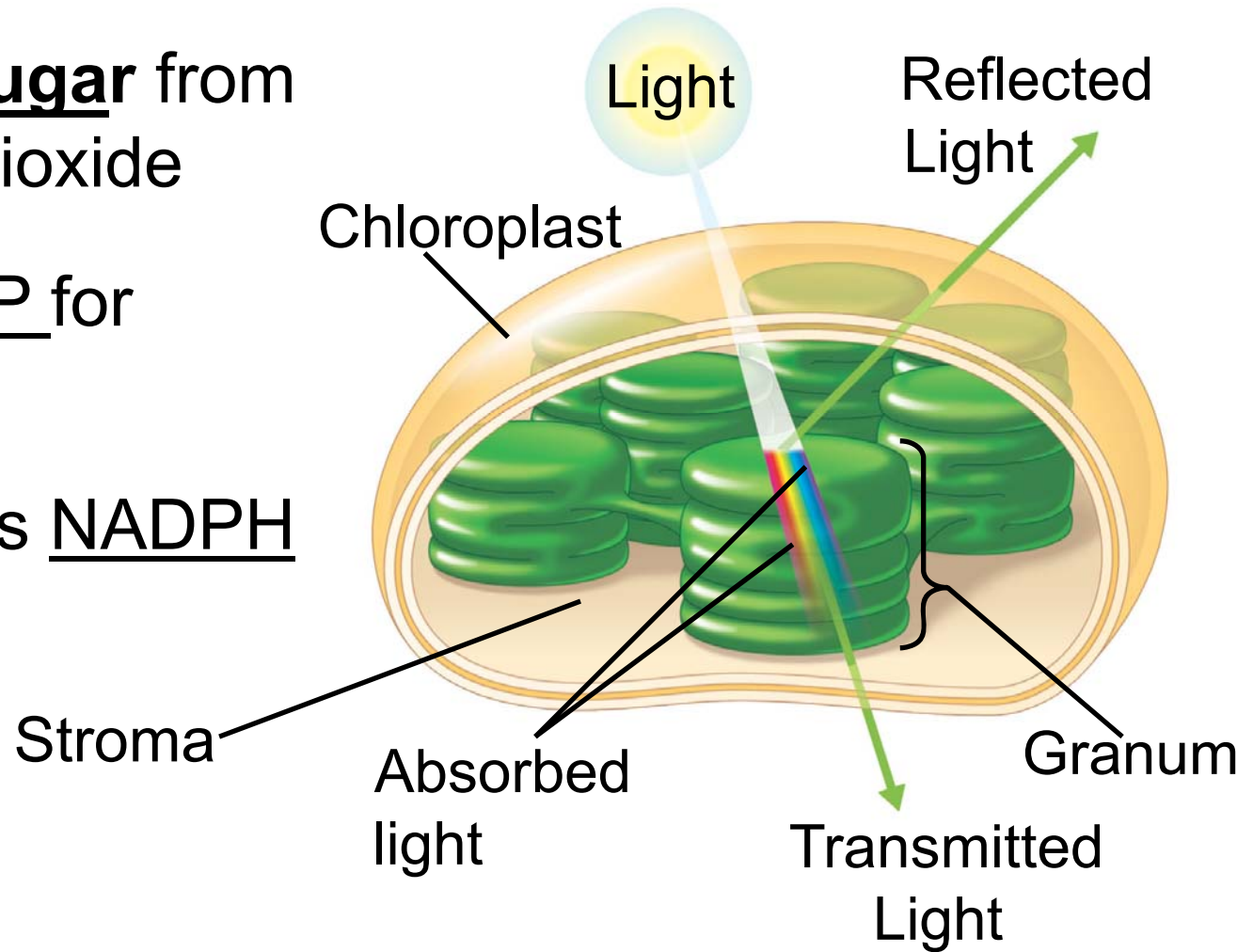
The Light Reactions

- Occur in the grana
 - Split water
 - Release oxygen
 - Produces ATP
(energy)
 - Produces NADPH
(carries H from the light reactions to the Calvin cycle)



