Chapter 9 - Cellular Respiration

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Food serves as a source of raw materials for the cells of the body and most of all it serves as a source of energy.

Cells gradually release the energy from glucose and other food components.

Overview of Cellular Respiration

Cellular respiration is the process that releases energy by breaking down glucose and other food molecules in the presence of oxygen.

Word Equation

oxygen + glucose ⟶ carbon dioxide + water + energy

Balanced Chemical Equation

$6O_2 + C_6H_{12}O_6 \longrightarrow 6CO_2 + 6\,H_2O + \text{energy}$

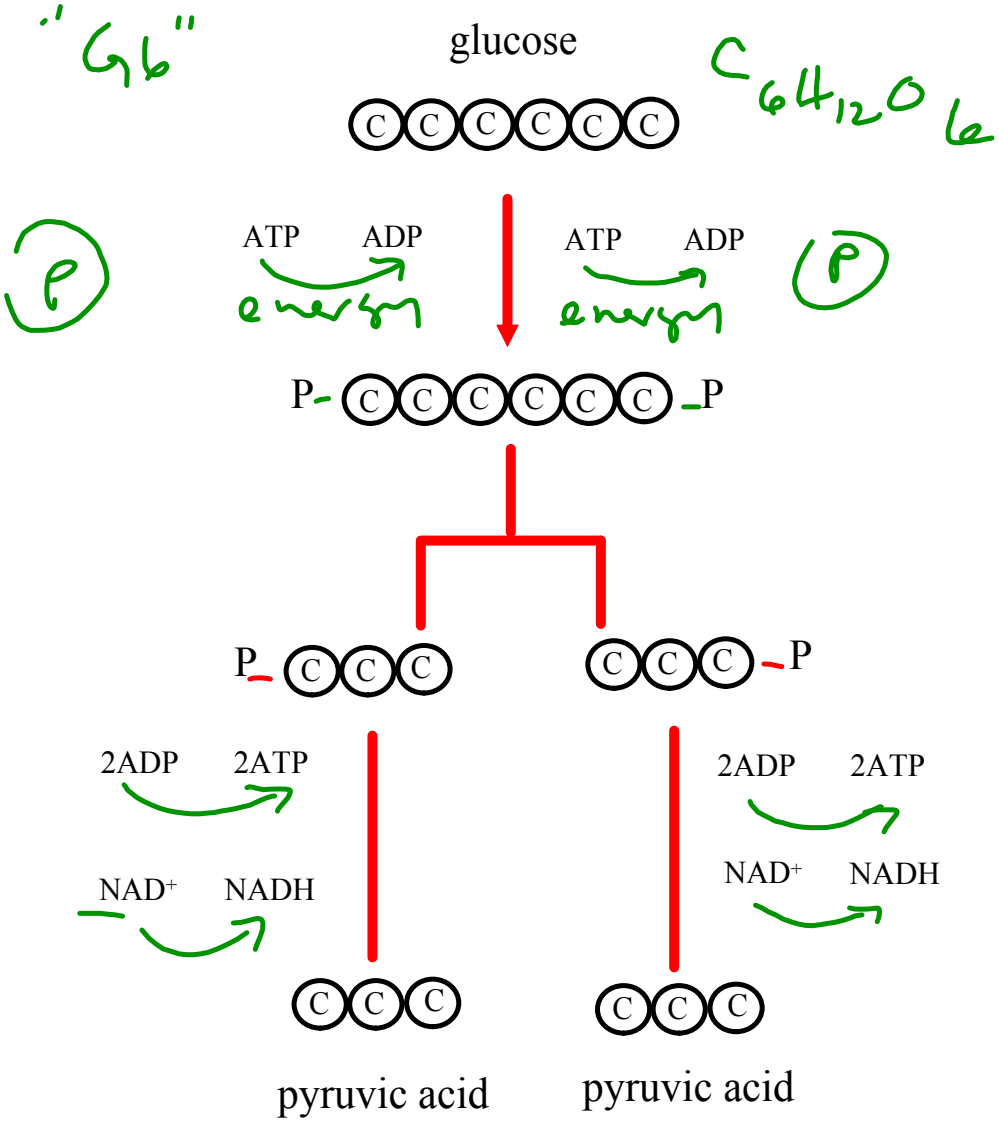
** Respiration does **not** take place in one step. The energy in food must be released a little bit at a time.

