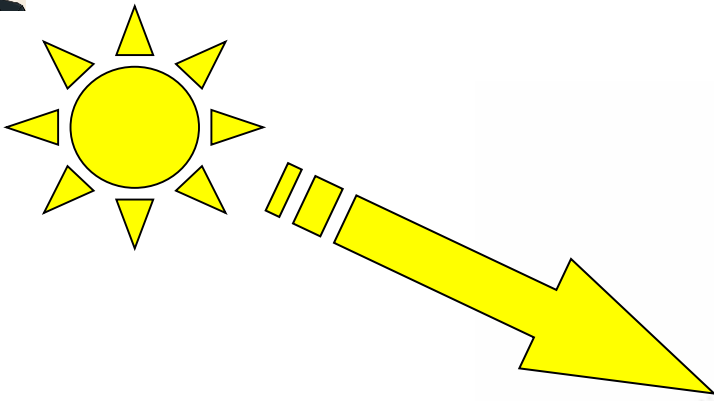


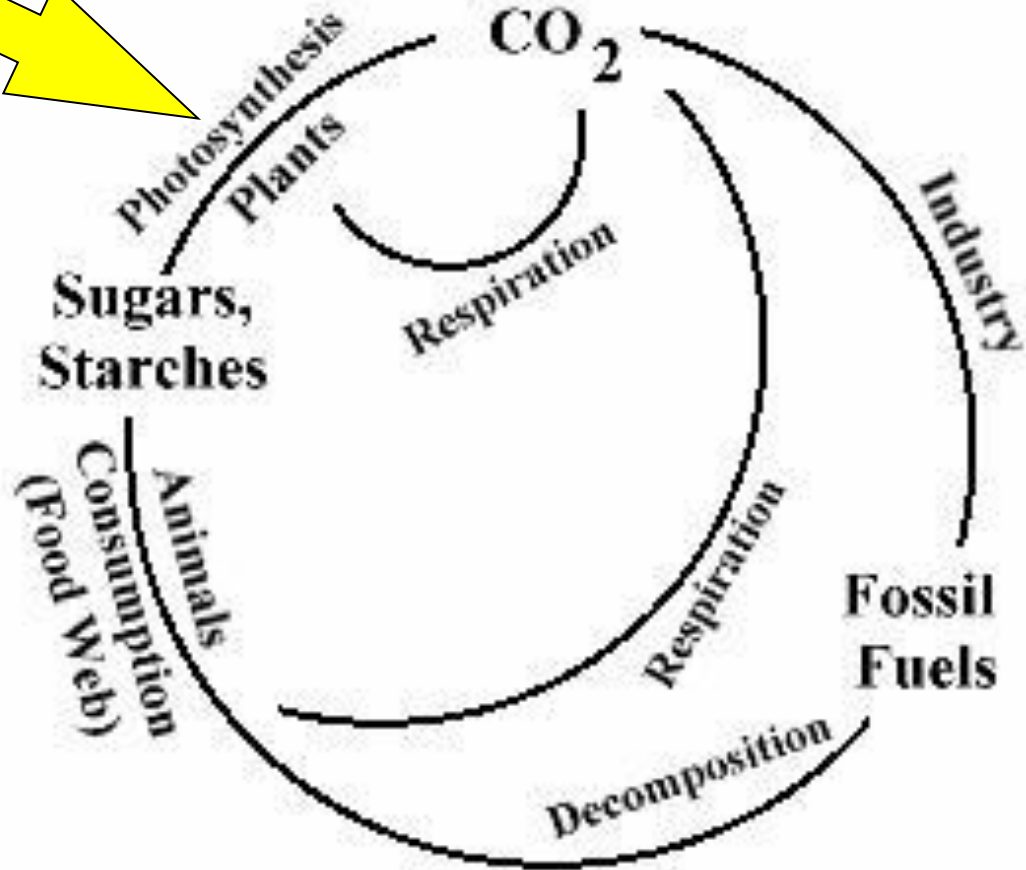


Photosynthesis

- Define the terms: *autotroph* and *heterotroph*.
- State that light energy is used during photosynthesis to produce complex organic molecules.
- Explain how respiration in plants and animals depends upon the products of photosynthesis.
- State that in plants photosynthesis is a two-stage process that takes place in chloroplasts.
- Explain how the structure of chloroplasts enables them to carry out their functions.
- Explain the importance of photosynthetic pigments in photosynthesis.
- State the location of the light-dependent stage and the light-independent stage.
- Outline how light energy is converted to chemical energy (ATP and reduced NADP) in the light-dependent stage.
- Explain the role of water in the light-dependent stage.
- Outline how the products of the light-dependent stage are used in the light-independent stage (Calvin cycle).
- Explain the role of carbon dioxide in the light-independent stage.
- State that TP (and GP) can be used to make carbohydrates, lipids and amino acids.
- State that most TP is recycled to RuBP.



Carbon Cycle



Where is the “pump” that keeps this turning?

