Introduction to Botany. Lecture 10

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Outline

1. Questions and answers
   - Quiz
2. Photosynthesis
   - C_4 and CAM plants
3. Plant cell
   - Discovery of cell
   - Structure of cell

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Questions and answers

Quiz

Final question (2 points)

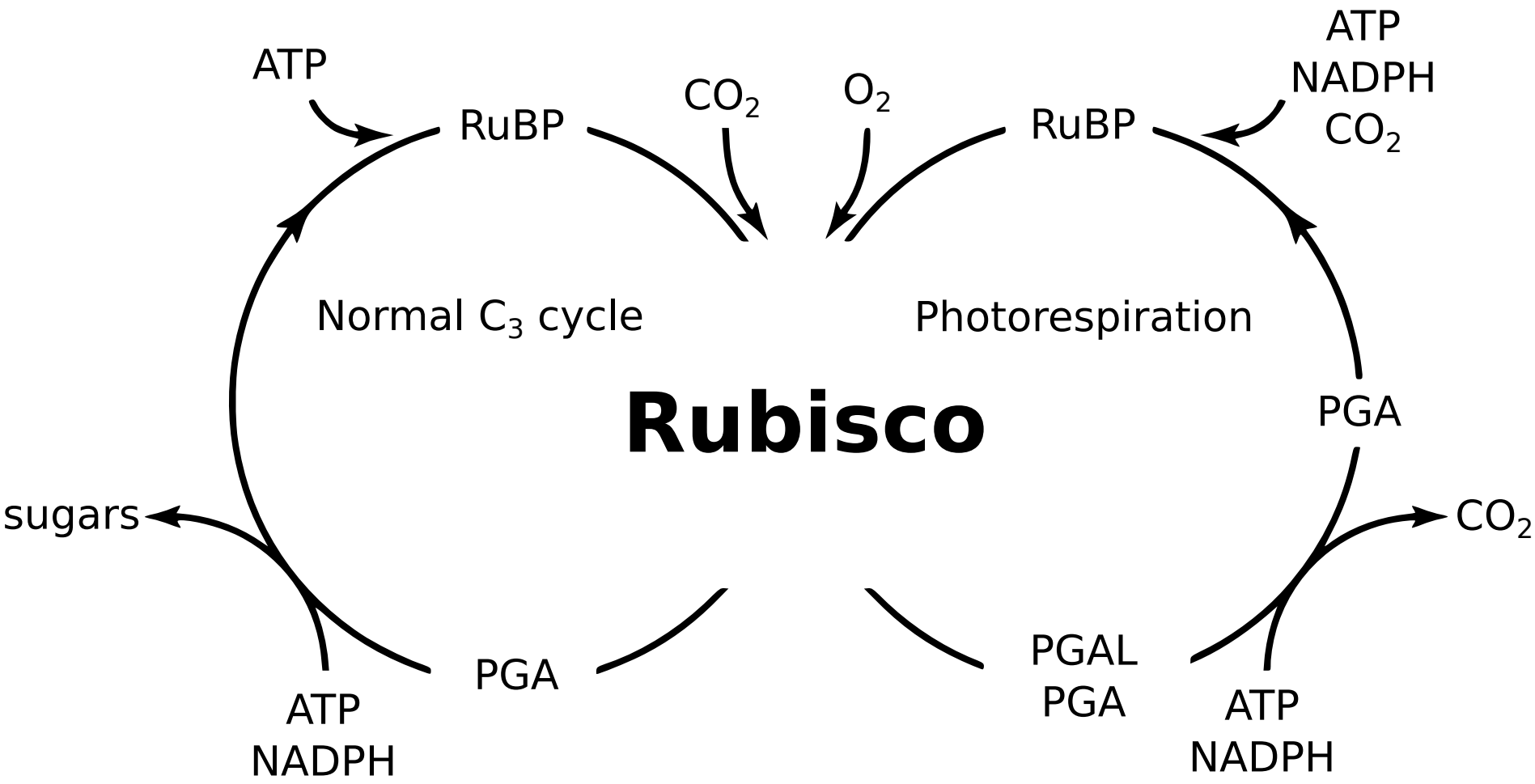
What is photorespiration?

