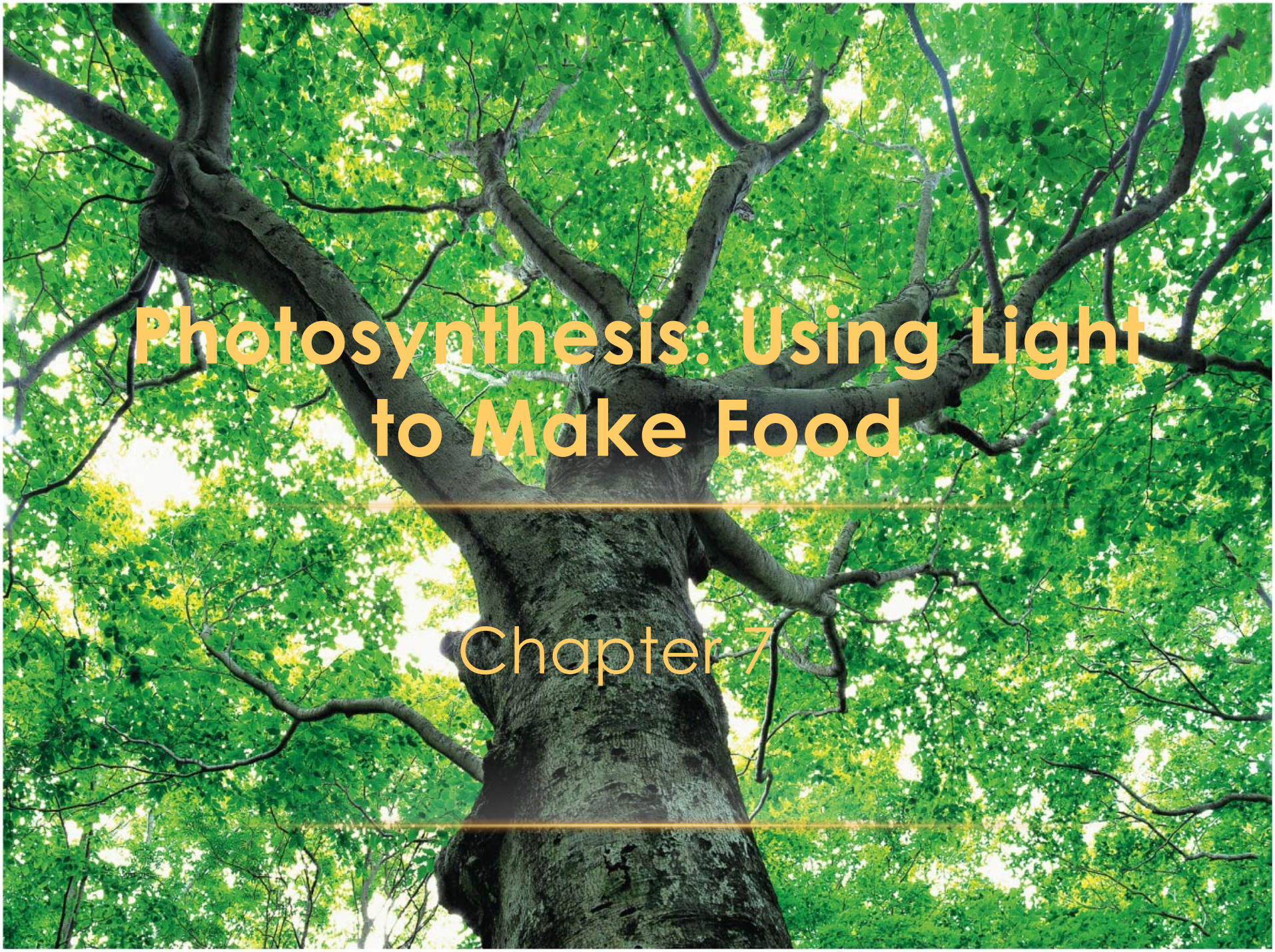


Photosynthesis: Using Light to Make Food

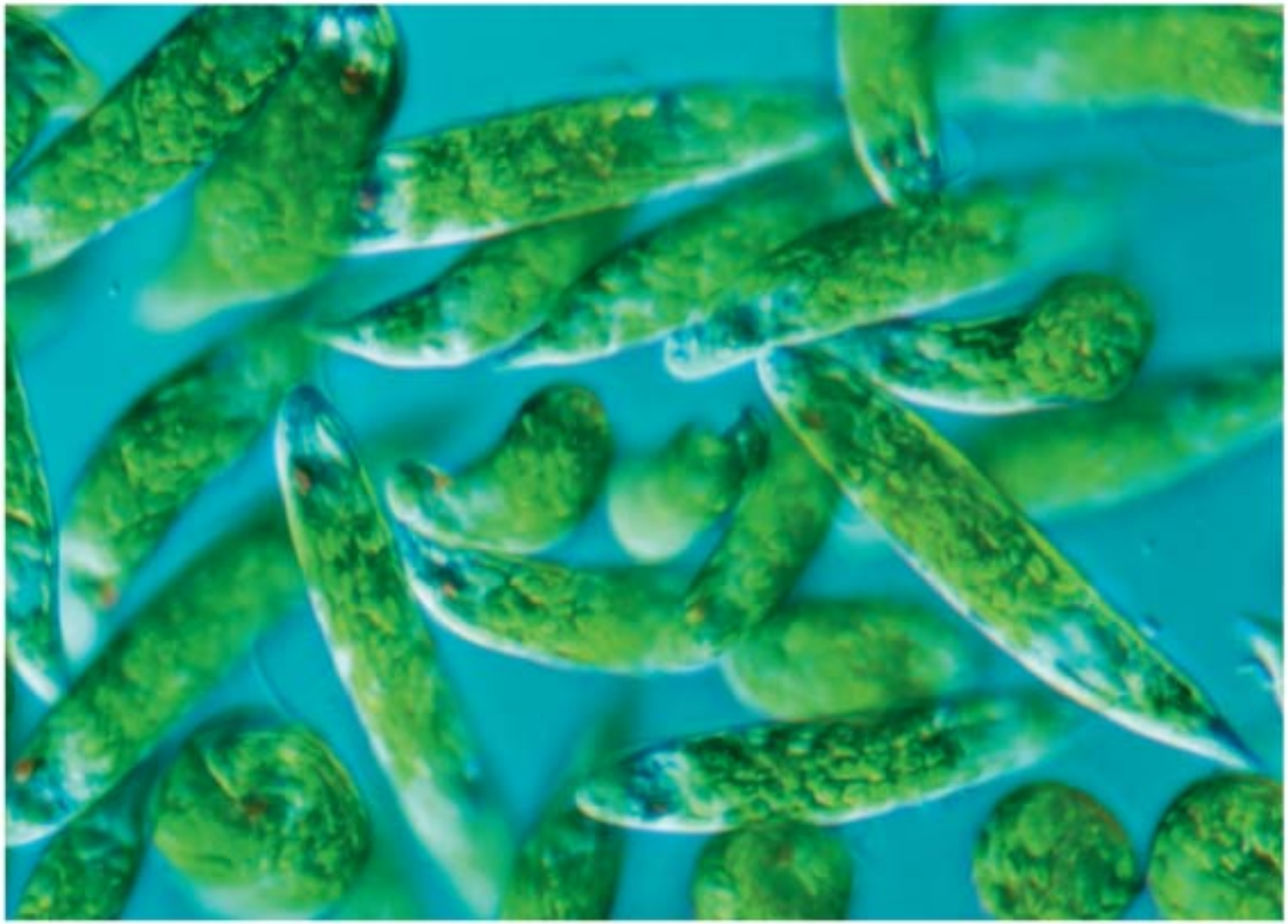
Chapter 7

After studying this chapter, you should …

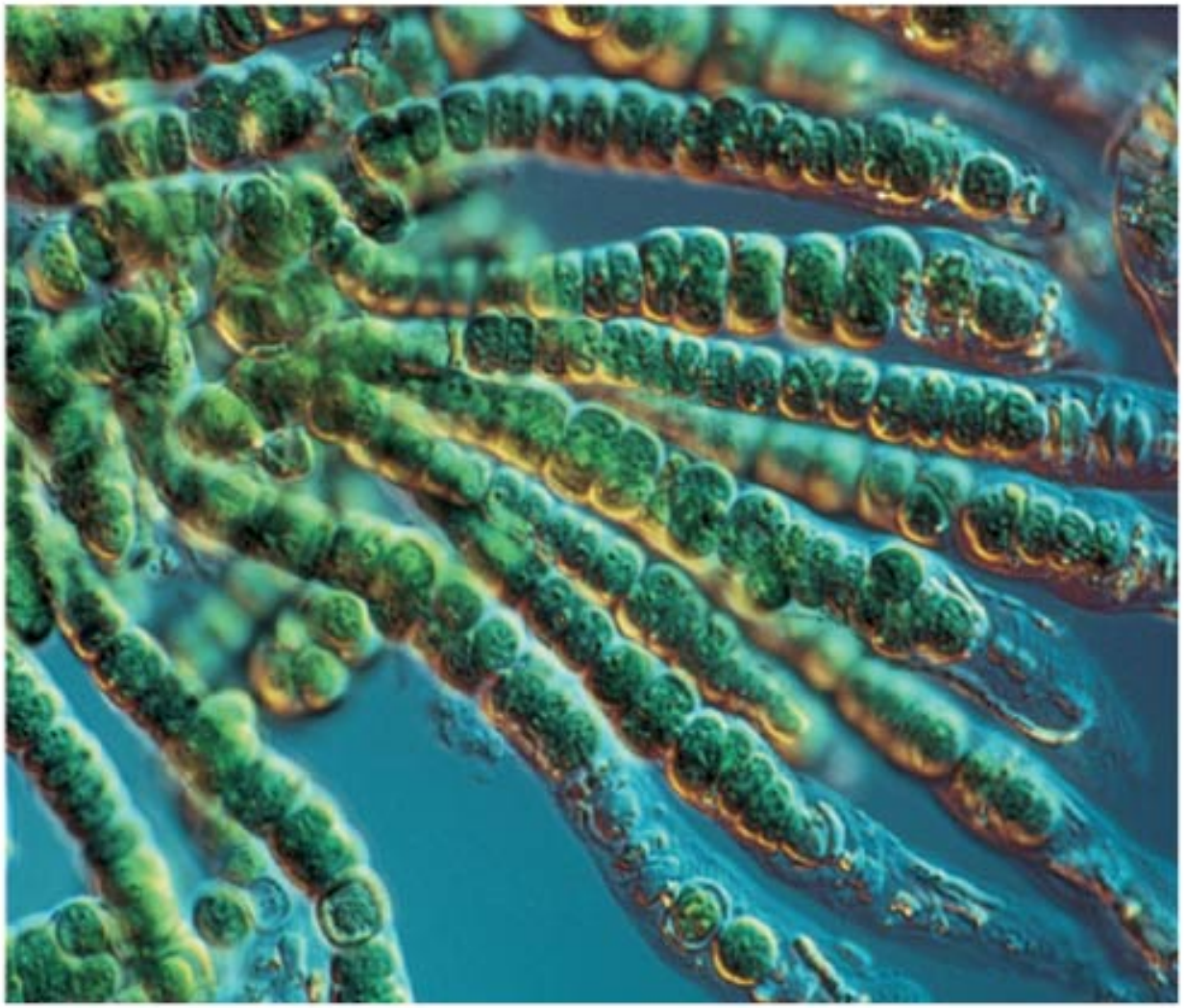
- Know how plants make sugars
- Understand the mechanisms behind photosynthetic processes
  - Trapping of solar energy
  - Storage of energy in chemical bonds
- Deepen your appreciation for plants

