Chapter 8 and 9 Notes

Photosynthesis

Energy Transfer

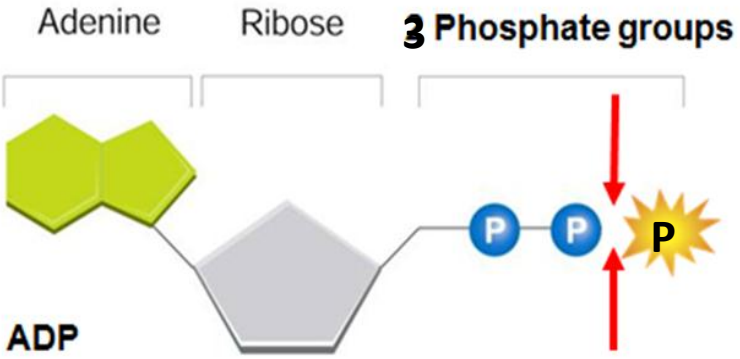
Cellular Respiration

All energy from the Sun

- Autotrophs organisms (plants that make their own food using the sun's energy)
- Heterotrophs eat other organisms (autotrophs) to get food.
  - 99% of energy comes from the sun

ATP

- Adenosine triphosphate (Adenine, ribose, phospate)
  - Energy currency of the cell (universal in body)
  - Energy stored in the bonds of the phosphate groups
    - Short term storage and transfer of energy
    - Mostly between 2nd and 3rd molecule
- Energy is released when the bond is broken
- Analogy
  - ATP = fully charged battery
  - ADP = ½ charged battery

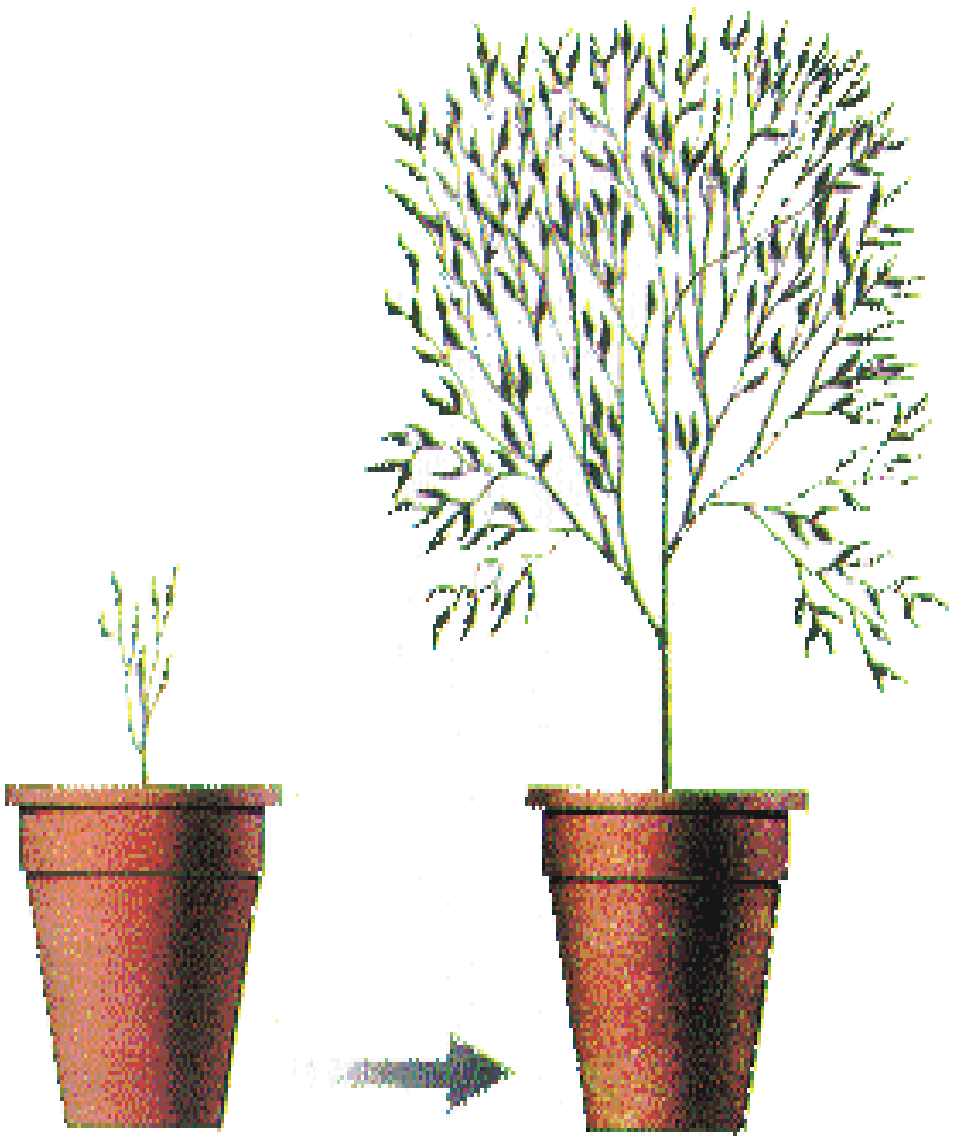


ATP cont.

