

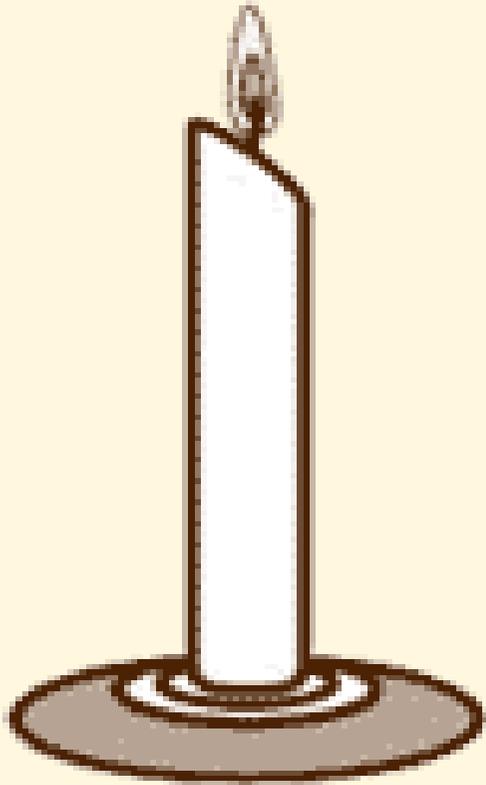
Cellular Respiration

1. Occurs in the Mitochondria
2. How are cells produce ATP (energy)

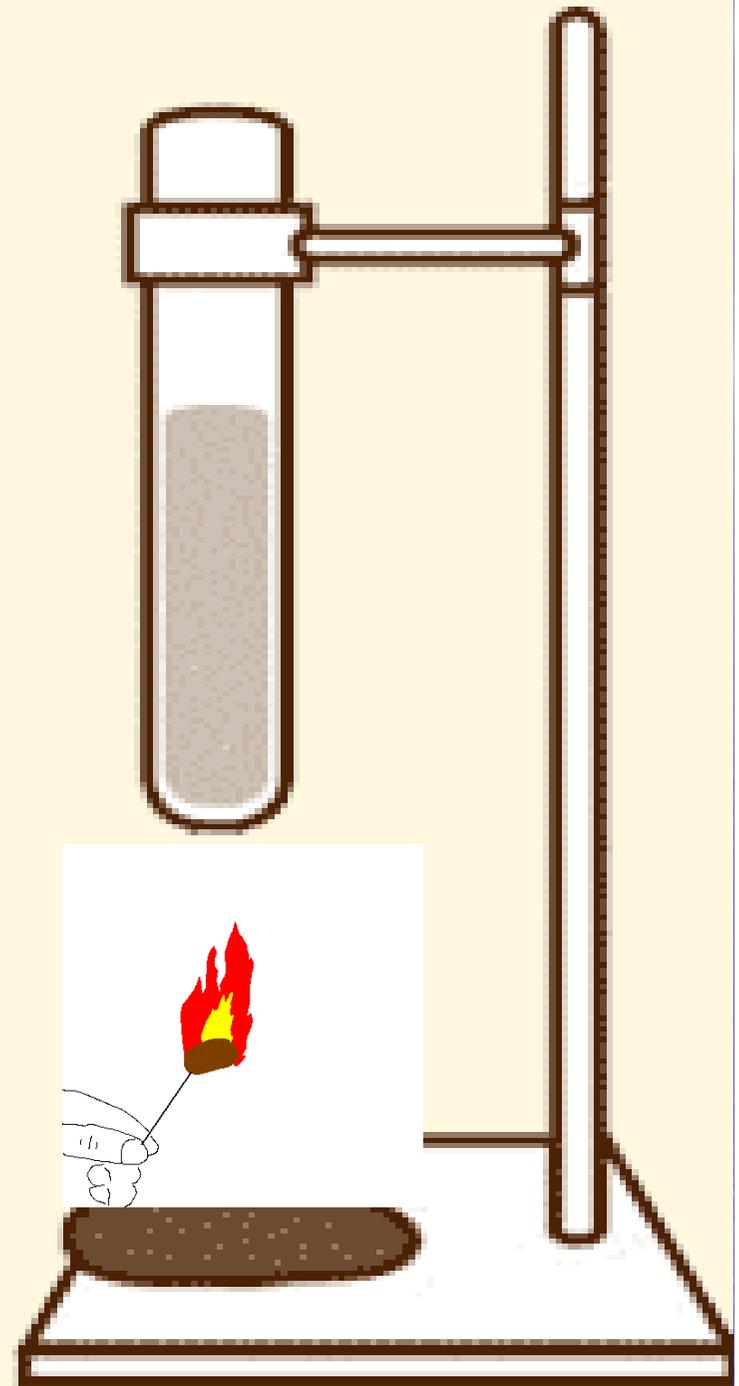


Consider the energy released by a burning peanut.....

How is this like cellular respiration?