(a) Plants

(b) Multicellular alga

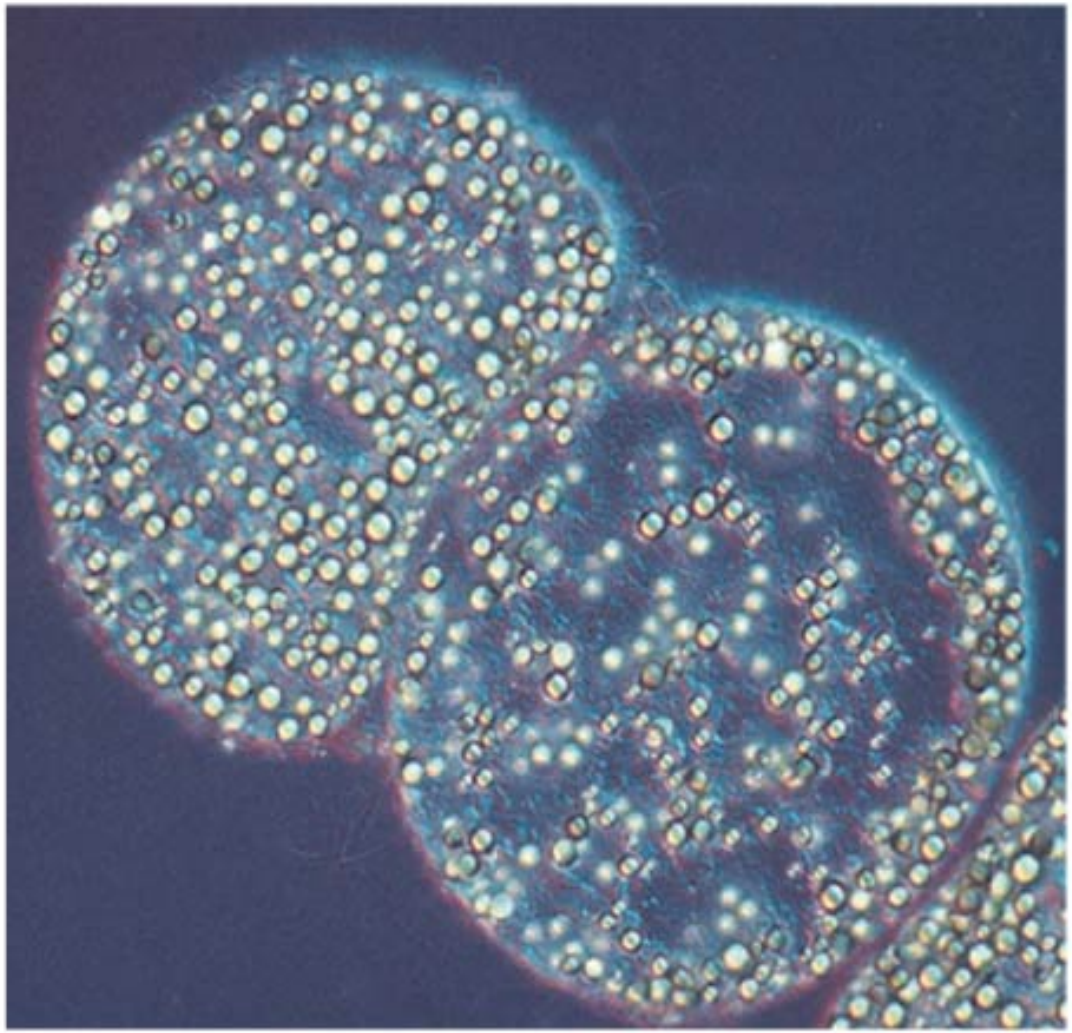


(c) Unicellular eukaryotes



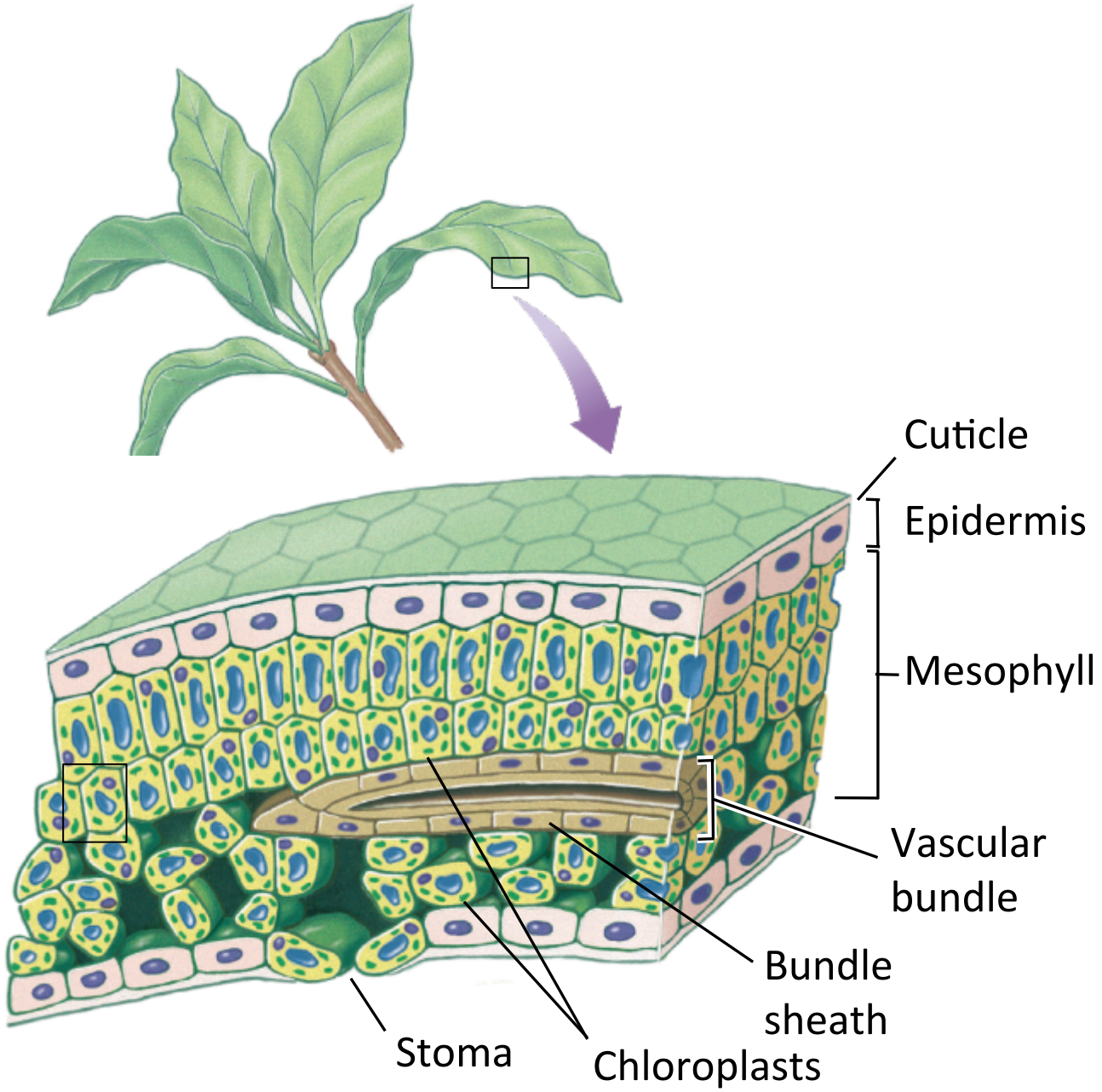
(d) Cyanobacteria

40 μm



(e) Purple sulfur bacteria

Figure 07_05



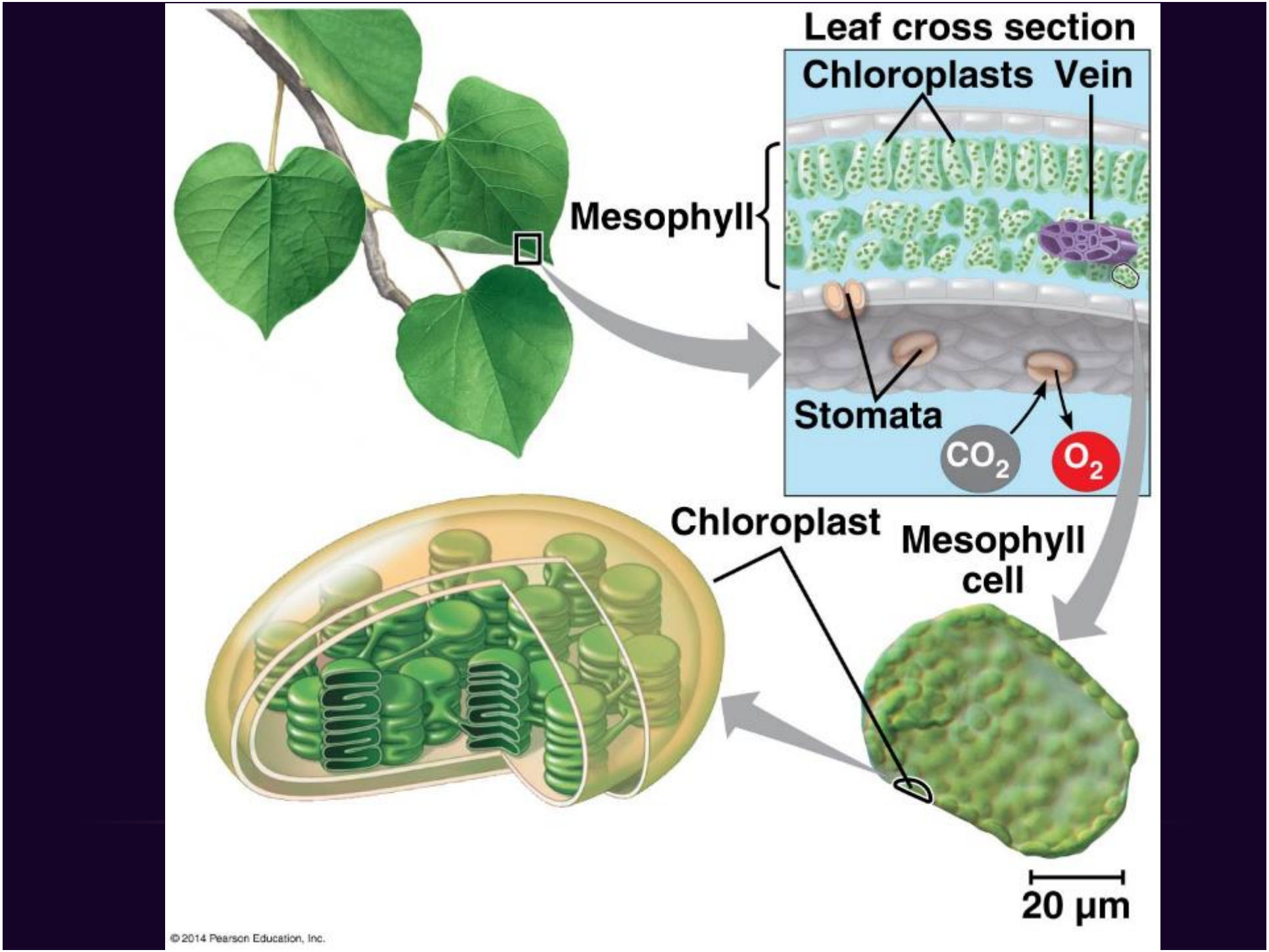


Figure 07_02

Chloroplasts look like tiny green jelly beans within each plant cell.

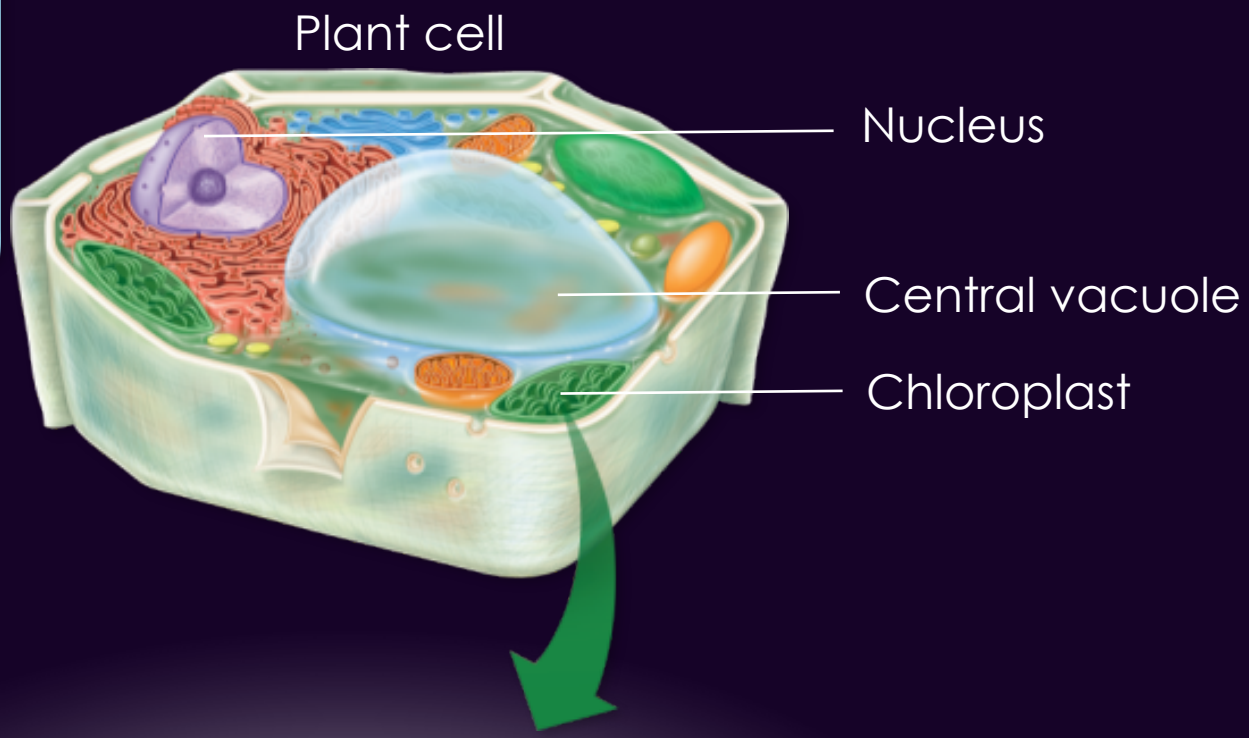


Figure 07_02

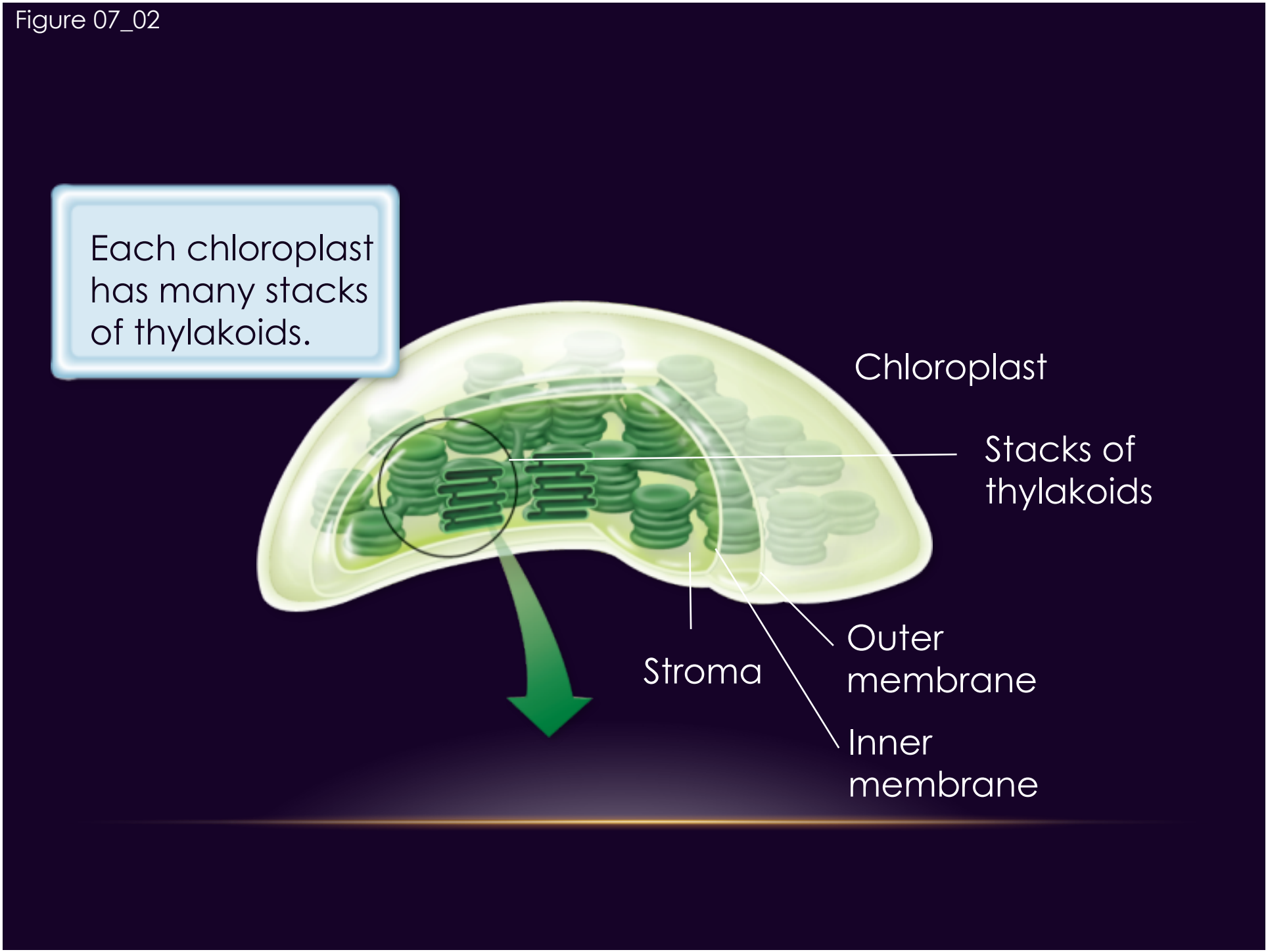
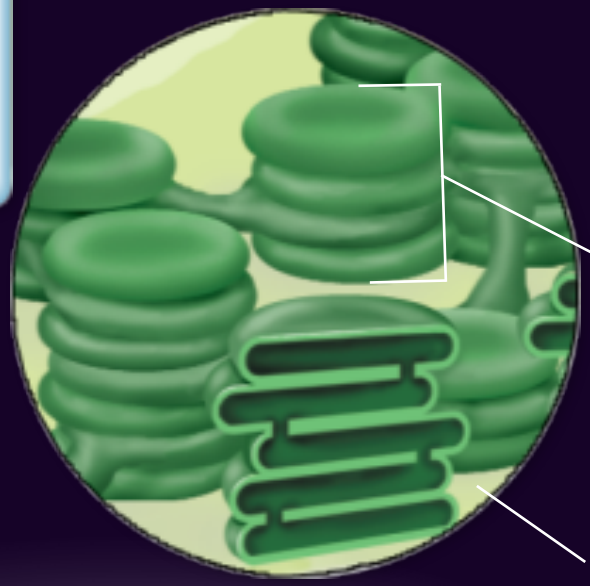