- Most energy is between 2nd and 3rd phospate
- Energy used
  - Active transport (Na+/K+ pumps)
  - Synthesis of proteins, nucleic acids, etc…
  - Respond to chemical signals
  - Light (firefly)
- ATP can regenerate easily (ADP → ATP)
- For long term storage glucose is used (90X ATP)

Photosynthesis History

- Van Helmont: Soil, pot, water, seedling
  - Year 1 = 1 kg
  - Year 5 = 76 kg = **Water**
- Joseph Priestley: candle, glass jar, plant
  - With plant – candle stays lit
  - Without plant – candle goes out = **Oxygen**
- Ingenhousz: candle, glass jar, plant, dark
  - In dark – candle goes out
  - In light – candle stays lit = **Light**



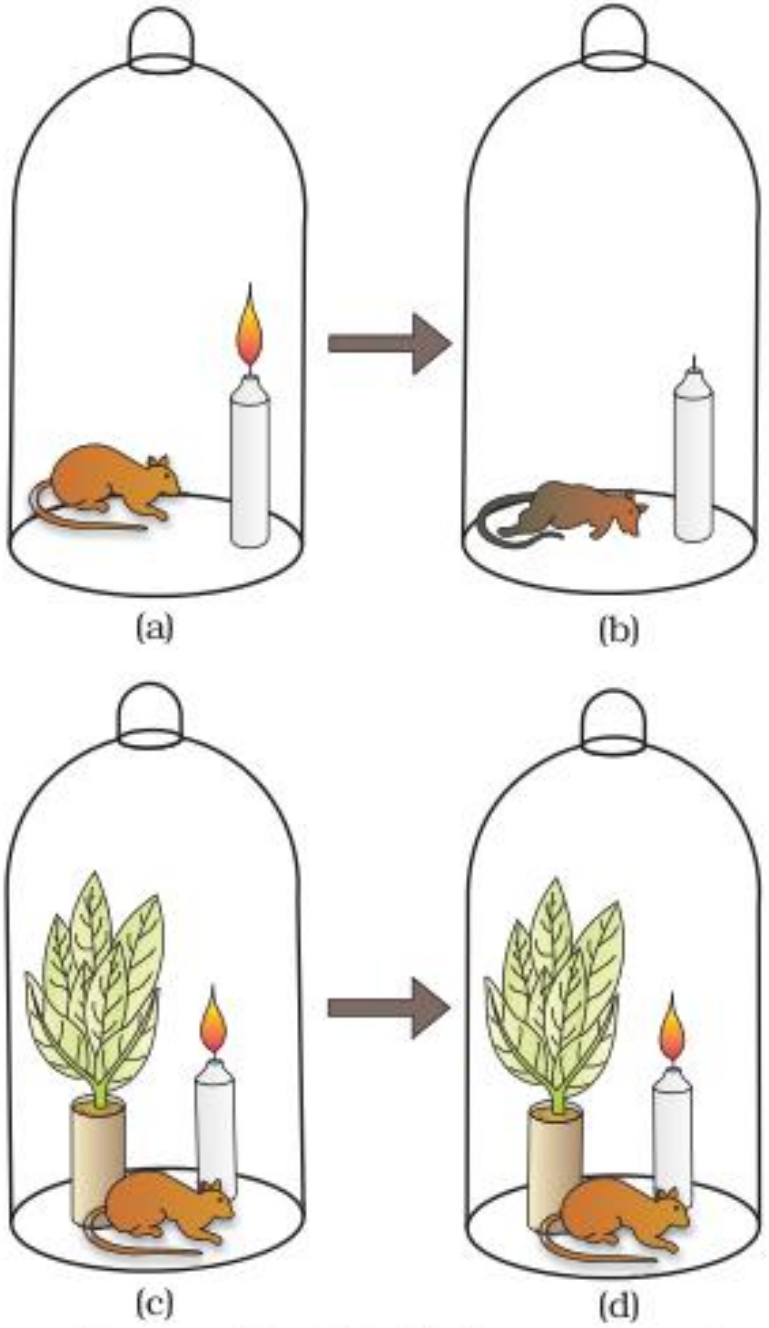
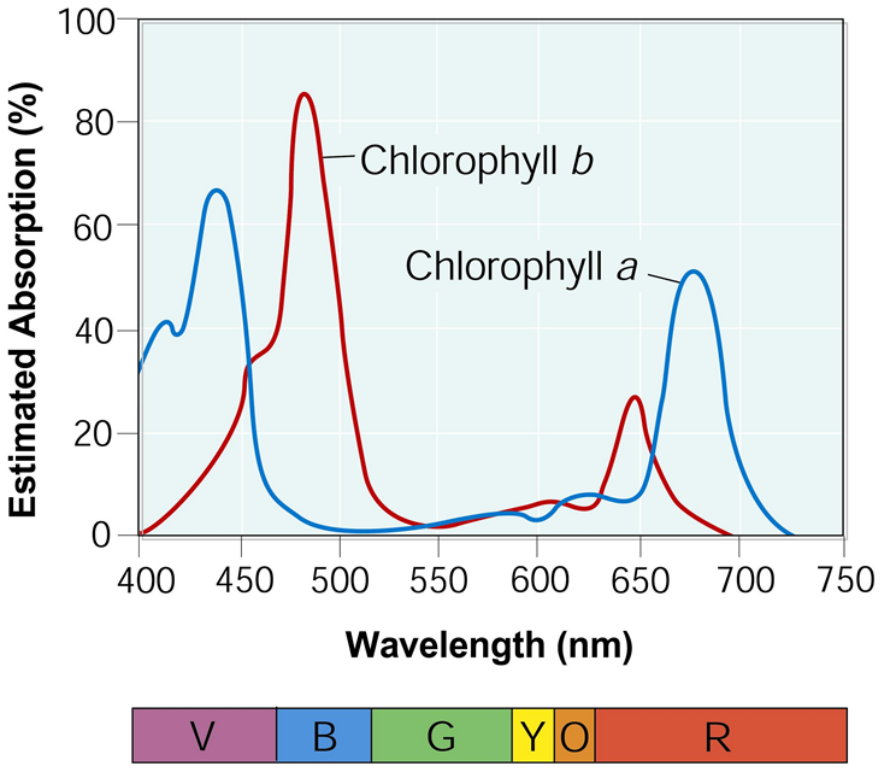


