

CELLULAR RESPIRATION

Learning Goals

Unit Learning Goal: You can compare/contrast **all** components of photosynthesis & cellular respiration in terms of energy, organic and inorganic molecules as well as accurately diagram **all** the processes as part of the flow of energy and matter through all levels of organization in an ecosystem.

Presentation Learning Goal(s):

1. You can identify organic & inorganic molecules of the process of cellular respiration and write out the equation using proper chemical notation.
2. You can compare the 2 stages of cellular respiration and identify the differences within fermentation using scientific vocabulary.
3. You can link the structure of the mitochondria to the process of cellular respiration.
4. You can describe the process of cellular respiration as a part of the biochemical pathway that facilitates the flow of energy and matter through all levels of organization in an ecosystem.

Unit Learning Goal Scale

4 - You can compare/contrast all components of photosynthesis & cellular respiration in terms of energy, organic and inorganic molecules as well as accurately diagram all the processes as part of the flow of energy and matter through all levels of organization in an ecosystem.

3 - You can compare/contrast some components of photosynthesis & cellular respiration in terms of energy, organic and inorganic molecules as well as diagram most of the processes as part of the flow of energy and matter through all levels of organization in an ecosystem.

2 - You can explain some of the learning goal on your own but may need some help to complete the entire learning goal.

1 - You can answer questions about the learning goal but cannot give specifics using your own words.

Overview of Cellular Respiration

Definition: Process in which organisms make ATP (energy) by breaking down organic compounds (carbohydrates)

Formula: The overall process may be summarized as



Cellular respiration is carried out in two stages:

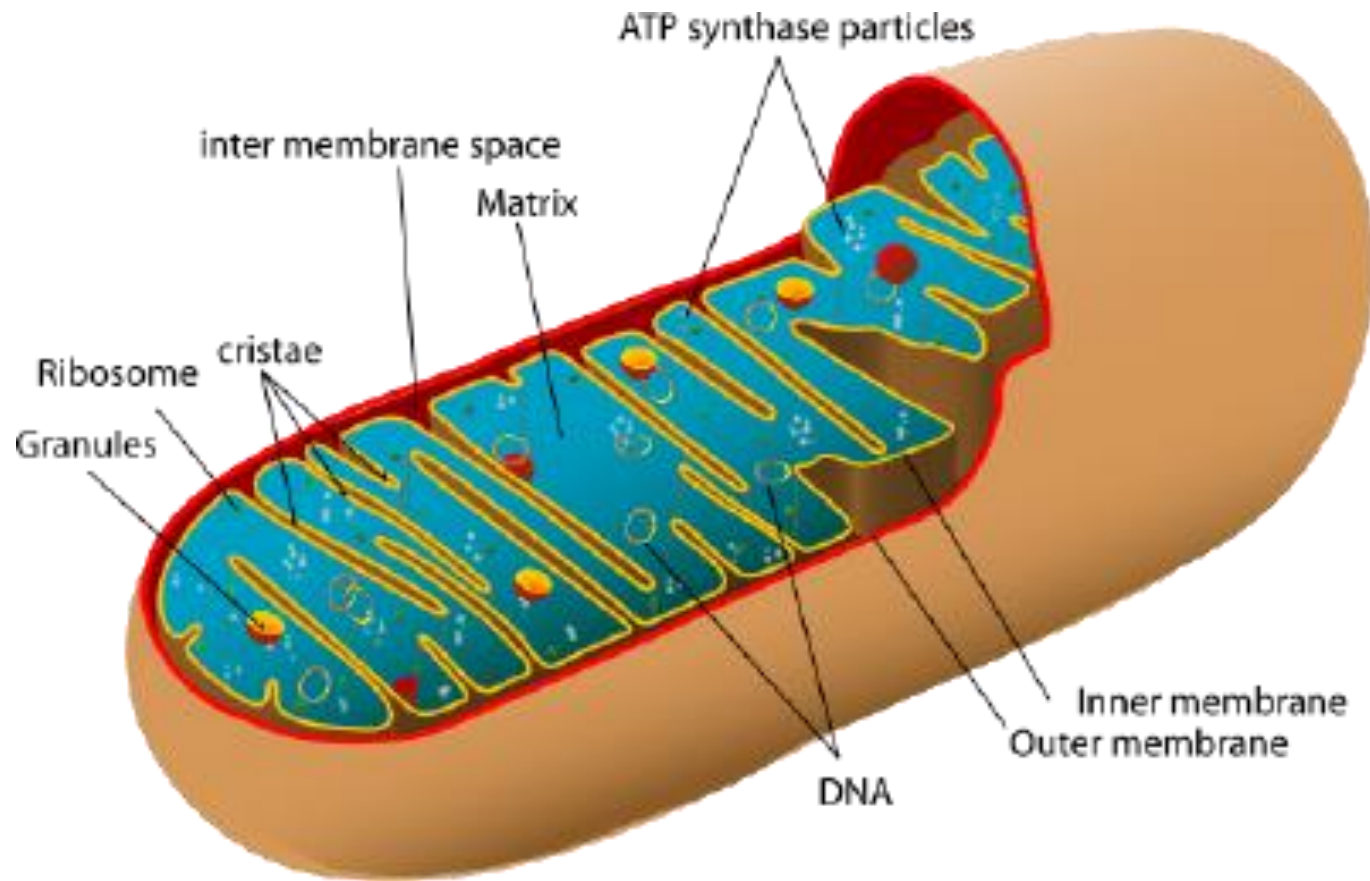
1. Glycolysis

Occurs in the cytoplasm

2. Oxidation

Occurs in the mitochondria

Where does Aerobic CR take place?



What is ATP?

- Adenosine triphosphate (ATP) is the major source of energy for cells
 - formed when phosphate group and adenosine diphosphate (ADP) molecule bond
 - Present in all living cells

