Introduction to Botany. Lecture 7

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Outline

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Previous final question: the answer

Explain the difference between light and enzymatic stages of the photosynthesis.

- Energy
- Carbon dioxide
- ~~Darkness~~

Enzymatic stage is not “dark”, is light-independent!!! If you switch the light off, in seconds photosynthesis will altogether stop.

Exam 1

1) Nucleotides
2) pH

Photosynthesis

Special case of photosynthesis: C_4 pathway

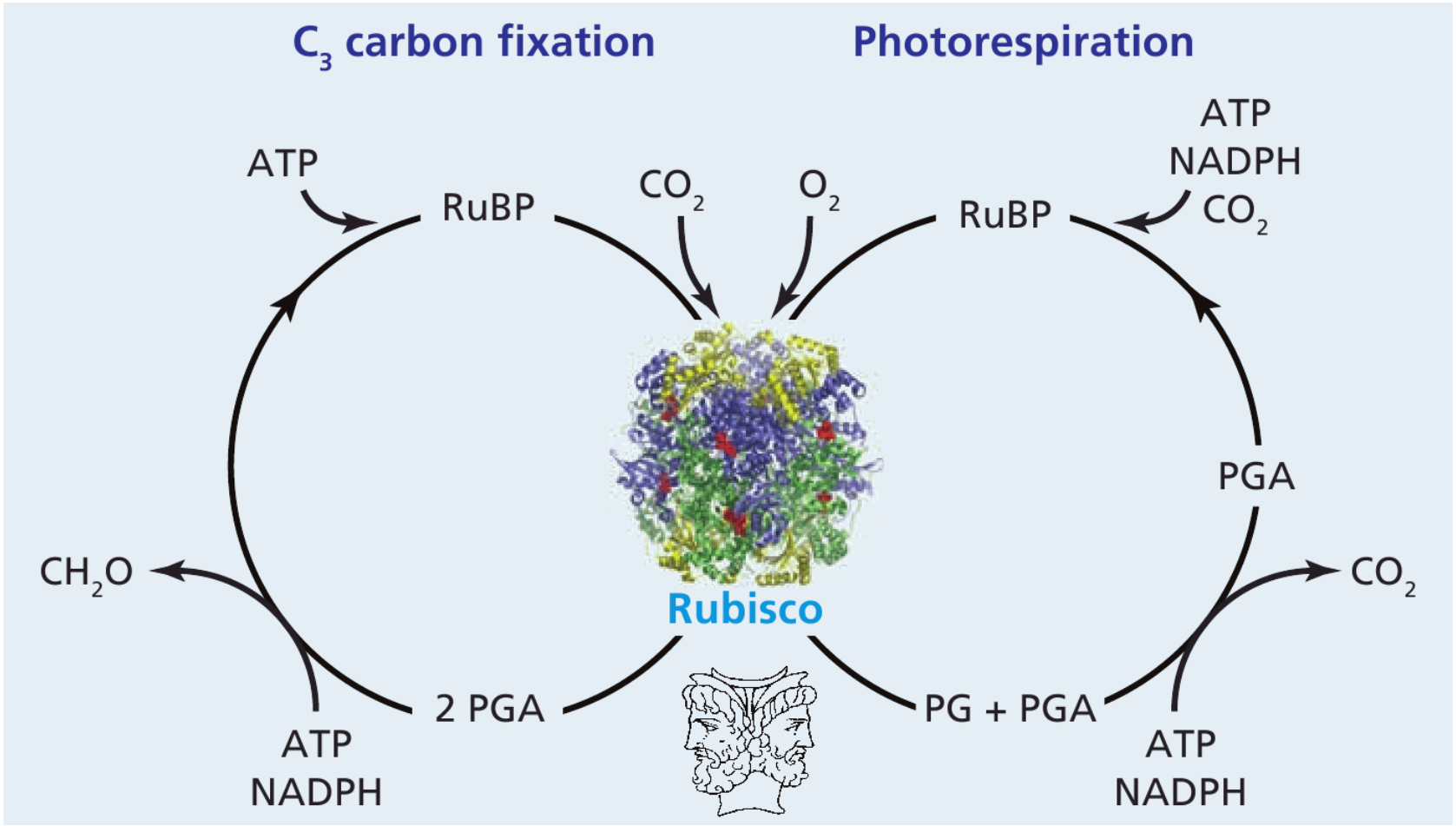
Photorespiration

Rubisco is two-faced enzyme, it catalyzes **photorespiration** if the concentration of O_2 and/or temperature is high:

O_2 + C_5 (ribulose biphosphate) $\xrightarrow{Rubisco}$ 3-phosphoglycerate (PGA) + phosphoglycolate (PGAL) $\longrightarrow$ glycolate

- To return glycolate into the Calvin cycle, cell must use peroxisomes, mitochondria and spend ATP
- Photorespiration wastes C_5 and ATP
- Photorespiration is said to be an evolutionary relic from times when atmosphere contained little oxygen

Two-faced Rubisco



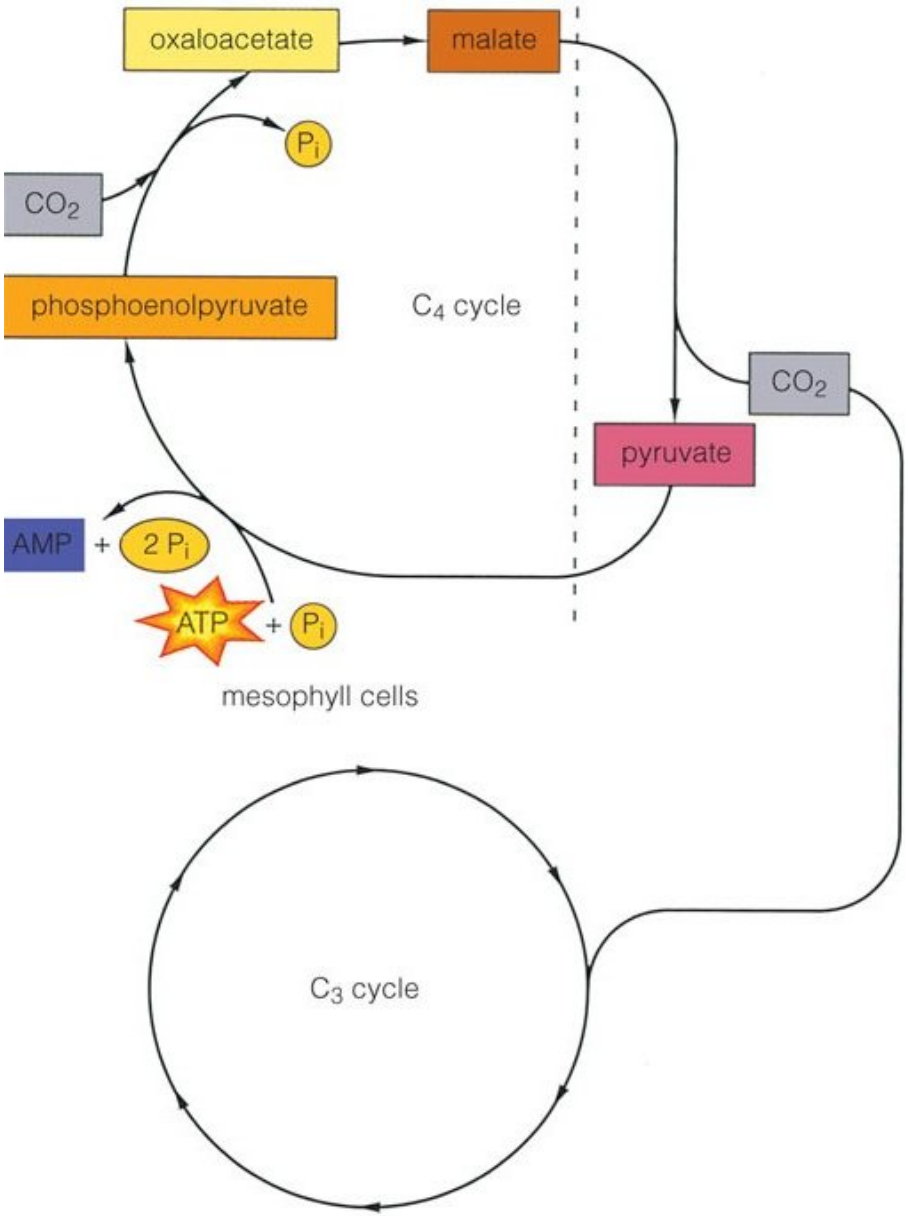
Minimization of photorespiration

To minimize photorespiration, plants need to increase concentration of CO_2. This is how they do it:

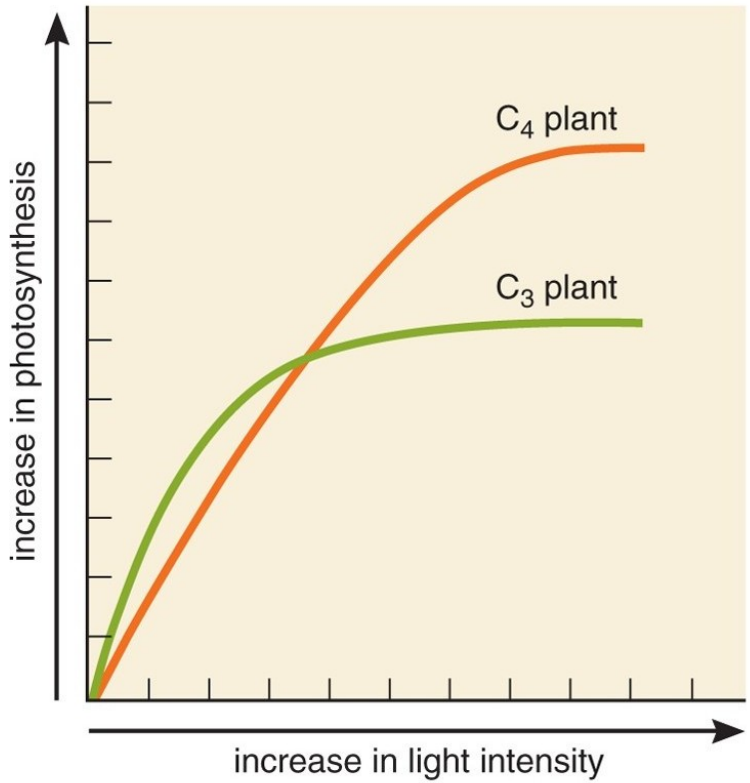
1. CO_2 + C_5 (PEP, phosphoenolpyruvate) $\xrightarrow{\text{PEP carboxylase}}$ C_4 (different organic acids): this is the temporarily accumulation of carbon dioxide
2. $C_4 \longrightarrow$ pyruvate + CO_2: release of carbon dioxide will increase its concentration
3. Pyruvate + ATP $\longrightarrow$ PEP + AMP + $2P_i$: PEP recovery costs ATP

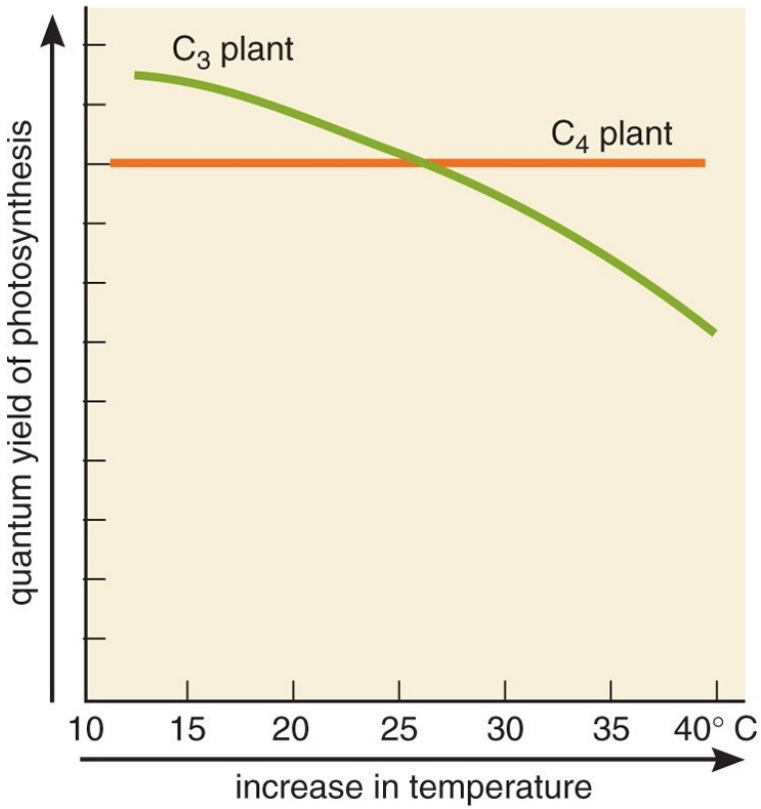
Processes above called C_4 pathway, it is an addition to Calvin (C_3) cycle in order to increase concentration of CO_2

C_4 pathway at-a-glance



C_4-pathway plants feel better at high temperature and light intensity





C_4-pathway plants waste ATP to recover PEP but outperform strict C_3 plants when concentration of oxygen is high

Summary

- To prevent wasteful **photorespiration**, plants “invented” the addition to photosynthesis, C_4-pathway
- Plants with C_4 pathway accumulate and then release carbon dioxide and therefore increase its concentration

For Further Reading

A. Shipunov.
Introduction to Botany [Electronic resource].
2015.
Mode of access:
http://ashipunov.info/shipunov/school/biol_154