[Hyperlink](#)



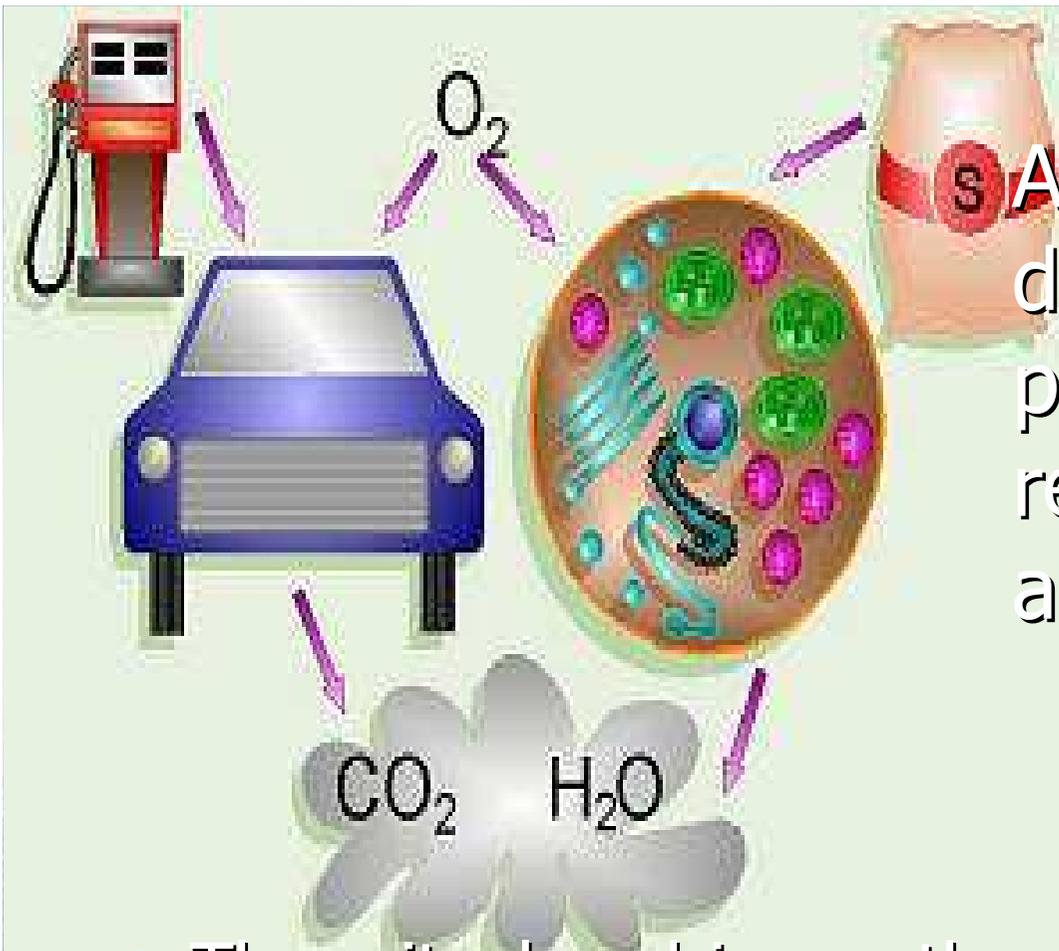
- **What happened to the peanut? What happened to the water? Why?**
 - The peanut burned completely. It changed in mass. The water temperature was raised.
 - When the peanut was burned, stored chemical energy was converted into heat energy,
 - thereby raising the temperature of the water.
- **B. Which organic compound is responsible for most of the calories found in a peanut?**
 - Peanuts contain mostly fat, followed by protein and carbohydrates.
- **C. What must happen to the food you eat before your cells can use the food's energy?**
 - Food must be digested, and then undergo cellular respiration, so that it is in the form cells can use for energy.
- **D. Explain how burning the peanut is similar to cellular respiration. Explain how it is different**
 - In both cases, the food is being oxidized. Chemical energy is being converted to heat energy.
 - The processes are different, because food is oxidized in cells during cellular respiration, while the food was ignited for the same effect in the experiment.



Cellular Respiration- the process by which living organisms harvest the energy in food molecules.



- This occurs when glucose molecules are broken down through a series of chemical reactions which produces ATP.
- The foods we eat provide our bodies with the raw materials for cellular respiration, which converts proteins, carbohydrates, and lipids into ATP.
- The O₂ in the air that we breathe makes this process more efficient.



An analogy can be drawn between the process of cellular respiration in our cells and a car.

- The mitochondria are the engines of our cells where sugar is burned for fuel and the exhaust is CO_2 and H_2O .
 - Note that in a car that burned fuel perfectly, the only exhaust should theoretically be CO_2 and H_2O also.

Cellular respiration

- What are the reactants of cellular respiration?
 - How do they get to our cells?
- What are the products of cellular respiration?
 - Where do the products go after they are produced?

