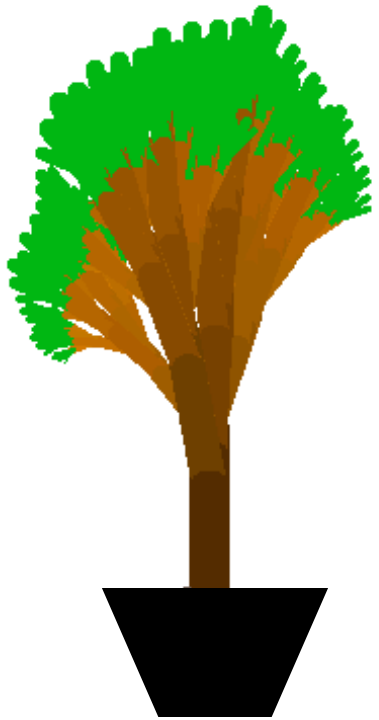
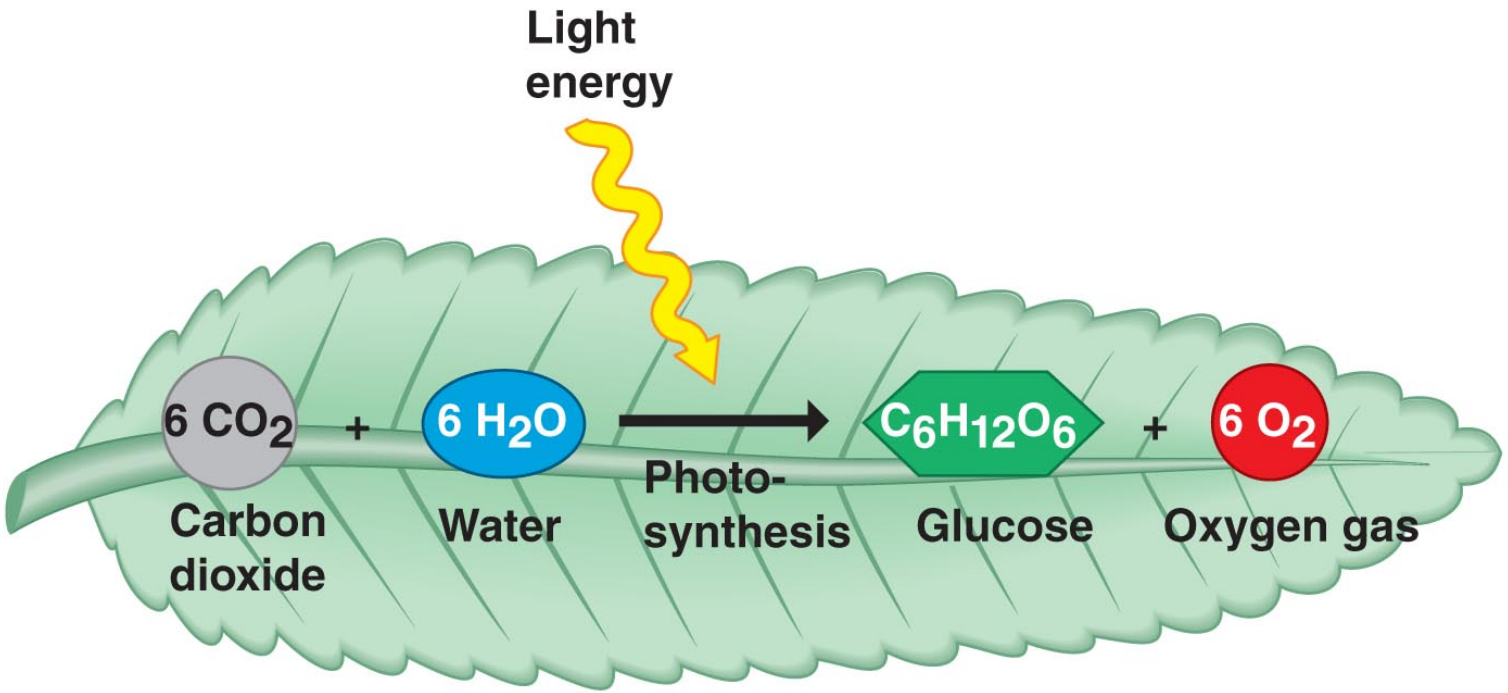
A SIMPLE EXPERIMENT

- Weigh (a) soil and (b) tree
- Plant tree in soil and provide distilled water ad lib
- Wait five years
- Weigh (a) soil and (b) tree