ATP - LIKE A RECHARGEABLE BATTERY

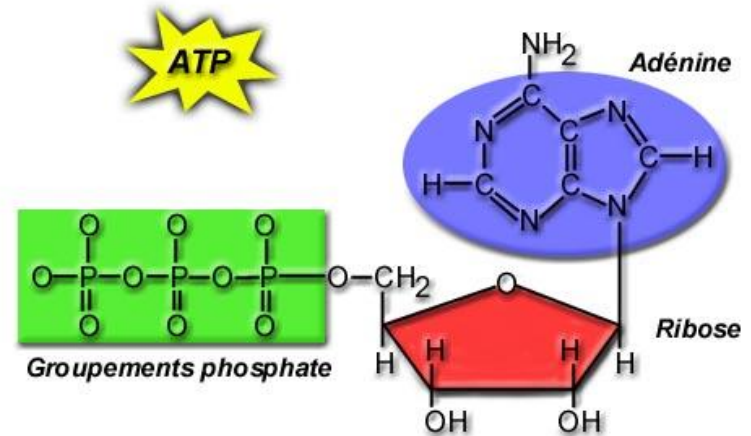
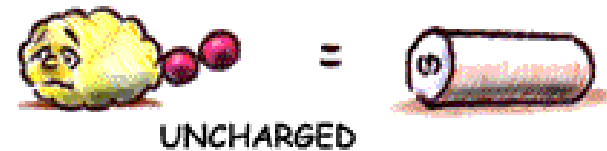