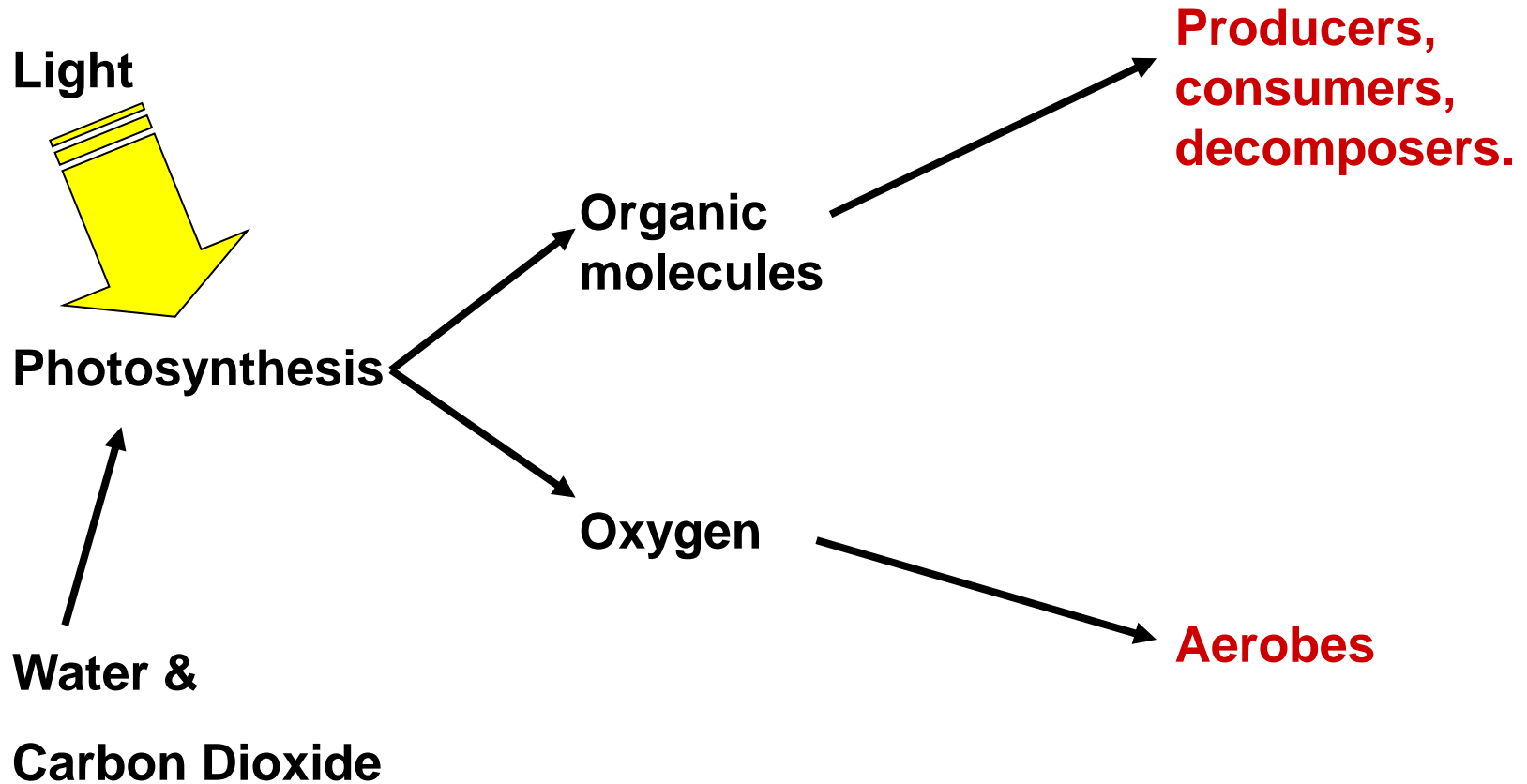


Photosynthesis

- A series of reactions where light energy is transformed into chemical energy, which is then used to manufacture large organic molecules from smaller inorganic ones.
- Possibly the most important biochemical process.



Other organisms depend on Photosynthesis





Heterotrophs v Autotrophs

- Autotrophs:
 - Organisms that use light energy or chemical energy to synthesise large organic molecules from smaller inorganic ones.
- Heterotrophs:
 - Organisms that ingest & digest complex organic molecules, using the chemical energy stored within them to synthesise their own.
 - Animals, fungi & some bacteria.



Autotrophs

- Chemoautotrophs:
 - Synthesise their organic molecules using energy from exergonic reactions or thermal oceanic vents.
 - Many bacteria (Nitrifying bacteria in N Cycle).
- Photoautotrophs:
 - Use photosynthesis to harness energy from sunlight.
 - Plants, some bacteria, some protocists.



Nitrification

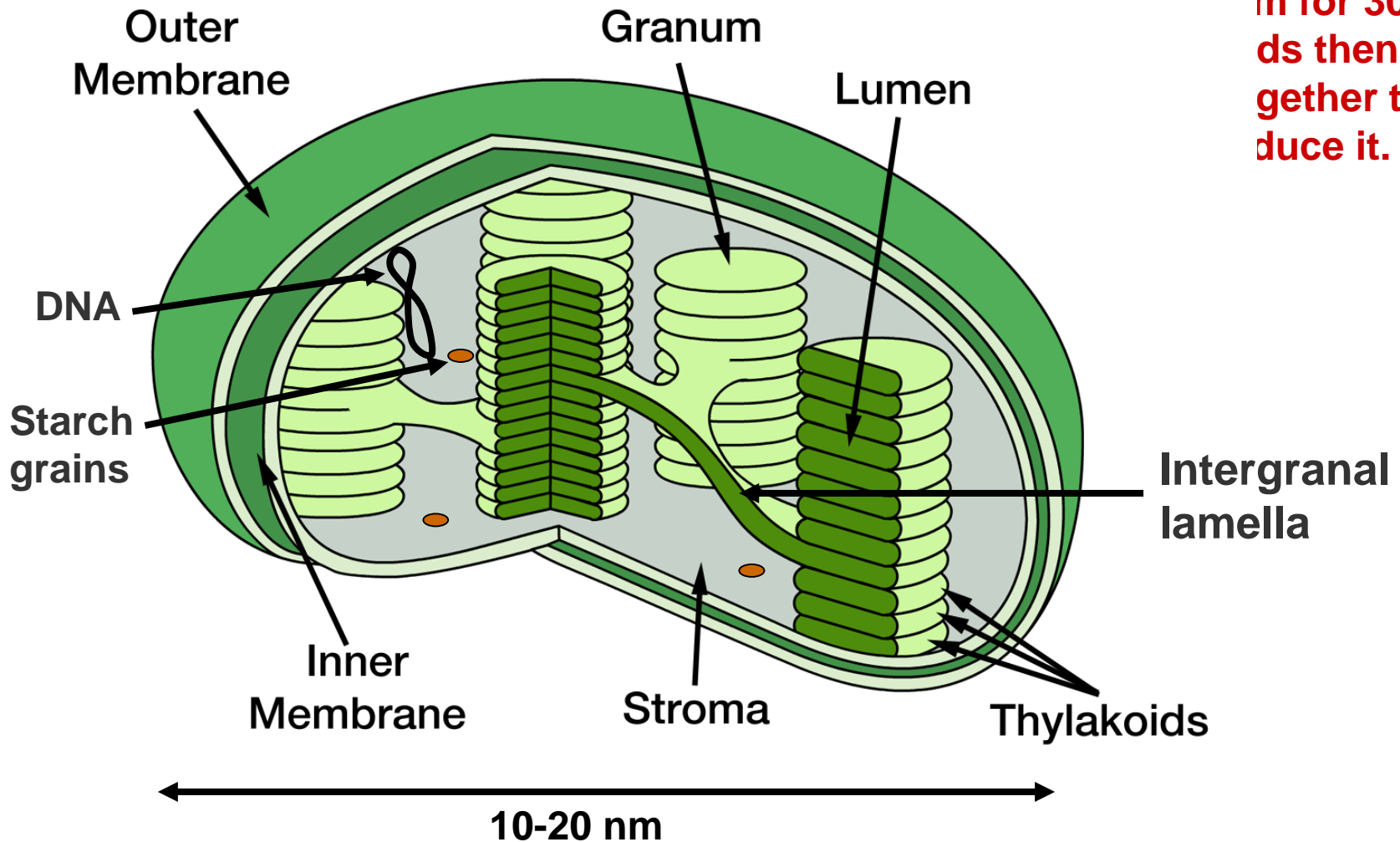
- Chemoautotrophic bacteria get energy by oxidising ammonium ions into nitrites or by oxidising nitrites into nitrates.