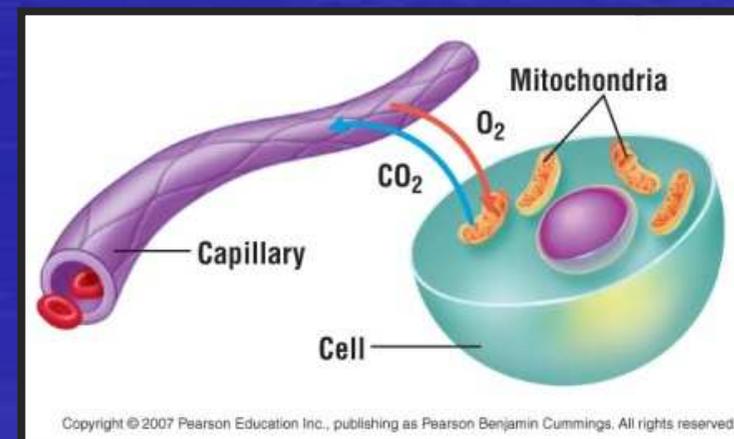
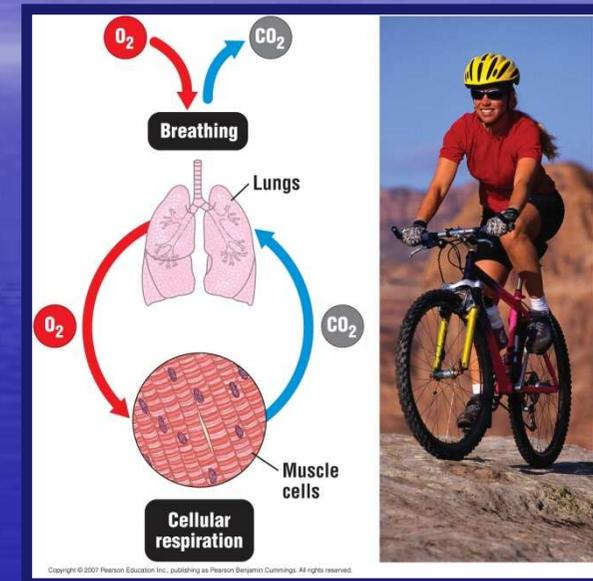
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How Breathing is Related to Cellular Respiration

Humans respire on two levels:

1) System level: The _____ system exchanges carbon dioxide for oxygen in the _____.

2) Cellular level: In each cell, oxygen is exchanged for carbon dioxide across the _____.



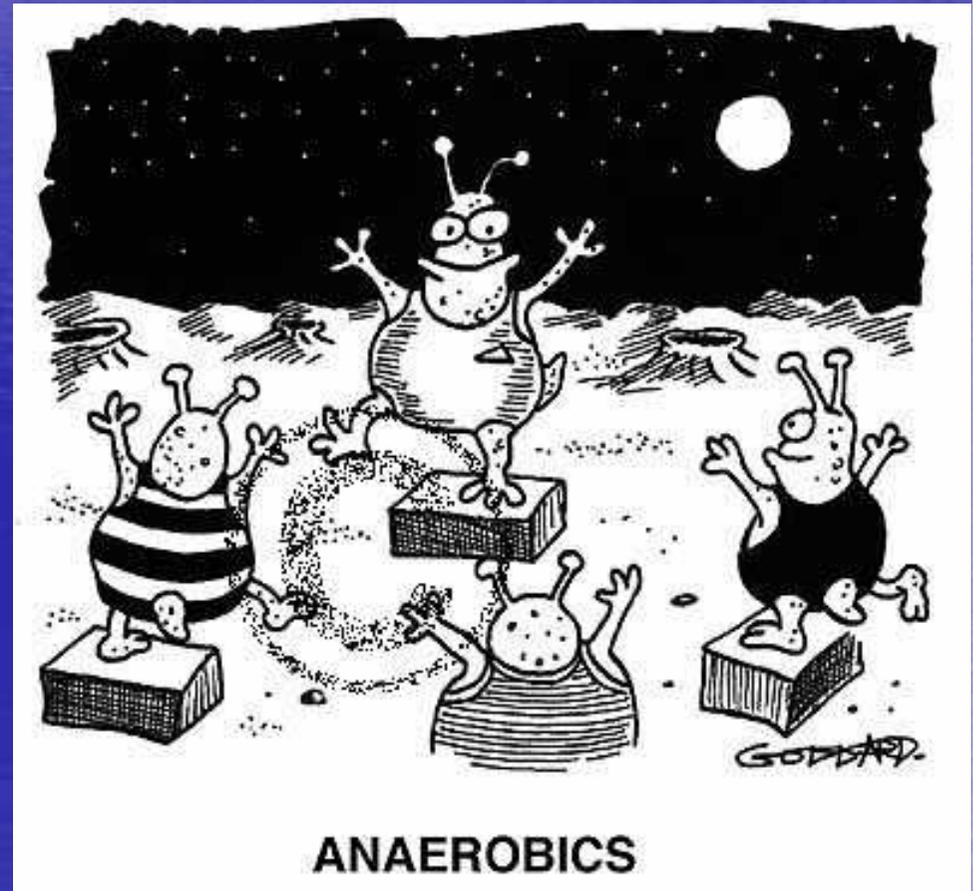
What is the goal of cellular respiration?