Figure 13.1 Priestley's experiment

Photosynthesis

- $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
  - Carbon dioxide + water → Sugar + Oxygen
- Sun is absorbed by Chlorophyll (pigment)
  - Absorbs Violet, blue and red
  - Reflects: green



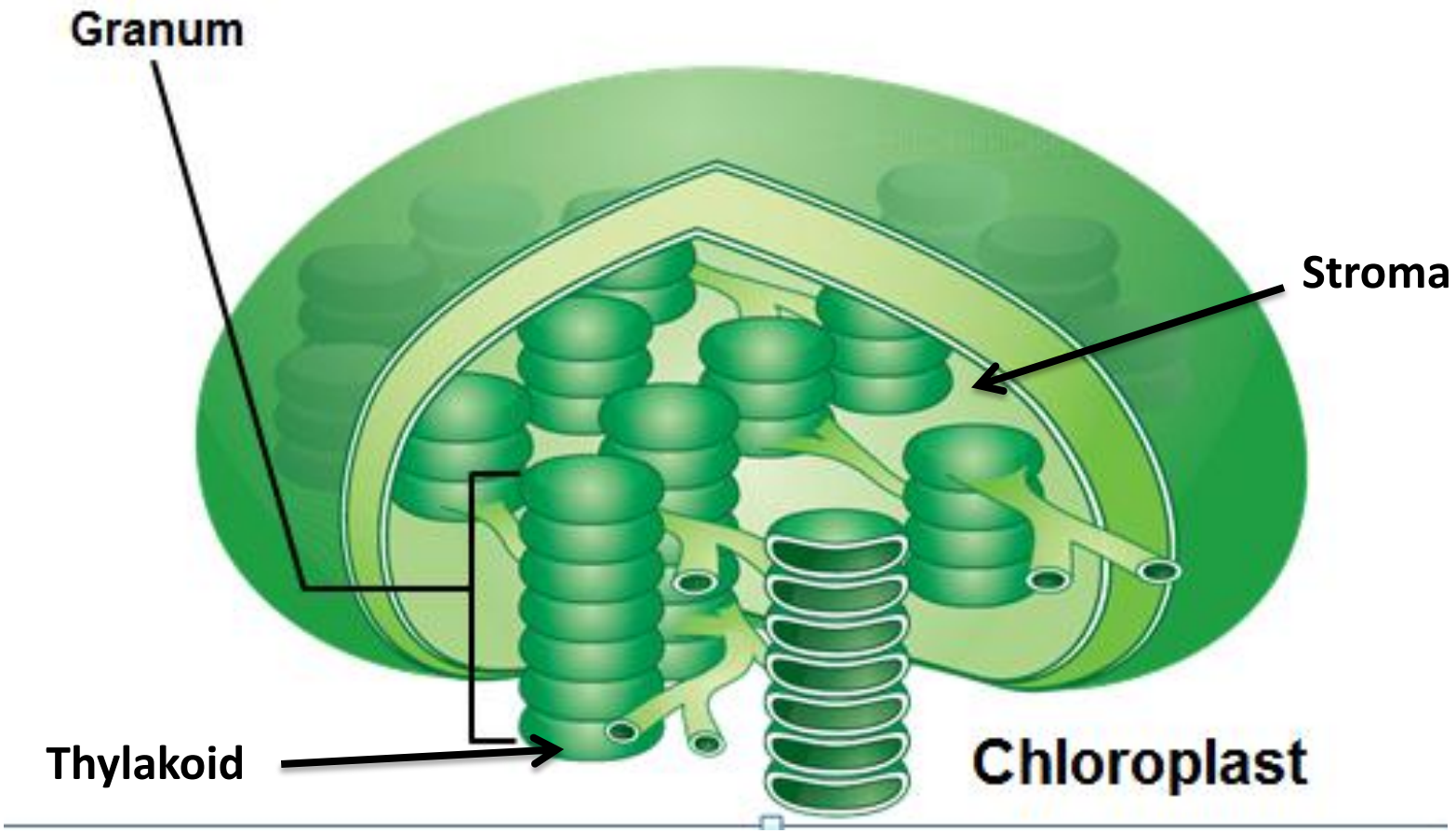
The Process of Photosynthesis

Chloroplast

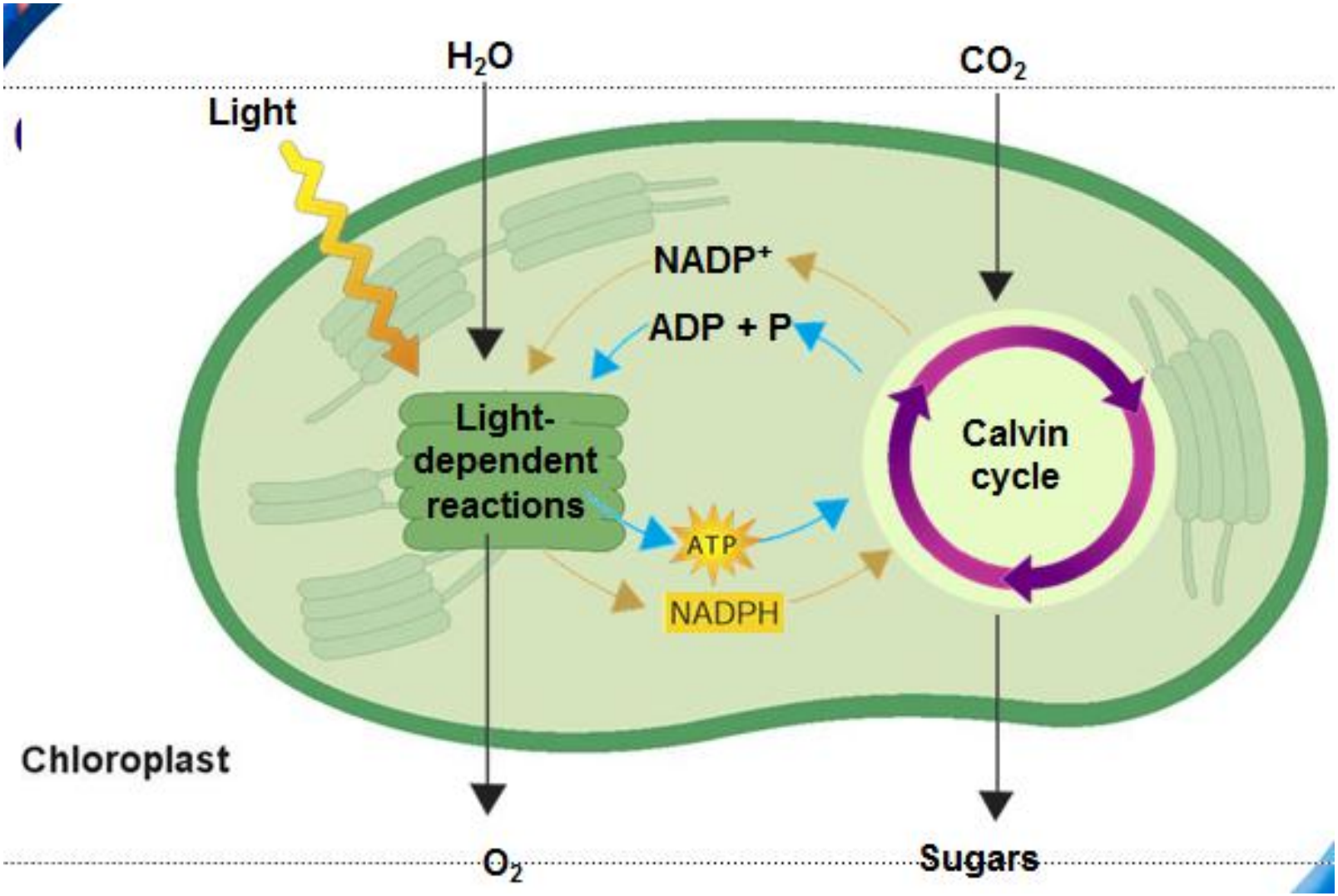
- Chloroplast contain …
  - stacks of thylakoids called granum
    - Chlorophyll in membrane of thylakoid
  - Space is called the stroma

  - Light dependent reaction = Thylakoid membrane
    - Uses H_2O + sun to make ATP + NADPH (electron carrier)
  - Light independent reaction (Calvin Cycle) = stroma
    - Called Calvin Cycle
    - Uses ATP + NADPH+ CO_2 to make sugar

Chloroplast



Chloroplast cont.