The site of photosynthesis

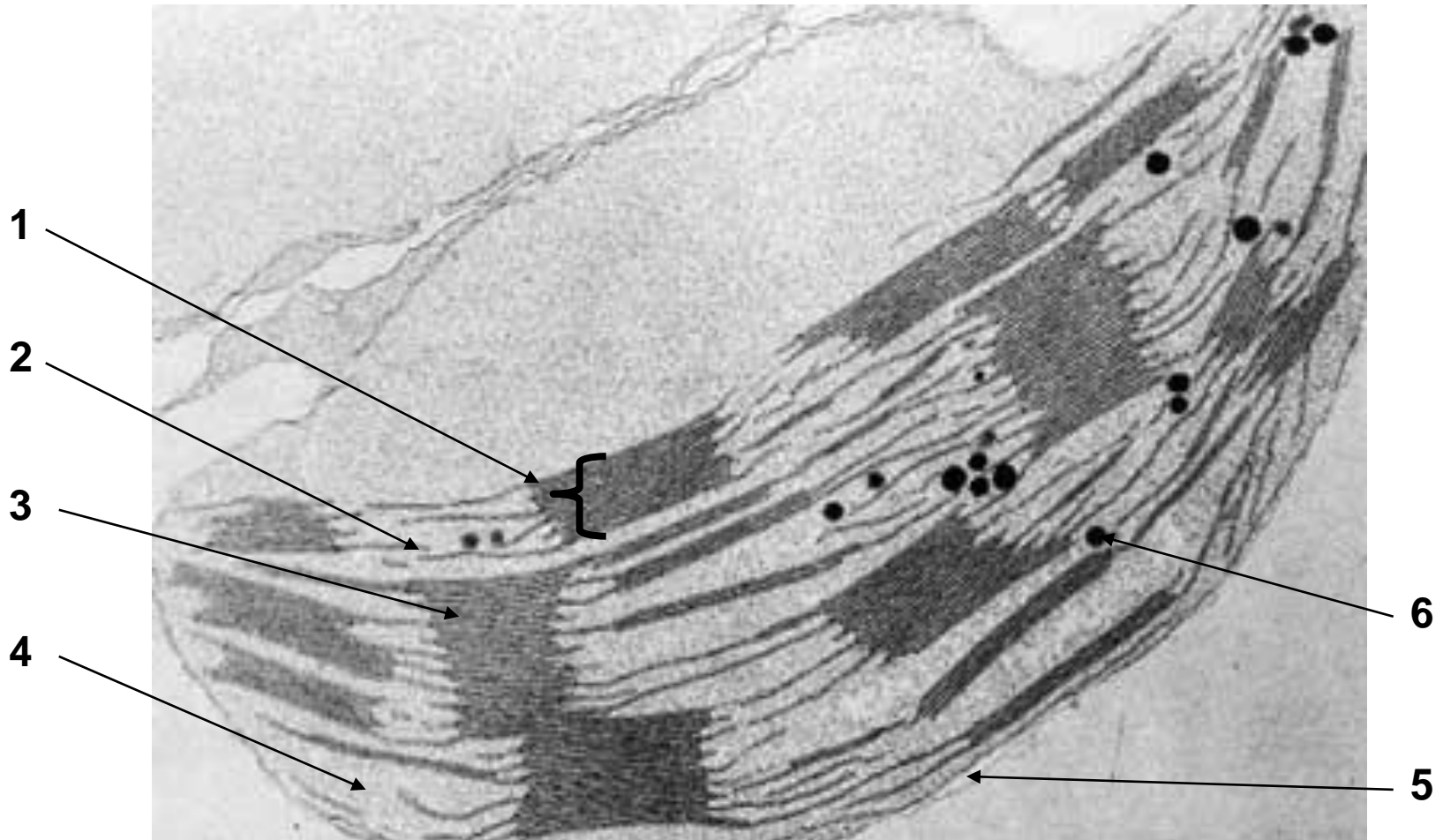
Chloroplast



at the
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duce it.



Still recognise the parts?





Chloroplasts v Photosynthetic Bacteria

- Similarities:
 - Similar size.
 - Contain circular DNA (no nucleus).
 - Similar ribosomes (different to eukaryotic ones).
 - Contain similar pigments.
- **Endosymbiont theory** suggests that chloroplasts may be primitive photosynthetic bacteria taken into early eukaryotic cells by endophagocytosis.