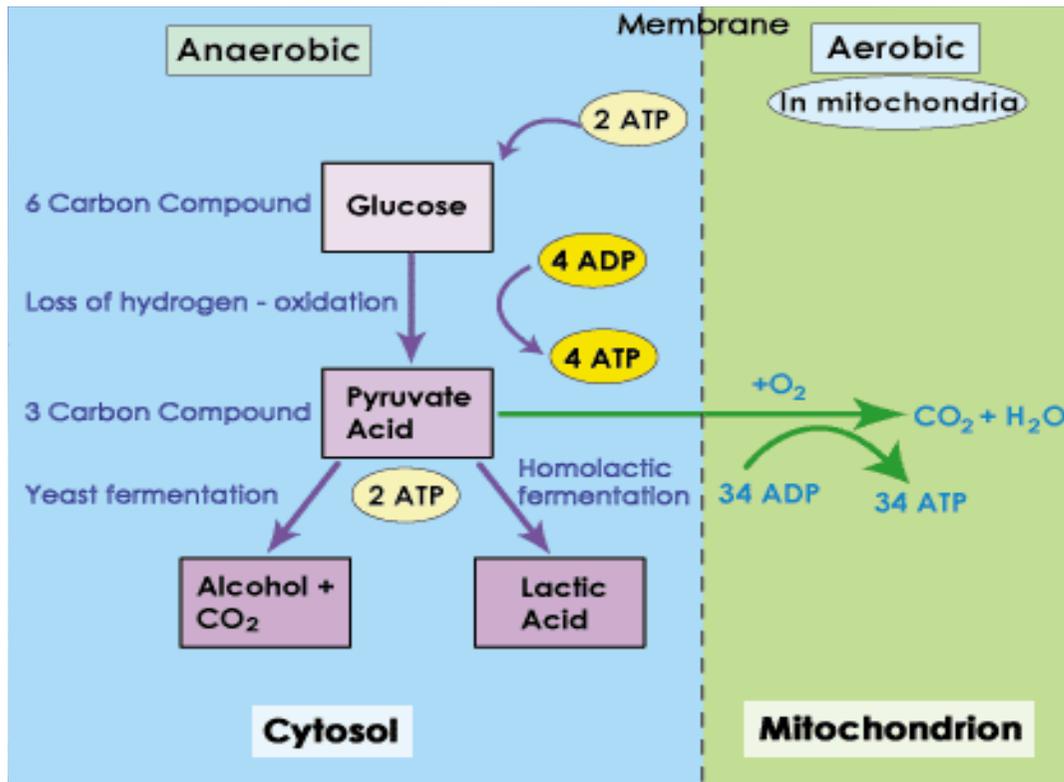


There are two forms of cellular respiration:

Aerobic, which requires oxygen produces 36 molecules of ATP for each molecule of glucose.

Anaerobic, which does not require oxygen produces only 2 molecules of ATP for each molecule of glucose.





Cellular Respiration:

Aerobic or Anaerobic

1. Glycolysis

- "to break apart a sweet"
- Glucose is converted to pyruvate, producing a small amount of ATP and NADH (4 ATP are produced, but two are consumed for a net of 2 ATP).
- occurs in the Cytoplasm

2a. **Aerobic**, which requires oxygen

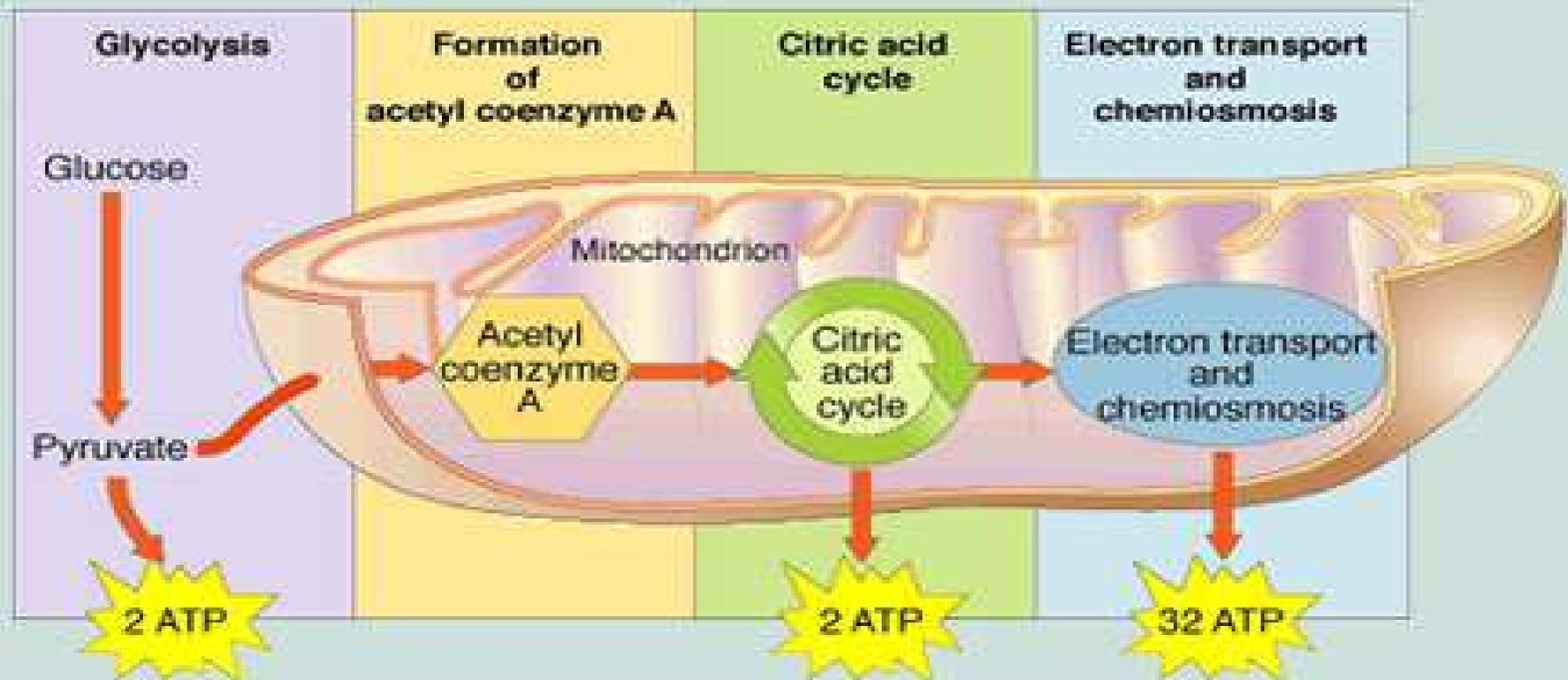
- produces 36 molecules of ATP for each molecule of glucose. (occurs in mitochondria)