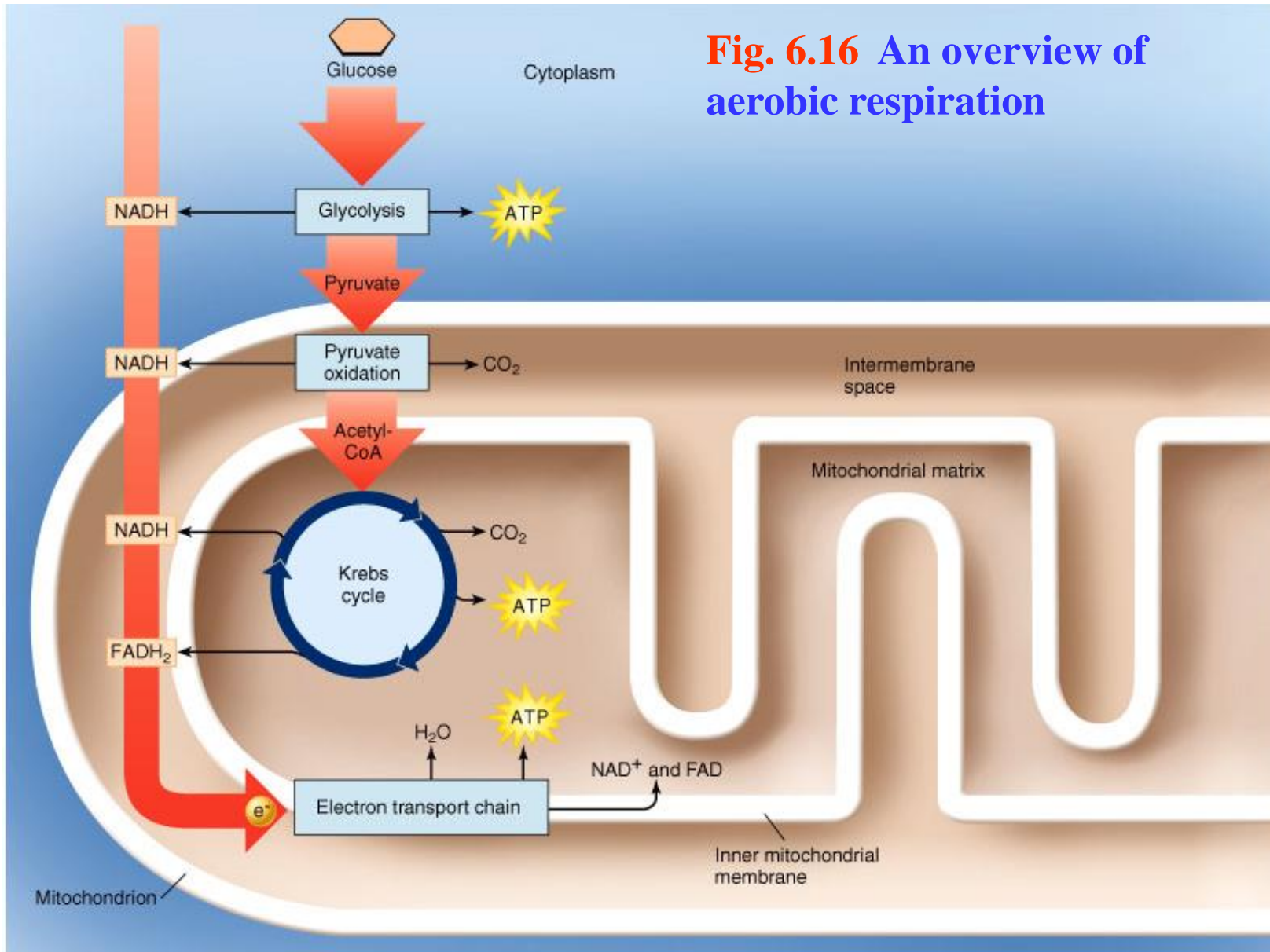
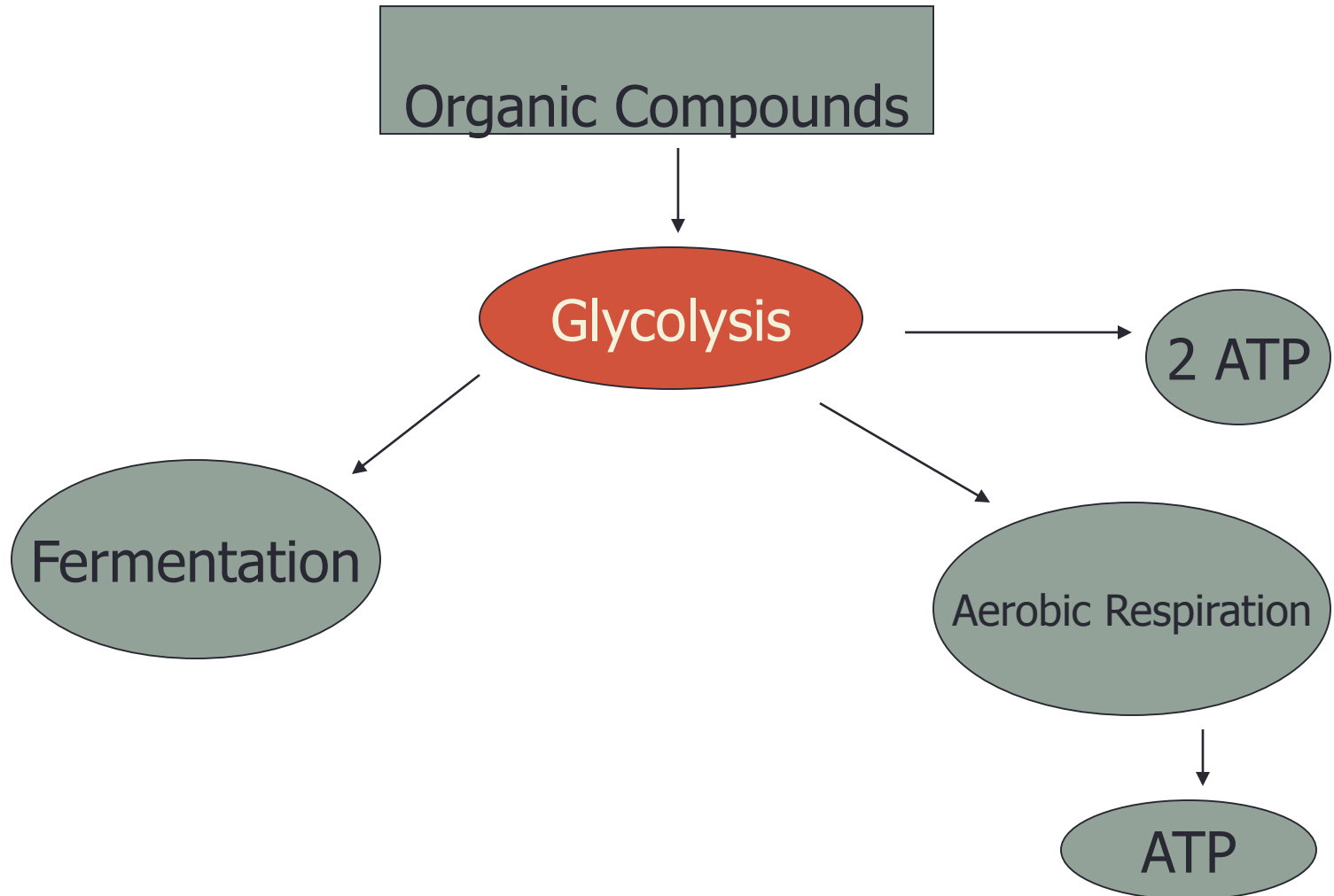