Animation Guide to Photosynthesis

1. **Light Dependent Reaction**
    1. **Capturing light**
    2. **Getting e- from water**
    3. **Pumping in H+**
    4. **Creating ATP**
2. **Calvin Cycle**
    1. **Using ATP, NADPH and CO_2**
    2. **Making Sugar $C_6H_{12}O_6$**

Rates of Photosynthesis

- Depend on
  - Temperature
  - Light intensity
  - water

Word Bank

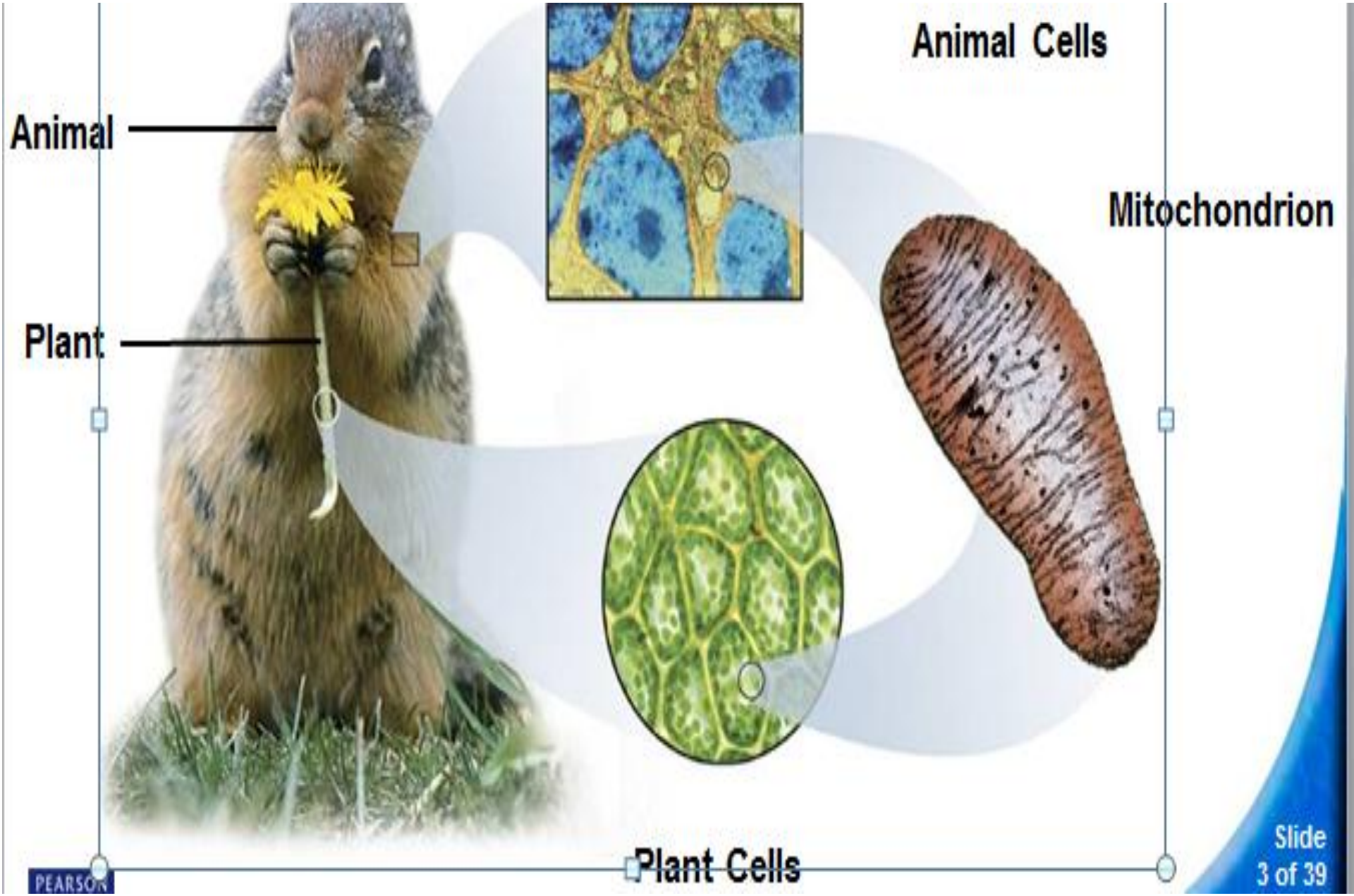
- ADP
- NADPH
- Calvin Cycle
- ATP
- Light Dependent Reaction
- Light
- Oxygen
- CO_2
- $NADP^+$
- Sugar
- Water