PLANTS BUILD MOLECULES

- $CO_2 + H_2O + \text{energy} \rightarrow CHO + O_2$



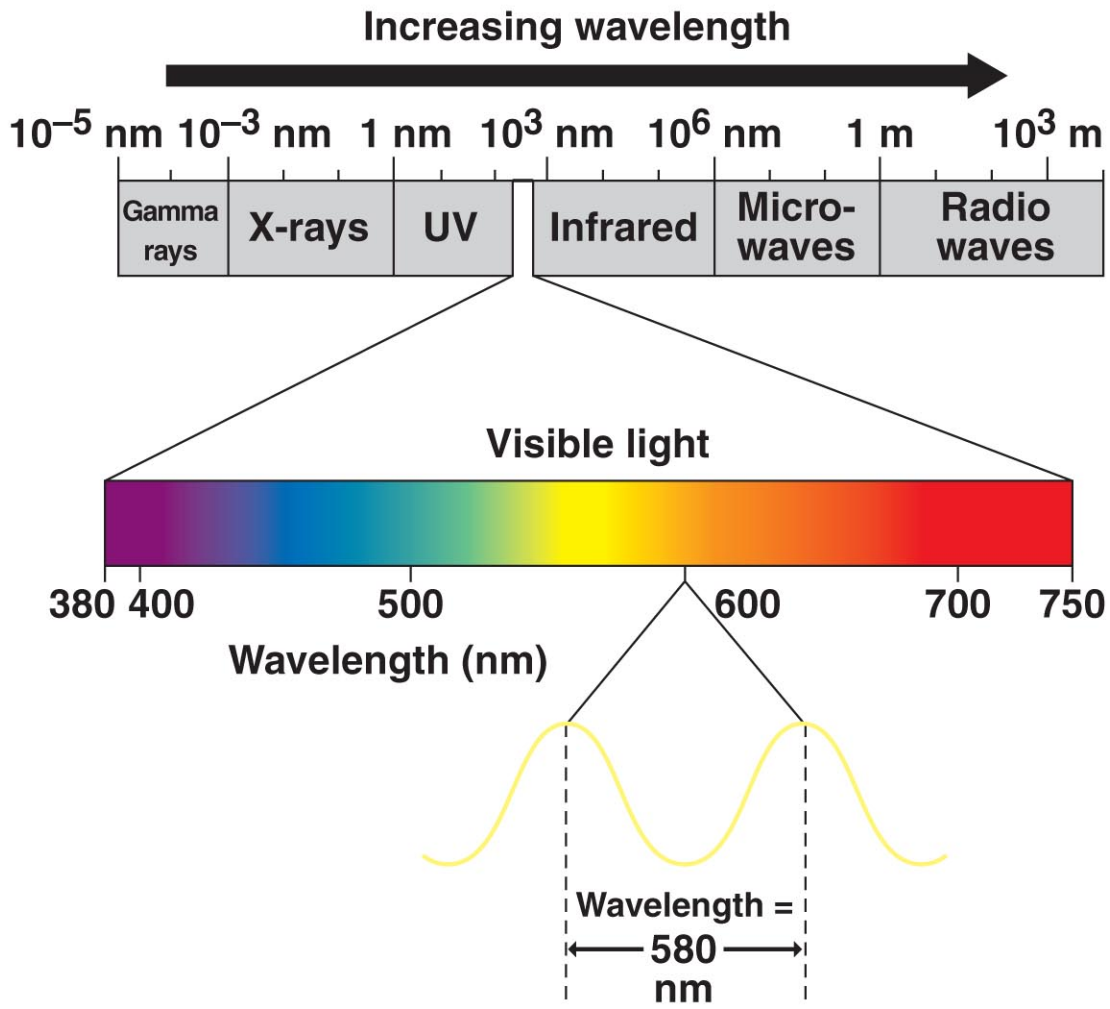
DOES OXYGEN COME FROM H_2O OR CO_2 ?

- **A SIMPLE EXPERIMENT**:
  - Label water and feed to plant
  - Label CO_2 and feed to another plant
  - Check each plant's O_2 emission for label

AND THE RESULT IS:

- Plant given labeled H_2O emits O_2

THE NATURE OF SUNLIGHT

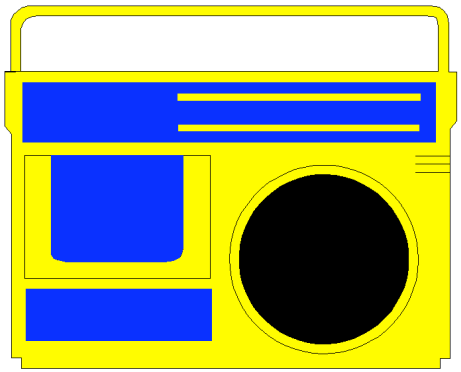


HOW IS ULTRAVIOLET LIGHT DANGEROUS?

- It is at a high enough energy state that it can break biologically meaningful bonds e.g. DNA