Fig. 6.16 An overview of aerobic respiration



Cellular Respiration



What is Glycolysis?

Definition: Process takes a molecule of glucose and converts it into two molecules of pyruvic acid

Reactants: 1 Glucose

Products: 2 ATP, 2 pyruvic acid

Location: Takes place in the cytoplasm (cytosol)

Who/What? All cells undergo glycolysis

What are the 2 conditions for CR?

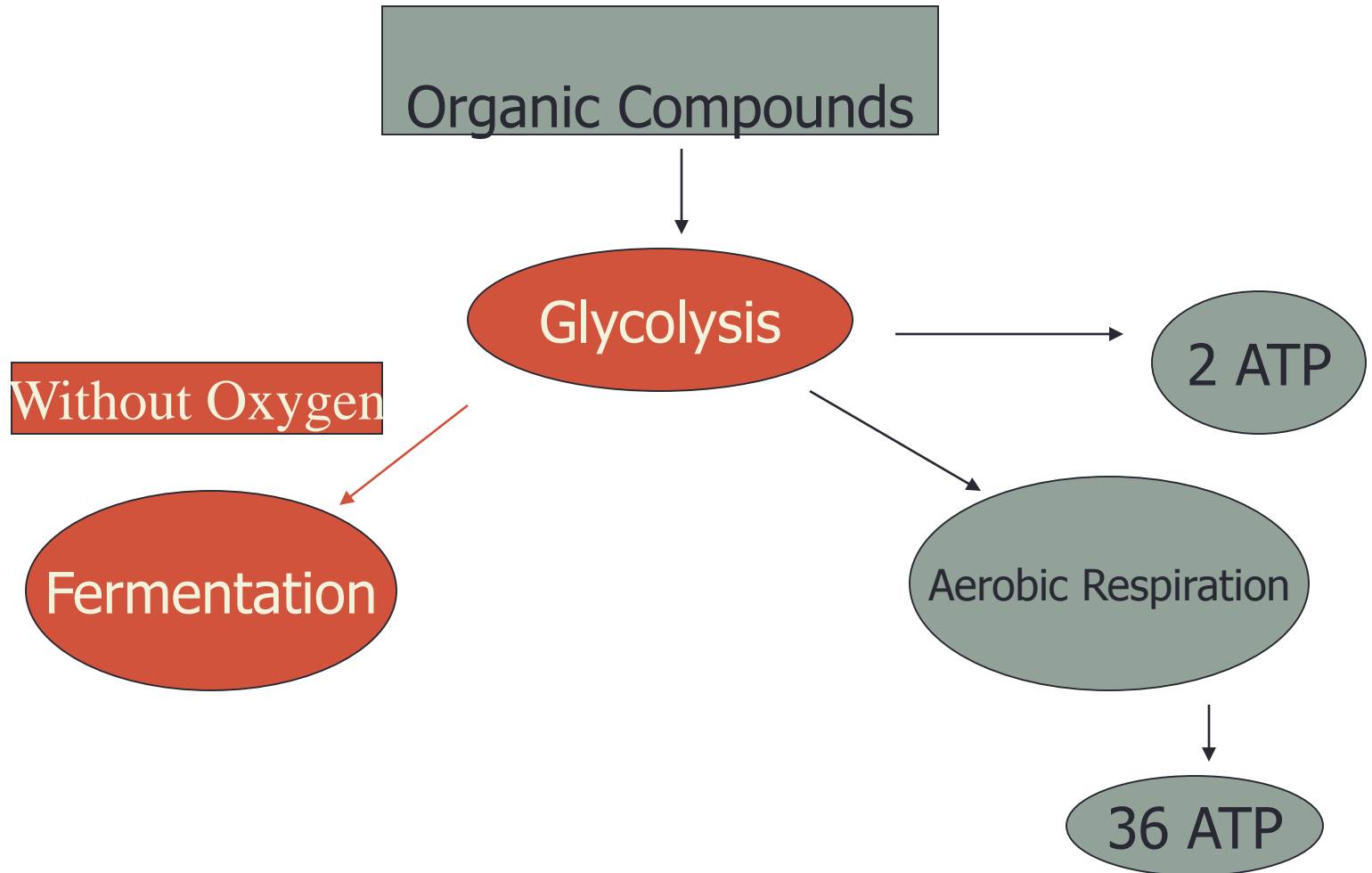
Oxygen present – Aerobic respiration

- Majority of ATP created in this process
- Takes place in organisms with large energy needs

Oxygen absent – Anaerobic respiration

- No ATP created
- Lactic acid fermentation
- Alcohol fermentation
- Takes place in organisms with small energy needs

Harvesting Chemical Energy



What is Fermentation?