Each chloroplast has many stacks of thylakoids.
Chloroplast
Stacks of thylakoids
Stroma
Outer membrane
Inner membrane

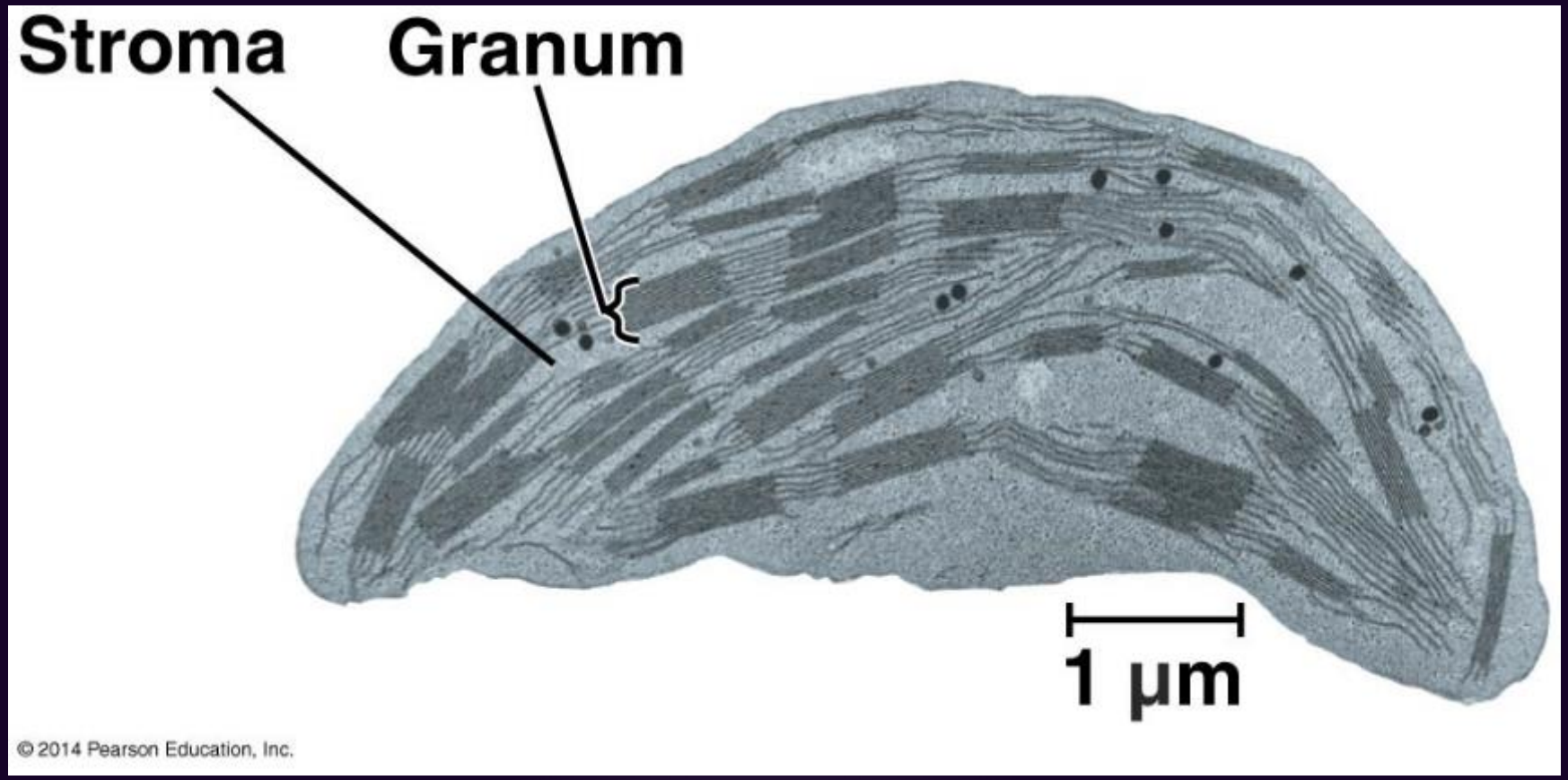
Figure 07_02

Pigment molecules embedded in thylakoid membranes make them look green.

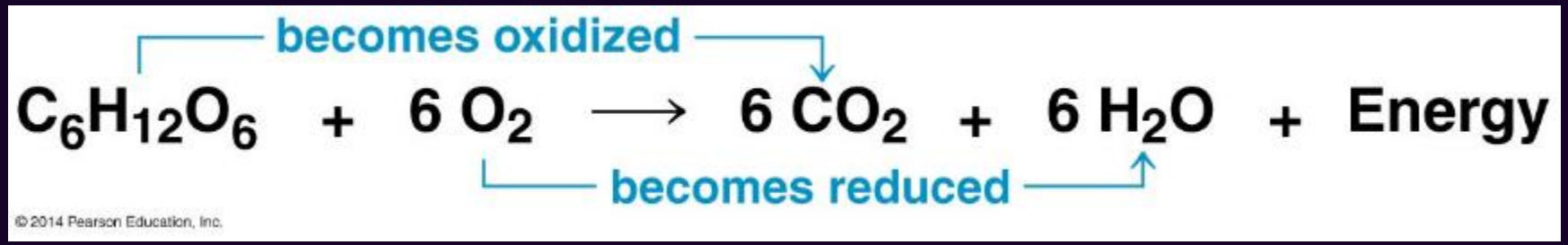


Thylakoid stack (granum)