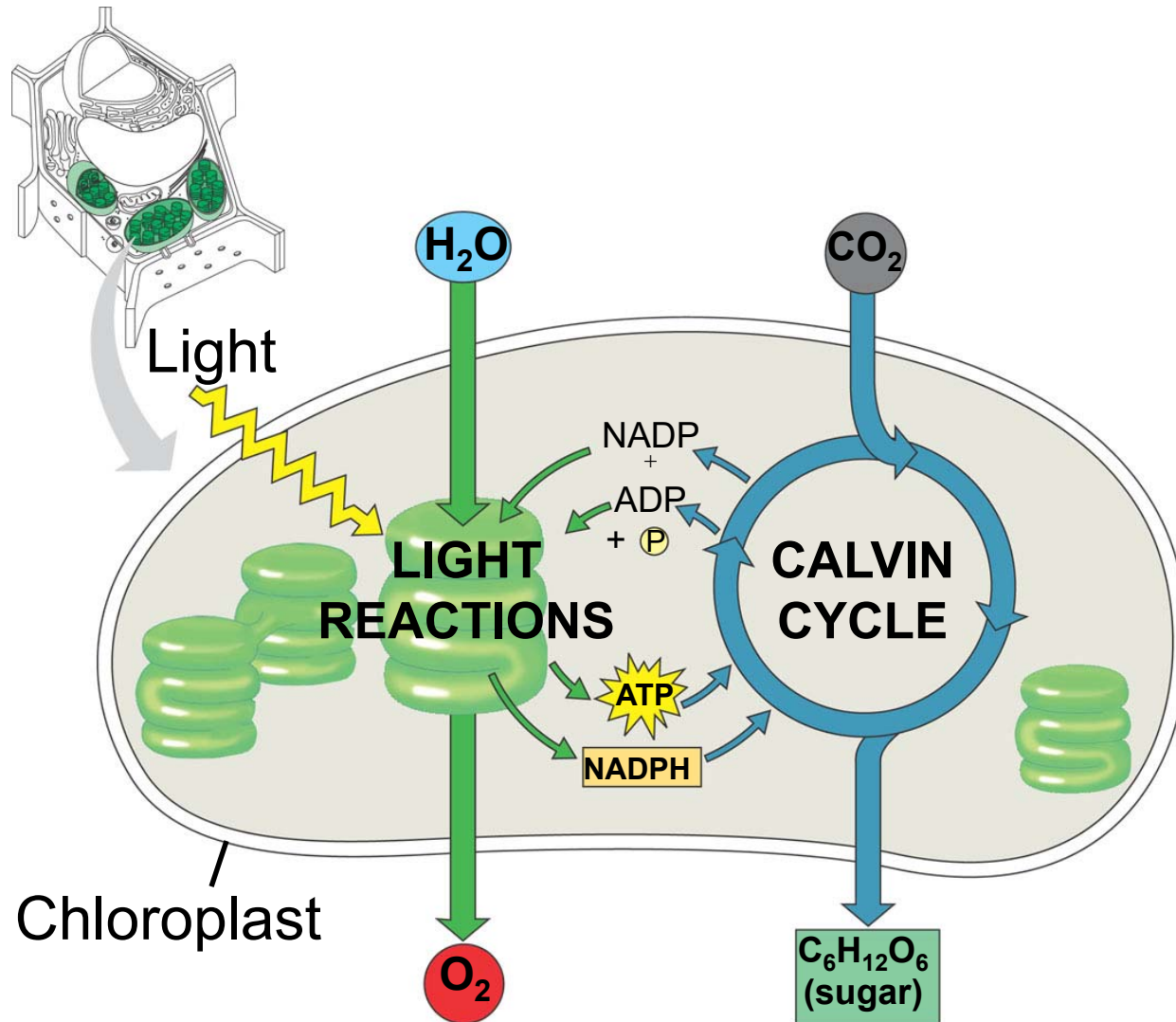
The Calvin Cycle

- Occurs in the stroma
 - Forms sugar from carbon dioxide
 - Uses ATP for energy
 - Also uses NADPH