Final question (2 points)

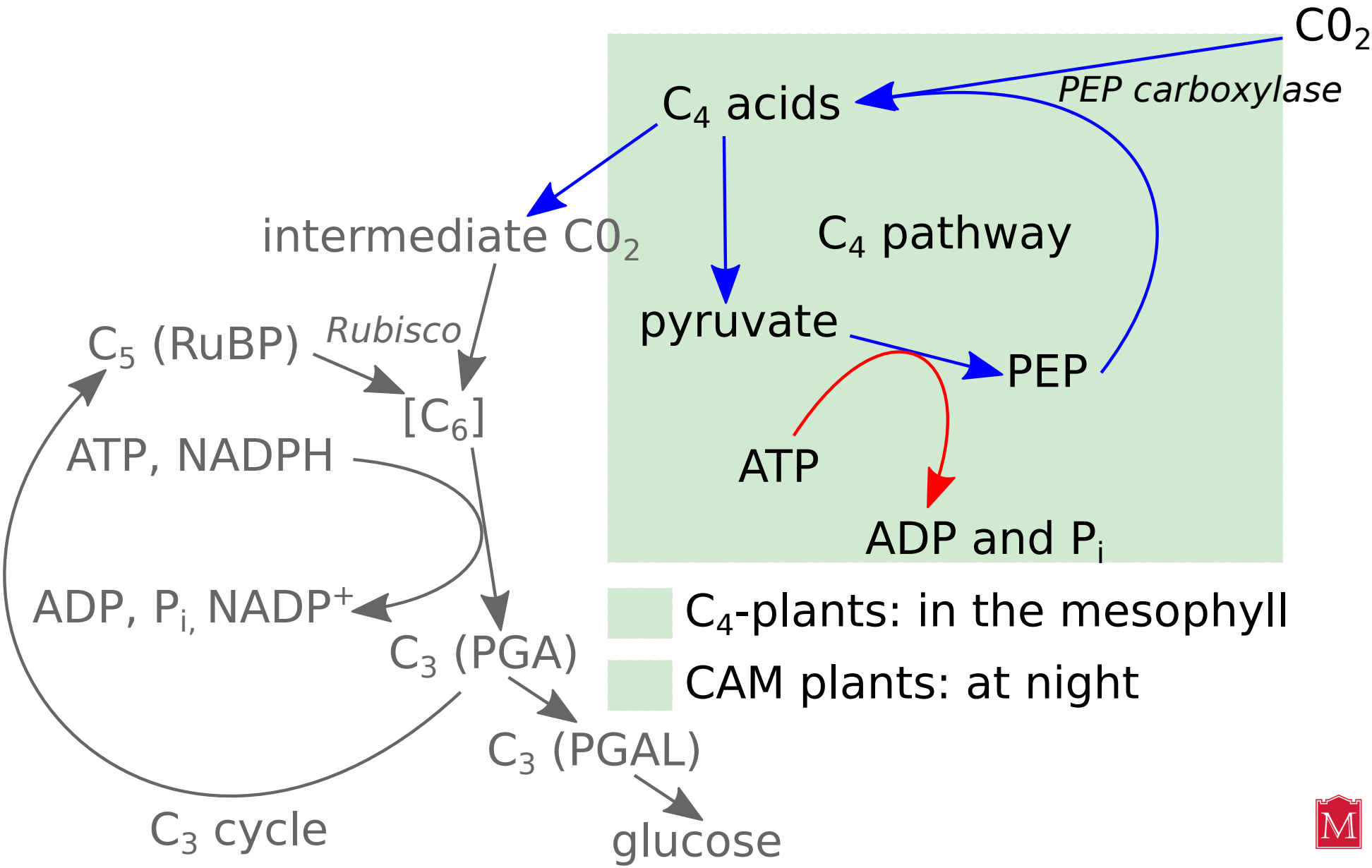
What is photorespiration?