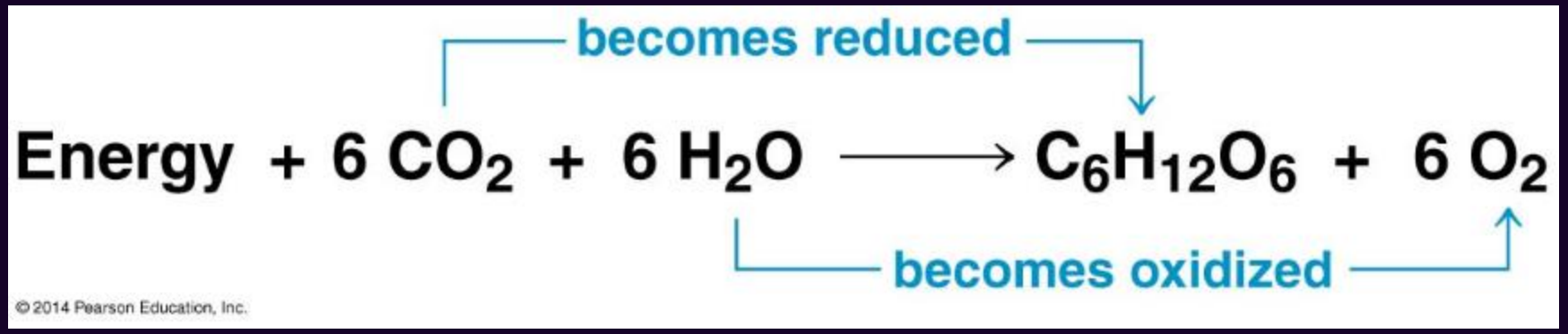
Stroma

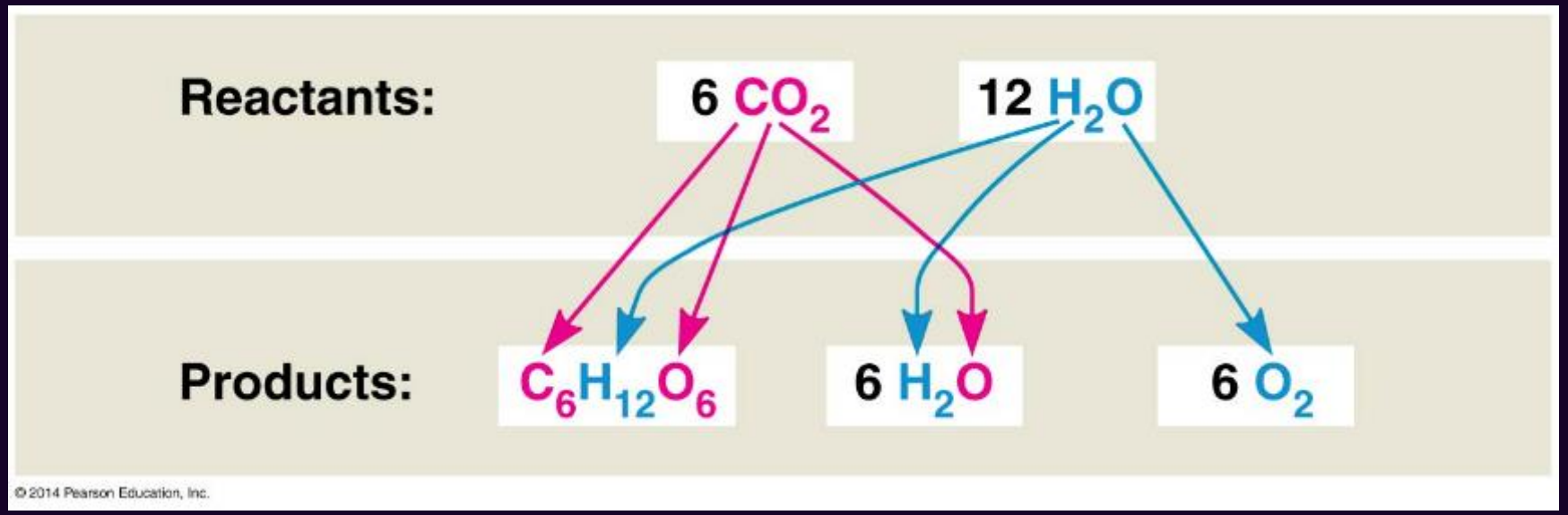


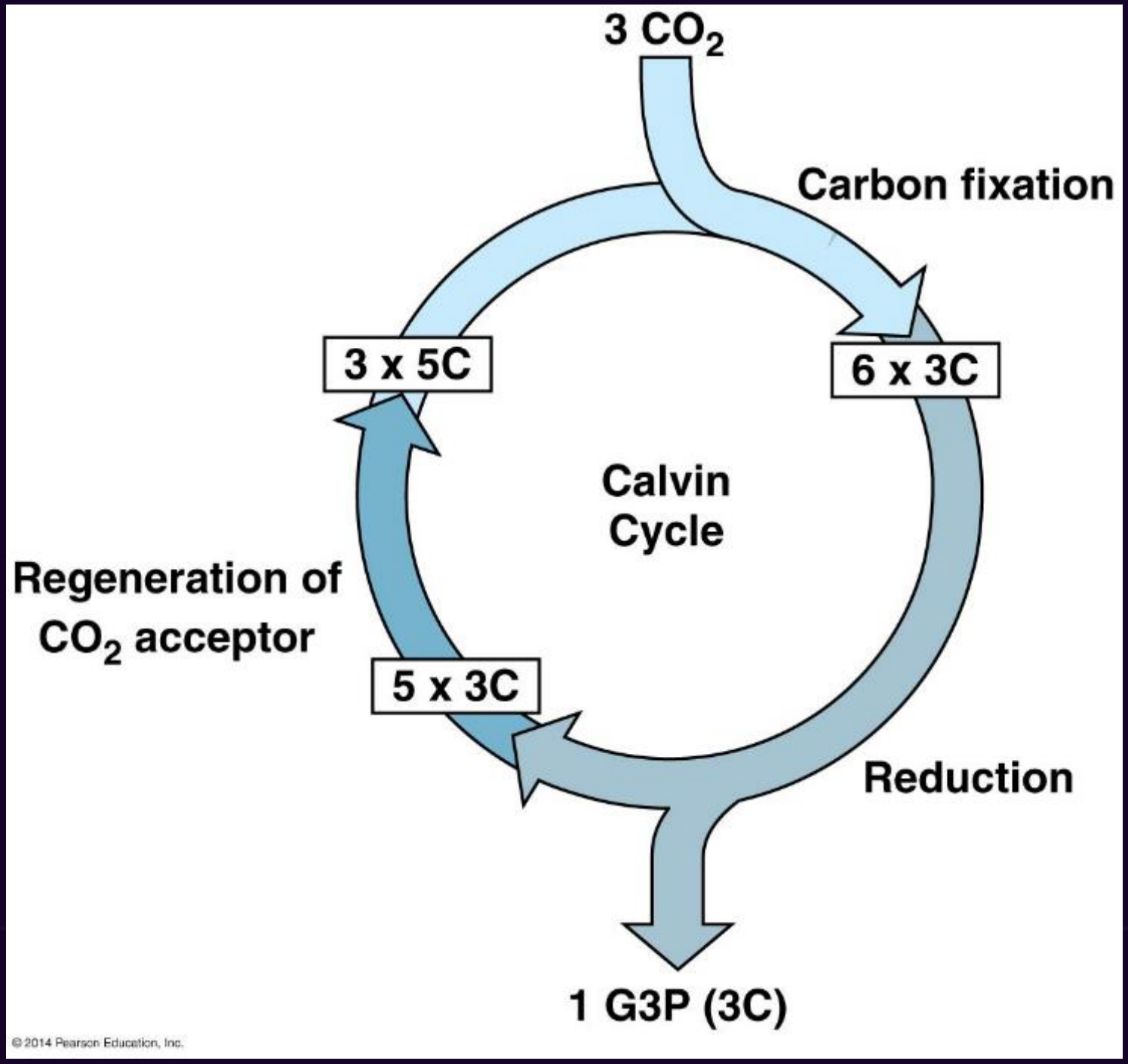
Cellular Respiration in short

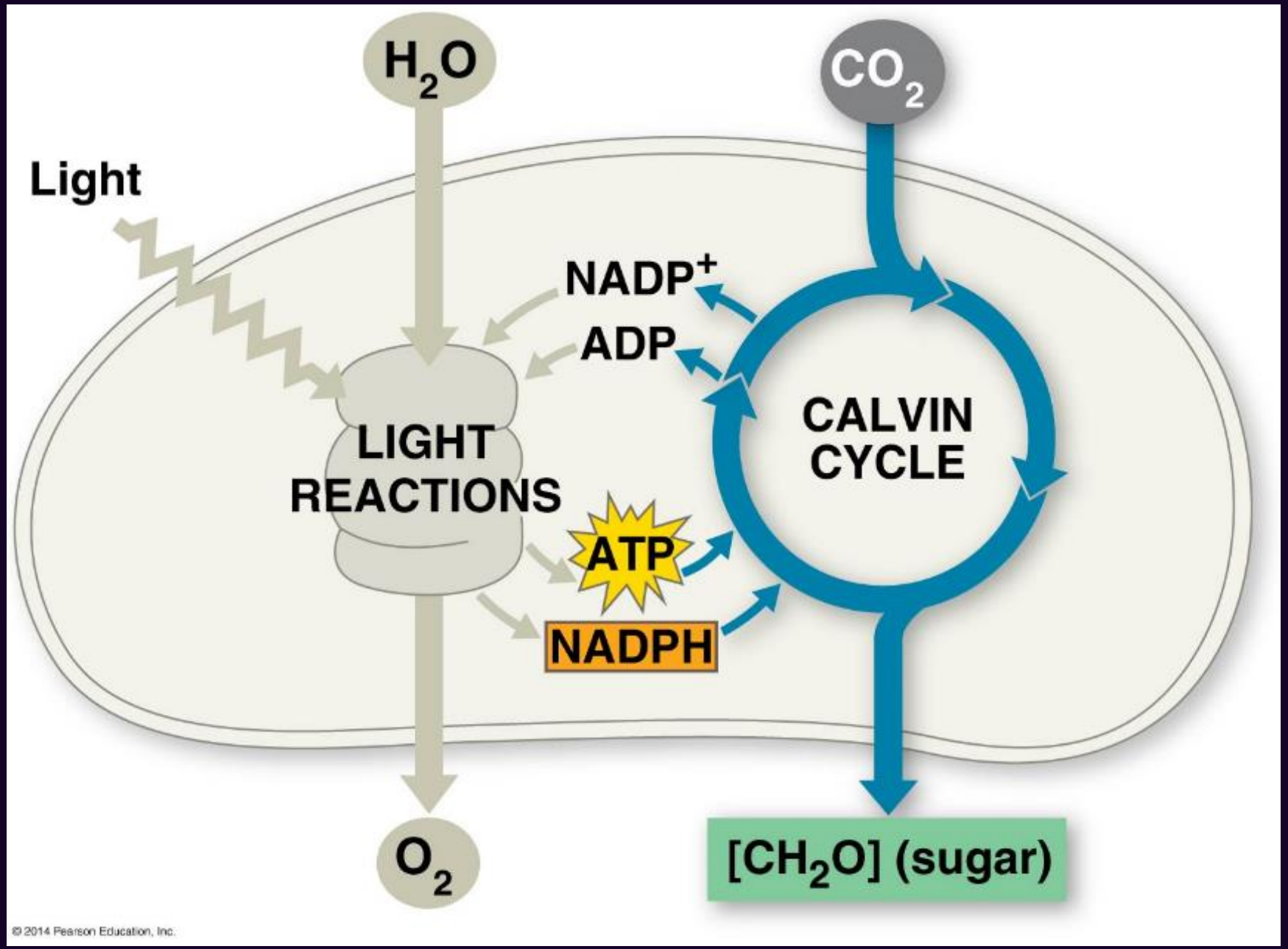


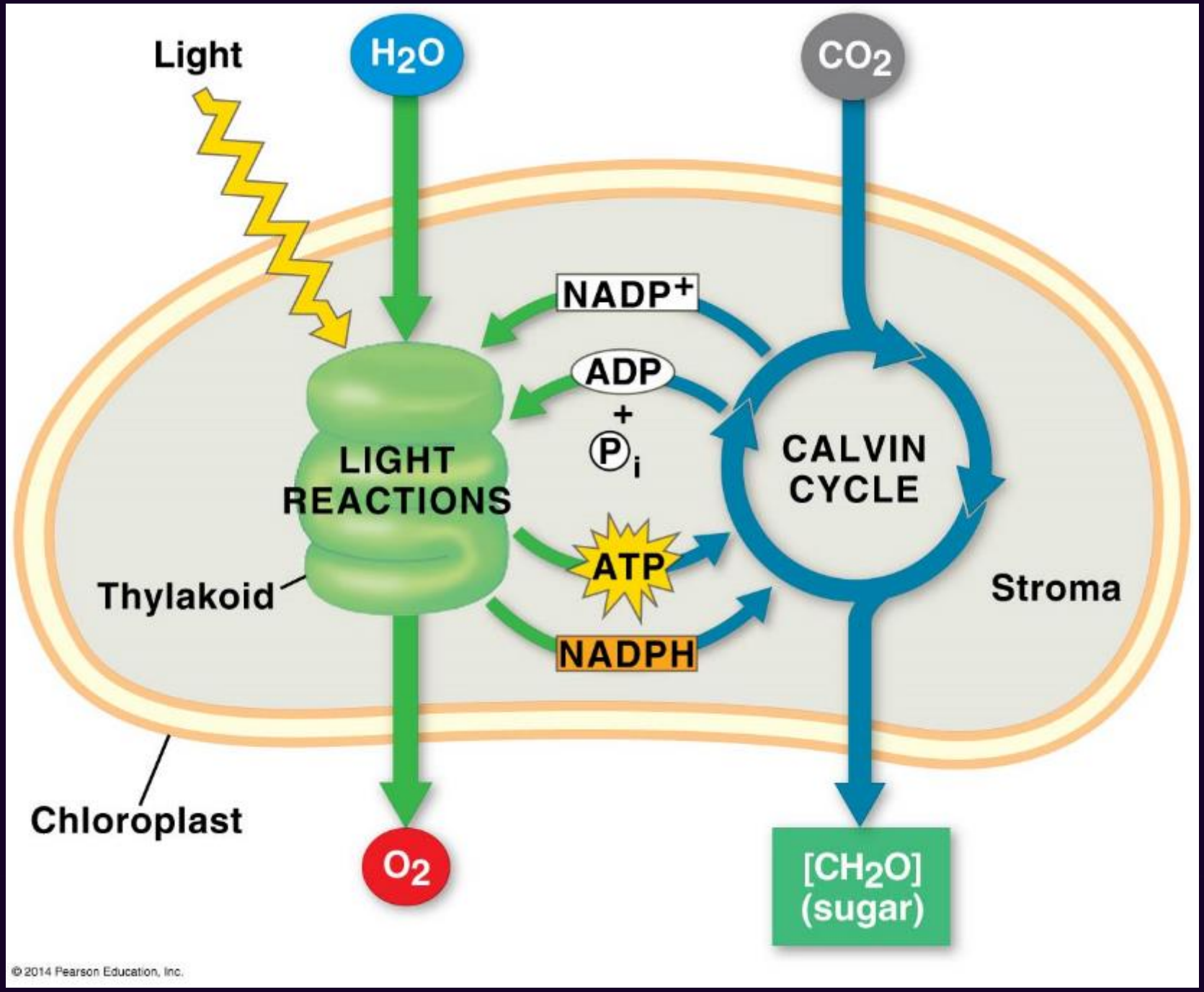
Photosynthesis in short

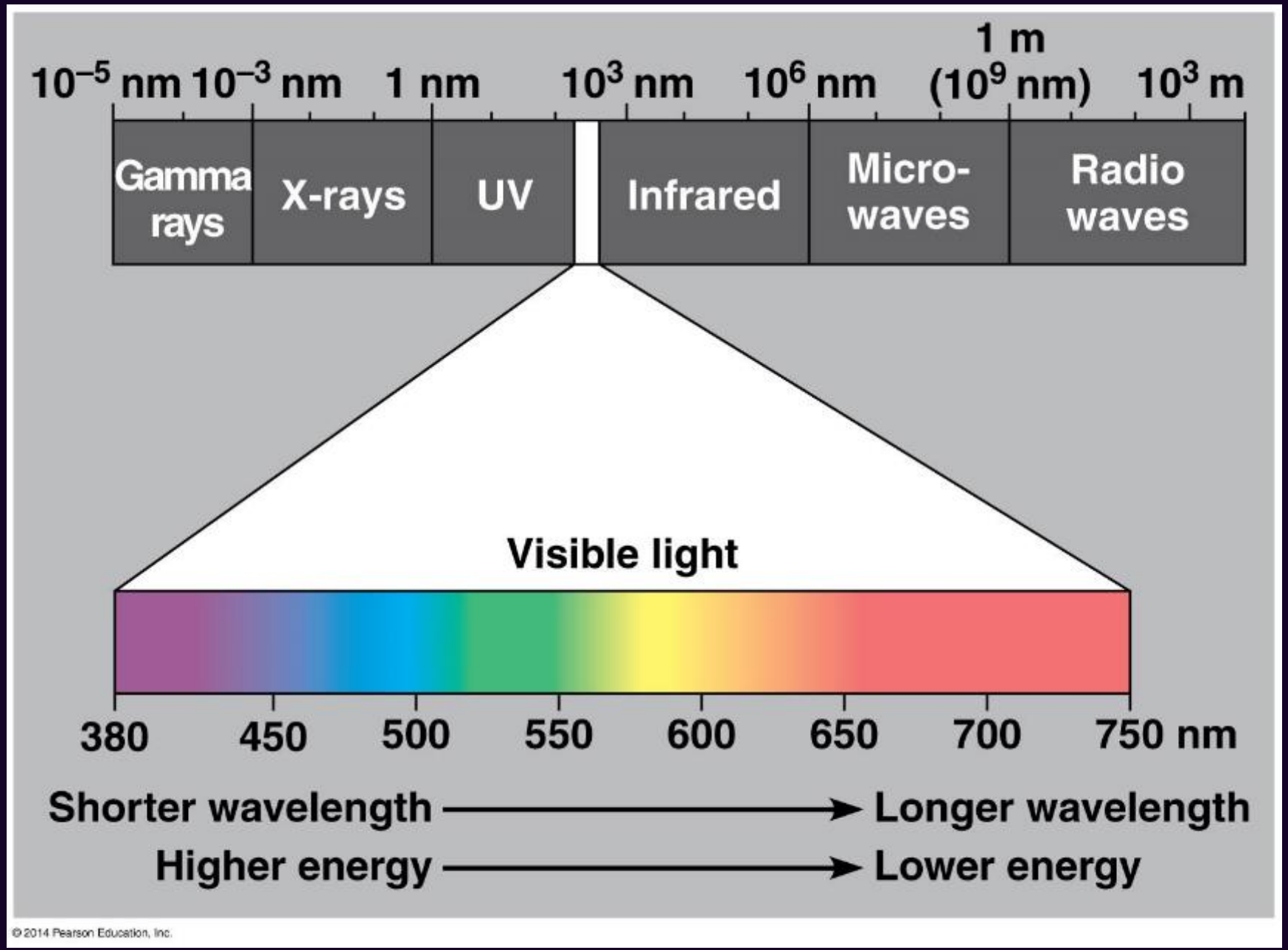


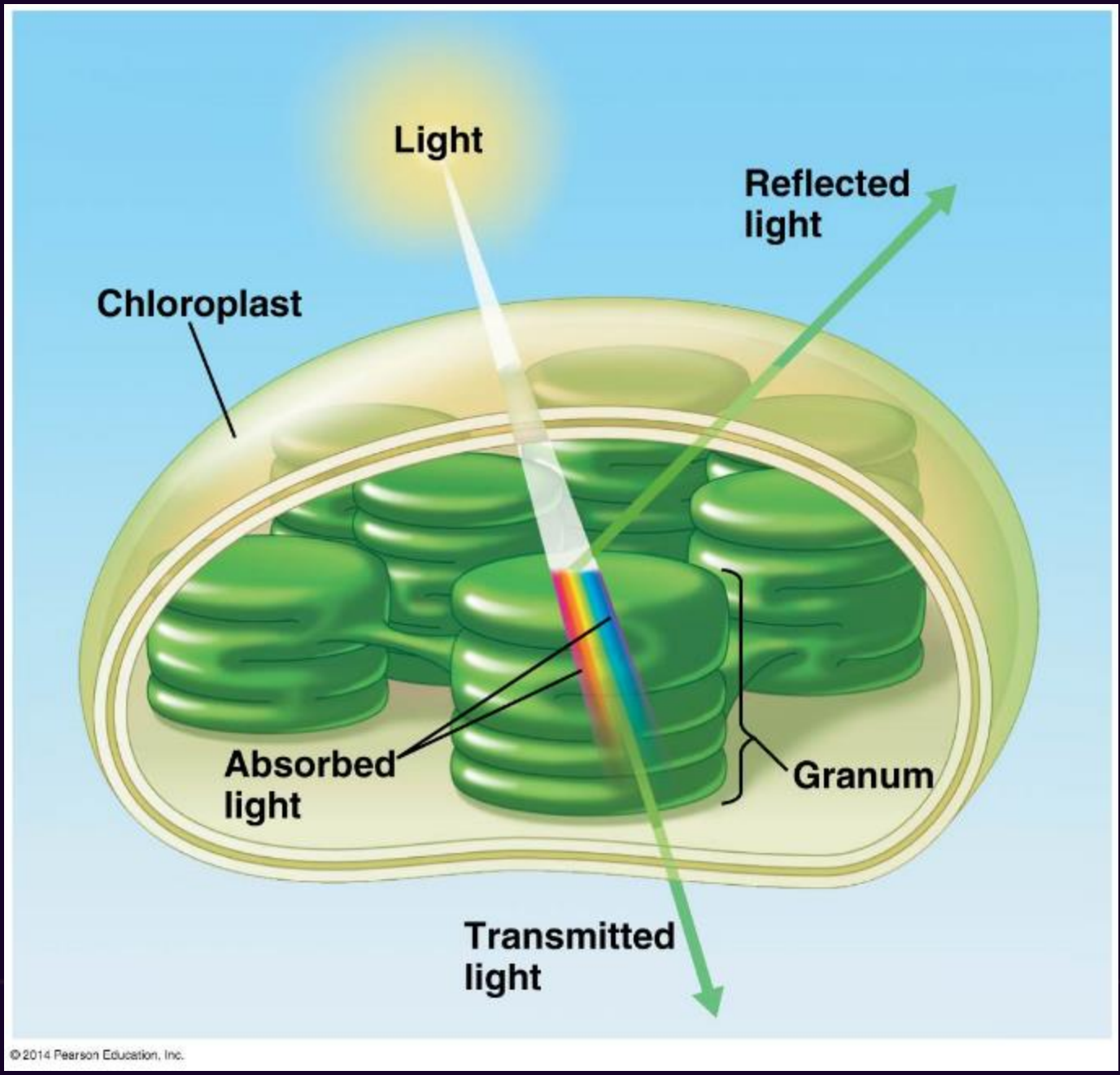


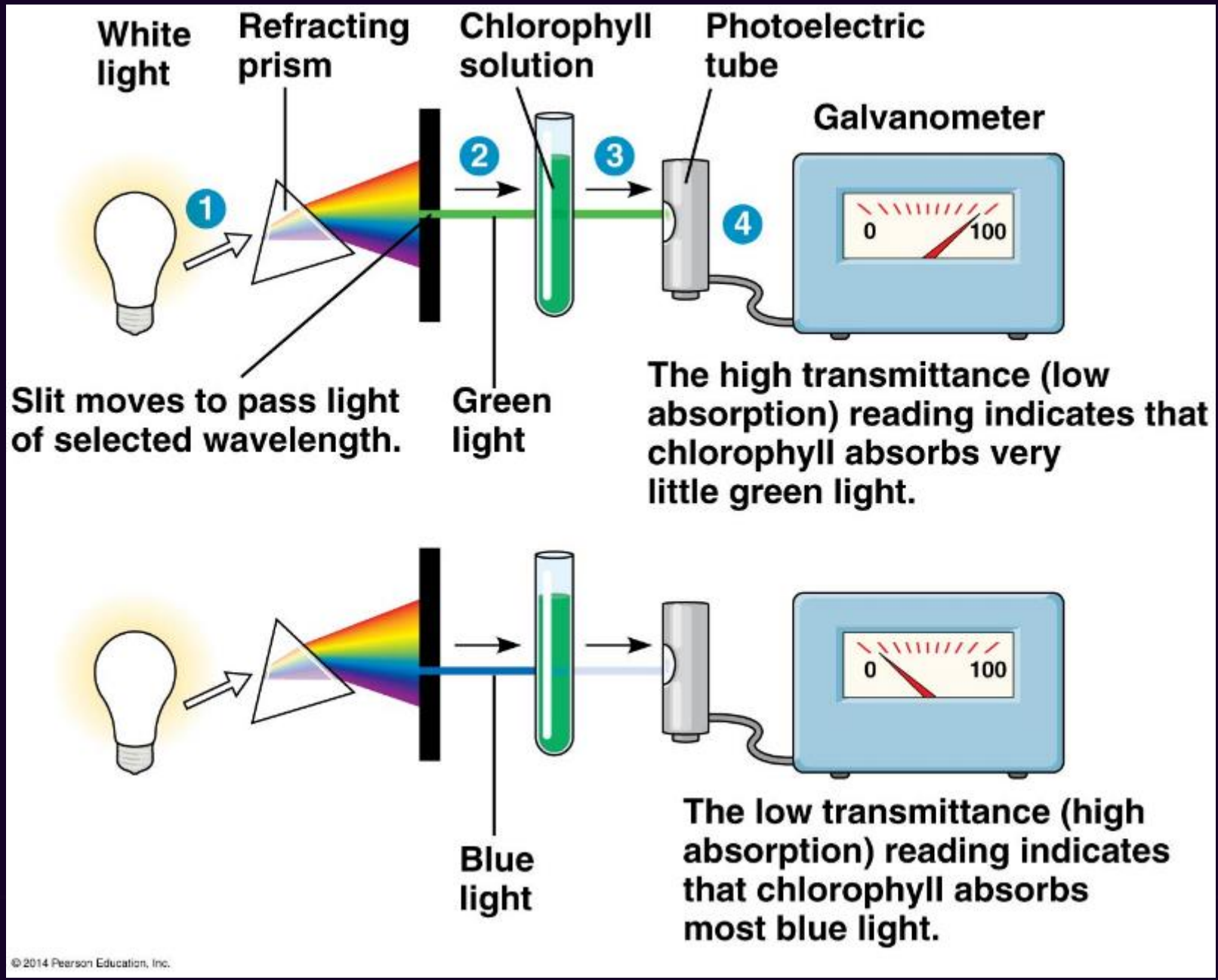











White light
Refracting prism
Chlorophyll solution
Photoelectric tube