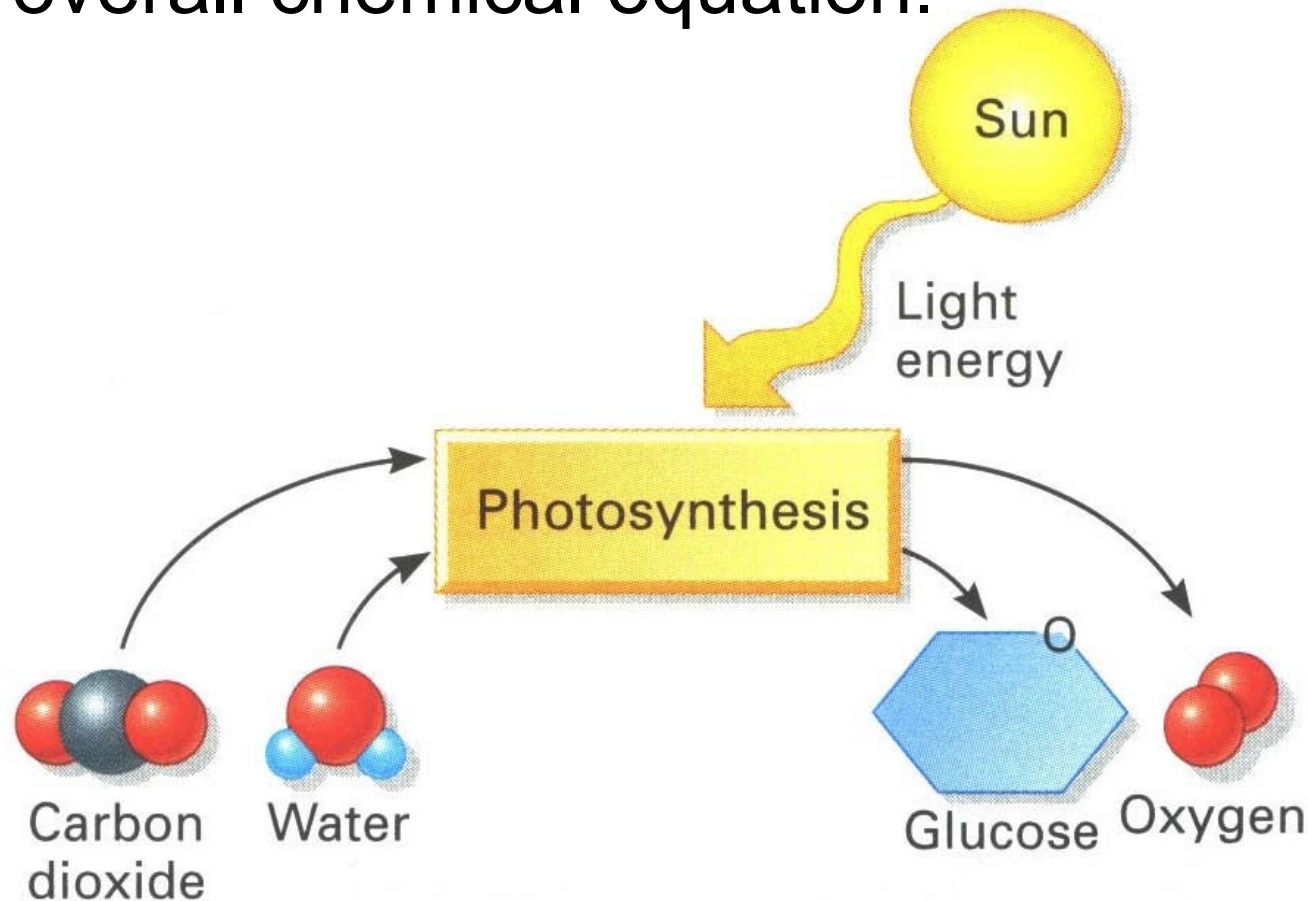
Putting The Two Stages Together

- The Light Reactions & The Calvin Cycle




Summary Of Photosynthesis

- The overall chemical equation:



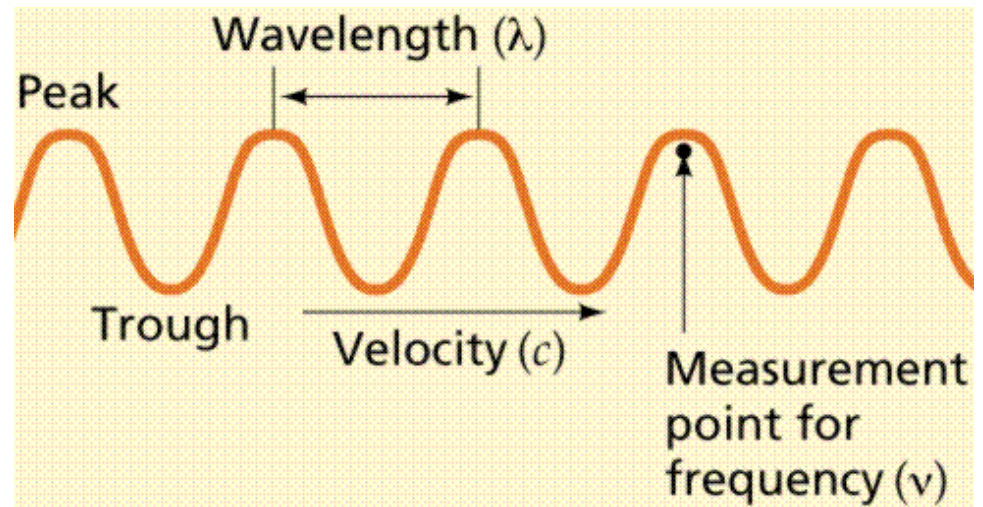
A More Detailed Summary

	Light Reactions	Calvin Cycle
Takes place in the....	Grana	Stroma
Reactants are....	Sunlight & H₂O	CO₂, ATP & NADPH
Products are....	ATP & NADPH + O₂	C₆H₁₂O₆