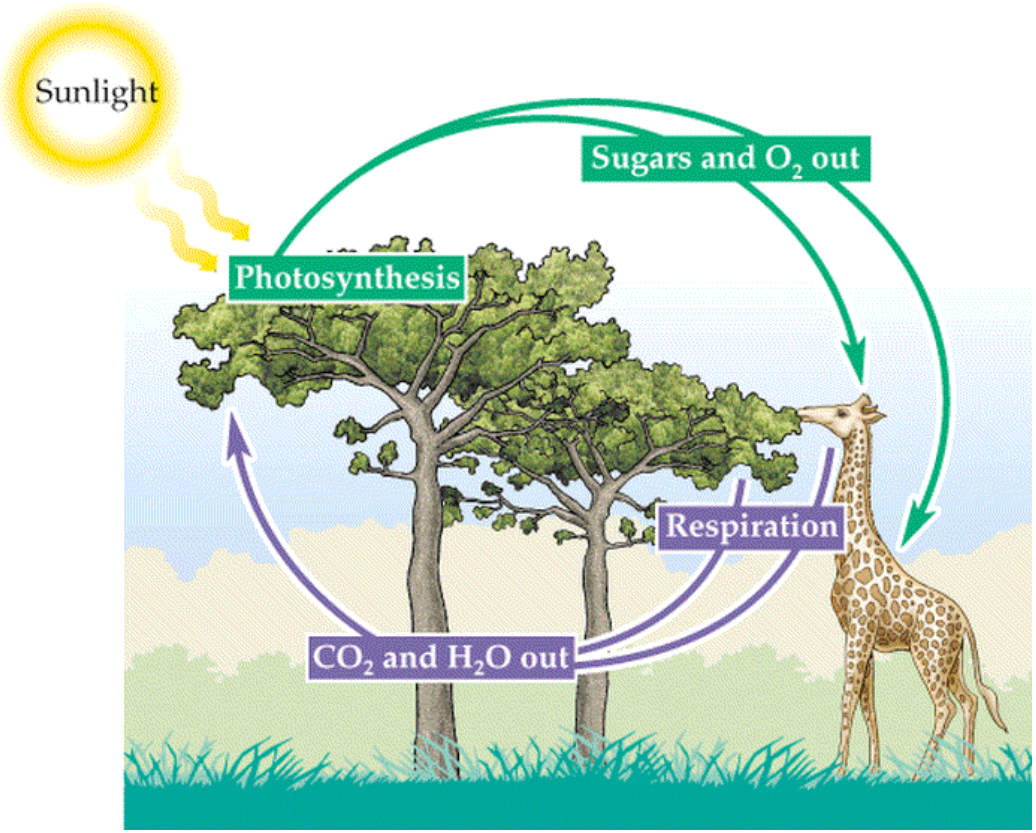
A FACT

- Wavelengths longer than visible light (i.e. lower frequency) are not at a high enough energy state to elicit biologically meaningful reactions (i.e. heat only)



A CONSTRAINT

- To employ light energy a plant first has to capture it

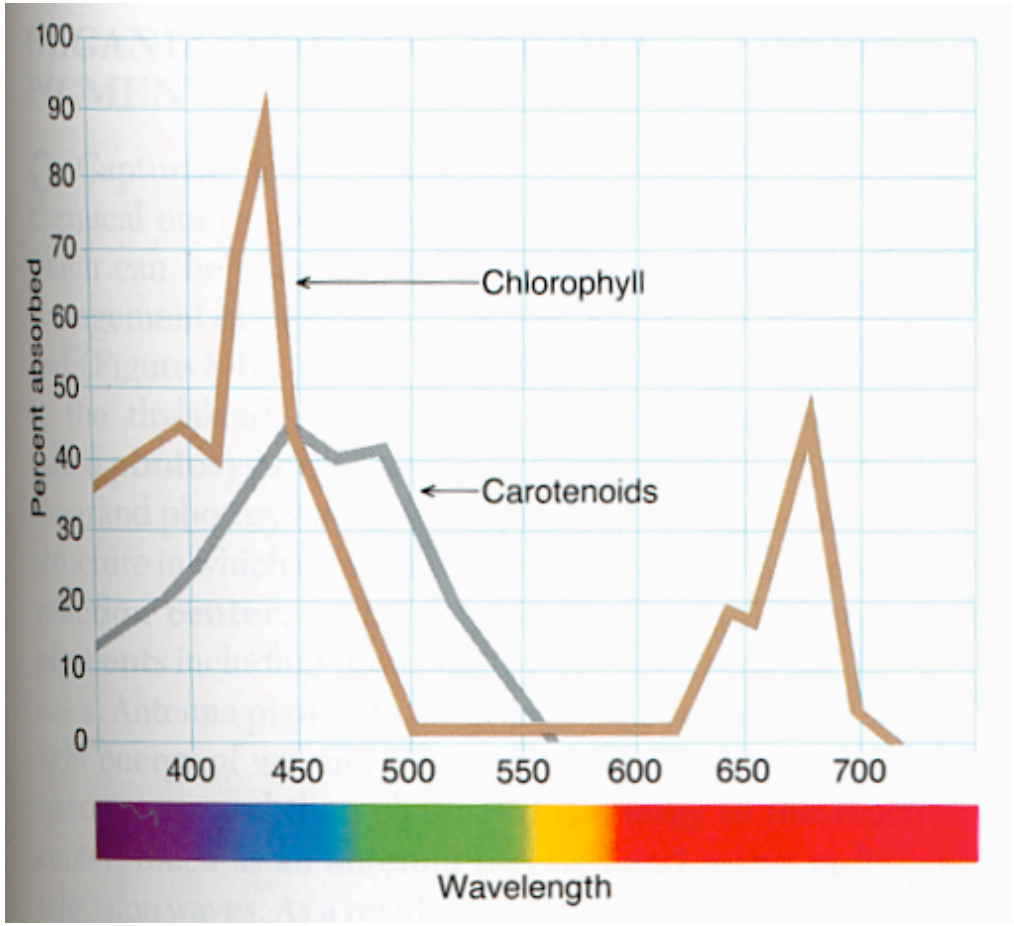


PIGMENT

- Def’n - A light-absorbing substance.

PLANTS CONTAIN TWO CLASSES OF PIGMENT

- Chorophylls
- Carotenoids (a & b)



FALL COLOURS

- Typical in
  temperate habitats

FALL COLOURS FROM TWO PIGMENTS

- Anthocyanins (red)
- Carotenoids (yellow)

FALL COLOURS: HOW?

- Loss of cholophyll pigment and production of anthocyanins

FALL COLOURS: WHY?

