

Introduction to Botany. Lecture 6

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1 Questions and answers

- Enzymatic stage: fixation of carbon dioxide



Previous final question: the answer

Which photosystem is responsible for every product of the light stage?

At the end	Photosystem ...
H ₂ O (result of pump) and O ₂	...
Chlorophylls	...
ATP	...
NADPH	...



Previous final question: the answer

Which photosystem is responsible for every product of the light stage?

At the end	Photosystem ...
H ₂ O (result of pump) and O ₂	II
Chlorophylls	II and I
ATP	II
NADPH	I



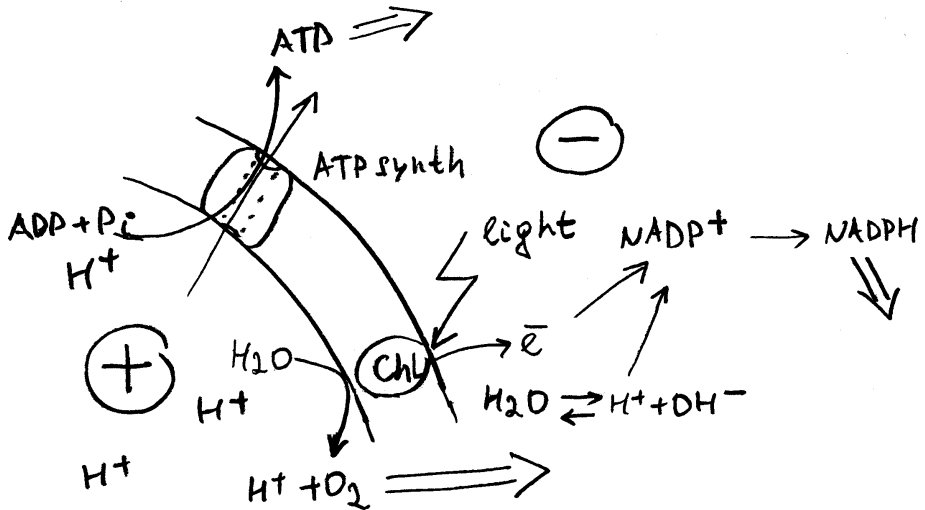
Photosystems movie



Results of the light stage

At the start	At the end
H_2O Photosystems II and I ADP and P_i (inorganic phosphate) NADP^+	H_2O (result of pump) and O_2 Photosystems II and I ATP NADPH





Questions and answers

Enzymatic stage: fixation of carbon dioxide



Participants of enzymatic stage

- 1 Carbon dioxide (CO_2)
- 2 Hydrogen carrier with hydrogen (NADPH)
- 3 Source of energy (ATP)
- 4 Ribulose biphosphate (RuBP, five-C-hydrocarbonate, “ C_5 ”)
- 5 *Rubisco* and other enzymes

Place: in the stroma of chloroplast

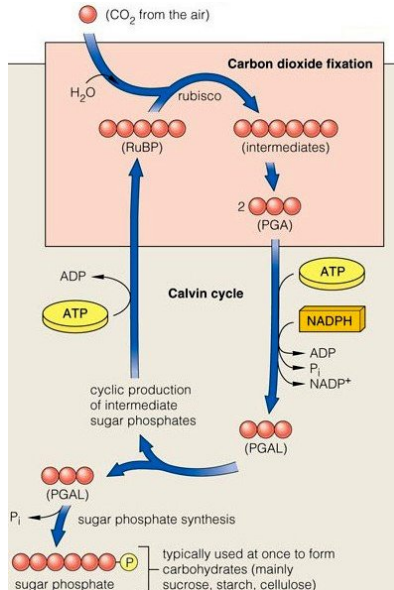


Main events of enzymatic stage

- ① $\text{CO}_2 + \text{C}_5$ (RuBP, ribulose biphosphate) $\xrightarrow{\text{rubisco}}$ C_6
- ② $\text{C}_6 \longrightarrow 2\text{C}_3$ (PGA, phosphoglyceric acid)
- ③ $\text{C}_3 + \text{NADPH} + \text{ATP} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6$ (or other organic molecules) + $\text{C}_5 + \text{NADP}^+ + \text{ADP} + \text{P}_i$ (inorganic phosphate)
 - Organic molecules are synthesized from C_3 (PGA) through energy-rich **PGAL** (phosphoglyceric aldehyde)
- ④ Processes above are **Calvin (C_3) cycle**, because PGA and PGAL (both C_3) are its most important components



Calvin (C_3) cycle

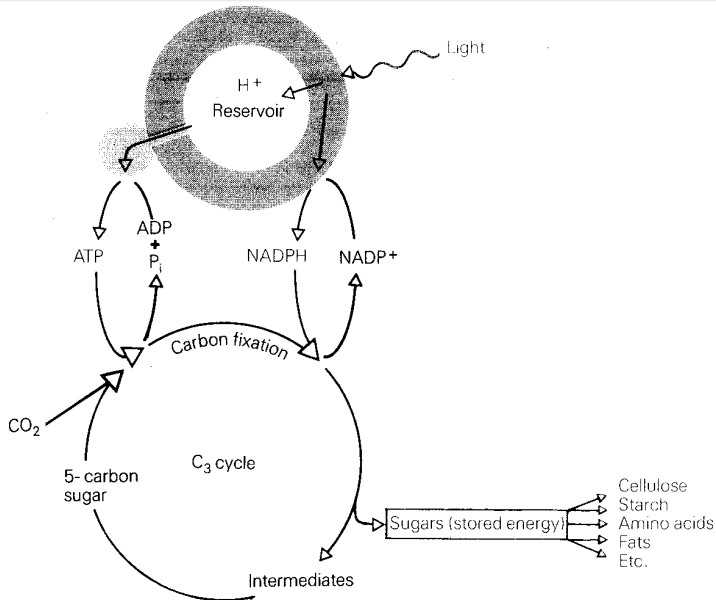


Results of enzymatic stage

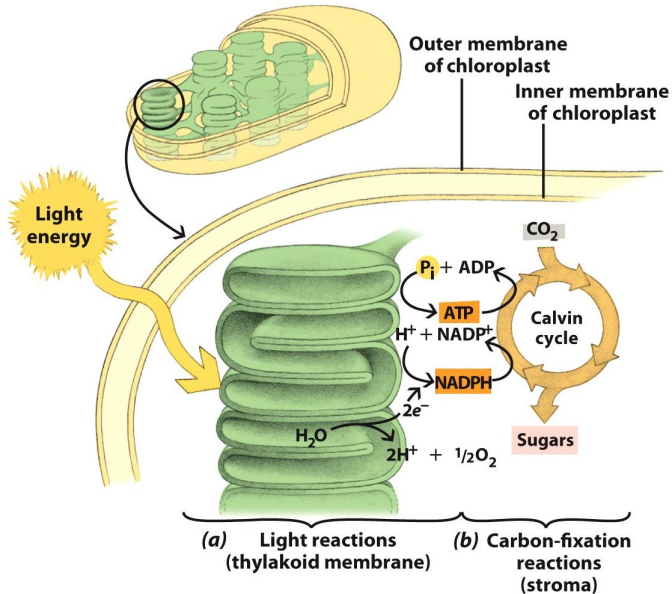
At the start	At the end
CO ₂	C ₆ H ₁₂ O ₆ (or other organic molecules)
NADPH	NADP ⁺ (and H to organic molecules)
ATP	ADP and P _i (inorganic phosphate)
C ₅	C ₅
Rubisco	Rubisco



Overview of photosynthesis



Photosynthesis in the cell



Photosynthesis movie



Final question (2 points)

What is wrong in this picture?



Final question (2 points)

What is wrong in this picture?

Before photosynthesis	After photosynthesis
H_2O NADP^+ CO_2	O_2 NADPH $\text{C}_6\text{H}_{12}\text{O}_6$ (or other organic molecules)



Summary

- **Photosynthesis** is a sum of light-dependent and light-independent reactions
- **Light stage** of photosynthesis results in accumulation of energy and hydrogen, and release of oxygen
- **Enzymatic stage** of photosynthesis results in synthesis of organic molecules



For Further Reading



A. Shipunov.

Introduction to Botany [Electronic resource].

2010—onwards.

Mode of access:

http://ashipunov.info/shipunov/school/biol_154



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.

Plant Biology. 2nd edition.

Thomson Brooks/Cole, 2006.

Chapters 2 and 10.