Glycolysis - Page 223

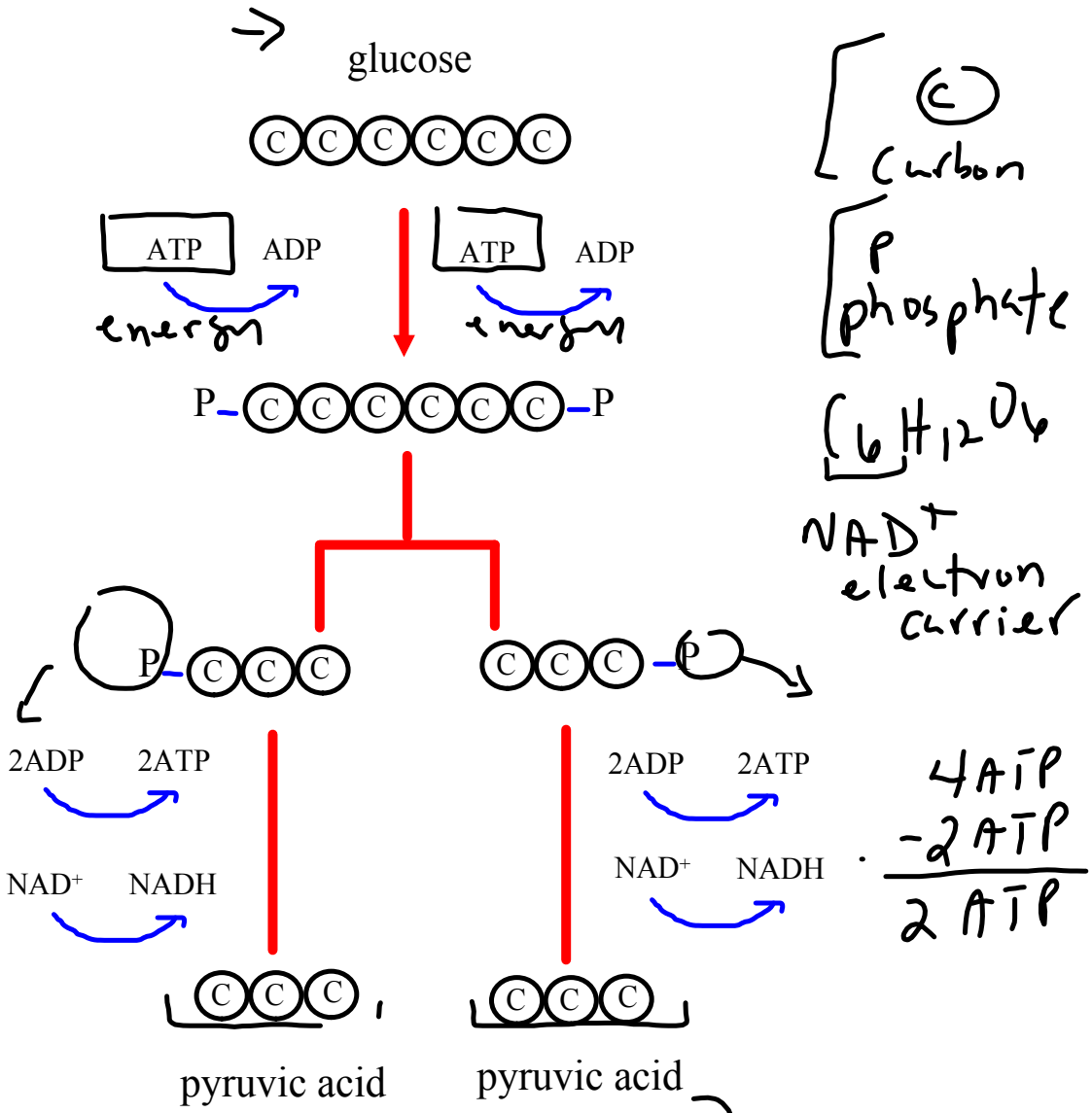
Greek: *glucus* -> sweet
lysis -> process of decomposing

glycolysis -> breaking down glucose

Glycolysis is the first set of reactions in cellular respiration and is an energy-releasing process. Glycolysis takes place in the cytoplasm of the cell.



products: 2 pyruvic acid ⇒
2 NADH ⇒
2 ATP ⇒



C Carbon

P phosphate

$C_6H_{12}O_6$

NAD^+ electron carrier

4 ATP
-2 ATP
2 ATP

products: 2 ATP
2 NADH
2 pyruvic acid

(pyruvate)

MR

NAD^+ - electron carrier or carrier molecule
- accepts a pair of high-energy electrons and H+

NADH - holds electrons until they can be transferred to other molecules

The energy yield from glycolysis is small, but very fast. Since glycolysis does not require oxygen this process can supply chemical energy to cells when oxygen is not available.