- Adaptive explanations:
  - Protection against abiotic factors
  - Interactions with animals

ABIOTIC PROTECTION

- Adaptive explanations:
  - Photoscreening
  - Antioxidants
  - Resorption
  - Leaf warming

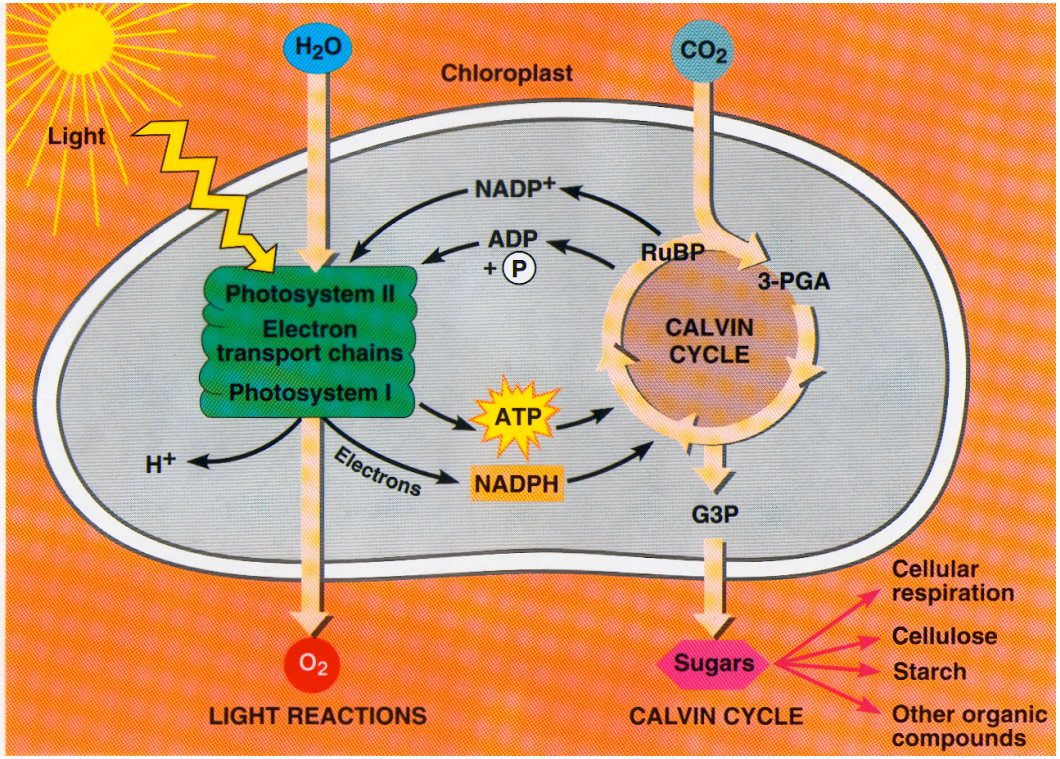
BIOTIC INTERACTIONS

- Adaptive explanations:
  - Red is a warning signal to insect herbivores
  - Fruit flag to advertise to birds
- Non-adaptive (for trees):