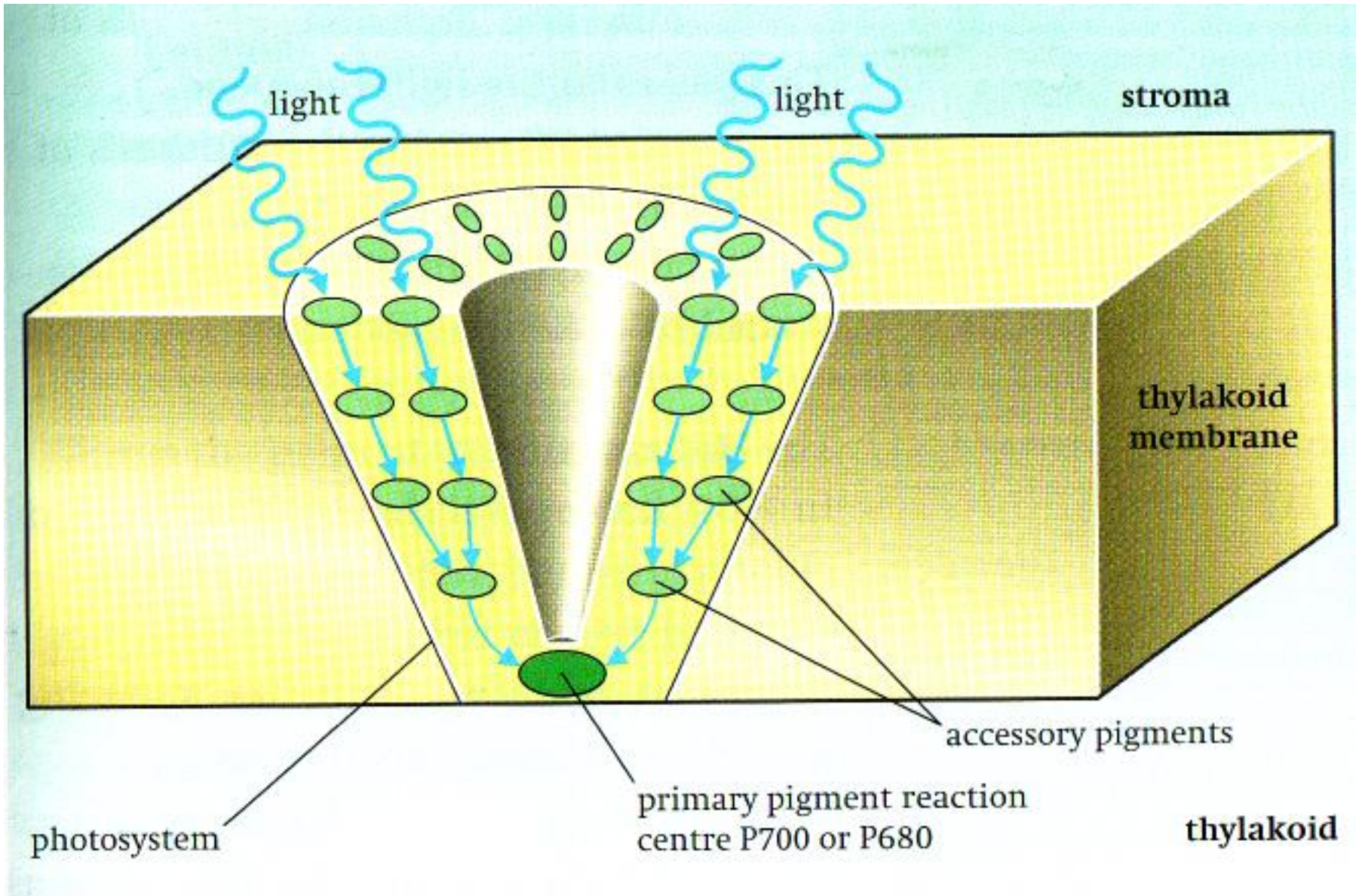


Adaptations of Chloroplasts

- Inner membranes contain transport proteins to control entry/exit of substances.
- Many stacks of thylakoid membranes increase surface area for photosystems, electron carrier proteins & ATP Synthase.
- Photosystems contain pigments to absorb light.
- Proteins in the membranes hold photosystems together.
- Stroma contains the enzymes needed for the reactions.
- DNA contains genes to produce these enzymes & other proteins.



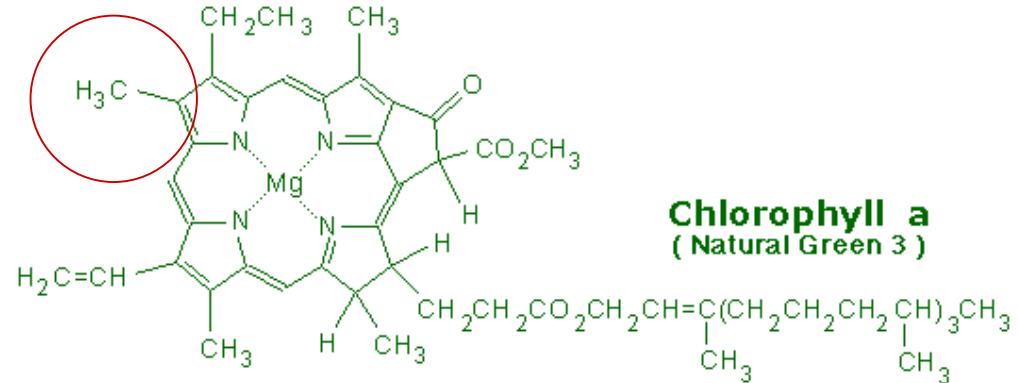
Photosystems



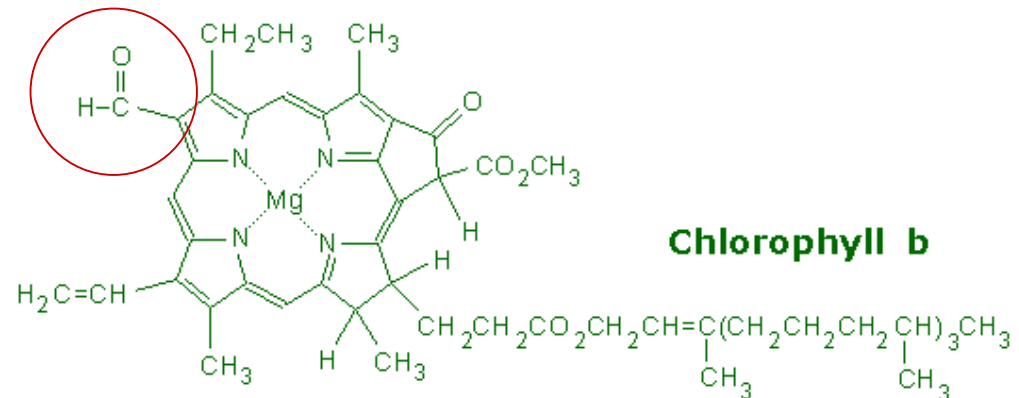


Chlorophylls

- Chlorophylls a and b have a similar structure:
 - Long hydrocarbon chain (Phytol chain)
 - Porphyrin head group.
 - Similar to Haem group of Hb but contains Mg.



Chlorophyll a
(Natural Green 3)