- No oxygen present – **anaerobic** pathway
- Occurs in the cytoplasm (cytosol) in eukaryotic and prokaryotic cells.
- No ATP is created
- Regenerates an electron carrier molecule that keeps glycolysis going = keeps ATP in production
- Two types of fermentation
 - Lactic fermentation – large organisms
 - Alcoholic (Ethanol) – small organisms

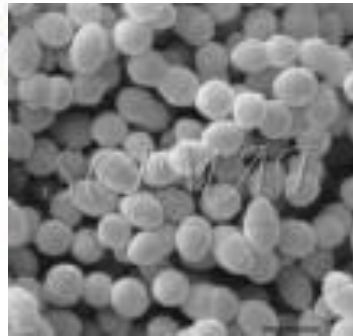
What is Lactic Fermentation?

- Important in making of yogurt and cheese
- Occurs in your muscle cells during strenuous exercise.
 - When oxygen is depleted at faster rate than can be supplied to cells, cells switch from aerobic to anaerobic respiration
 - Lactic acid accumulates in muscle cells (in cytosol)
 - Increased acidity in cytosol reduces cells capacity to contract = fatigue, pains, muscle cramps

What is Alcoholic Fermentation?

- Example - Yeast
- Converts pyruvic acid into ethyl alcohol
- Important to wine and beer industry
- Yeast added to fermentation mixture
 - Ethyl alcohol accumulates until it reaches a concentration that inhibits fermentation
 - CO₂ released in production of wine
 - CO₂ retained in production of champagne

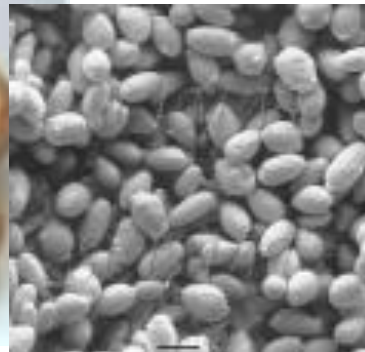
Fermentation products



Yogurt/bacteria



Soy sauce/fungus



Bread/fungus

Pop Quiz

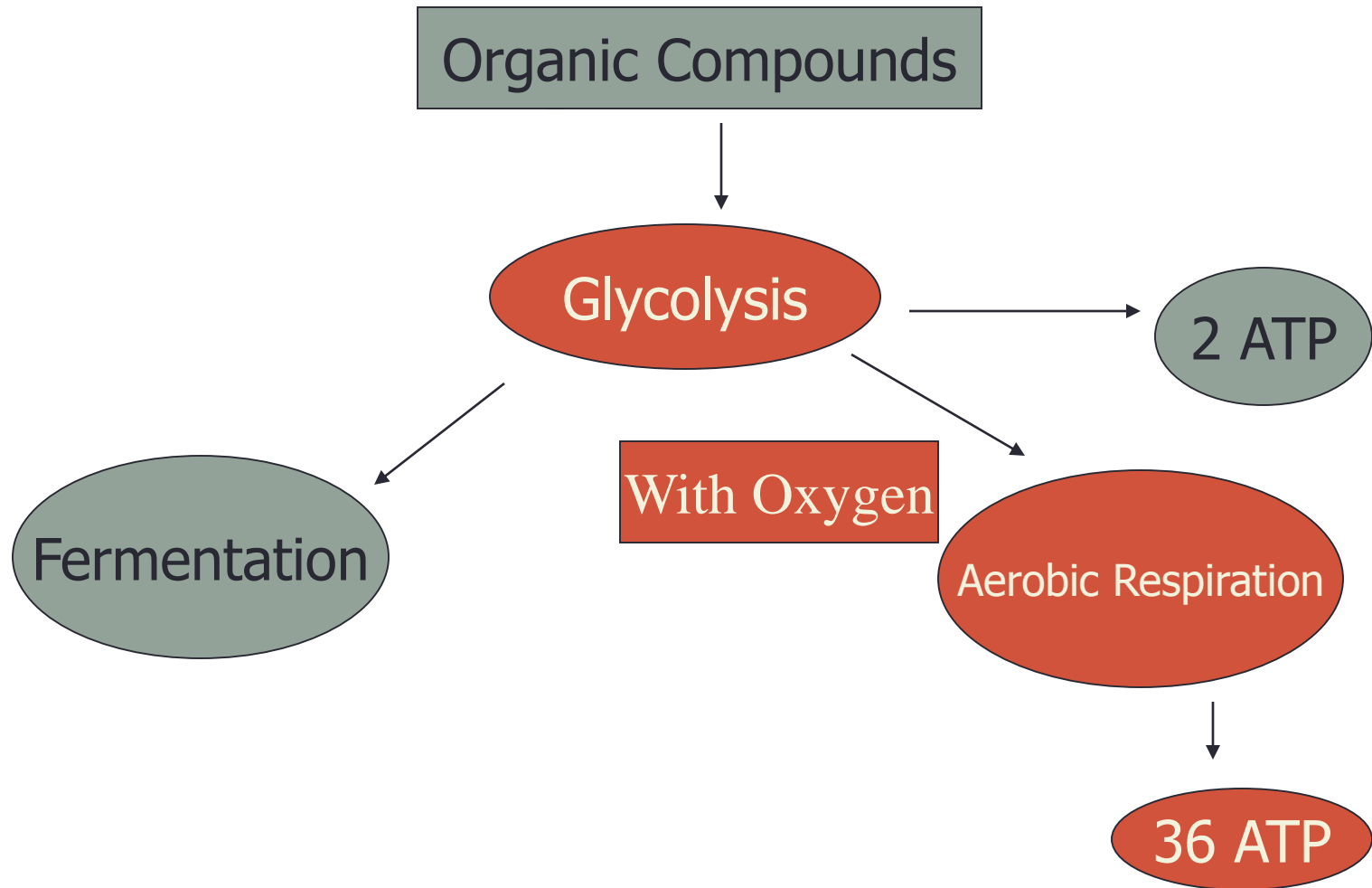
What are the two types of fermentation?