  - Insects do not prefer red leaves

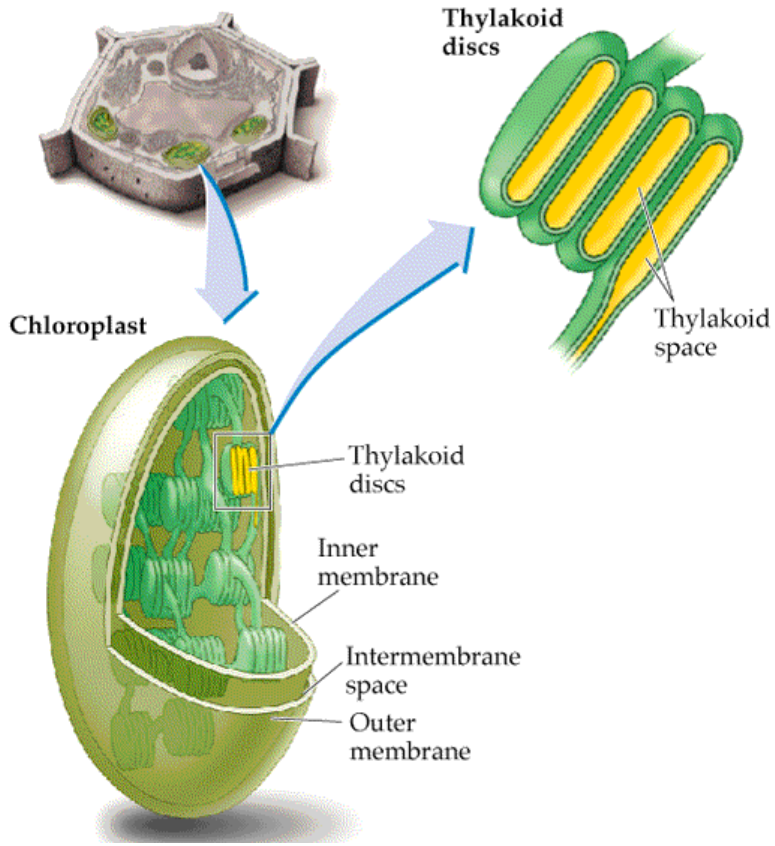
A FACT

- To sustain life, plants must transform light energy into chemical energy



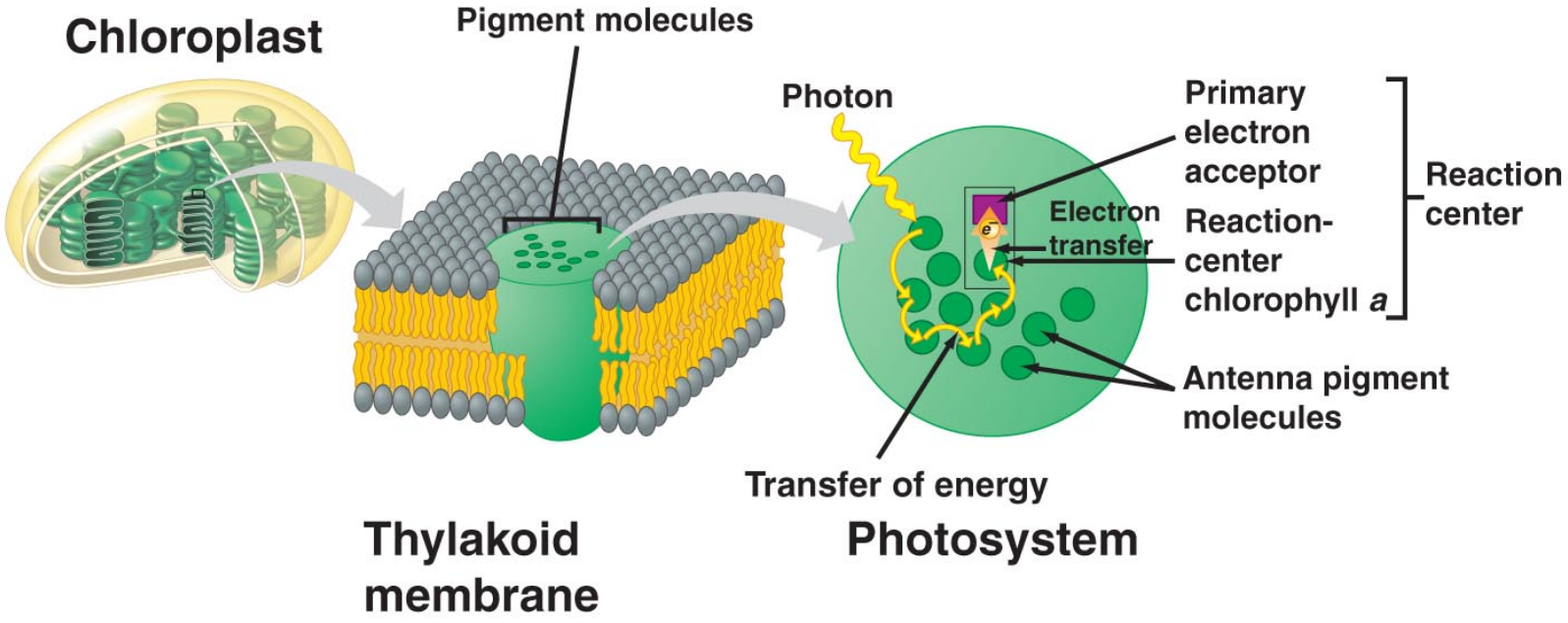
A FACT

- All photosynthetic events occur within the chloroplast



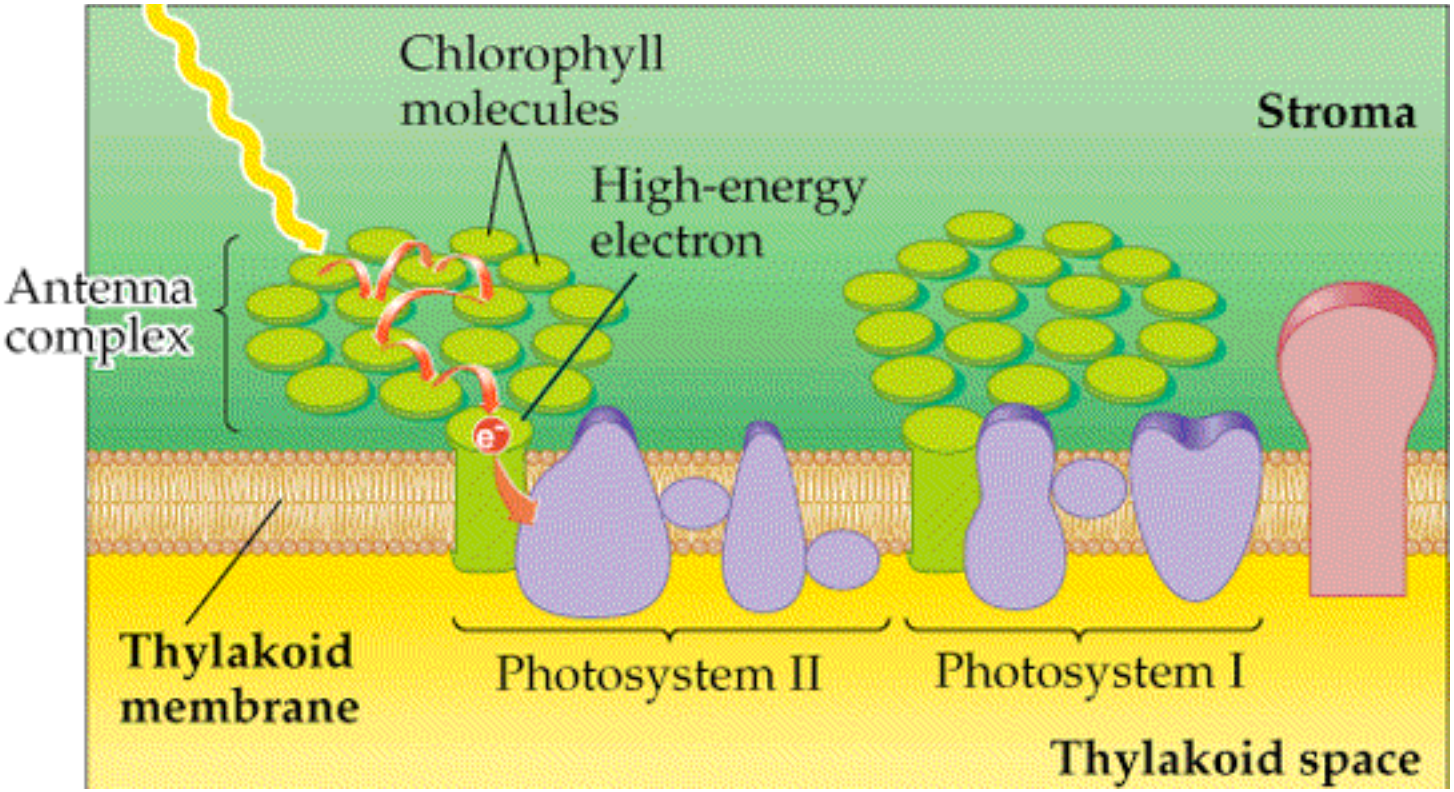
ANOTHER FACT

- Light energy is harvested at the thylakoid membrane and is converted to usable (chemical) energy in the stroma