Leaves the leaf via the stomata

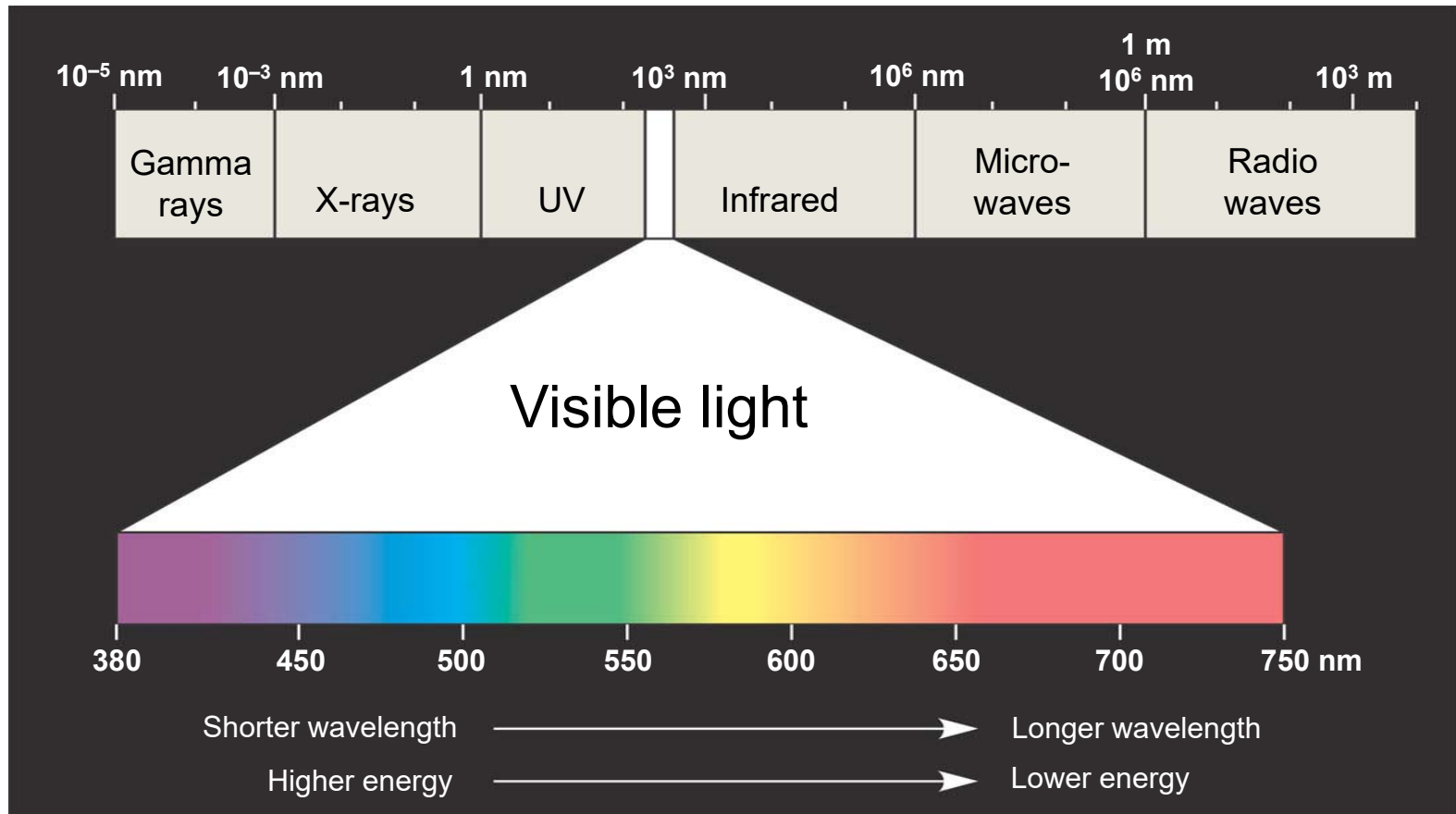
The Nature of Sunlight

- Light reactions convert solar energy to the chemical energy stored in the bonds of glucose molecules.
- Sunlight is a form of electromagnetic energy, which travels in waves
- A wavelength is the distance between the crests of waves
- Wavelengths determine the type of electromagnetic energy
- With visible light, the wavelength determines the color of the light



The Electromagnetic Spectrum

- Is the entire range of electromagnetic energy (also called electromagnetic radiation)