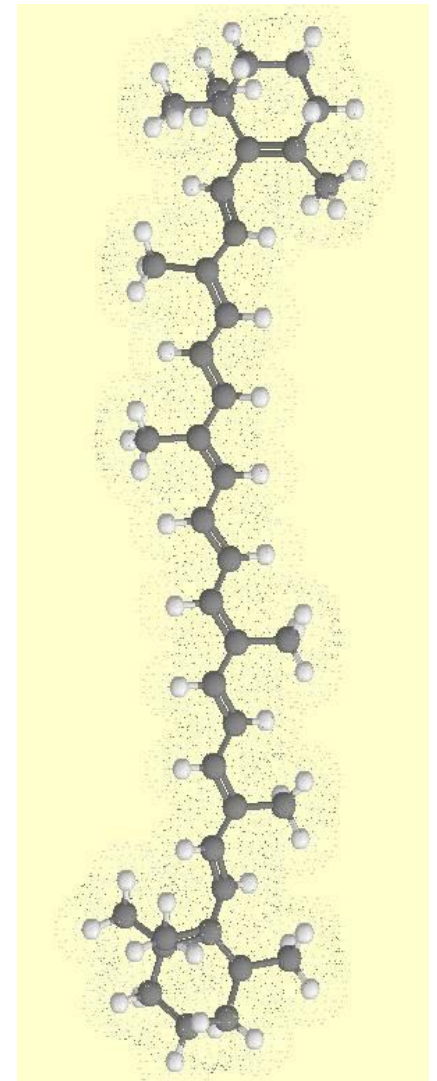


Chlorophyll b

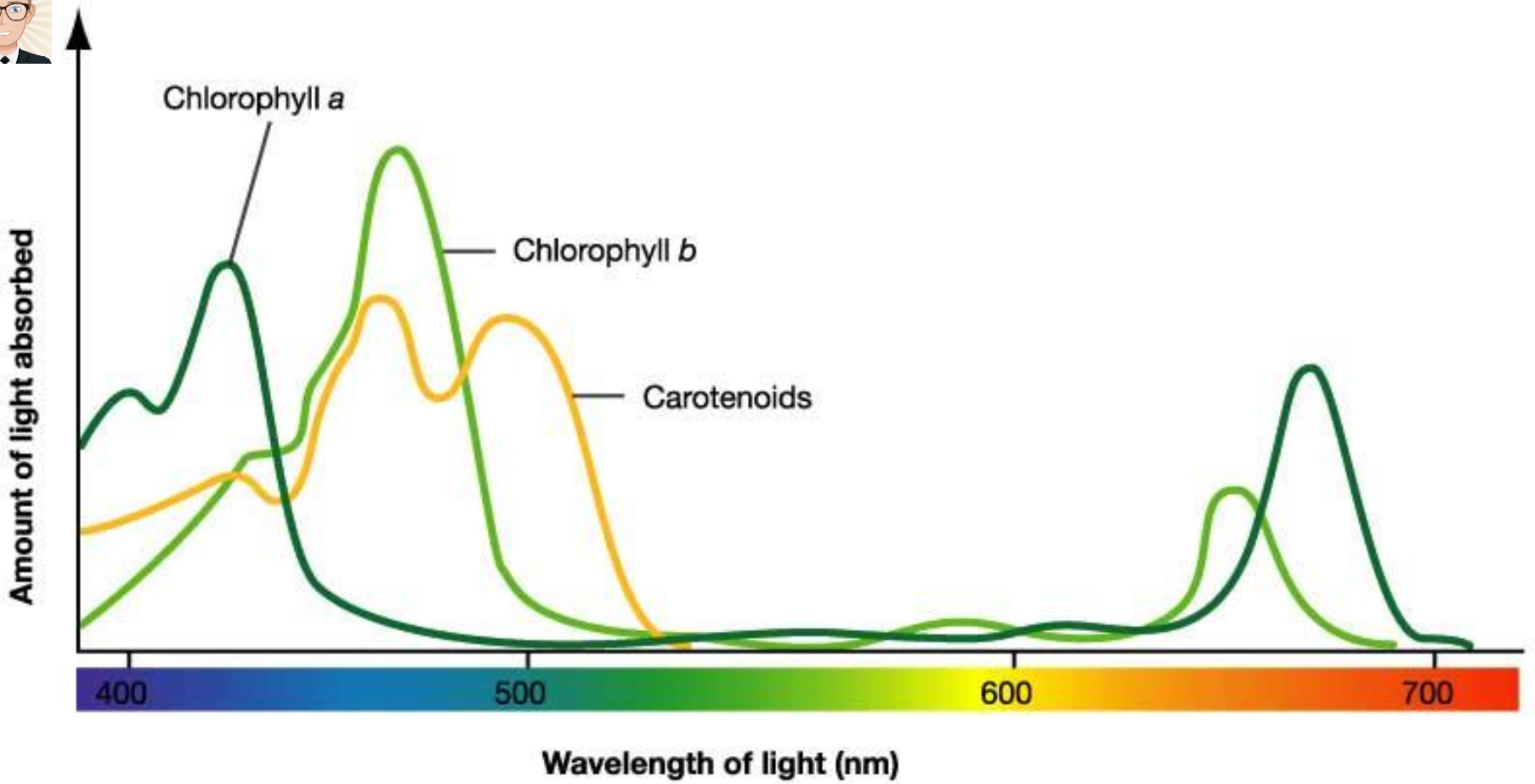


Carotenoids

- No porphyrin group.
- Absorb wavelengths not well absorbed by chlorophylls.
- Carotene & Xanthophyll are the main ones.



B-Carotene



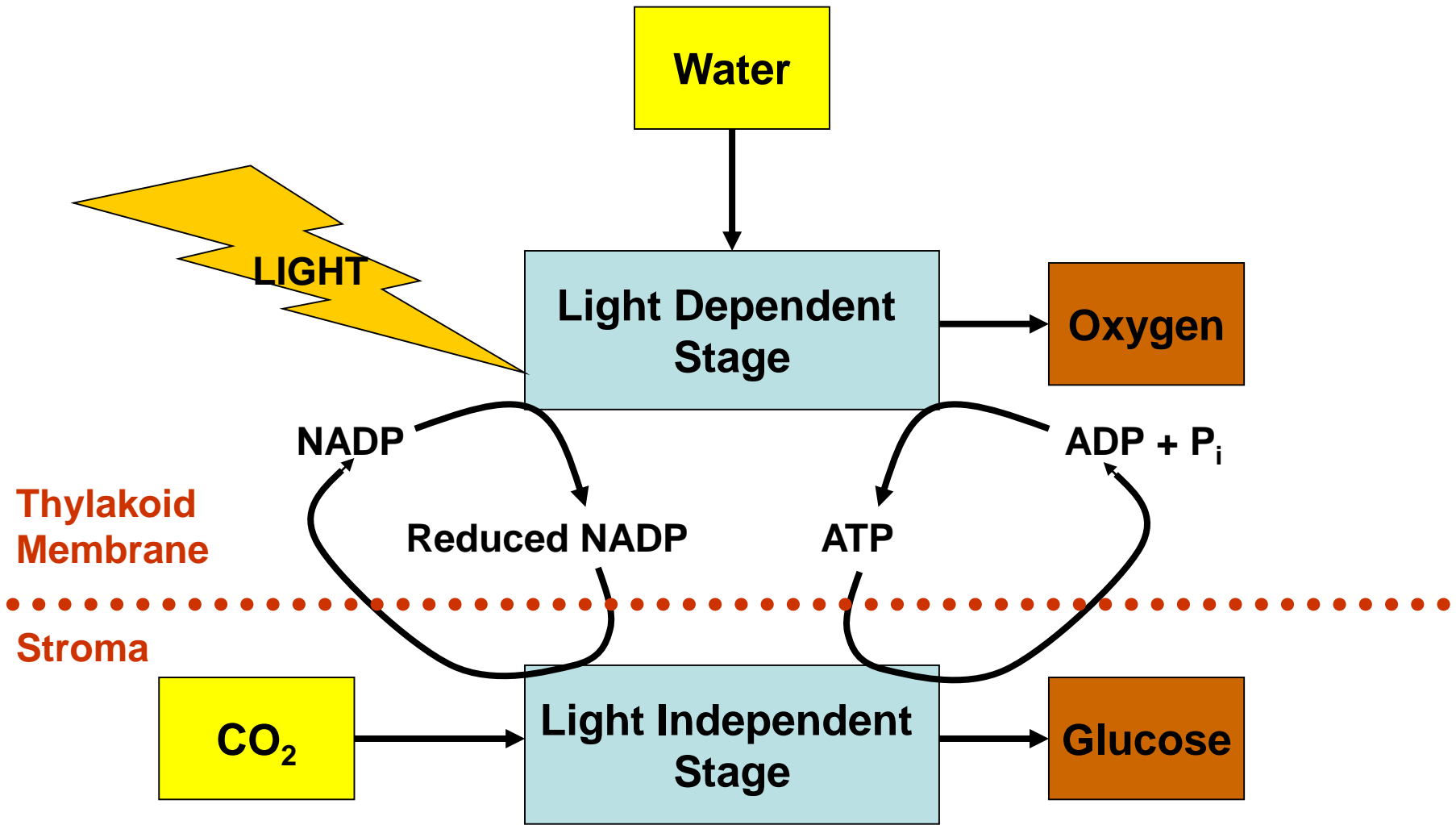


Two Stages of Photosynthesis

- Light Dependent Stage
 - Water is split into H^+ , e^- and O_2
 - Light energy converted to chemical energy (ATP).
- Light Independent Stage
 - CO_2 is fixed & used to build up complex organic molecules.