2b. **Anaerobic**, which does not require oxygen-

- produces only 2 molecules of ATP for each molecule of glucose.

There are three steps in the process of aerobic cellular respiration:

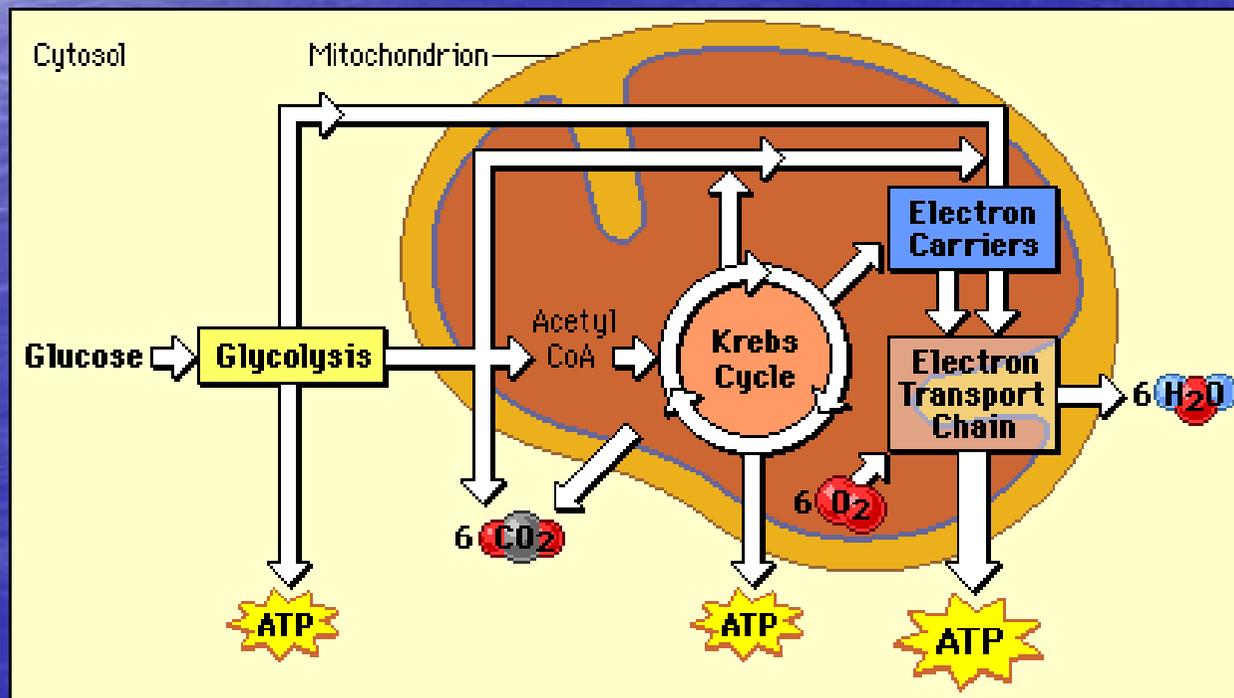
- Glycolysis
- Krebs cycle
- electron transport chain.



There are three steps in the process of cellular respiration:

1. Glycolysis occurs in the cytosol.
2. The Krebs cycle takes place in the matrix of the mitochondria.
3. Electron transport chain is carried out on the inner mitochondrial membrane.

ALTERNATIVE: In the absence of oxygen, respiration consists of two metabolic pathways: glycolysis and fermentation. Both of these occur in the cytosol.



Anaerobic Cellular Respiration:

1. Glycolysis- 4 ATP are produced, but two are consumed for a net of 2 ATP
2. Fermentation-the extraction of energy from pyruvate in the absence of oxygen
 - a. Alcoholic Fermentation-Produces CO_2 and Ethanol. Produces 2 ATP.
 - b. Lactic Acid Fermentation-Produces lactic acid. Produces 2 ATP



When oxygen is not available to serve as the final electron acceptor, electrons carried by NADH are transferred to pyruvate produced during glycolysis. This is known as **Fermentation**. The two types of fermentation are:

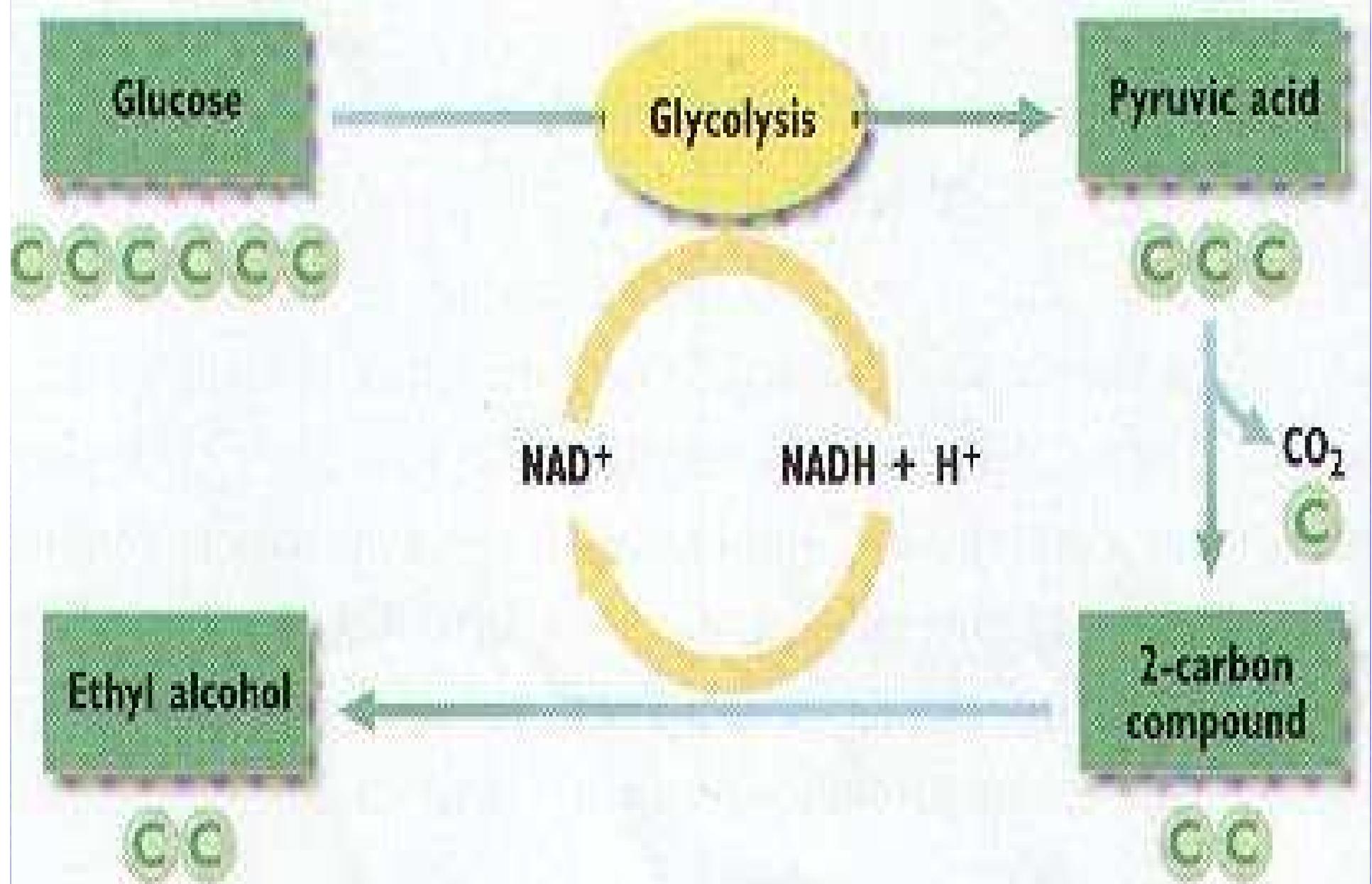
Lactic Acid Fermentation

Alcoholic Fermentation

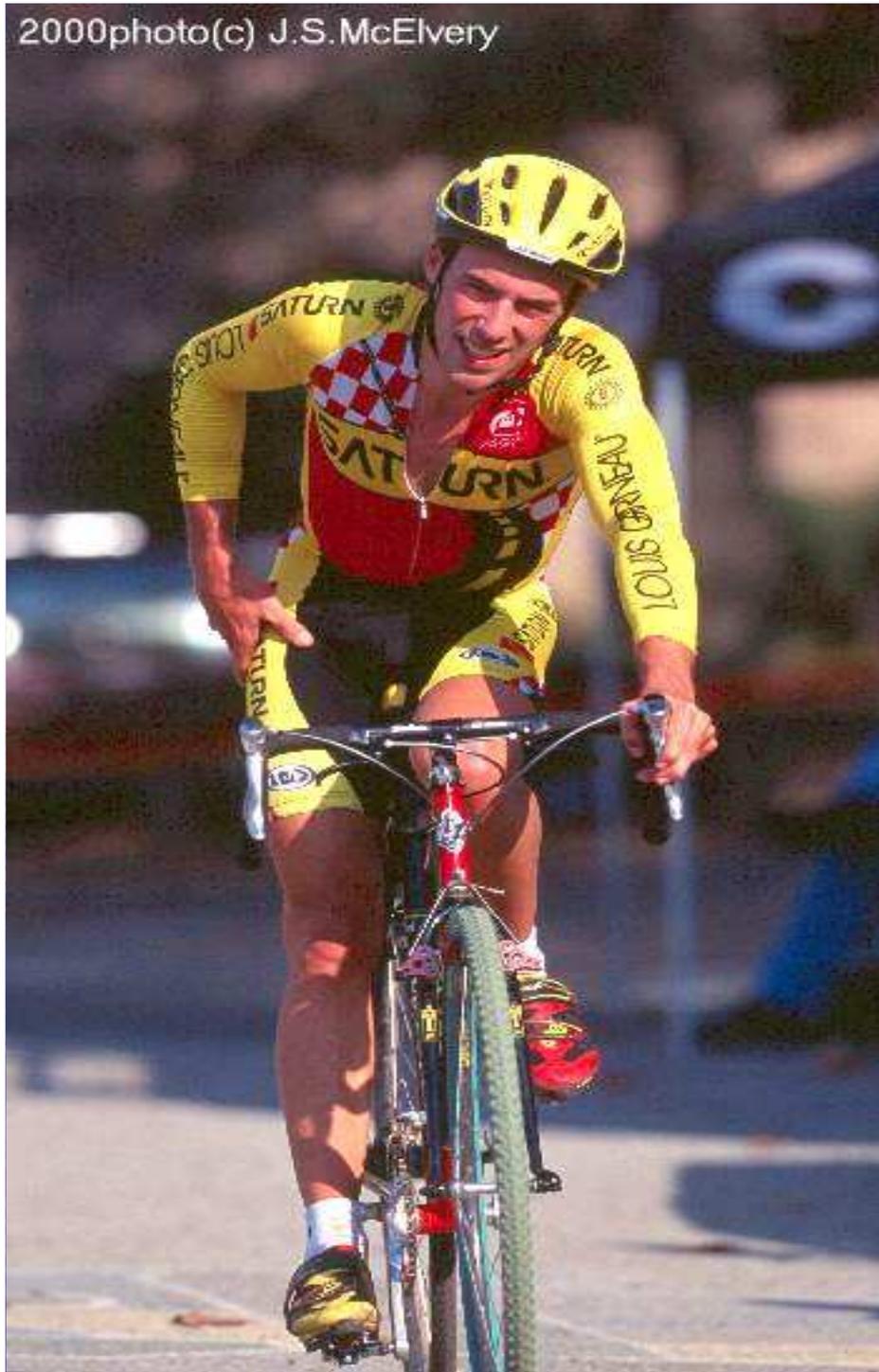
Fermentation is the extraction of energy from pyruvate in the absence of oxygen.