MORE PHYSICS

- Photo energy excites electrons i.e. causes them to move to higher orbitals



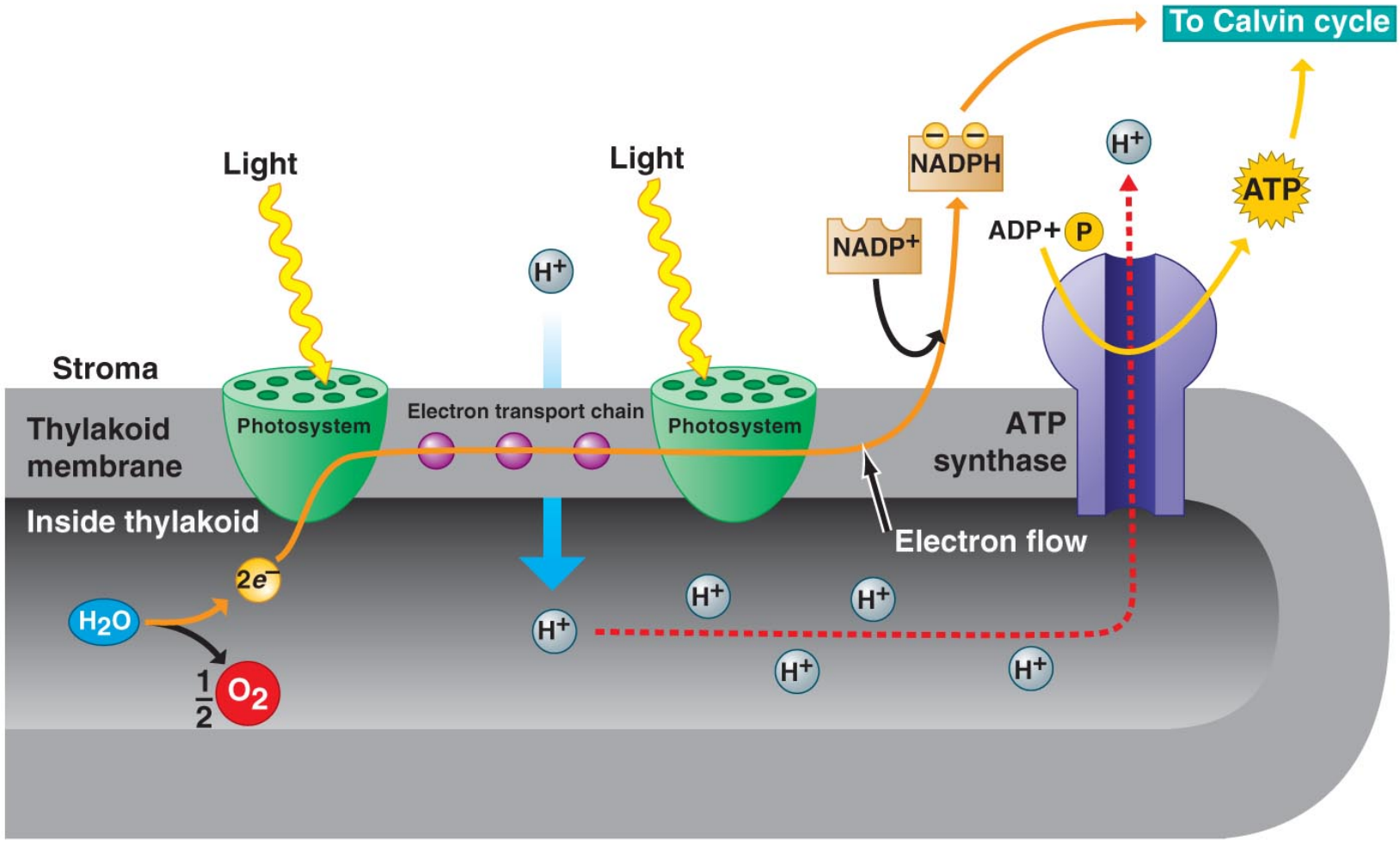
A QUESTION AND AN ANSWER:

- Where do positively-charged photosystems get their electrons from?
- H_2O (photolysis)

PRODUCTS OF 1'ST STAGE LIGHT-DEPENDENT REACTIONS

- Oxygen
- High energy electrons
- Uncharged photosystem
- Protons released into the thylakoid space