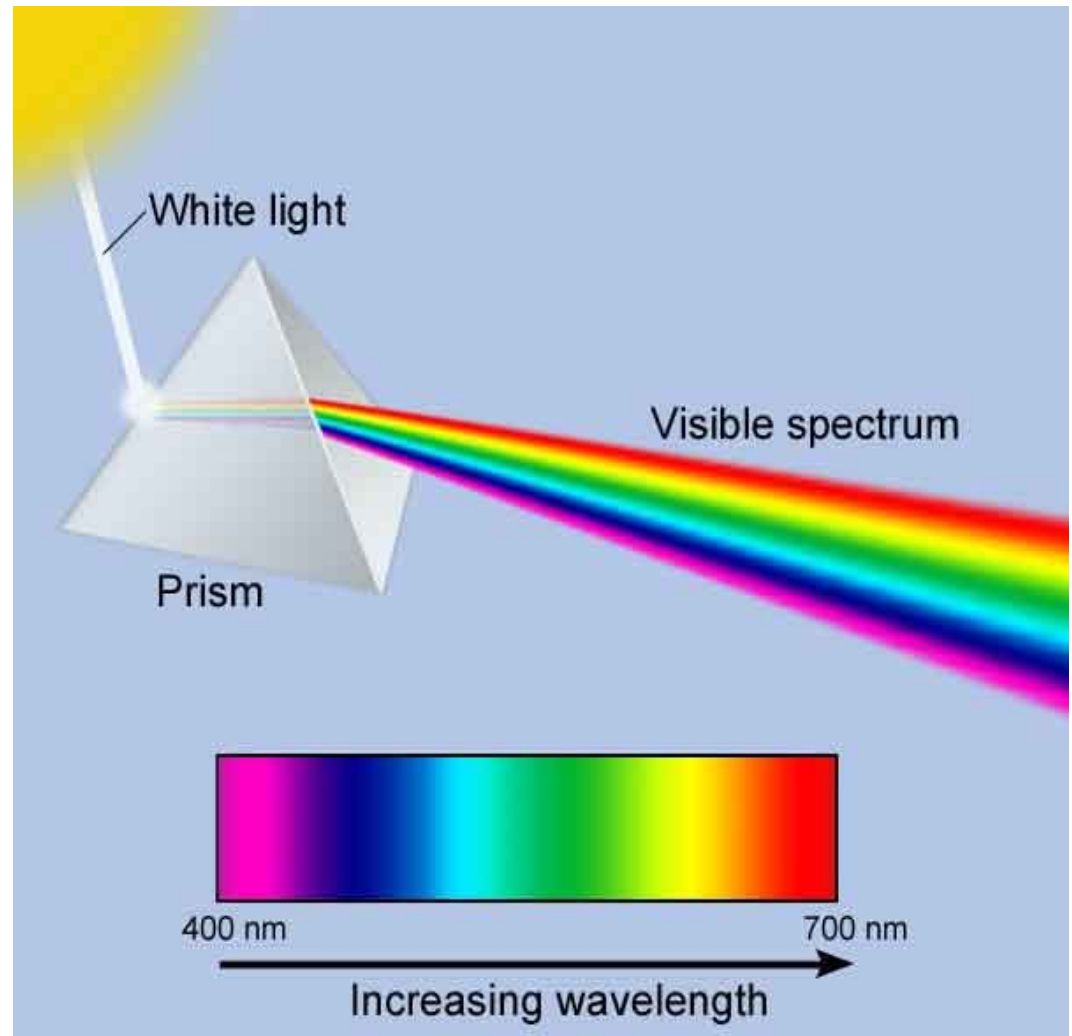


The Electromagnetic Spectrum

- The visible light spectrum
 - Includes the colors of light we can see
 - Includes the wavelengths (colors of light) that power photosynthesis
- Pigments
 - Are substances that absorb visible light AND Reflect light, which include the colors we see
 - Chlorophyll is the most abundant pigment in plants

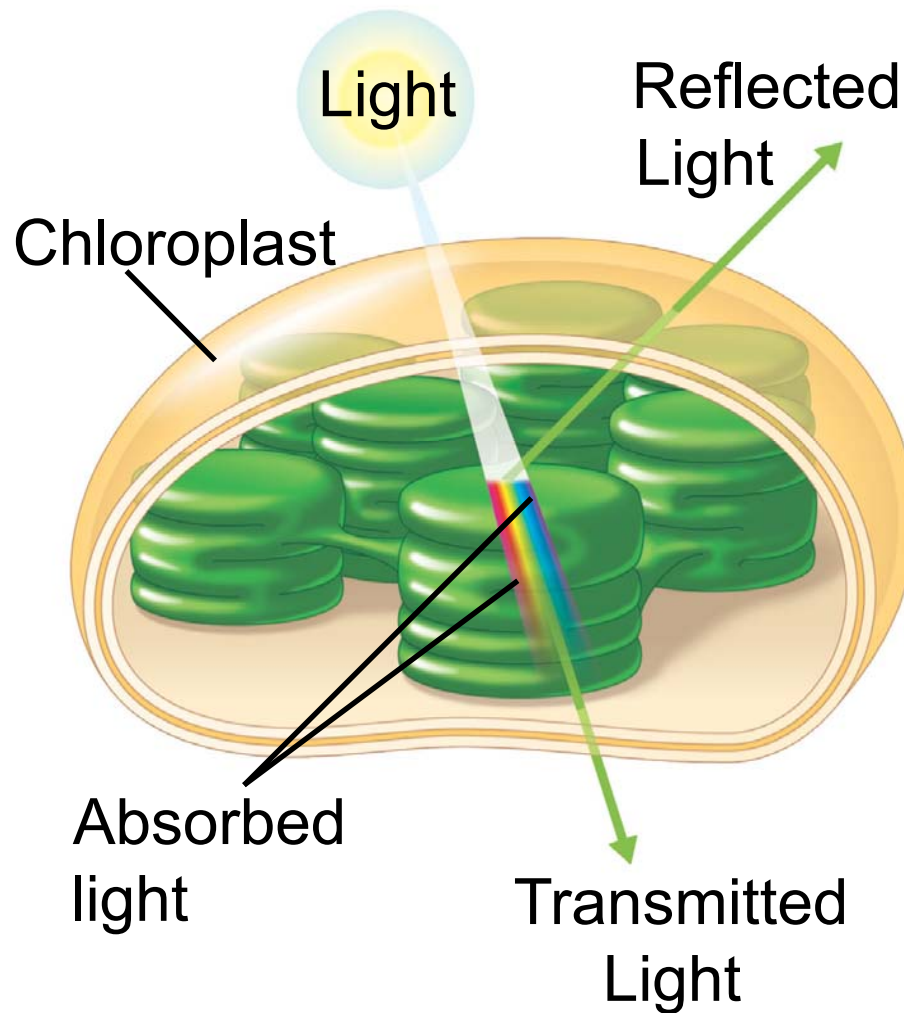
What is White Light?