Yields 2 ATP

(b) ALCOHOLIC FERMENTATION

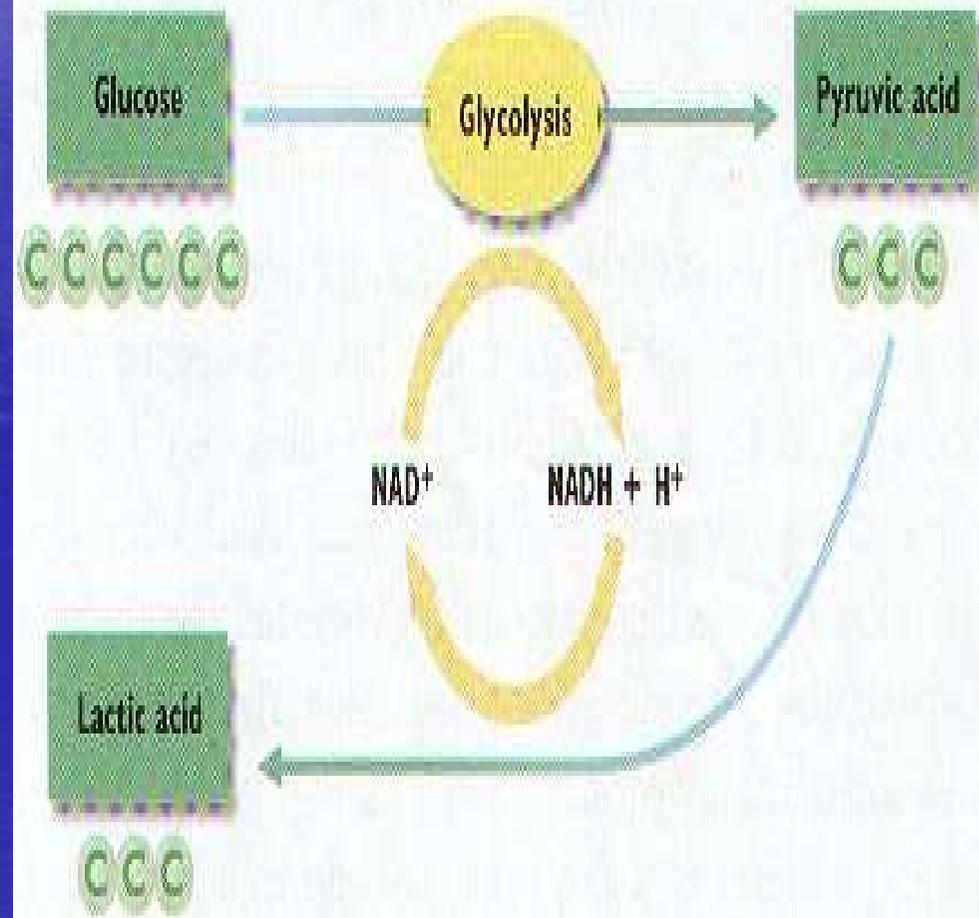


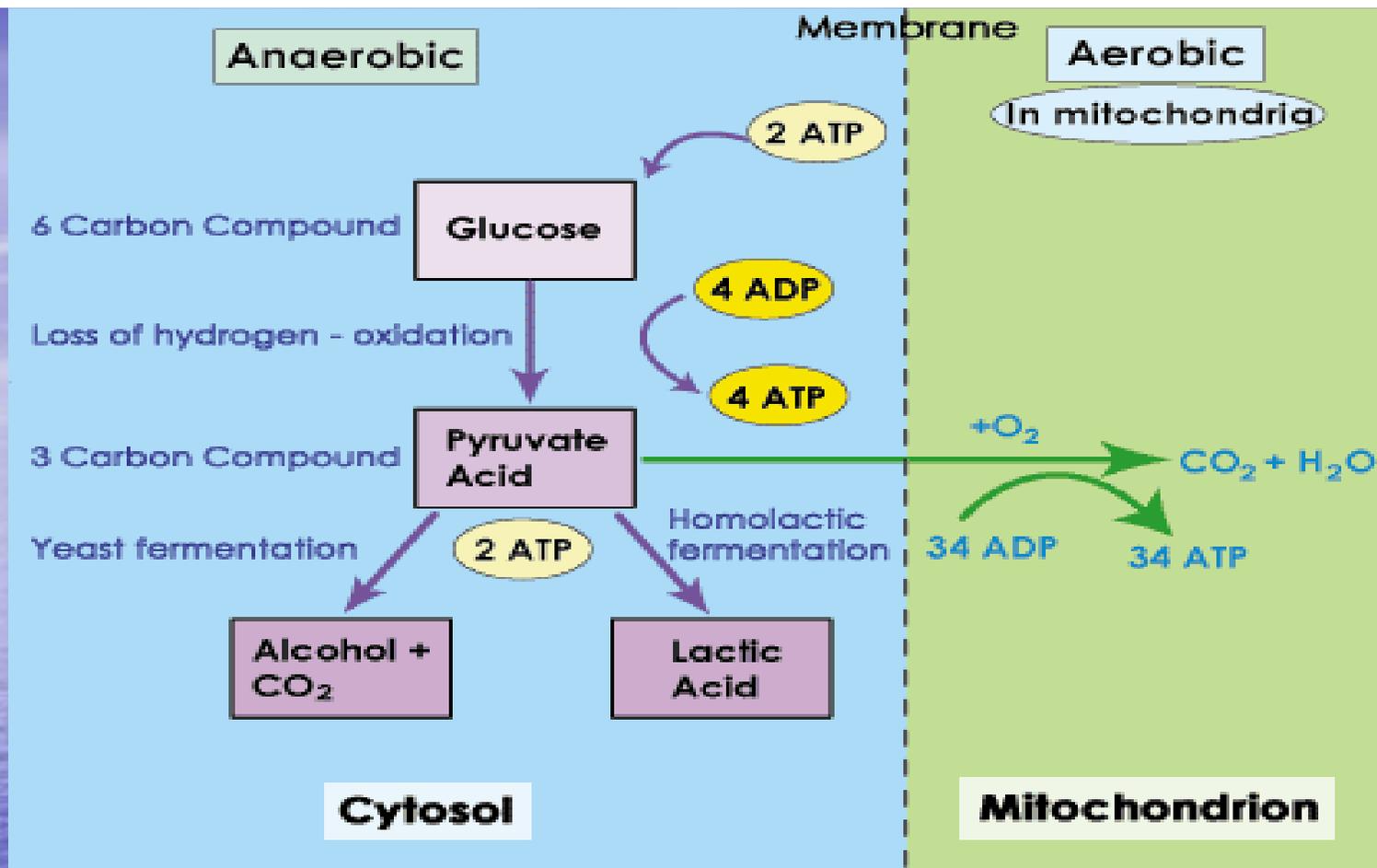
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During vigorous exercise pyruvate in muscles is converted to lactate when muscle cells must operate under low oxygen conditions. This fermentation allows glycolysis to continue to produce ATP, however lactate builds-up in muscles creating soreness.

(a) LACTIC ACID FERMENTATION





Anaerobic Cellular Respiration:

- **Glycolysis**- same as above
- **Fermentation**-the extraction of energy from pyruvate in the absence of oxygen.
 - Alcoholic Fermentation**-Produces CO₂ and Ethanol (alcohol). Produces 2 ATP.
 - Lactic Acid Fermentation**-Produces lactic acid (think yogurt). Produces 2 ATP

What You Need to Know

1. That ATP is generated from the enzymatic breakdown of glucose
2. That the process of making ATP from glucose is called cellular respiration
3. Be able to write the chemical equation for cellular respiration
4. That cellular respiration is divided into 3 parts
 - Glycolysis – cytoplasm
 - Citric acid cycle – mitochondria
 - Electron transport chain – mitochondria
5. Know that electrons are stripped from glucose as it is broken down and that these electrons are carried to the electron transport chain in the form of NADH to make most of the ATP
6. Know that the entire process converts 1 molecule of glucose to 36 molecules of ATP mainly through the enzyme ATP synthase.
7. Know that oxygen is needed to accept the electrons after they have been through the electron transport chain and that the oxygen and its accepted electrons eventually form harmless metabolic water.
8. Know that fermentation is a less efficient method of getting energy (ATP) from glucose when oxygen is not available and that lactic acid in animals and ethyl alcohol in microbes is the result of fermentation.