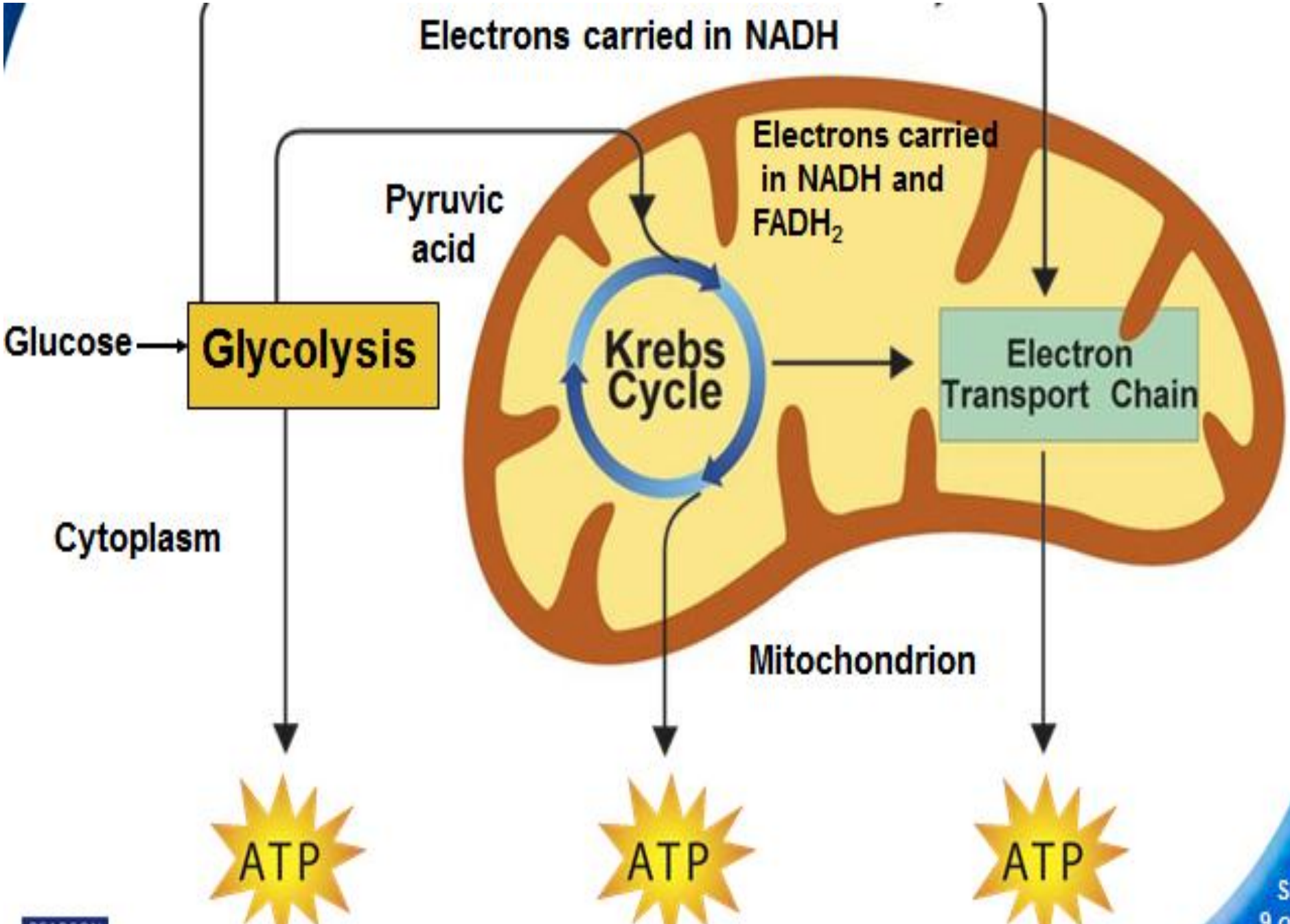
Photosynthesis: Comes in Twos

- **Light Dependent Reaction**
- **Calvin Cycle**
- Water
- CO2
- **Oxygen**
- **Sugar**
- ATP
- NADPH
- **ADP**
- **NADP+**

Cellular Respiration

- Takes place in the cytoplasm and mitochondria
- Food (sugar-glucose) → ATP
- 3 steps
  1. Glycolysis
  2. Krebs Cycle
  3. Electron Transport Chain
- Done by Plants and Animals