- White light contains all the colors of the visible light spectrum.
- White light is separated into the different colors (=wavelengths) of light by passing it through a prism.
- Colors of visible light spectrum = red, orange, yellow, green blue, indigo, violet (ROY G. BIV)



What Colors Of Light Are Used By A Plant?

- Reflected light includes the colors we see
- Absorbed light is used in photosynthesis

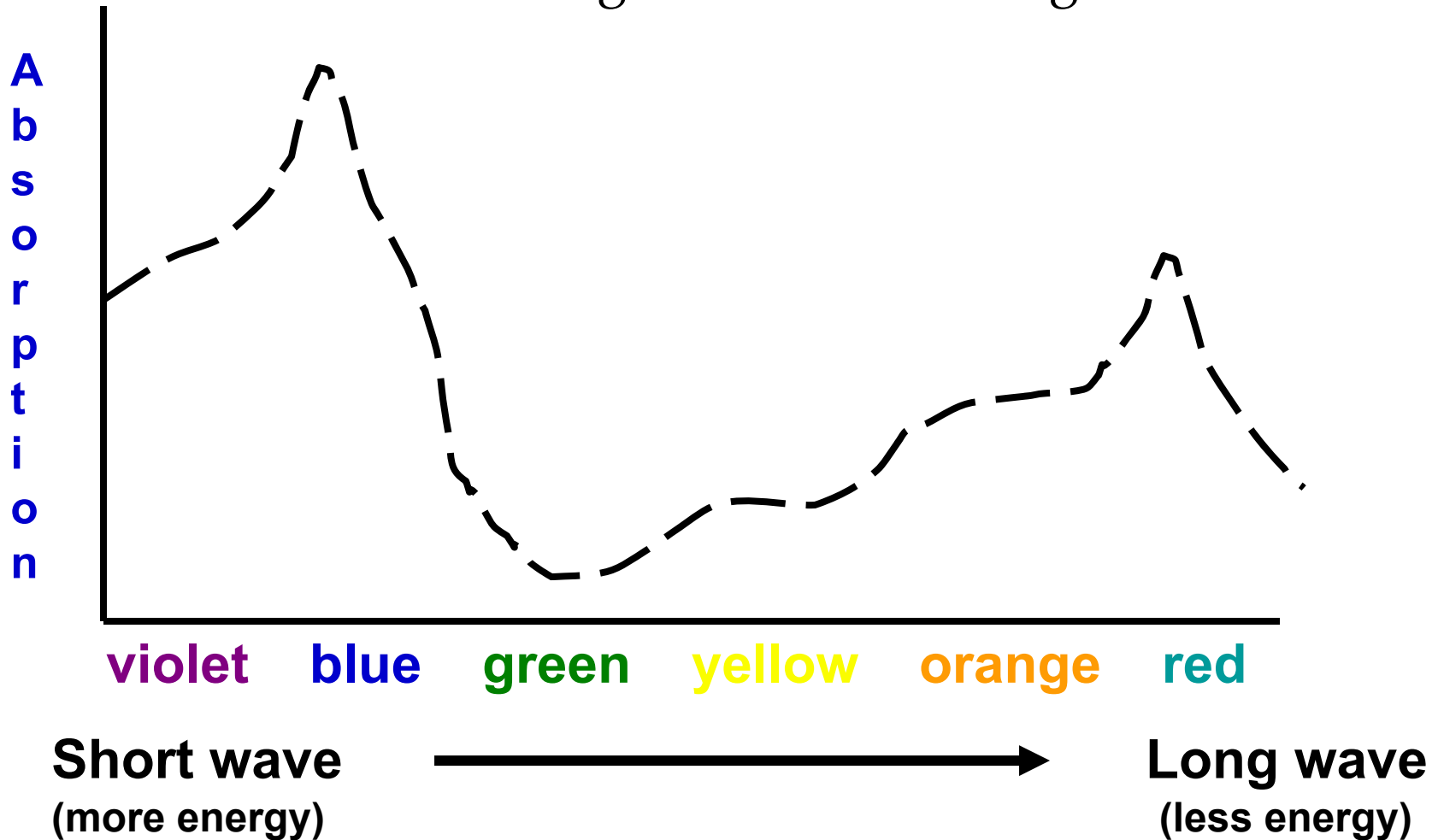


What Colors Of Light Are Used By A Plant?