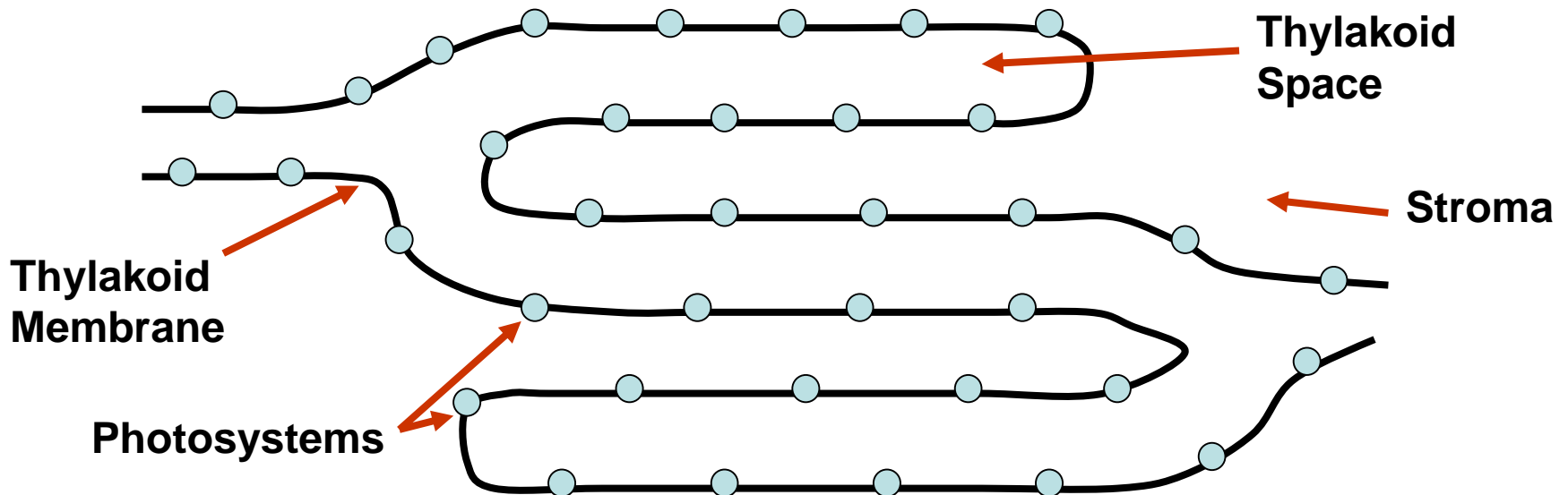
Photosynthesis Overview



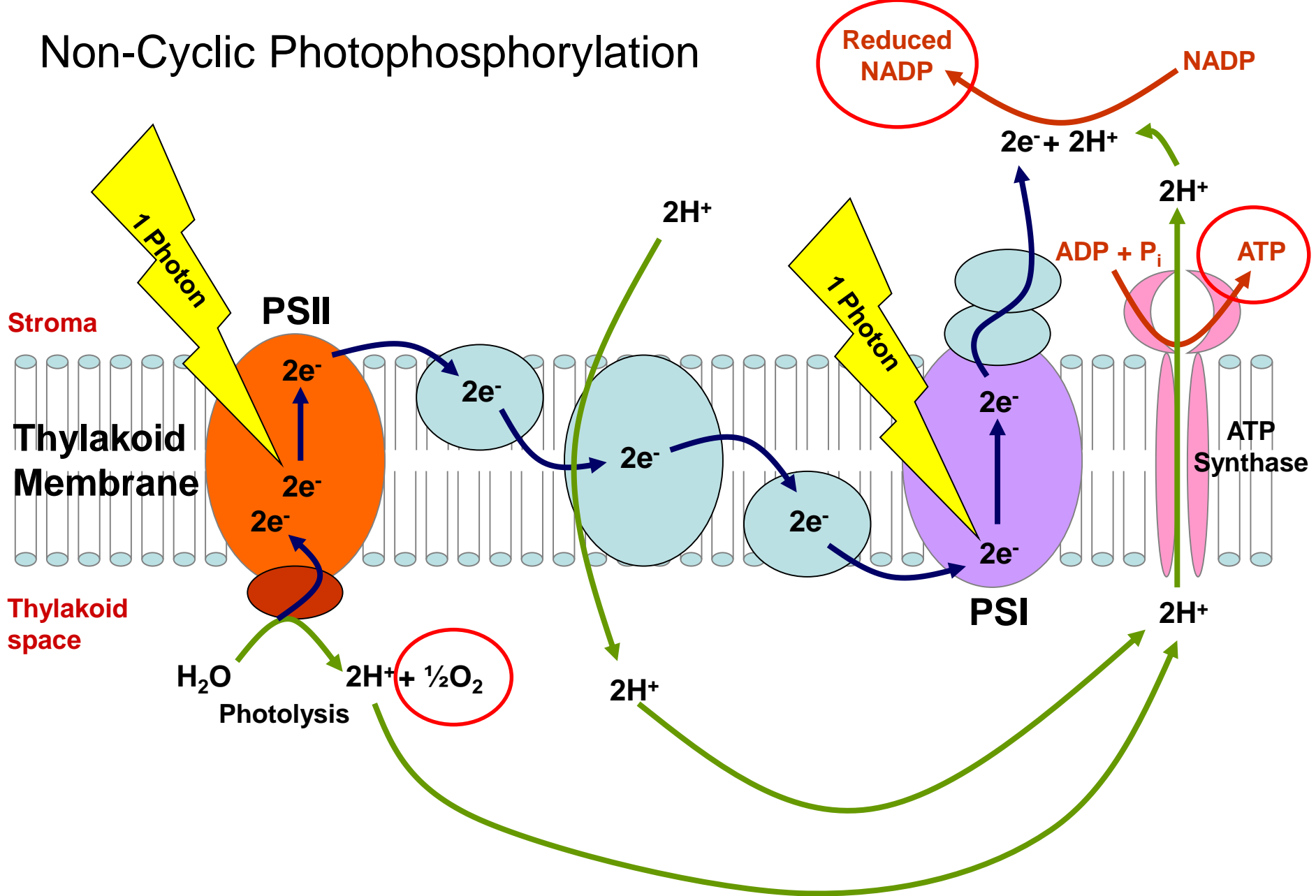


Light Dependent Stage

- Occurs in the photosystems on thylakoid membranes.
 - PS I occurs mainly on intergranal Lamellae.
 - PS II occurs only on granal lamellae.