- This is a “wrong turn” of Calvin cycle when there are too many oxygen molecules
- Instead of carbon dioxide, Rubisco takes oxygen and then many efforts (and ATP) required to restore everything back to normal

Two-faced Rubisco



C_4 pathway at-a-glance



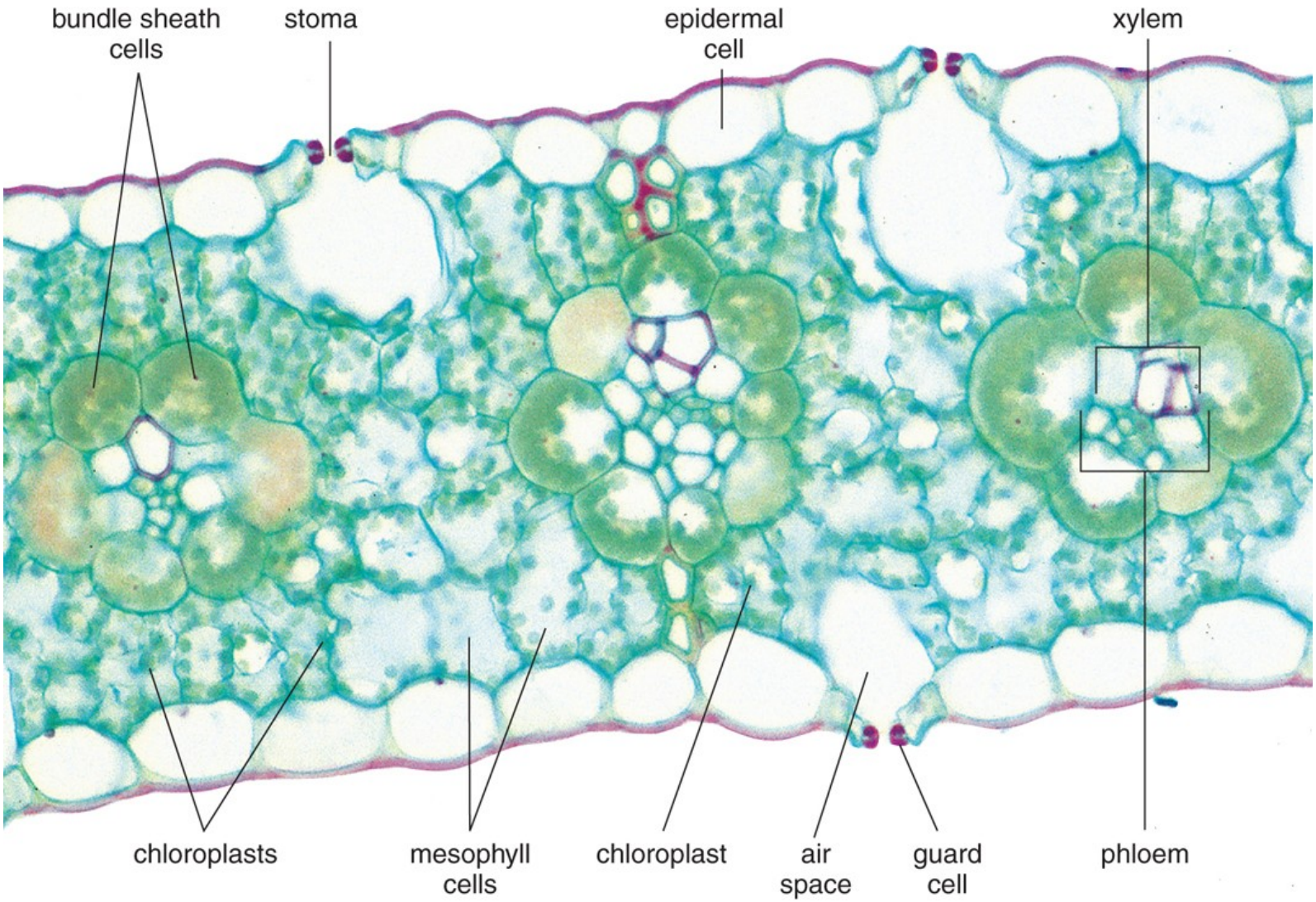
Photosynthesis

C_4 and CAM plants

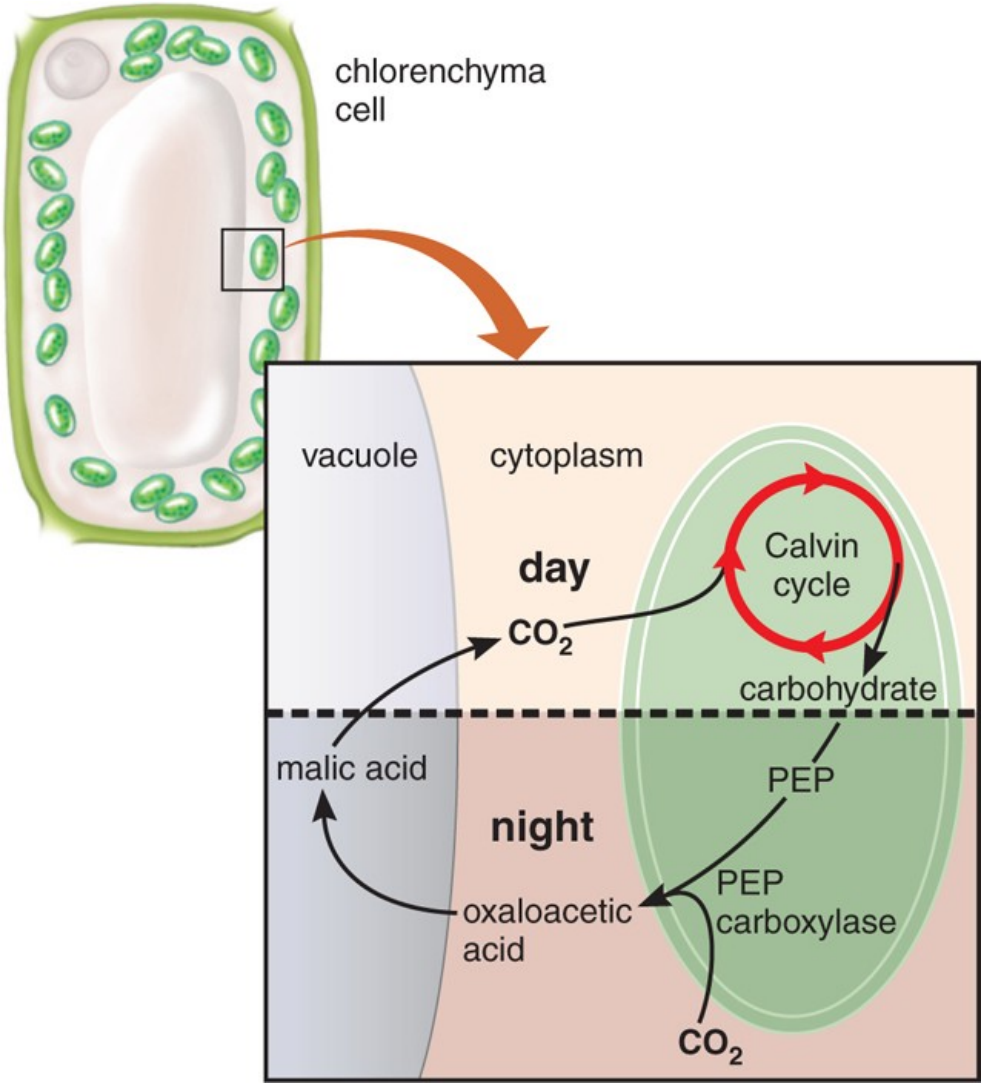
C_4 and CAM plants both use C_4 pathway

- **CAM-plants** which drive C_4 cycle at nights:
  - This is a **temporal** separation between accumulation of CO_2 and photosynthesis)
  - CAM-plants (17,000 species, 7% of plant biodiversity) are mostly succulents from different orders and families (e.g., cacti—Cactaceae from Caryophyllales)
- **C_4-plants** which drive C_4 in mesophyll cells and C_3 in bundle sheath cells:
  - This is a **spatial** separation between accumulation of CO_2 and photosynthesis: C_4 pathway is located in "normal" mesophyll cells whereas the Calvin cycle is separated to **bundle sheath cells**.
  - C_4-plants (7,300 species, 3%) are especially common among Poales (grasses order, e.g., corn) and Caryophyllales (pink order)