Galvanometer
1
2
3
4
0
100
Slit moves to pass light of selected wavelength.
Green light
The high transmittance (low absorption) reading indicates that chlorophyll absorbs very little green light.
Blue light
The low transmittance (high absorption) reading indicates that chlorophyll absorbs most blue light.
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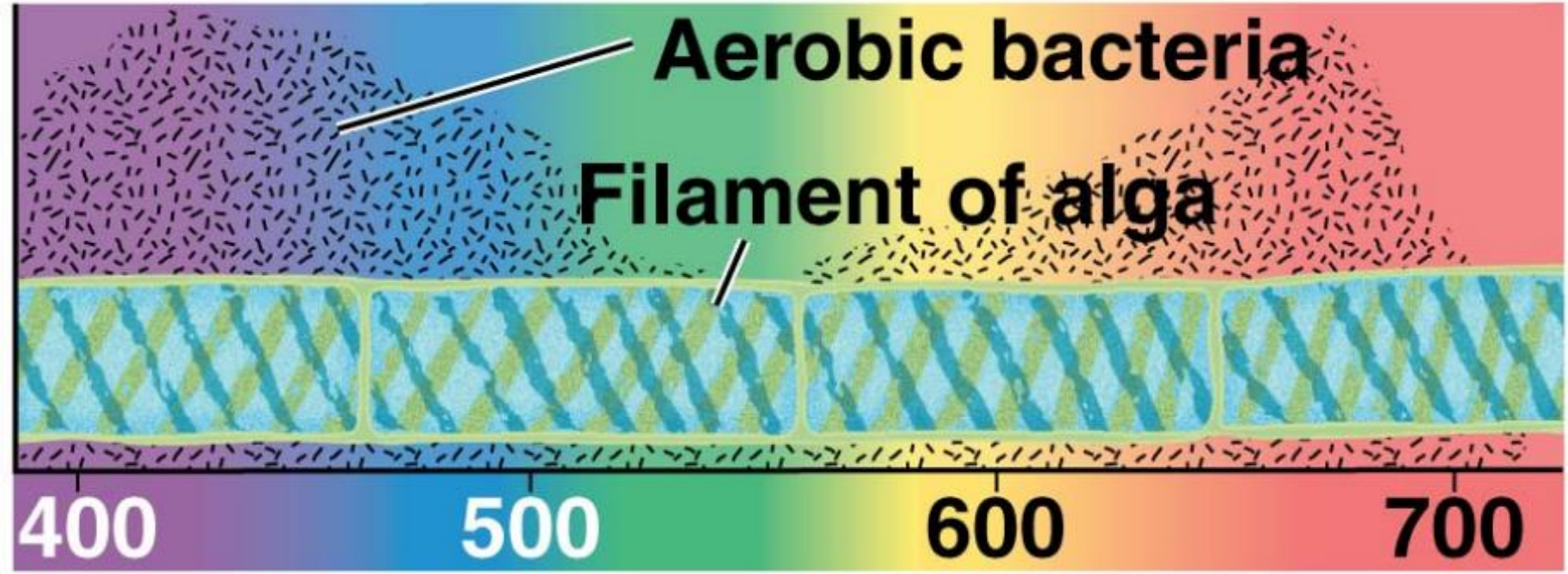
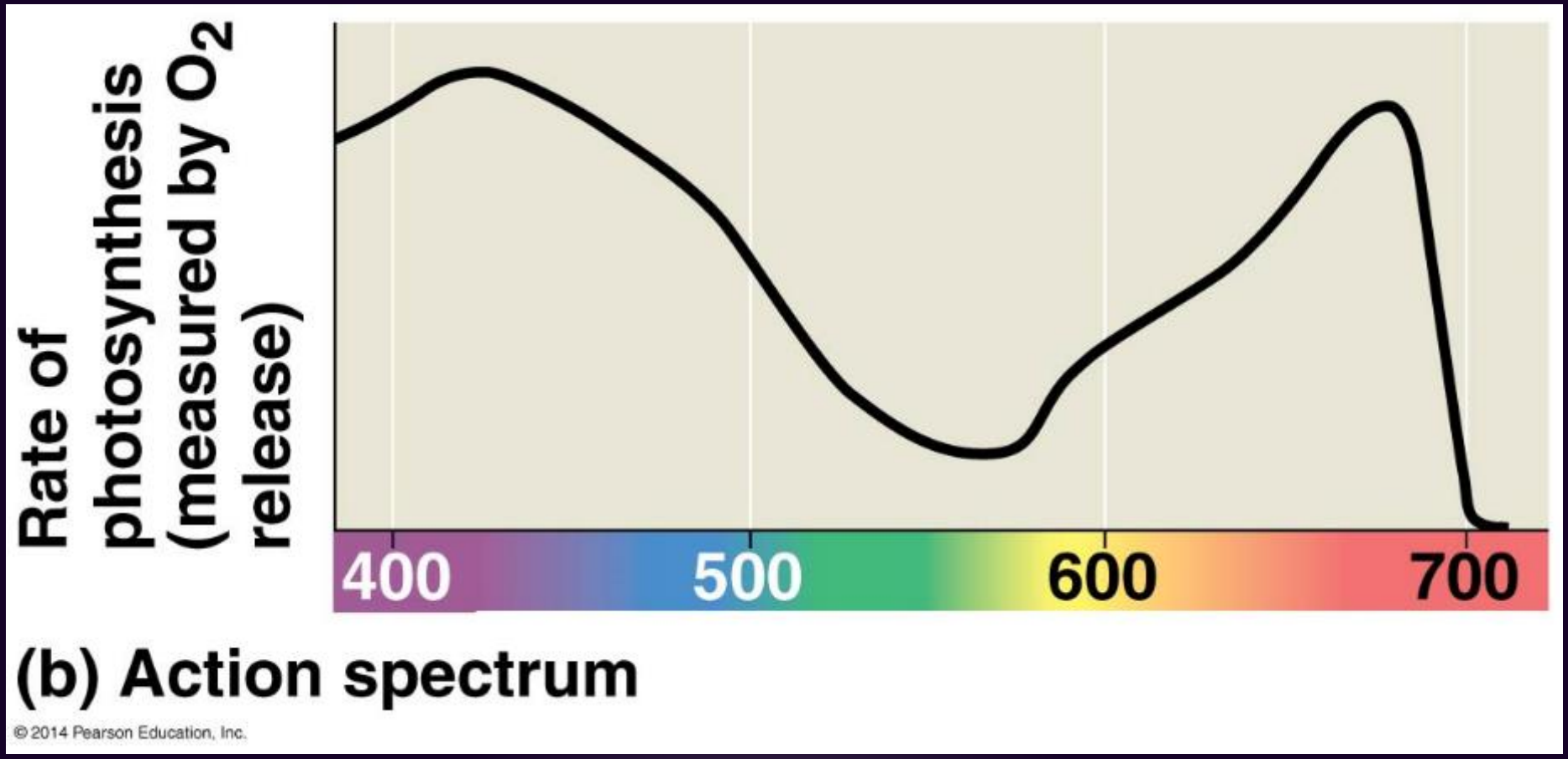
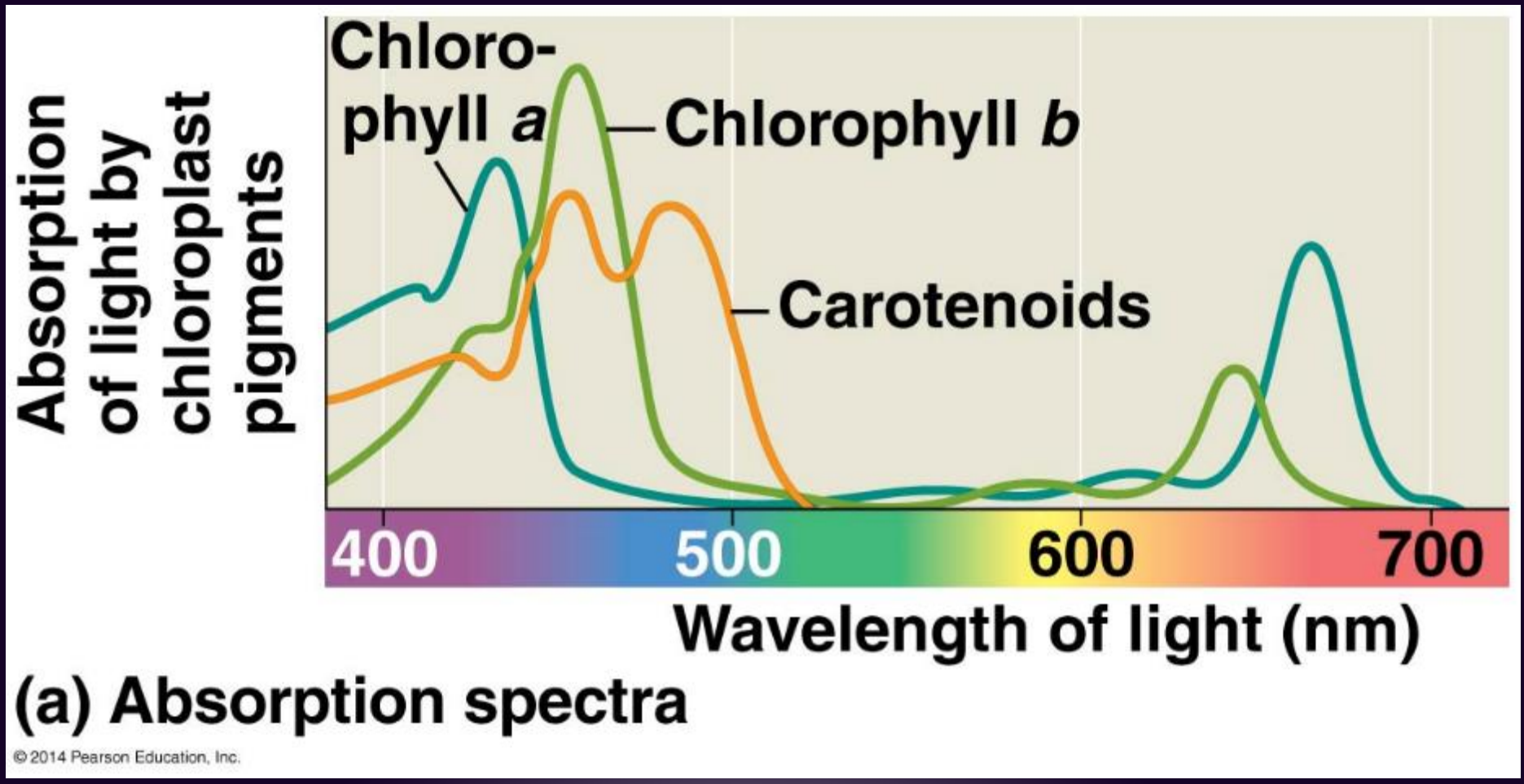