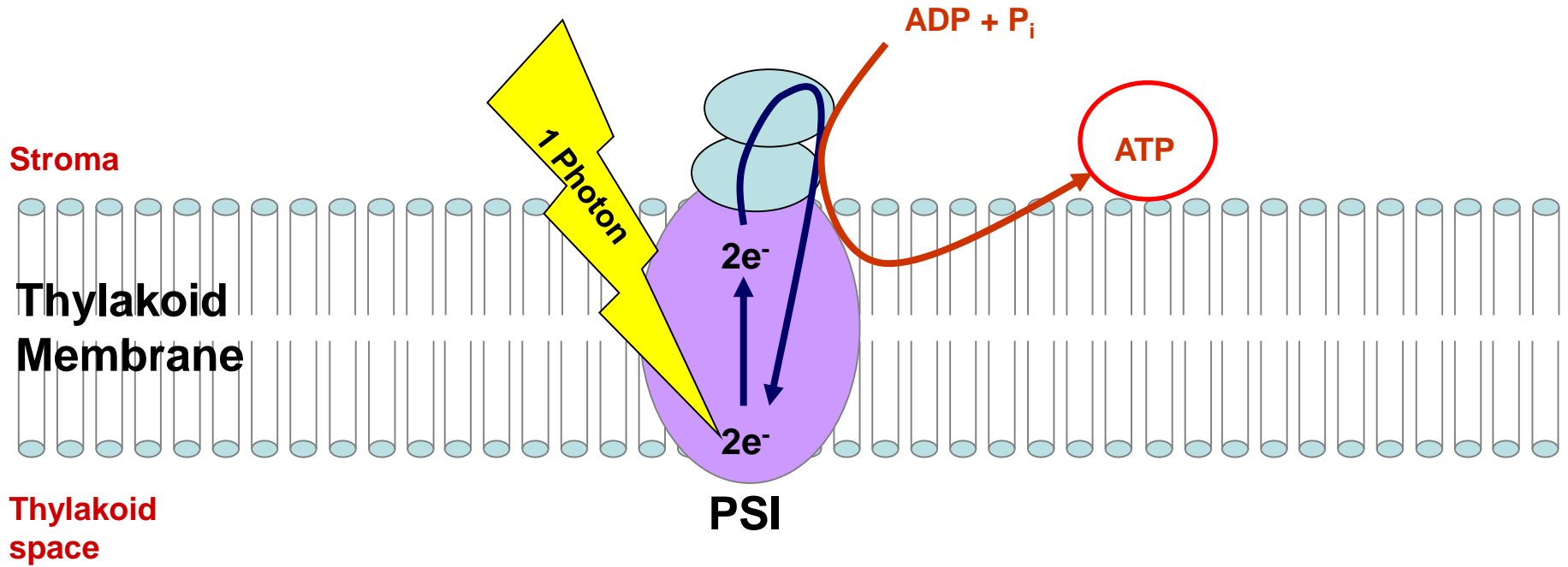
Non-Cyclic Photophosphorylation



Products: Reduced NADP, ATP + Oxygen



Cyclic Photophosphorylation

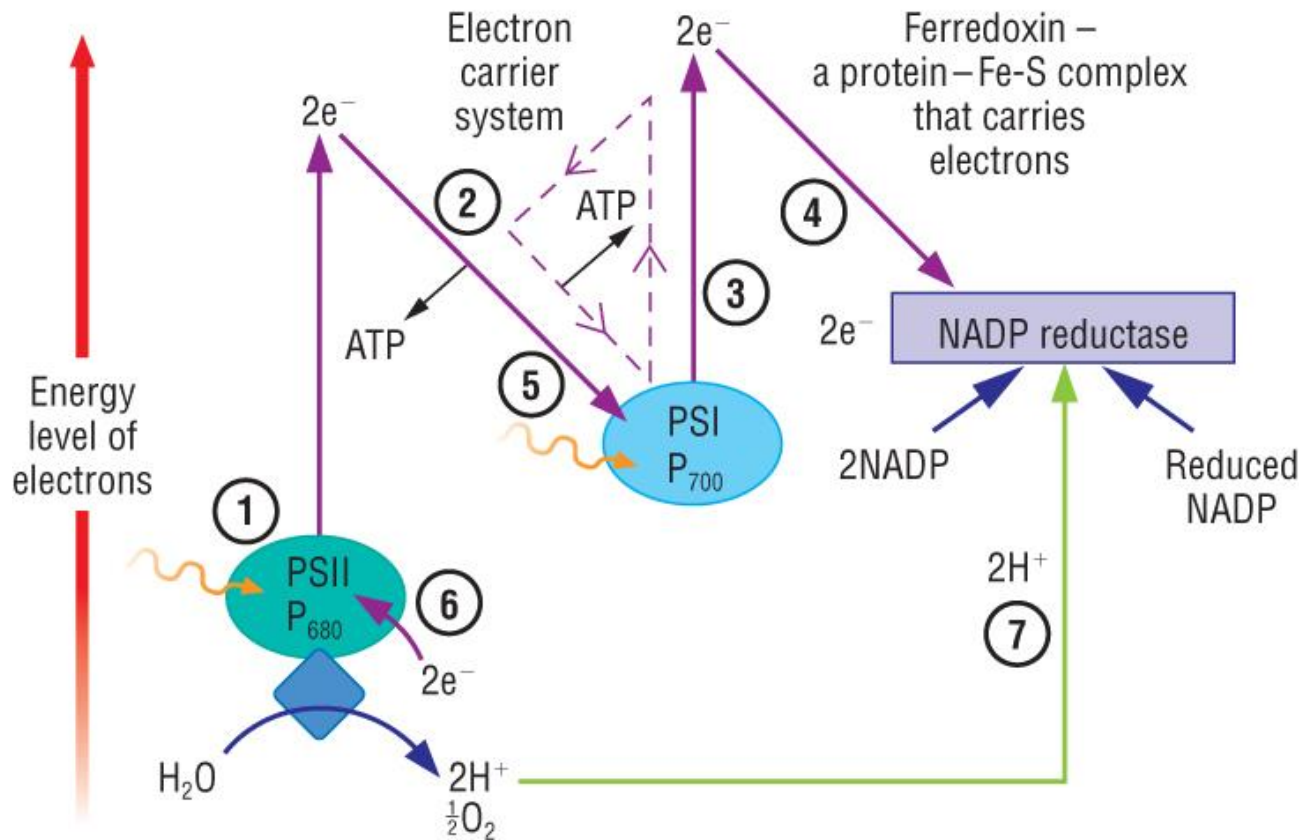


Product: ATP





Another way of showing it...