Lactic Acid and Alcohol

Quick Write

What are differences between aerobic and anaerobic cellular respiration?

Cellular Respiration Pathway



What is Aerobic Respiration

- Oxygen present
- Occurs in cytoplasm (cytosol) in prokaryotes
- Occurs in mitochondria in eukaryotes
- Produces up to 36 ATP molecules

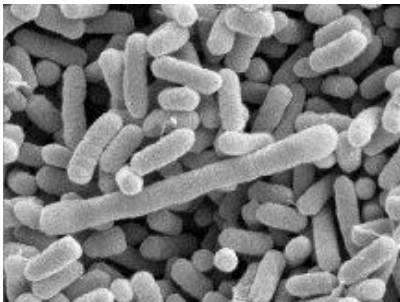
Our bodies use ATP at a rate of one million molecules per cell per second!

Krebs (Citric Acid) Cycle

- Complex series of reactions only in aerobic respiration
- Basically, sugar is broken down into energy carriers (NADPH, ATP) using energy derived from oxygen
 - CO_2 is produced as waste at this step
- Those energy carriers then drive the creation of most of the ATP in the electron transport chain in the mitochondria

Energy Requirements

- Present day unicellular organisms can acquire enough energy from anaerobic pathways
- Large multicellular organisms must acquire energy from aerobic pathways.



Do plants carry out cellular respiration?

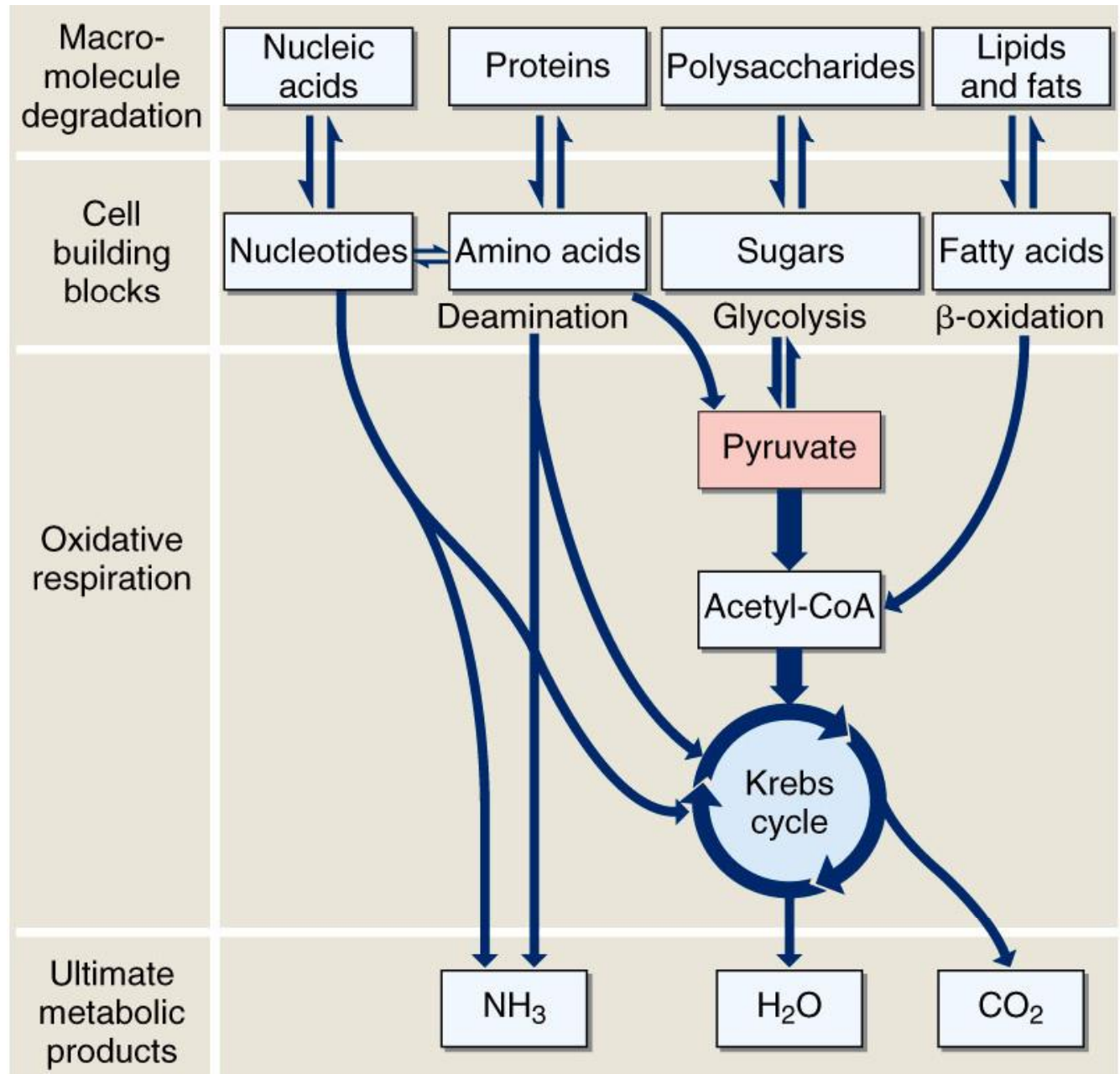
Yes!

Cellular respiration does not mean breathing – it is breaking down organic compounds to release stored energy.

What are the Other Sources of Energy?

- Food sources, other than sugars, can be used in cellular respiration
- These complex molecules are first digested into simpler subunits
 - These subunits are modified into intermediates
 - These intermediates enter cellular respiration at different steps

Fig. 6.27
How cells
obtain
energy from
foods



Pop Quiz

How are photosynthesis and cellular respiration related to one another?

Products of photosynthesis are used as reactants of cellular respiration

How does energy flow in an ecological system?

Sun → Autotrophs → Heterotrophs

Reflection Time: Learning Goals

Ticket Out the Door: Rate yourself on one of the learning goals and summarize what you know about that learning goal. Make sure to write out the number of the learning goal.

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