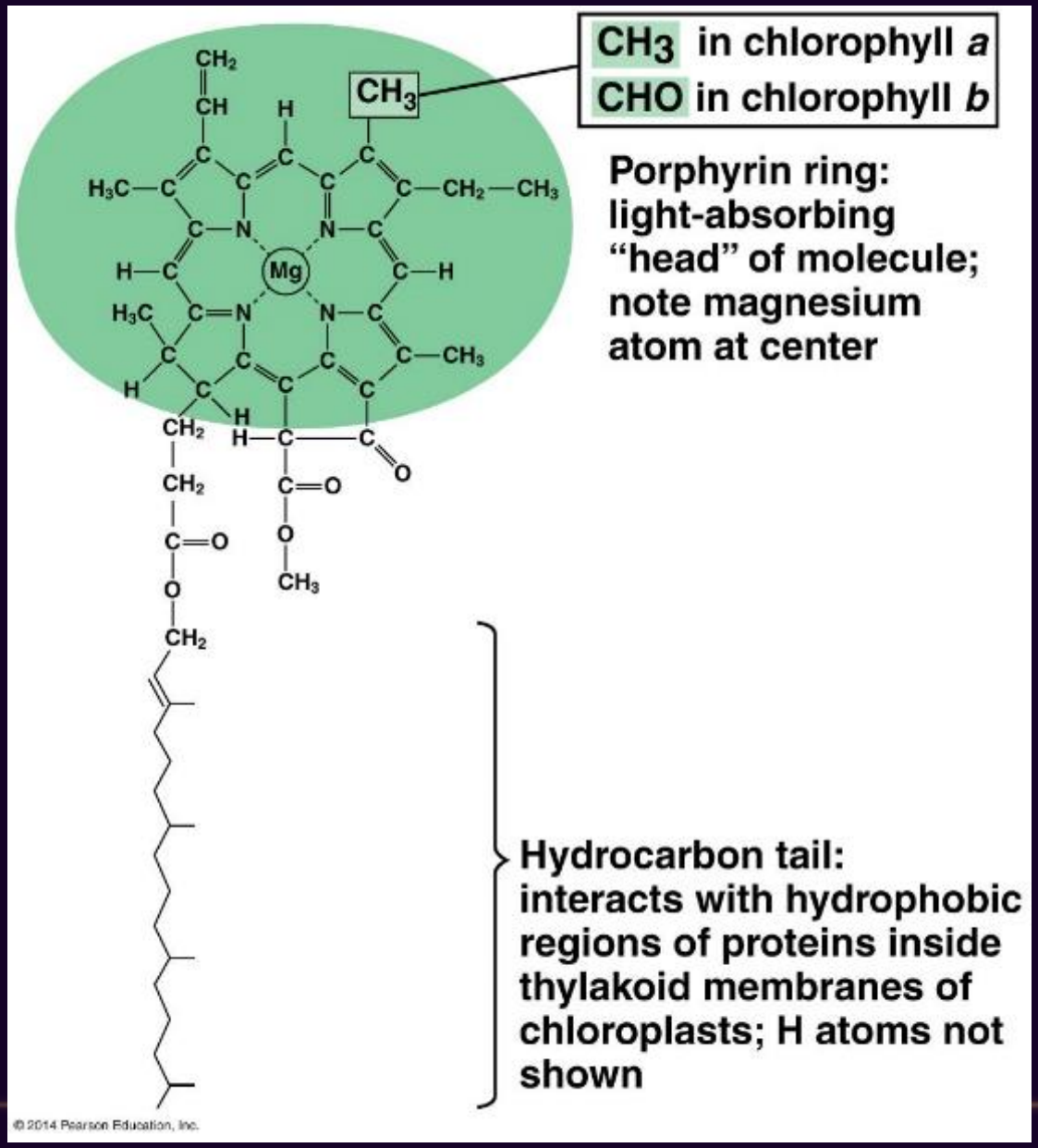
(c) Engelmann's experiment

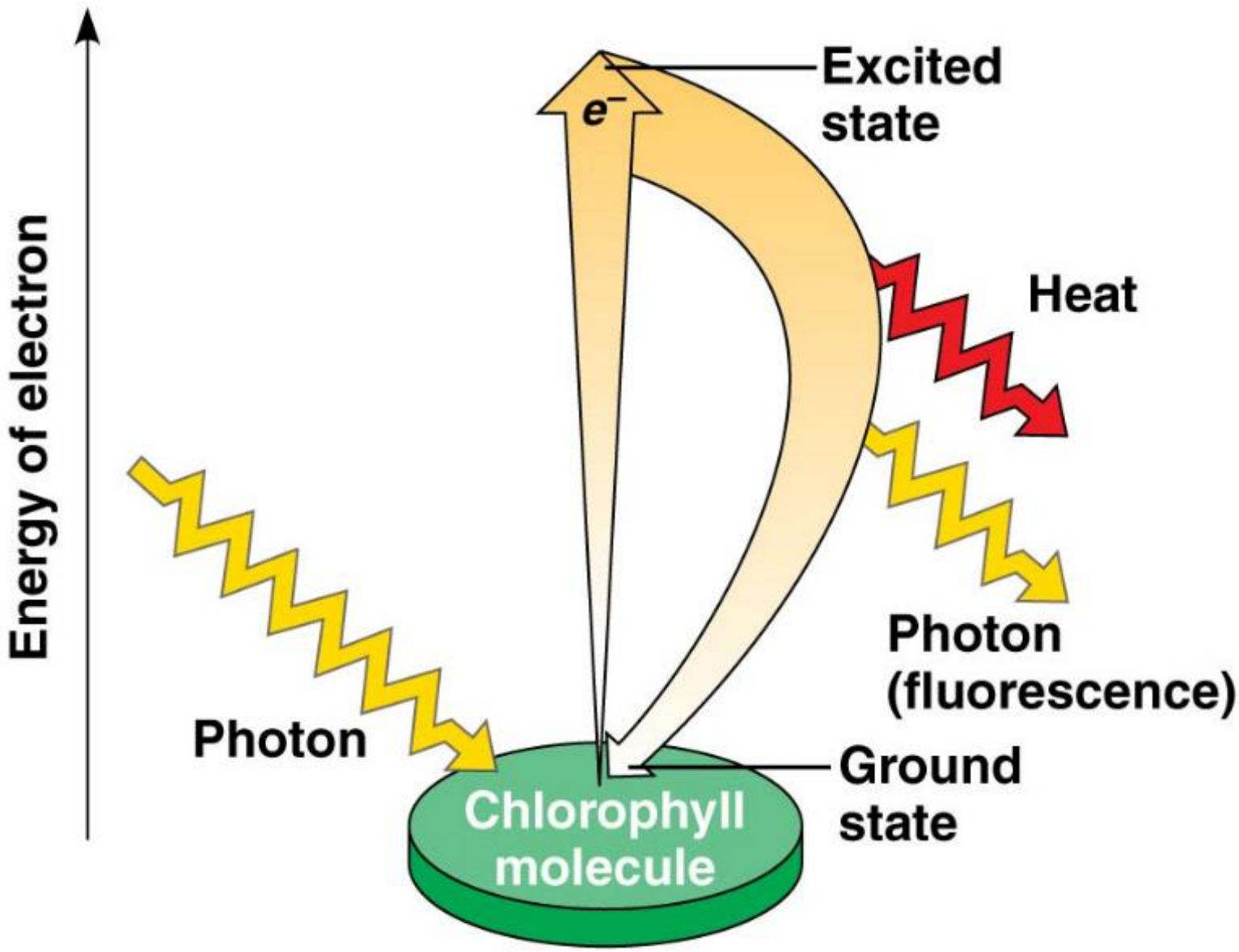


(b) Action spectrum

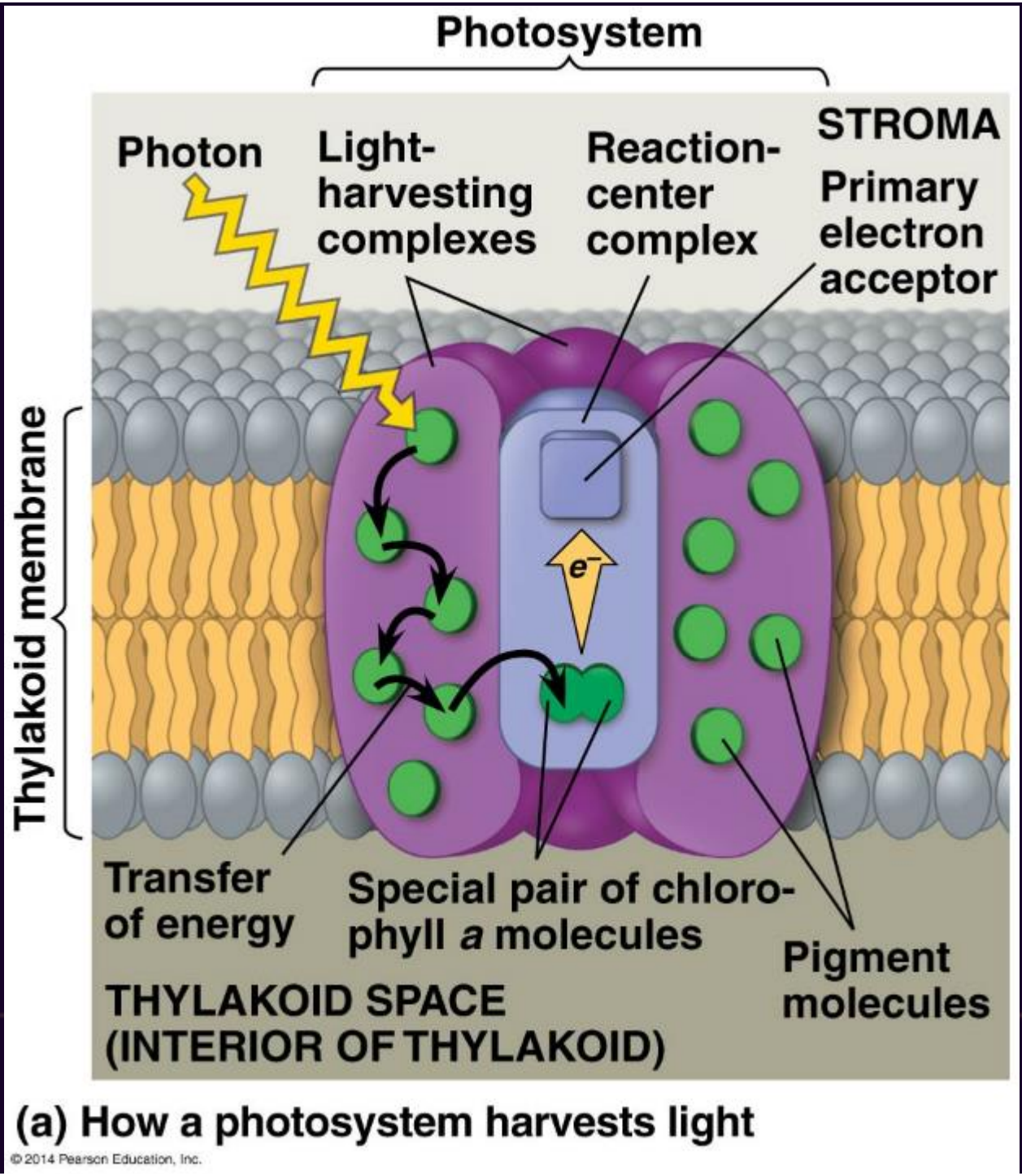


(a) Absorption spectra


CH3 in chlorophyll a
CHO in chlorophyll b
Porphyrin ring: light-absorbing "head" of molecule; note magnesium atom at center
Hydrocarbon tail: interacts with hydrophobic regions of proteins inside thylakoid membranes of chloroplasts; H atoms not shown
© 2014 Pearson Education, Inc.