Key

- Light
- Non-cyclic photophosphorylation
- Cyclic photophosphorylation

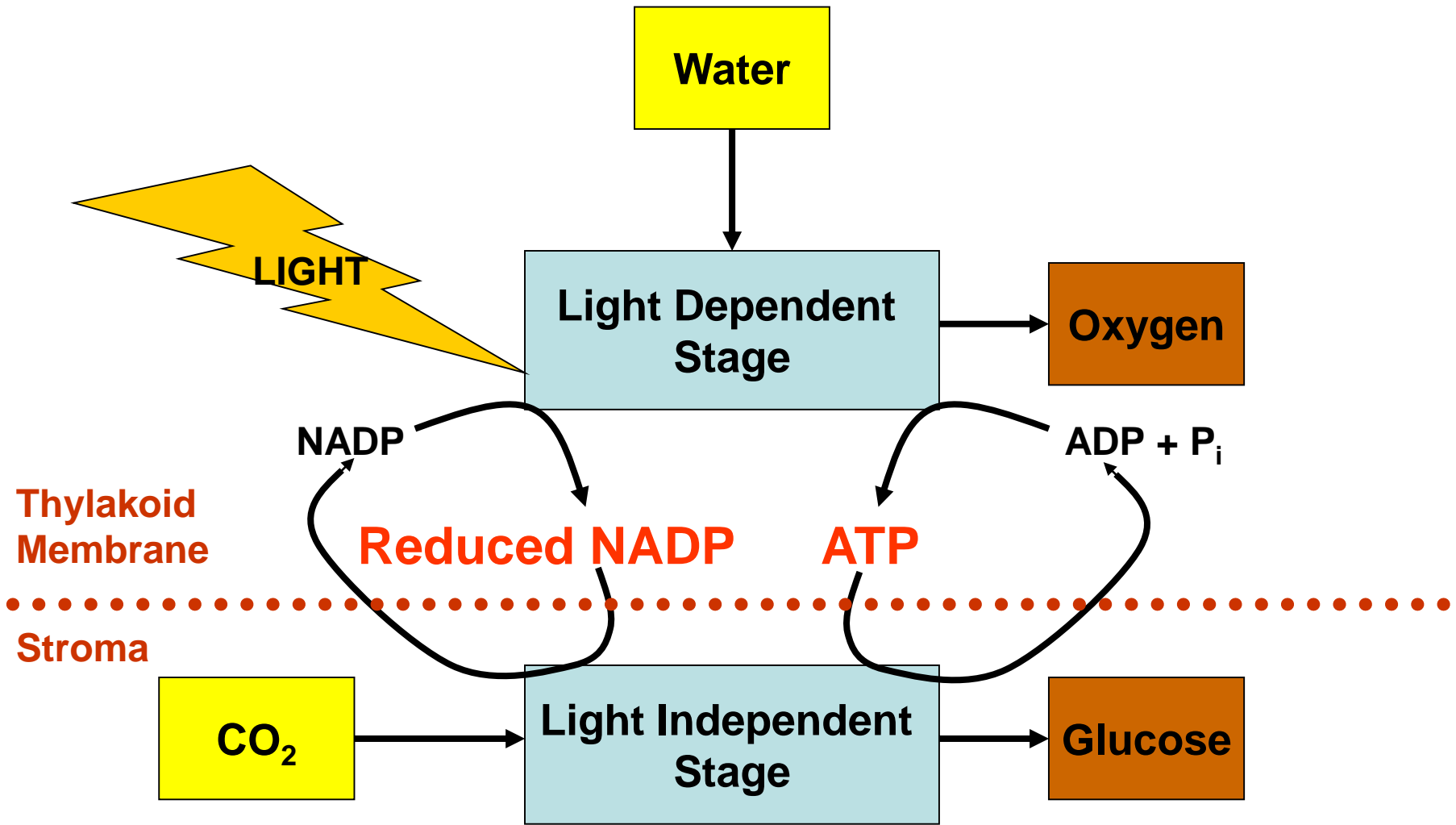


Cyclic v Non-Cyclic Photophosphorylation

	Cyclic	Non-Cyclic
Photosystems involved?	PSI Only	PSII and PSI
Is photolysis involved?	No	Yes
Fate of $2e^-$ from photosystems?	Fall back down to Chlorophyll	Captured by electron carriers
Products?	ATP Only	Reduced NADP, ATP & O_2



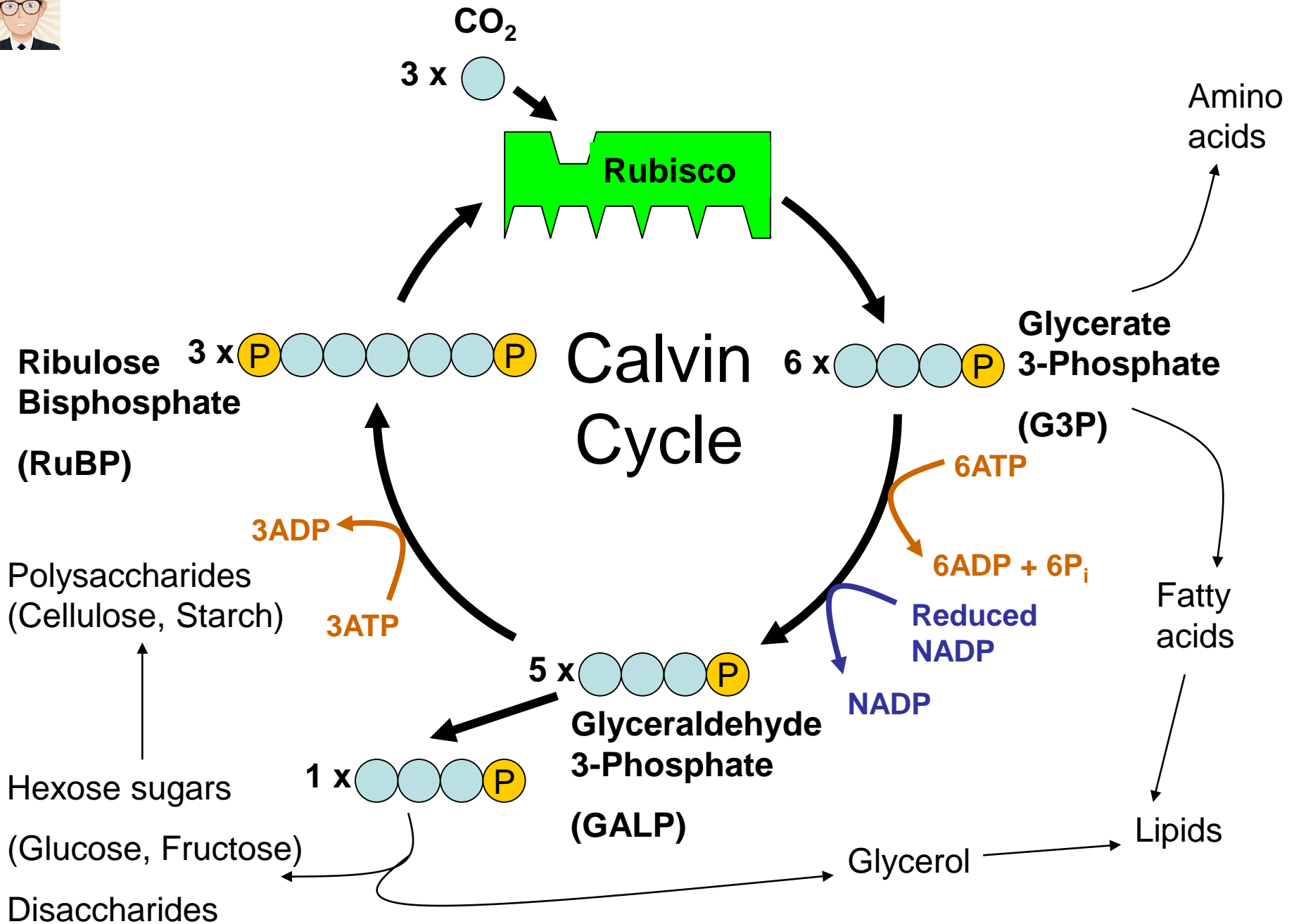
Photosynthesis Overview





Light Independent Stage

- Occurs in the stroma.
- Also called the Calvin Cycle





Another way of showing it...