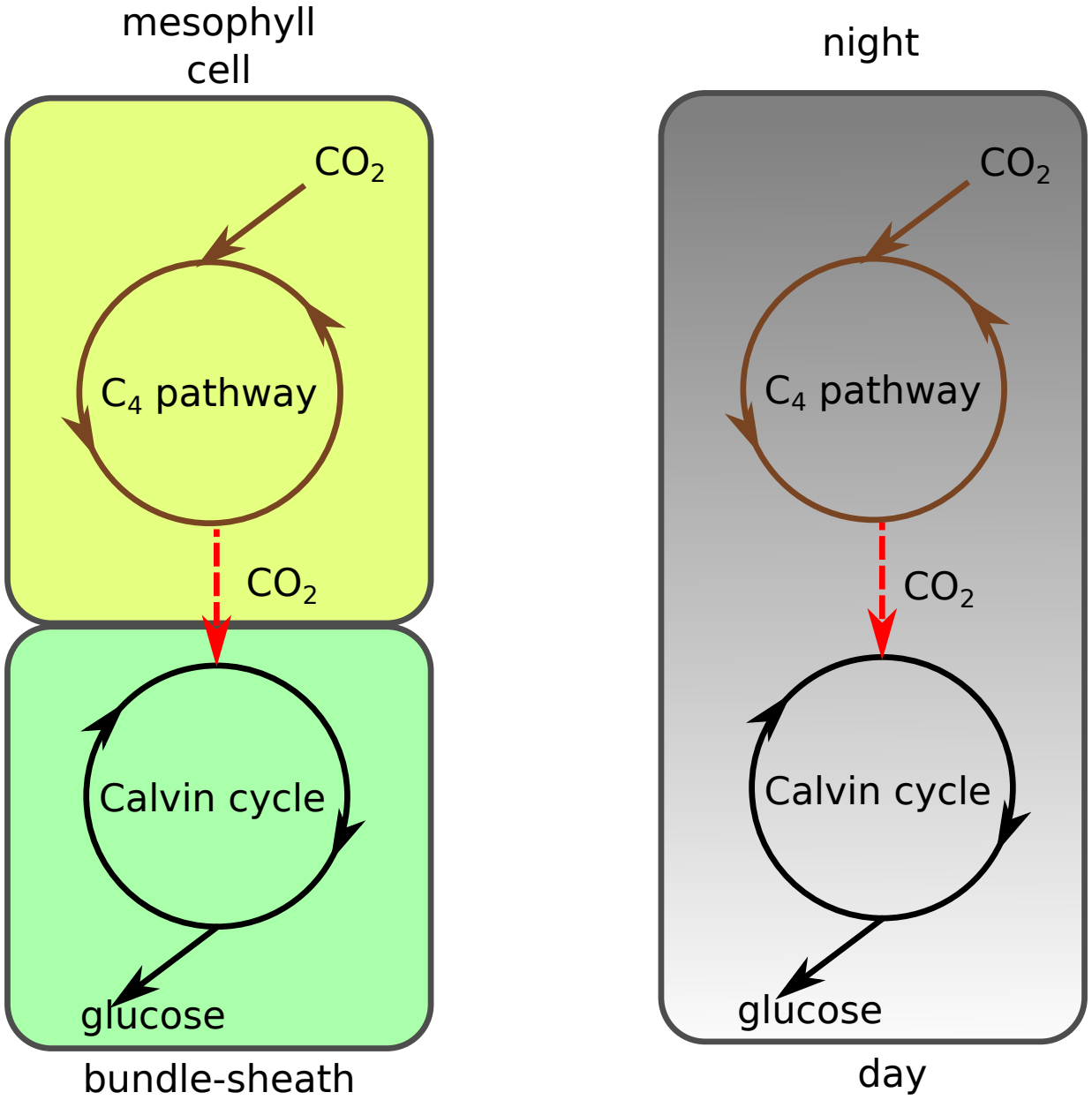
Leaf of C_4 plant: spatial separation of C_3 and C_4 pathways