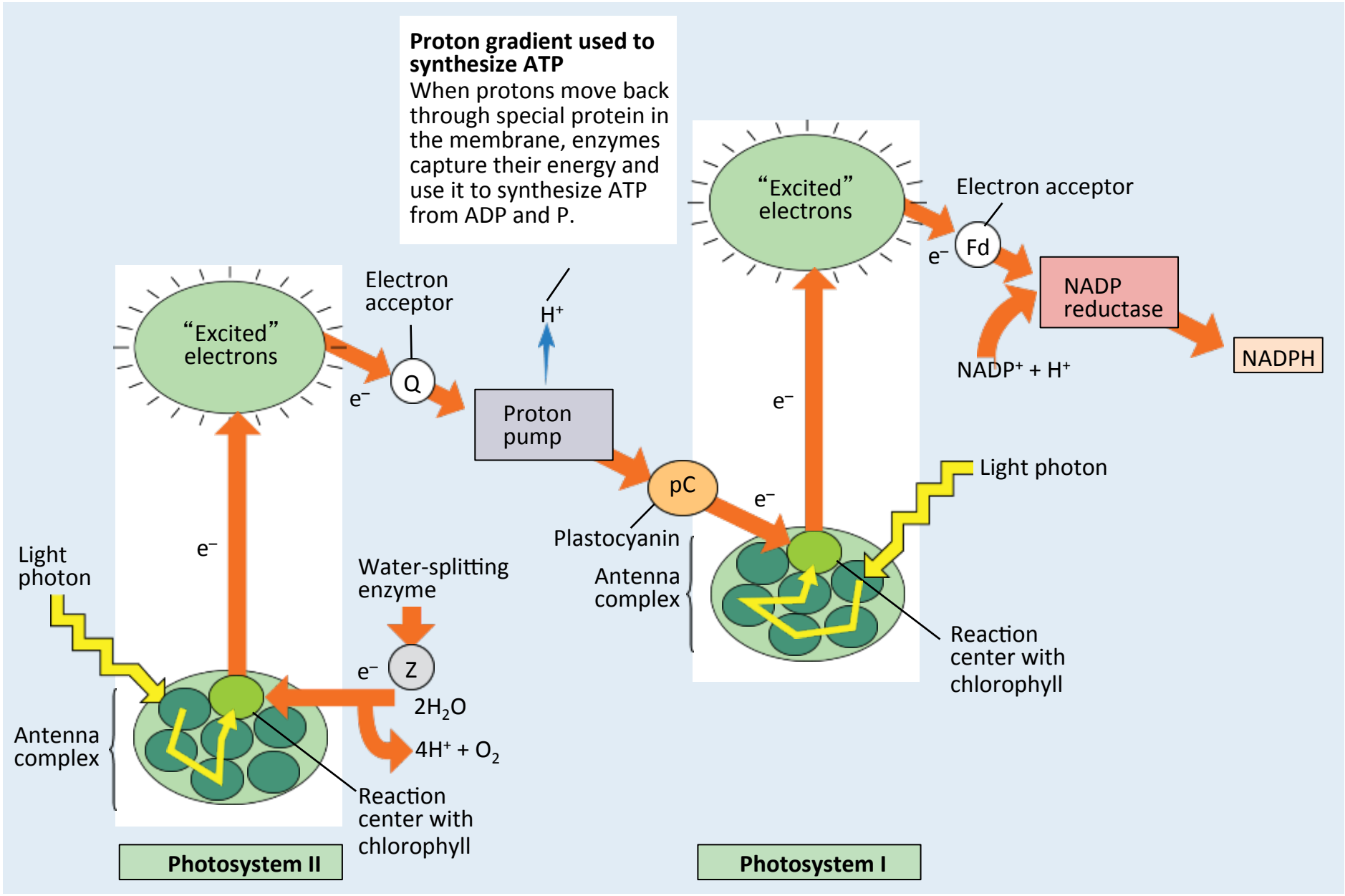


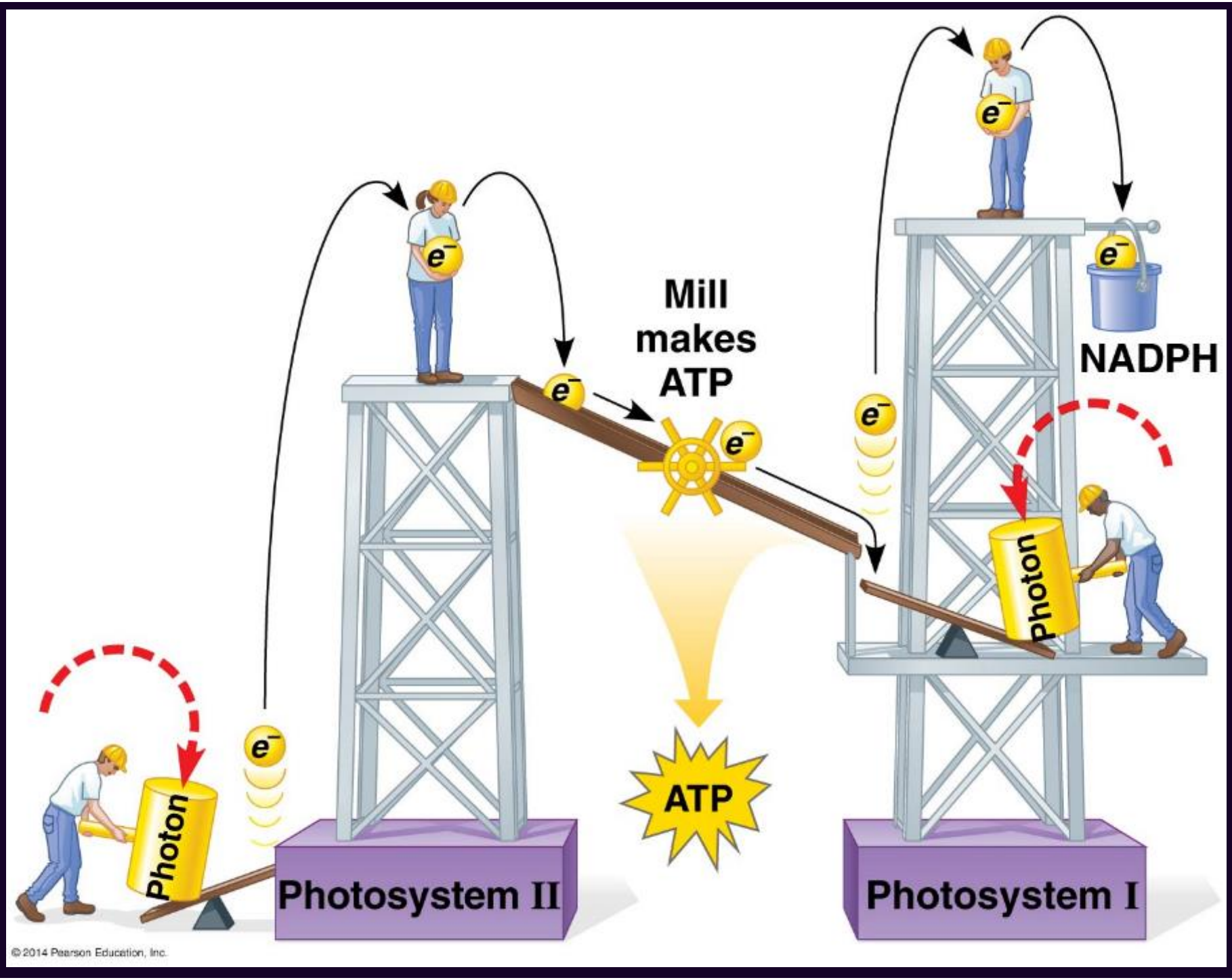
(a) Excitation of isolated chlorophyll molecule



(a) How a photosystem harvests light

Figure 07_07




e⁻
e⁻
Mill makes ATP
e⁻
e⁻
e⁻
NADPH
Photon
Photon
e⁻
ATP
Photosystem II
Photosystem I
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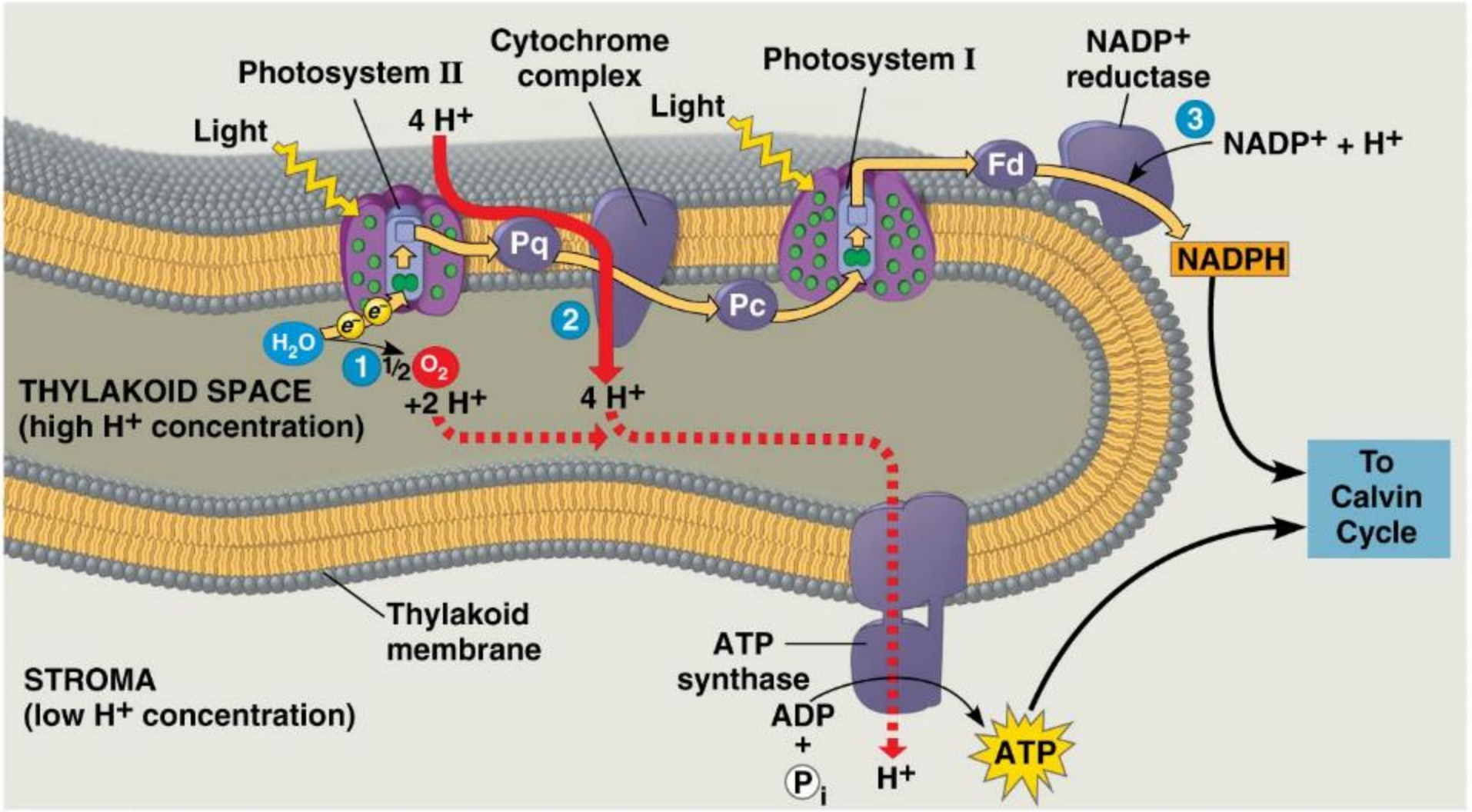
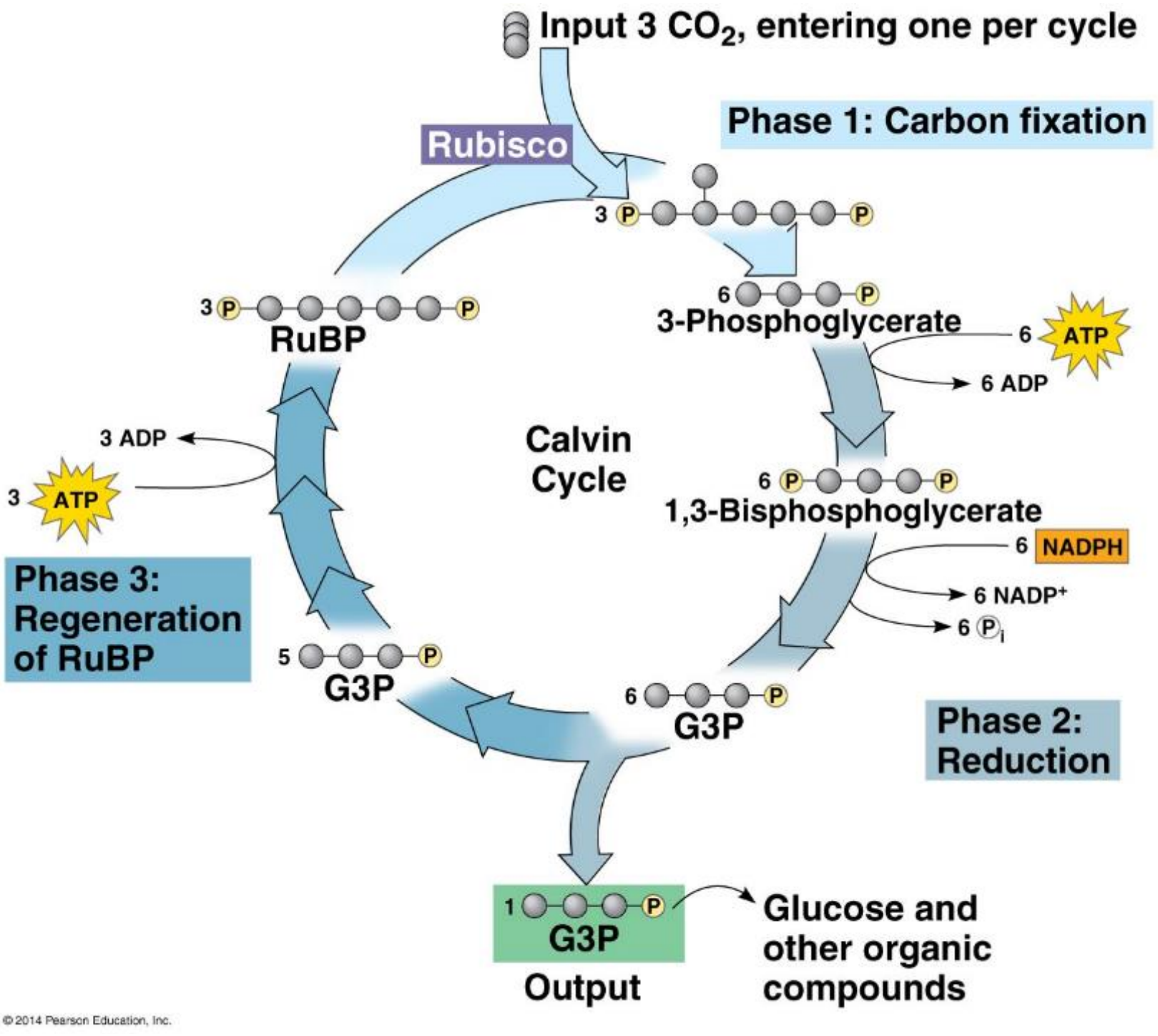
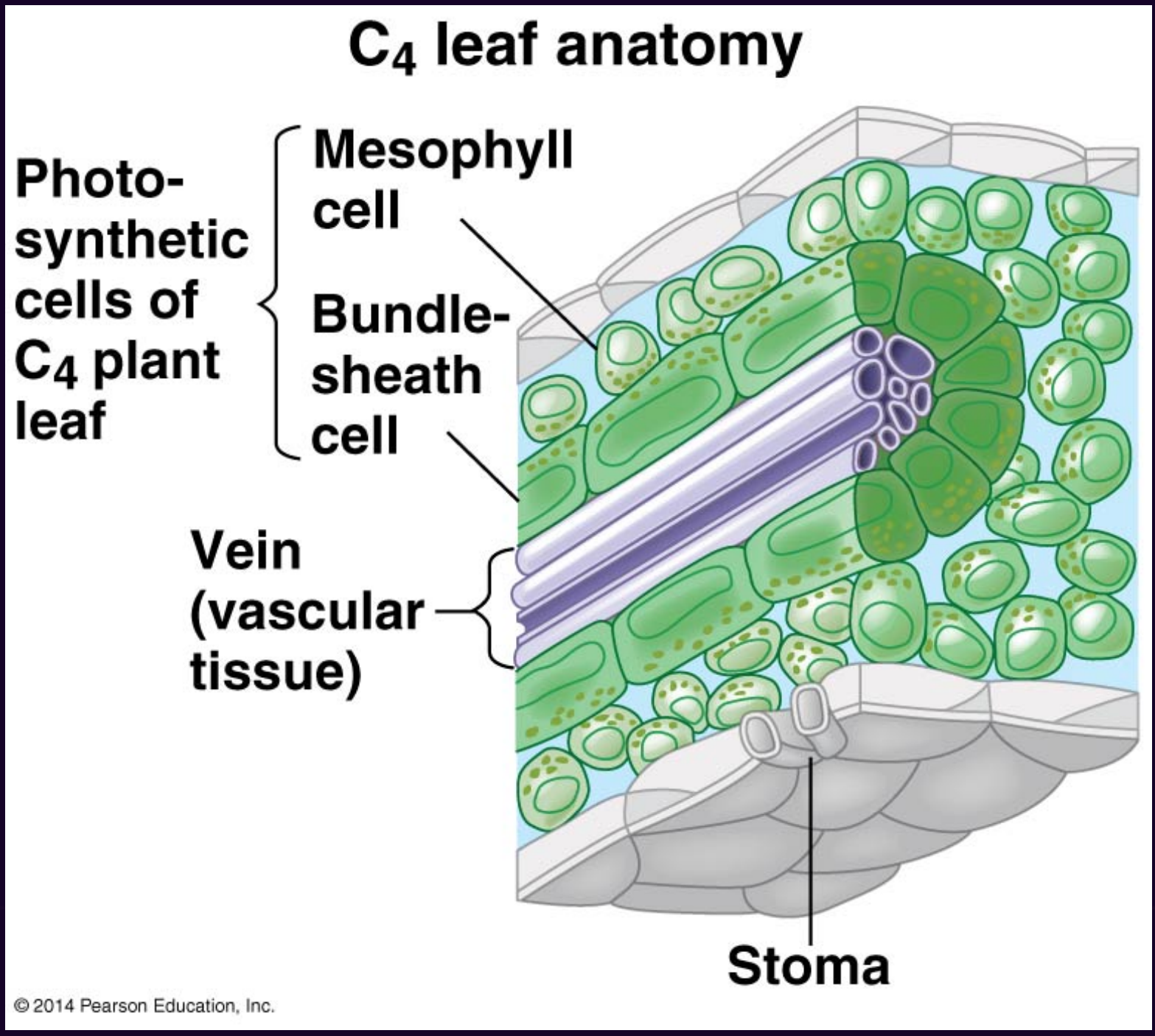