Animal
Plant
Animal Cells
Mitochondrion
Plant Cells


Electrons carried in NADH
Electrons carried in NADH and $FADH_2$
Pyruvic acid
Glucose
Glycolysis
Krebs Cycle
Electron Transport Chain
Cytoplasm
Mitochondrion
ATP
ATP
ATP

Glycolysis

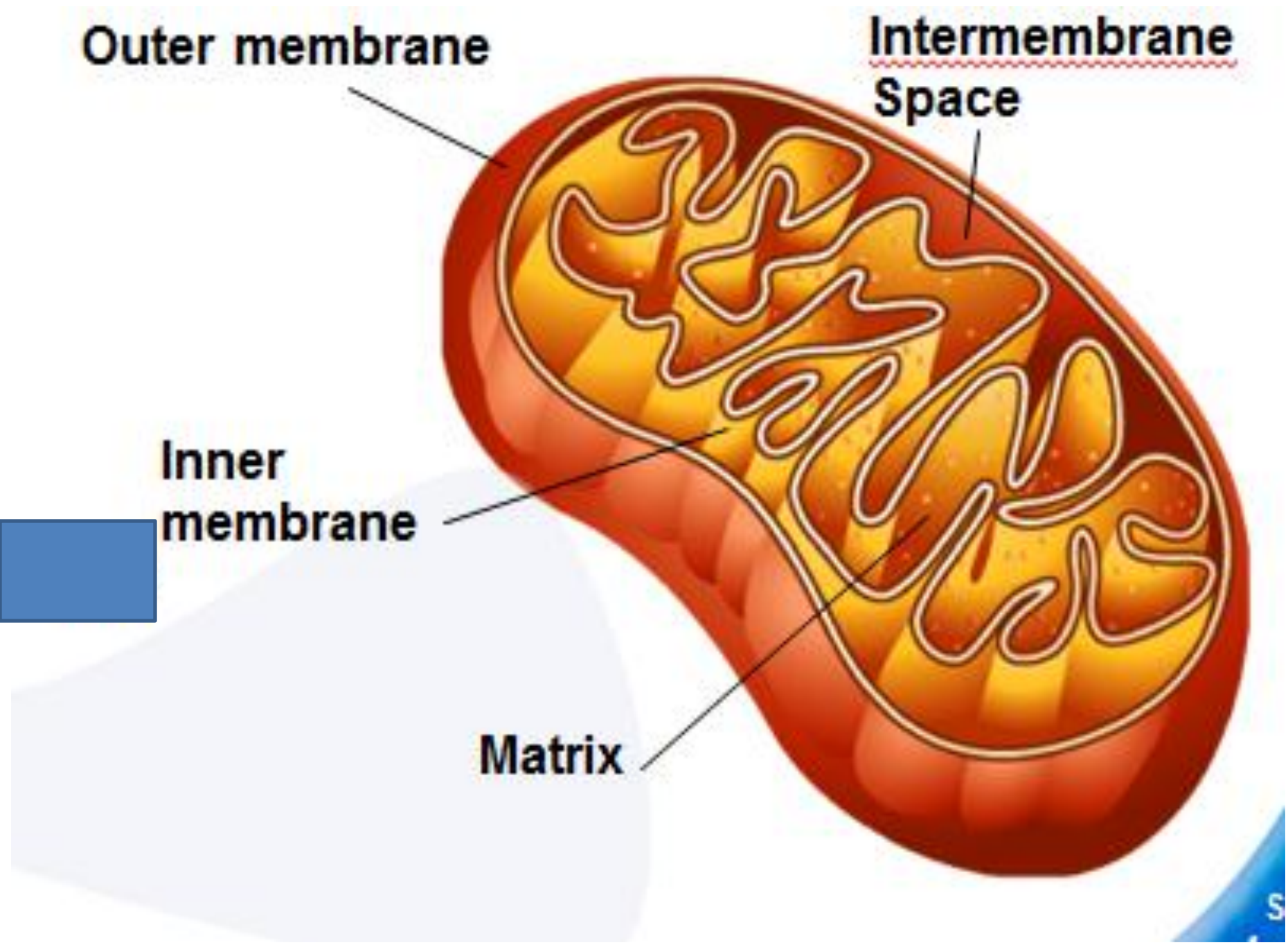
- Takes place in the cytoplasm
- Glucose is split into 2 pyruvic acids
- 2 ATP are created
- NADH (electron carrier) is created

Krebs Cycle

- Takes place in the matrix of the mitochondria
- Pyruvic Acid broken down into CO_2
- ATP produced
- NADH + $FADH_2$ are produced (both electron carriers)