CAM plants separate C_3 and C_4 pathways in time



CAM plants and C_4 plants



Jade plant

CAM is named after the family Crassulaceae,
Jade plant (*Crassula ovata*) family

Corn

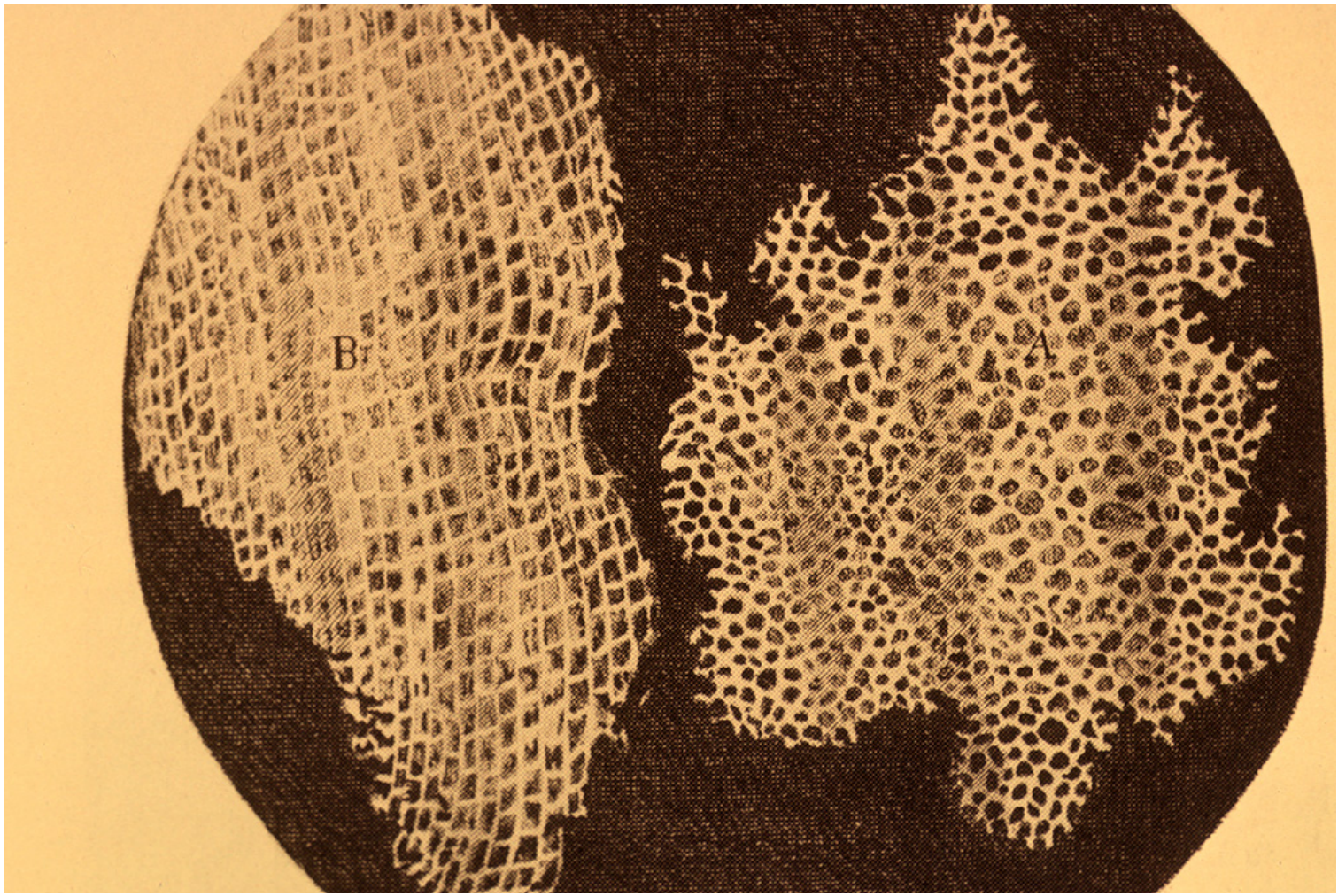
Corn (*Zea mays*) is the C_4 plant which minimizes photorespiration at higher temperatures

Why to know photosynthesis?

http://www.nature.com/nature/journal/vaop/ncurrent/full/nature13776.html

Plant cell
Discovery of cell

Discovery of cells



In 1665, Robert Hooke looked at cork tissue under microscope and found “little boxes or cells distinct from one another ... that perfectly enclosed air”

Hooke's microscope

National Library of Medicine

Cell theory

1. All plants and animals are composed of cells (1839, Matthias Schleiden and Theodor Schwann)
2. Cell is most basic unit (atom) of life (1839, Matthias Schleiden and Theodor Schwann)
3. All cells arise by reproduction from previous cells (1858, Rudolf Virchow)

Miscroscopes

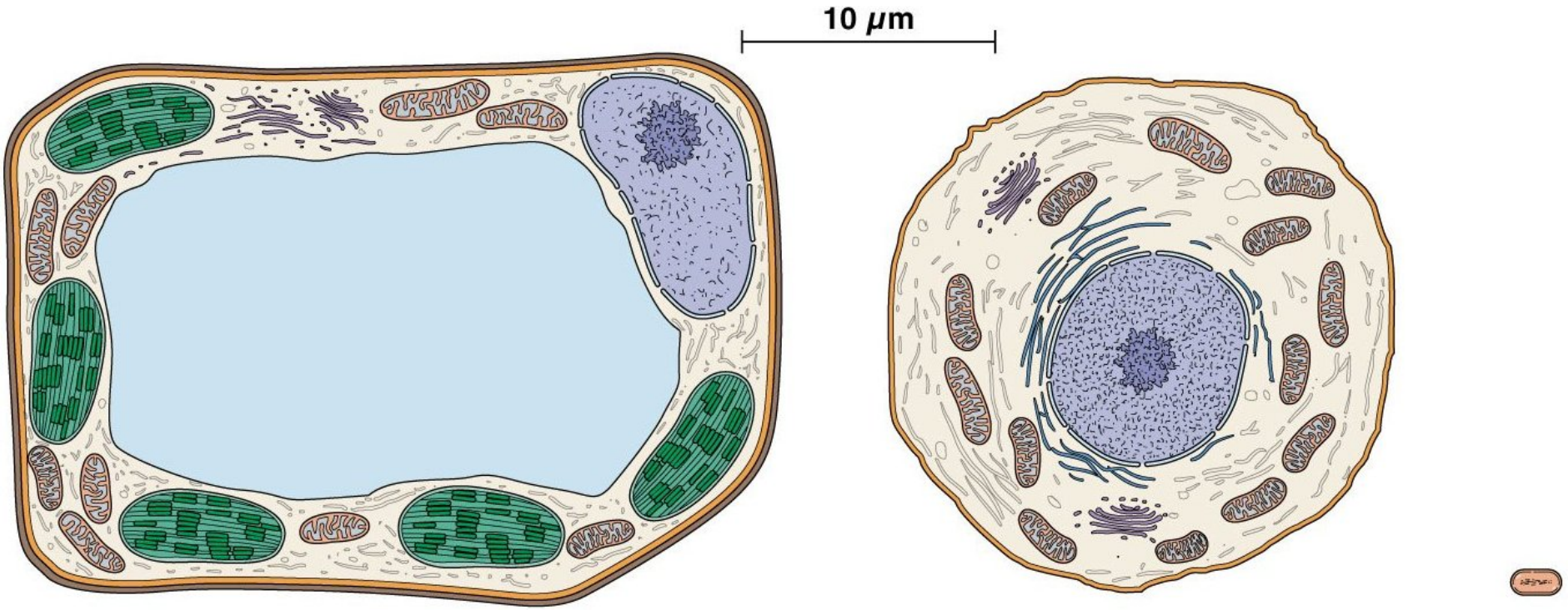
Light microscopy was an early technological breakthrough that contributed to our understanding of cell structure. Dissectiscopes use reflected light, microscopes use translucent light. Magnification is of 10^3 order.

Transmission electron microscopy (TEM) allows us to see the internal organization of cells and organelles. Use translucent electronic "light" (electronic beam) which kills objects. Objects are often stained with osmium (Os). Magnification if of 10^7 order.

Scanning electron microscopy (SEM) provides an image of the surface of cells and organisms. Use reflected electronic "light" (electronic beam). Objects are covered with thin layer of gold (Au). Magnification if of 10^6 order.

Plant cell
Structure of cell

Cells and cells



Eukaryotic and prokaryotic cells are fundamentally different

Plant cell

Final question (2 points)

Final question (2 points)

How to avoid photorespiration?

Summary

- C_4 and CAM plants accumulate and then release carbon dioxide and therefore increase its concentration

For Further Reading

A. Shipunov.
Introduction to Botany [Electronic resource].
2016.
Mode of access:
http://ashipunov.info/shipunov/school/biol_154