ATP PRODUCTION FROM PHOTOSYNTHESIS

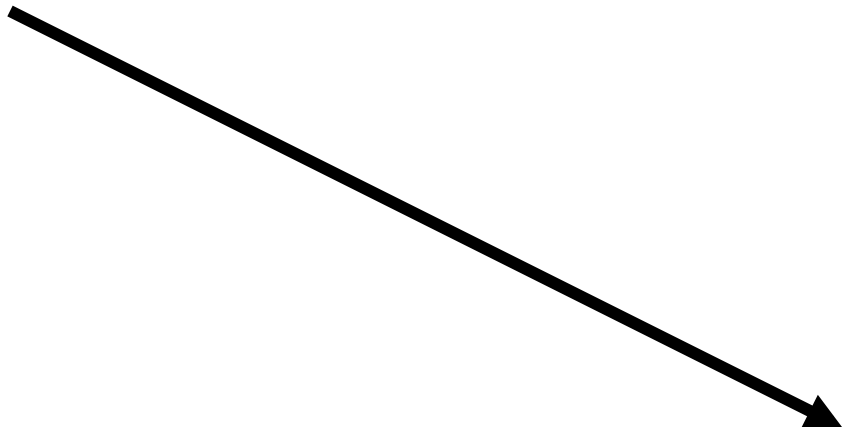


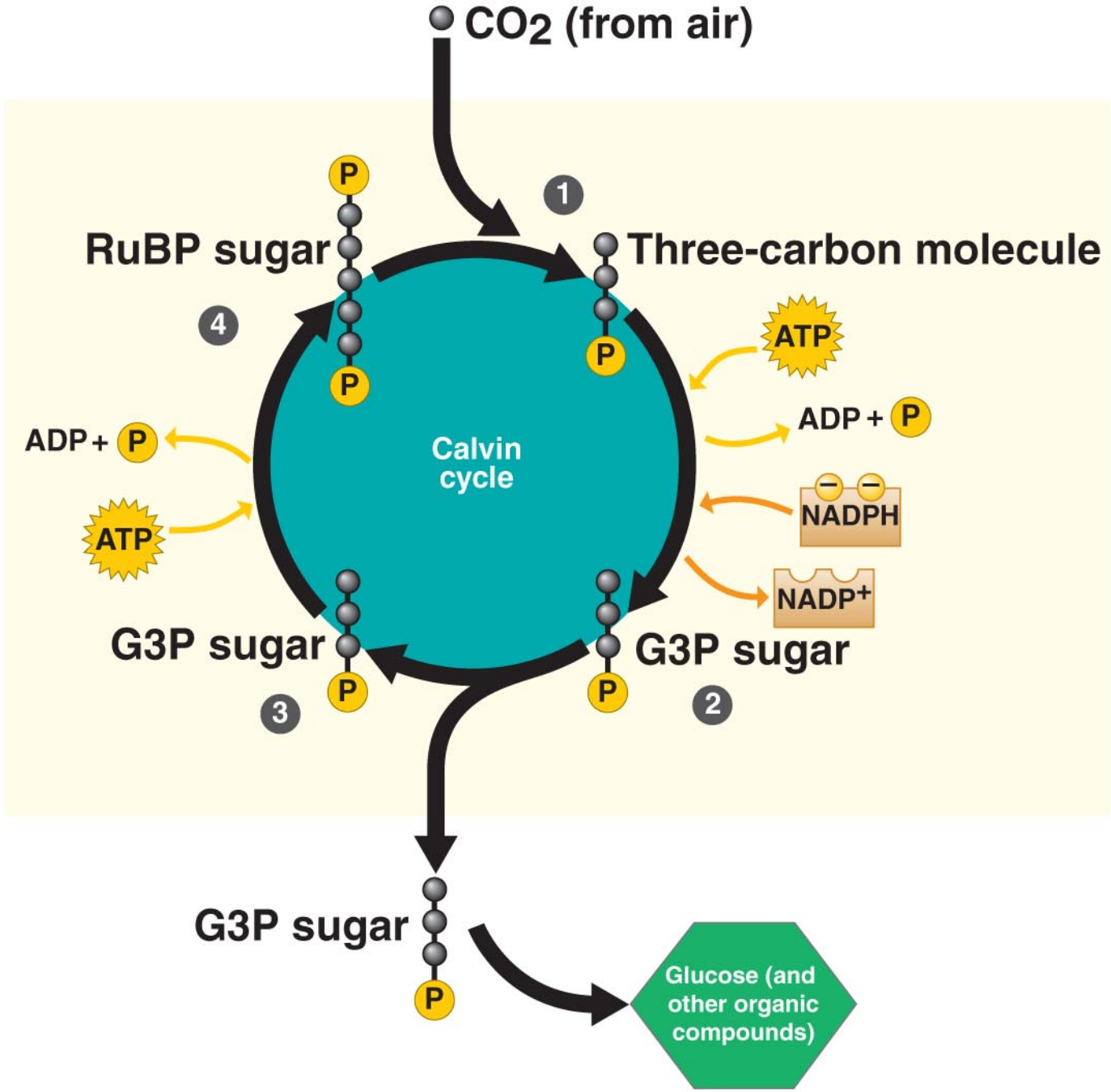
CARBON FIXATION

- The processing of carbon atoms from atmospheric gas (CO_2) into sugars.

ANOTHER FACT

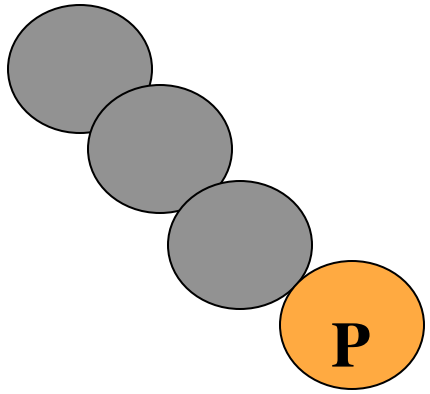
- Storage products are built by light-independent reactions in the stroma - Calvin cycle





YET ANOTHER FACT

- The Calvin cycle produces 3-carbon sugars



Glyceraldehyde 3-phosphate

IT'S TRUE:

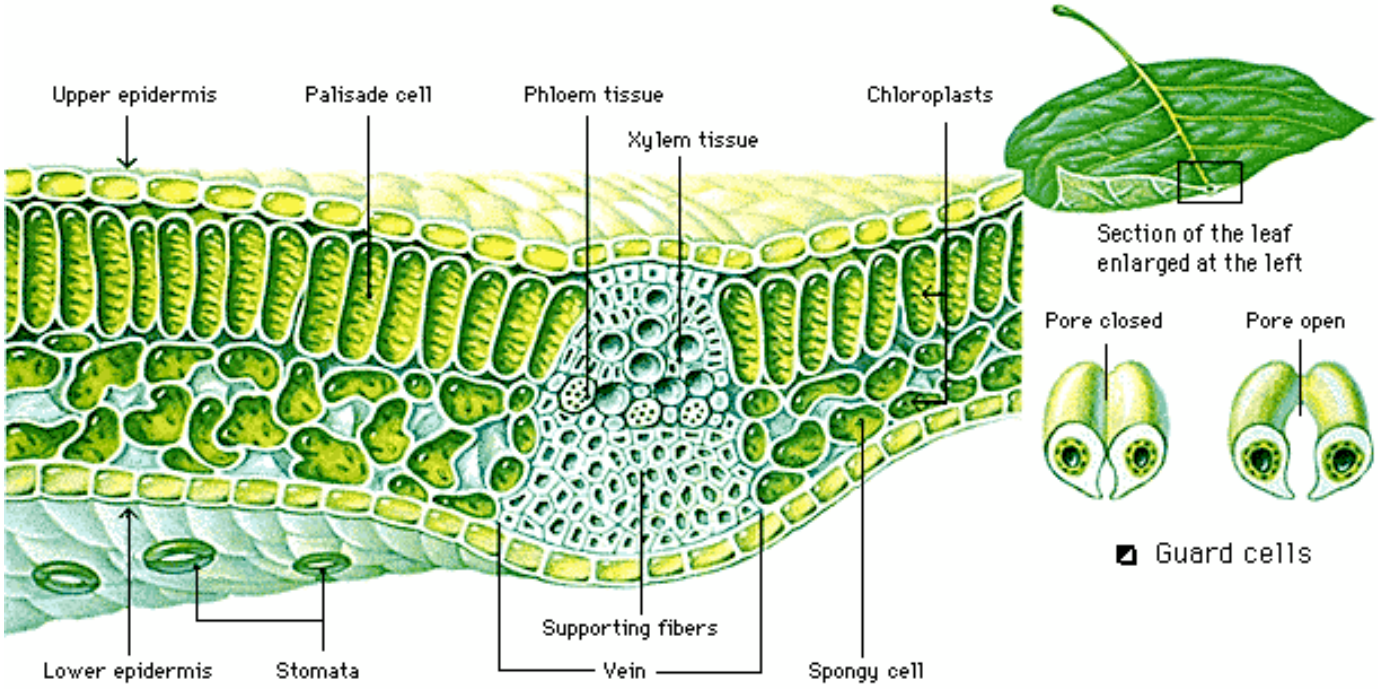
- RuBP carboxylase is one of the most common proteins on this planet

PRODUCTS FROM C_3 SUGARS

- Glucose - assembled in cytoplasm
- Sucrose - assembled in cytoplasm
- Starch - assembled in chloroplast

A TRADEOFF

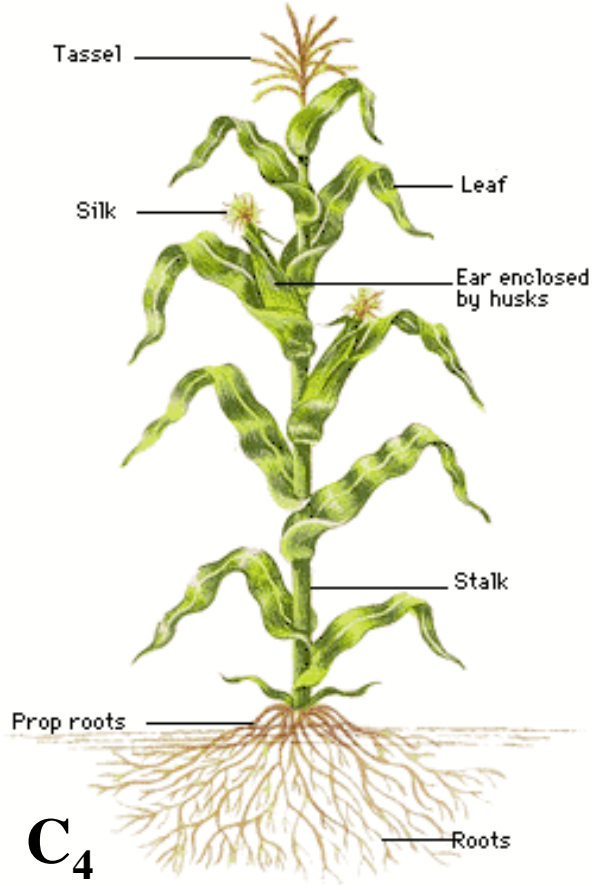
- One way to reduce water loss is to close stomata BUT this procedure also reduces CO_2 availability



SOLUTION TO TRADEOFF

- Change pathway - C_4
- Change timing of events - CAM

CAM



C_4

A FACT

- The C_4 pathway has independently evolved in several plant families. This is a good example of convergent evolution.