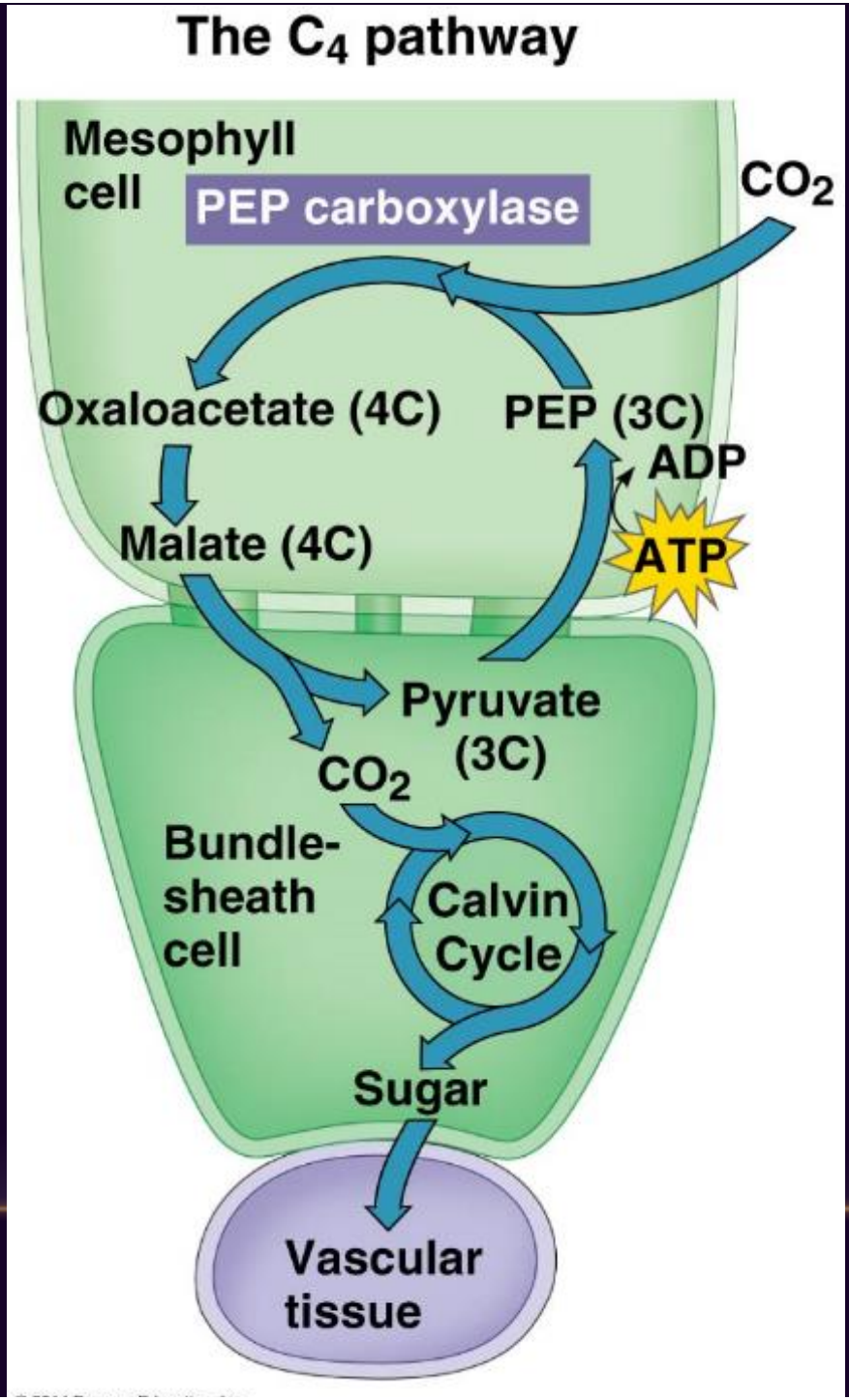


Photorespiration decreases the photosynthetic output

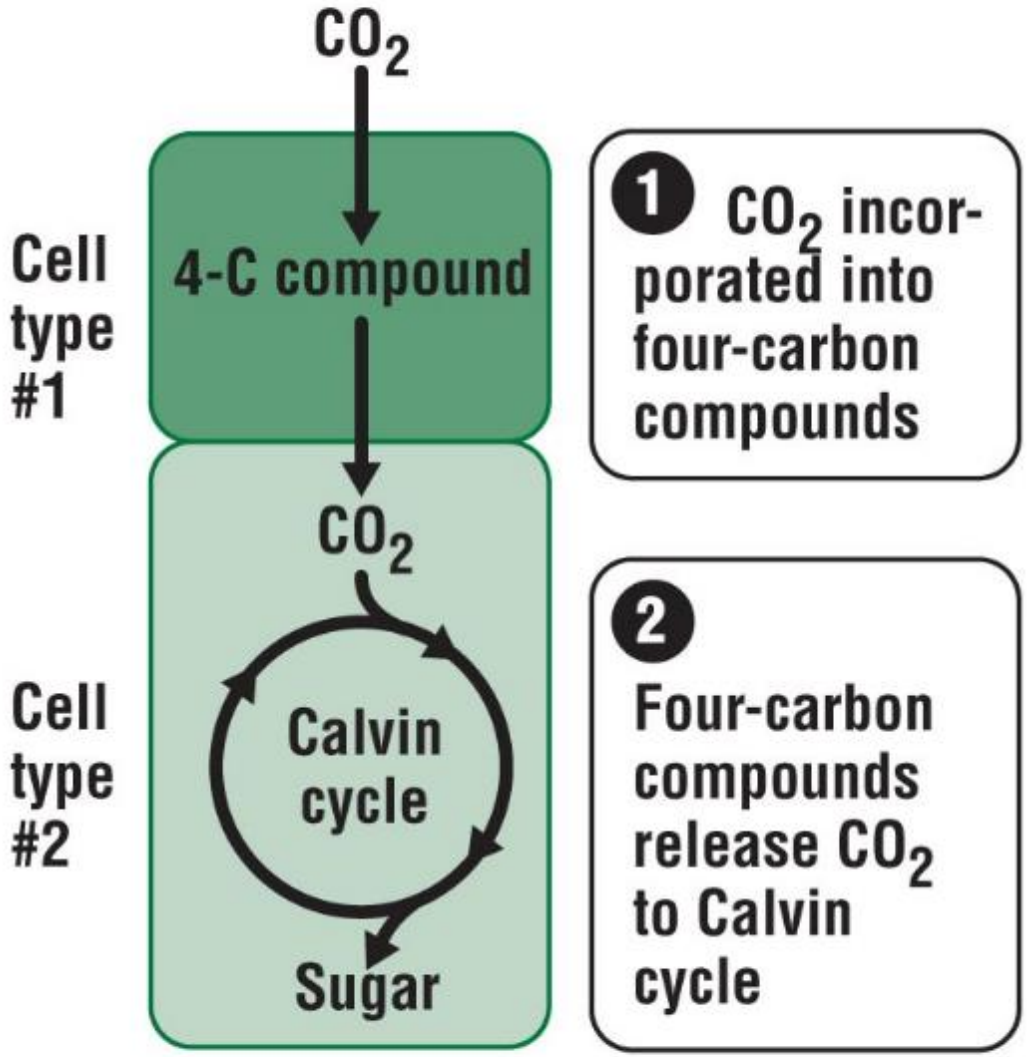
- Stomata close (partly) during hot days; level of CO_2 drops
- RubisCO can bind O_2
- A 2-carbon compound is formed after RubisCO adds O_2 to Calvin cylce
- This compound is converted again into CO_2 in the cell (respiration)

C_4 leaf anatomy

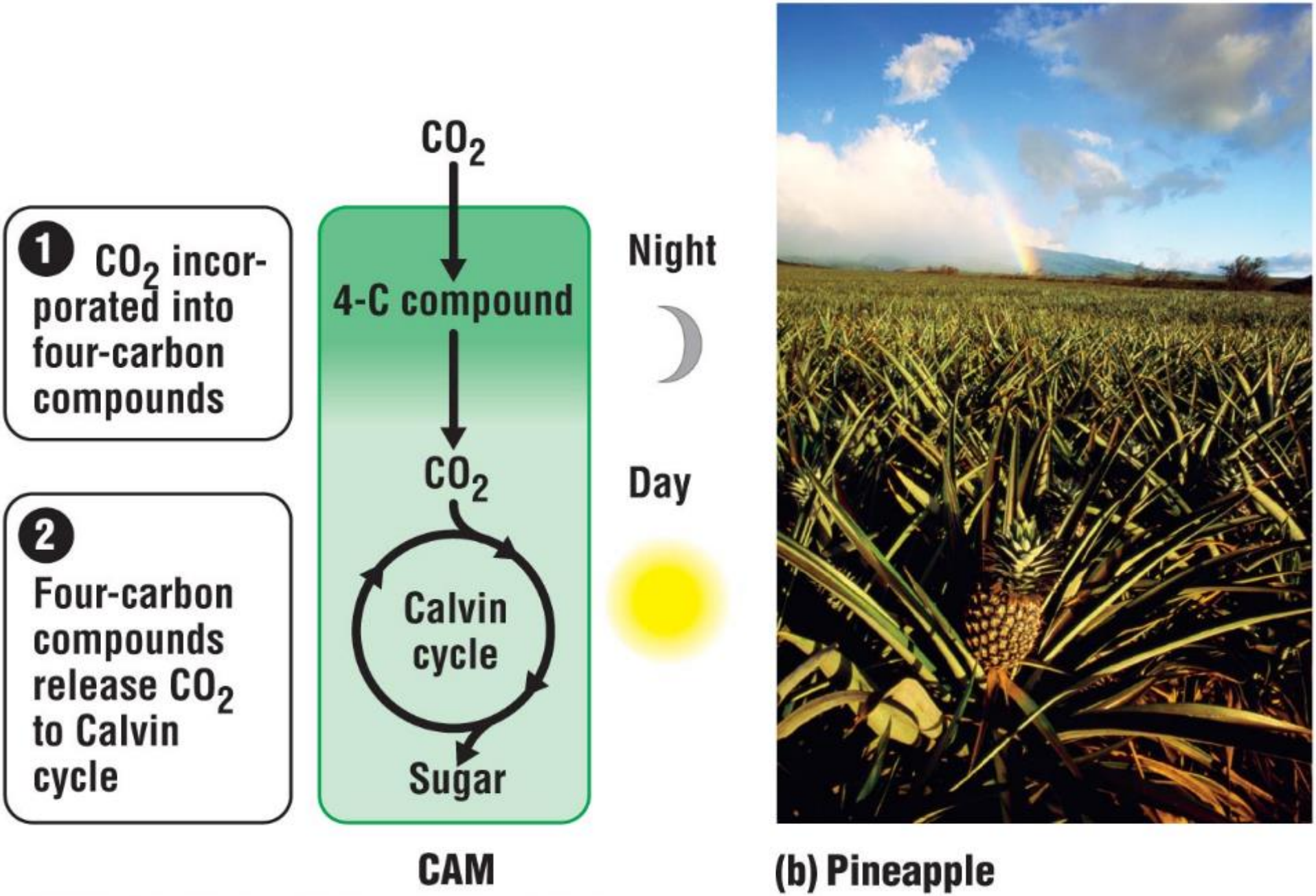


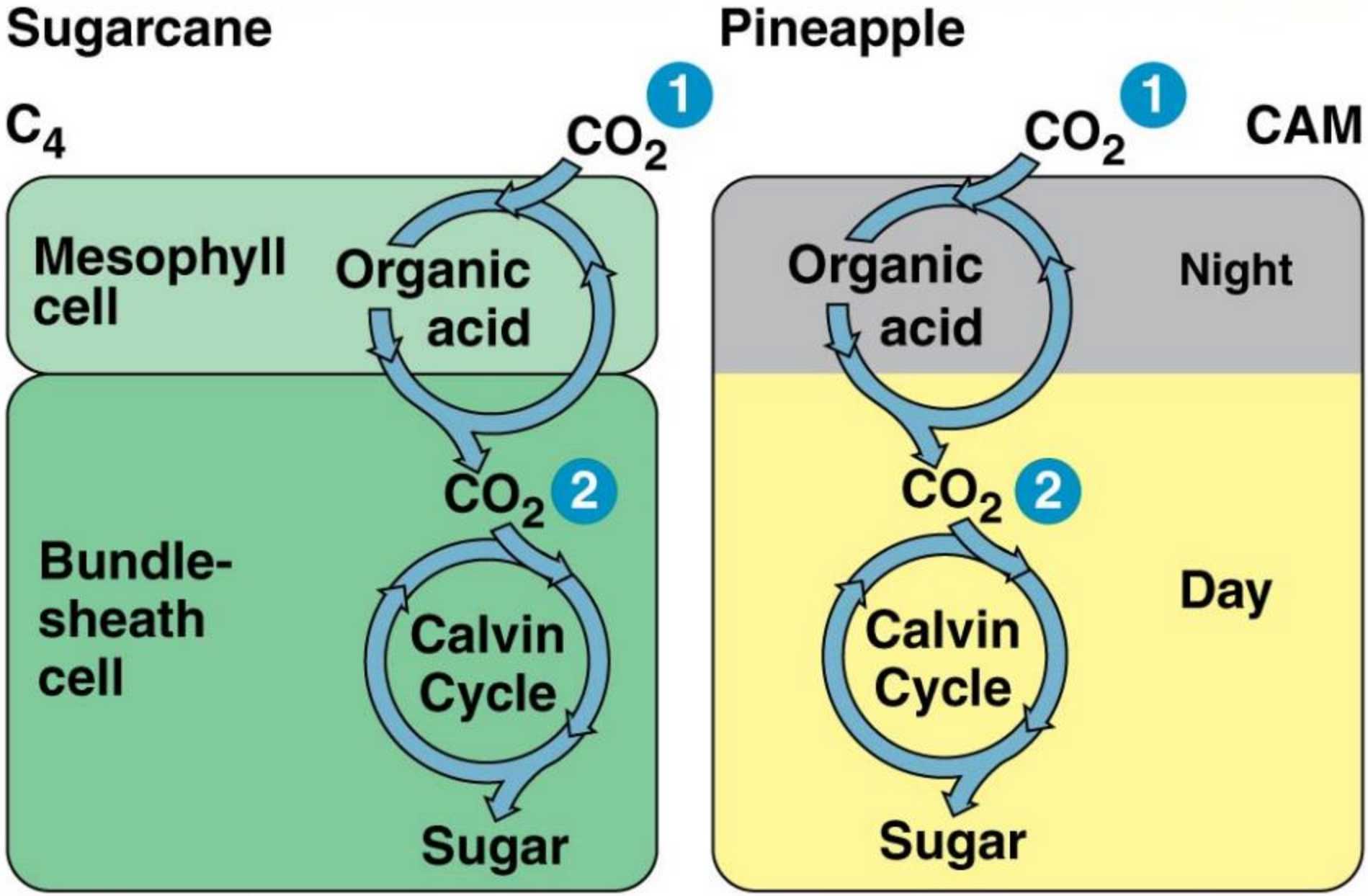

The C_4 pathway
Mesophyll cell
PEP carboxylase
CO_2
Oxaloacetate (4C)
PEP (3C)
ADP
ATP
Malate (4C)
Pyruvate (3C)
CO_2
Bundle-sheath cell
Calvin Cycle
Sugar
Vascular tissue

(a) Sugarcane



C_4





(a) Spatial separation of steps

(b) Temporal separation of steps