- The absorption spectra of chloroplast pigments
 - Provide clues to the relative effectiveness of different wavelengths for driving photosynthesis

What Colors Of Light Are Used By A Plant?

What colors does Chlorophyll a absorb?
Are these long or short wavelengths?



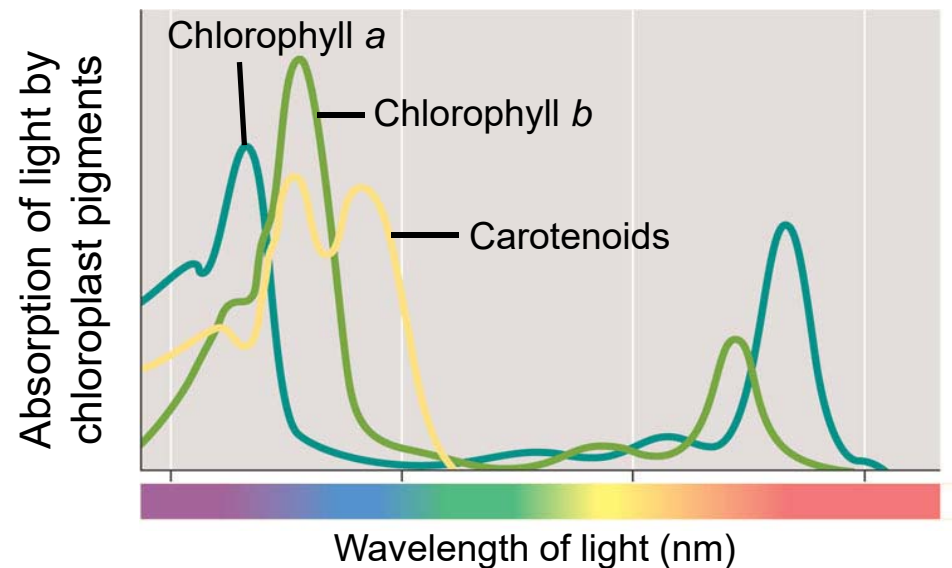
The Absorption Spectra

- The three curves show the wavelengths of light best absorbed by three types of chloroplast pigments.
- Green has the least absorption and the most reflection making plants appear green

EXPERIMENT

Three different experiments helped reveal which wavelengths of light are photosynthetically important. The results are shown below.

RESULTS



Question 1

What is the primary difference in the ways that plants and animals obtain energy?

Answer

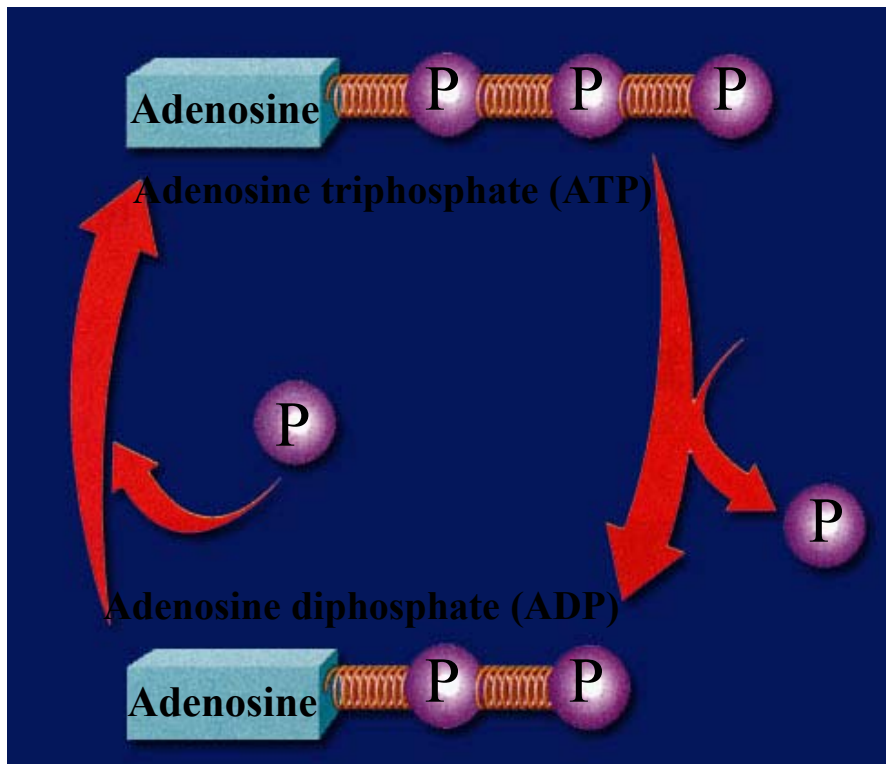
All living organisms need energy. Plants can trap light energy in sunlight and store it for later use in the process of PHOTOSYNTHESIS. Animals cannot trap energy from sunlight and must eat plants that contain stored energy.