When NAD^+ molecules are filled up with electrons, ATP production stops.

Fermentation - Page 224

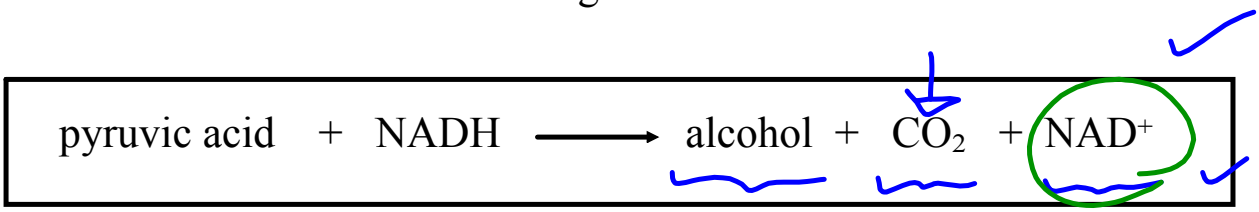
When oxygen is not present, glycolysis is followed by a particular chemical pathway. The combination of glycolysis and this pathway is called fermentation.

Fermentation does not require oxygen so it is said to be anaerobic which means "not in air".

There are two main types of fermentation: alcoholic fermentation and lactic acid fermentation.

Alcoholic Fermentation

Yeasts and a few other microorganisms use alcoholic fermentation.



The production of NAD^+ allows glycolysis to continue.

This type of fermentation causes bread to rise. When yeast in dough runs out of oxygen, it begins to ferment, giving off bubbles of carbon dioxide that form the air spaces you see in bread. The small amount of alcohol produced in the dough evaporates when the bread is baked.

Lactic Acid Fermentation

pyruvic acid + NADH ⟶ lactic acid + NAD^+

The production of NAD^+ allows glycolysis to continue.

Lactic acid is produced in your muscles during rapid exercise when the body cannot supply enough oxygen to the tissues.

Your muscle cells rapidly begin to produce ATP by lactic acid fermentation. The build-up of lactic acid causes a painful, burning sensation. This is why muscles may feel sore after only a few seconds of intense activity.

Some unicellular organisms produce lactic acid as a waste product. Prokaryotes are used in the production of cheese, yogurt, buttermilk, sour cream, pickles and sauerkraut (fermented cabbage).

Recipe - Sauerkraut

☆

At the end of glycolysis, 90% of the chemical energy stored in glucose is still unused, locked in the high-energy electrons of pyruvic acid.

Oxygen, the most powerful electron acceptor, is required for the final steps of cellular respiration. Because the next pathways require oxygen they are said to be aerobic meaning "in air".

The Krebs Cycle - Page 226

In the presence of oxygen, pyruvic acid produced in glycolysis passes to the second stage of cellular respiration, the Krebs cycle (named for British biochemist Hans Kreb).

Krebs

The Krebs cycle begins when pyruvic acid enters the mitochondria.

Mitochondria Structural Features

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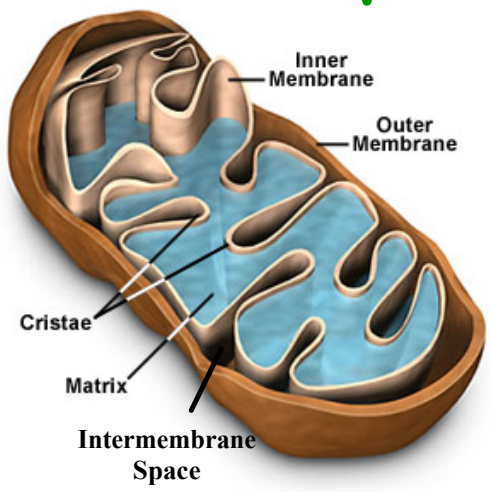

*two membranes
smooth outer membrane
folding inner membrane

cristae - fingerlike projections of the inner membrane
- increase surface area
- there are enzymes on the cristae that assist in the breakdown of sugar molecules in the mitochondrion

matrix - fluid inside the mitochondrion
- contains enzymes responsible for Krebs cycle reactions

Attachments

Two_Types_of_Cells__Prokaryotic_and_Eukaryotic.asf

Bacteria.asf