Electron Transport Chain

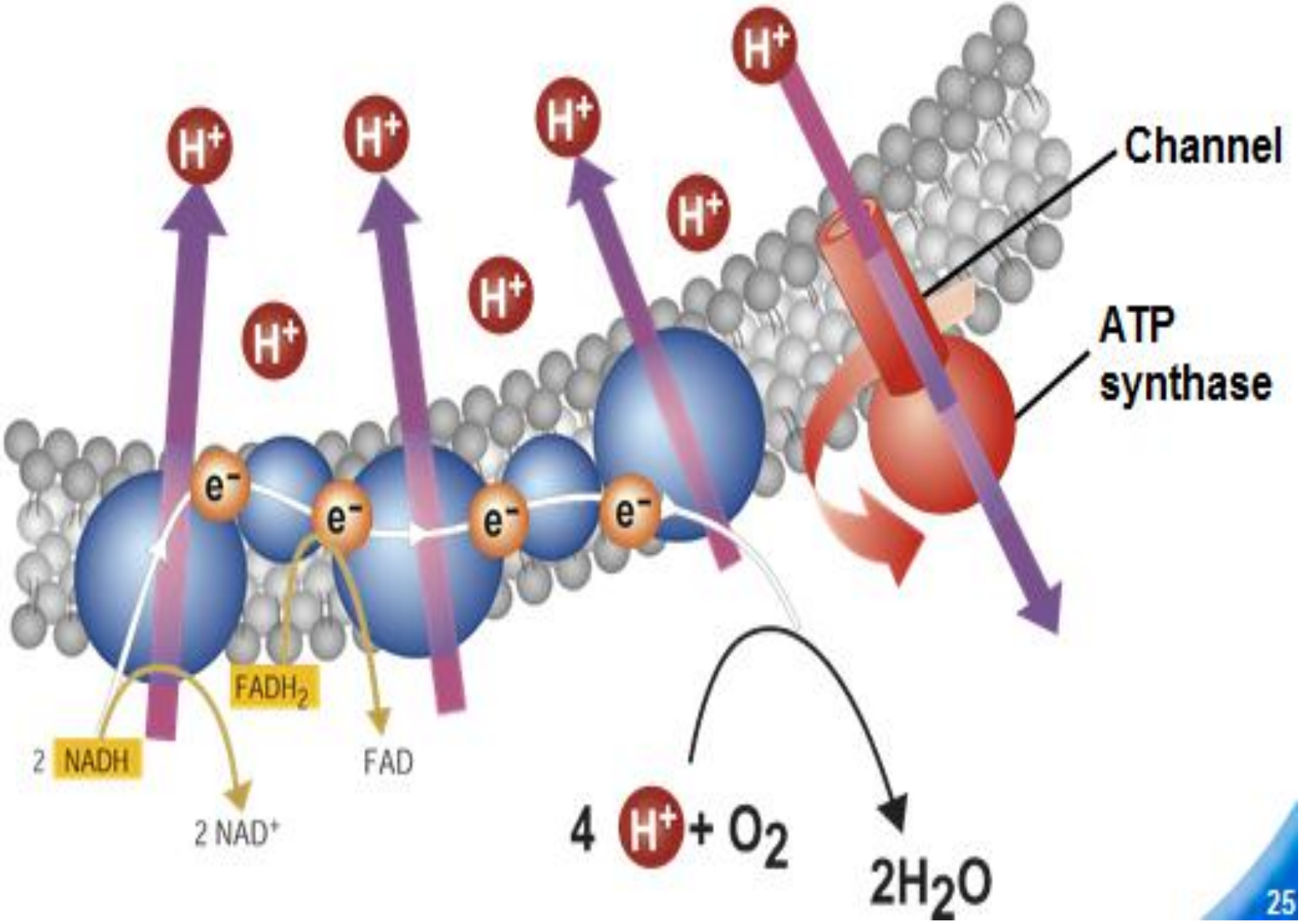
- Electrons from NADH and FADH2 are given to the inner mitochondria membrane
- The energy from electrons are used to pump H+ into the inner membrane space
- When the H+ leaves through ATP Synthase it produces ATP


Outer membrane
Intermembrane
Space
Inner
membrane
Matrix

Total ATP

- 2 from glycolysis
- 2 from Krebs Cycle
- 32 from NADH and FADH2 at the ETC
- 36 total ATP from 1 molecule of glucose

$6O_2 + C_6H_{12}O_6 \rightarrow 6CO_2 + 6H_2O + ATP\ (36)$


H+
H+
H+
H+
H+
H+
H+
Channel
ATP
synthase
e−
e−
e−
e−
FADH2
2 NADH
FAD
2 NAD+
4 H+ + O2
2H2O

Respiration v. Photosynthesis

Photosynthesis	Respiration
Plants	Plants and Animals
Chloroplast	Cytoplasm and Mitochondria
2 steps (Light dependent + Calvin Cycle)	3 steps (glycolysis, krebs cycle, ETC)
Sun → sugar	Sugar → 36 ATP
Produces oxygen and sugar	Produces carbon dioxide and water
Uses Carbon dioxide and water	Uses Oxygen and sugar