Question 2

Energy is temporarily stored in molecules of ATP. When a phosphate group is removed from ATP by hydrolysis, energy is released. The resulting molecule of adenosine with TWO phosphate groups bonded to it is _____.

- A. AMP
- B. ADP
- C. ATP
- D. ACP

The answer is B. ADP is adenosine diphosphate.



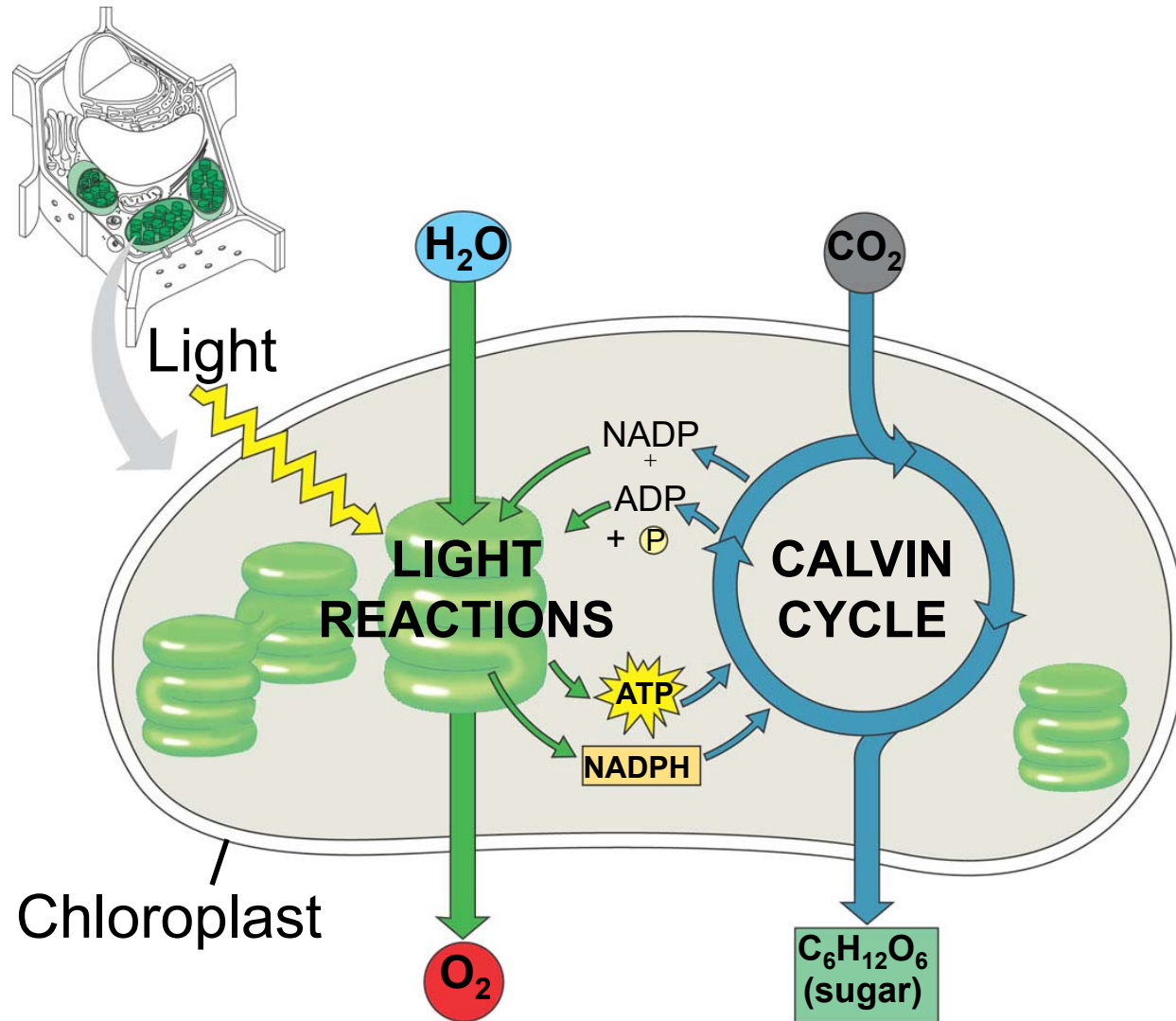
The addition and release of a phosphate group on adenosine diphosphate creates a cycle of ATP formation and breakdown. The change from a less stable molecule (ATP) to a more stable molecule (ADP) releases energy needed for cellular activities.

Question 3

In which stage of photosynthesis is carbon from CO_2 used to form a six-carbon sugar (glucose)?

- A. Calvin cycle
- B. The Cell Cycle
- C. The Light Reactions
- D. Mitosis

The answer is A.



Question 4

What component of thylakoid membranes absorbs specific wavelengths of sunlight?

- A. electrons
- B. pigments
- C. chloroplasts
- D. mitochondria

The answer is B. Pigments are arranged within the thylakoid membranes; the most common pigment is chlorophyll.

Question 5

What is the equation for the process of photosynthesis?

The answer is:

