

Introduction to Botany. Lecture 9

Alexey Shipunov

Minot State University

September 18, 2017



1 Questions and answers

- Quiz

2 Photosynthesis

- Enzymatic stage: fixation of carbon dioxide
- As a whole



1 Questions and answers

- Quiz

2 Photosynthesis

- Enzymatic stage: fixation of carbon dioxide
- As a whole



Questions and answers

Quiz



Final question (1 point)

Explain the role of NADP⁺



Final question (1 point)

Explain the role of NADP^+

- In the light stage of photosynthesis, with the help of Photosystem I (P_{700}) it takes hydrogen (protons from water and electrons from chlorophyll) and removes them from the space outside of membrane
- Hydrogen used lately
- Accumulated OH^- (hydroxide ion) makes the gradient and then the electrical flow through ATPase



Photosynthesis

Enzymatic stage: fixation of carbon dioxide



Participants of enzymatic stage

- A Carbon dioxide (CO_2)
- B Hydrogen carrier with hydrogen (NADPH)
- C Source of energy (ATP)
- D Ribulose biphosphate (RuBP, five-C-hydrocarbonate, “ C_5 ”)
- E *Rubisco* and other enzymes

Place: in the matrix (stroma) of chloroplast

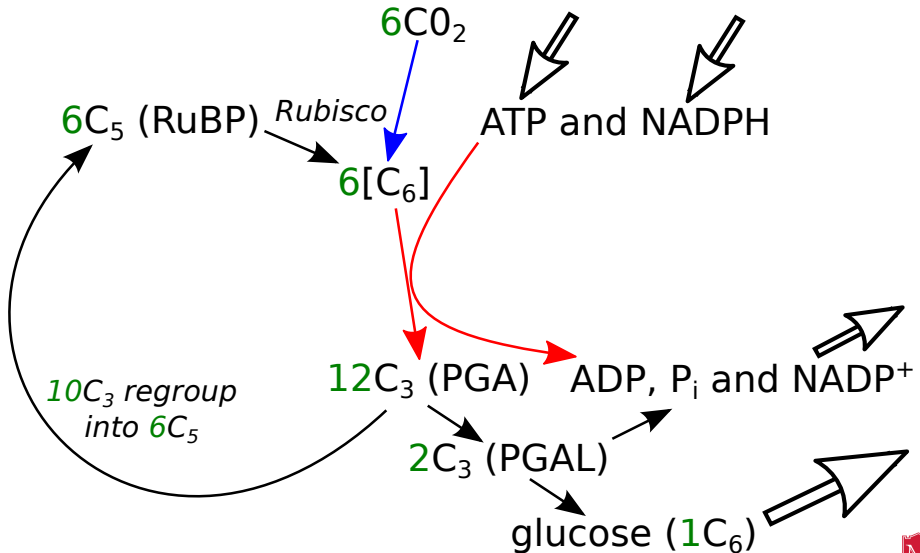


Main events of enzymatic stage

- A** $\text{CO}_2 + \text{C}_5$ (RuBP, ribulose biphosphate) $\xrightarrow{\text{rubisco}}$ C_6
- B** $\text{C}_6 \longrightarrow 2\text{C}_3$ (PGA, phosphoglyceric acid)
- C** $\text{C}_3 + \text{NADPH} + \text{ATP} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6$ (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)



Enzymatic stage: scheme



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

The other names for enzymatic stage are “Calvin cycle” and “C₃ cycle”



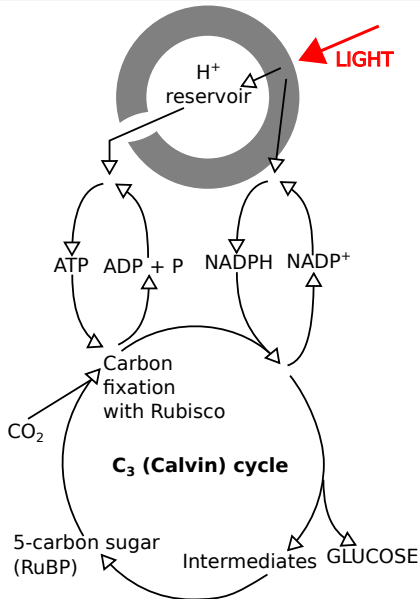
Photosynthesis

As a whole

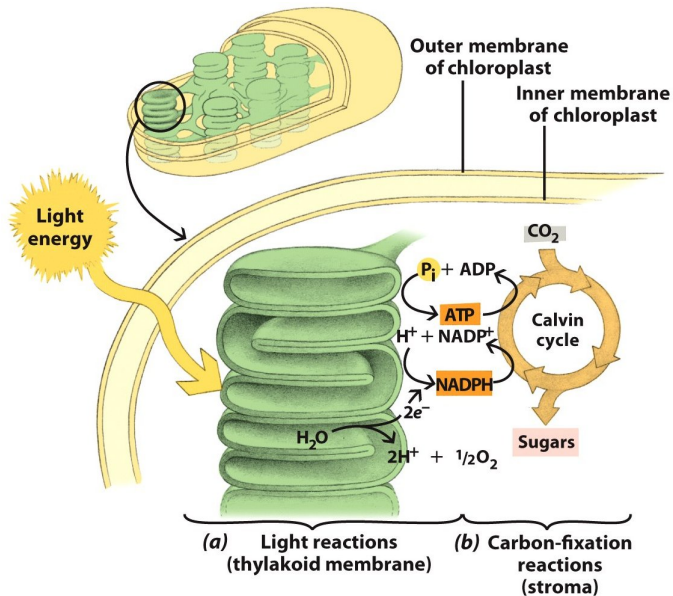




Overview of photosynthesis



Photosynthesis in the cell



Photosynthesis movie



Final question (2 points)



Final question (2 points)

Explain the role of NADPH in the enzymatic stage.



Summary

- **Photosynthesis** is a sum of light-dependent (photo-) and light-independent (auto-) reactions
- **Light stage** of photosynthesis results in accumulation of energy and hydrogen, and release of oxygen
- **Enzymatic stage** of photosynthesis results in assimilation of the CO_2 and synthesis of organic molecules



For Further Reading



A. Shipunov.

Introduction to Botany [Electronic resource].

Mode of access:

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

