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Glycolysis

1. Glucose uses 2 ATP molecules to change from a 6-C sugar to 2 molecules of PGAL (phosphoglyceraldehyde) which are 3-C sugars.
2. These 2 PGAL molecules in turn are broken down to 2 molecules of pyruvic acid. This reaction provides the energy to form 4 ATP molecules and also donates 4 hydrogen atoms. 2 combine with NAD (nicotinamide adenine dinucleotide) to form NADH and forms 2 ions of hydrogen H^+ .

Alcoholic Fermentation

(Anaerobic Respiration)

1. Pyruvic acid is broken down by yeast to form ethanol (ethyl alcohol) (C_2H_5OH) and carbon dioxide (CO_2). In the process, it uses NADH and H^+ to form NAD, which is of course used in glycolysis. This allows glycolysis to continue.
2. This is the alcohol used in alcoholic drinks. It is limited to about 14% alcohol content because the alcohol kills the yeast. The CO_2 is also the source of gas to raise bread.

Lactic Acid Fermentation

(Anaerobic Respiration)

1. Pyruvic acid is broken down by bacteria to form lactic acid. In the process, it uses NADH and H^+ to form NAD, which is of course used in glycolysis. This allows glycolysis to continue.
2. Selected bacteria are used for various food products such as yogurt, cheese, and soy sauce. Muscles also will use lactic acid fermentation to provide energy when not enough oxygen is available.

Aerobic Respiration

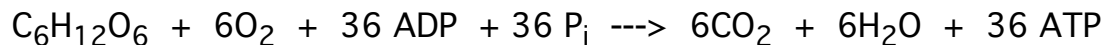
1. Pyruvic acid is changed by enzyme action into 2-C acetic acid and a CO_2 molecule is released. It is moved into a mitochondrion.
2. Coenzyme-A joins with acetic acid forming acetyl coenzyme-A .
3. The coenzyme-A has transformed the pyruvic acid into a product which can in turn join with oxaloacetic acid. The coenzyme-A leaves to get more acetic acid.

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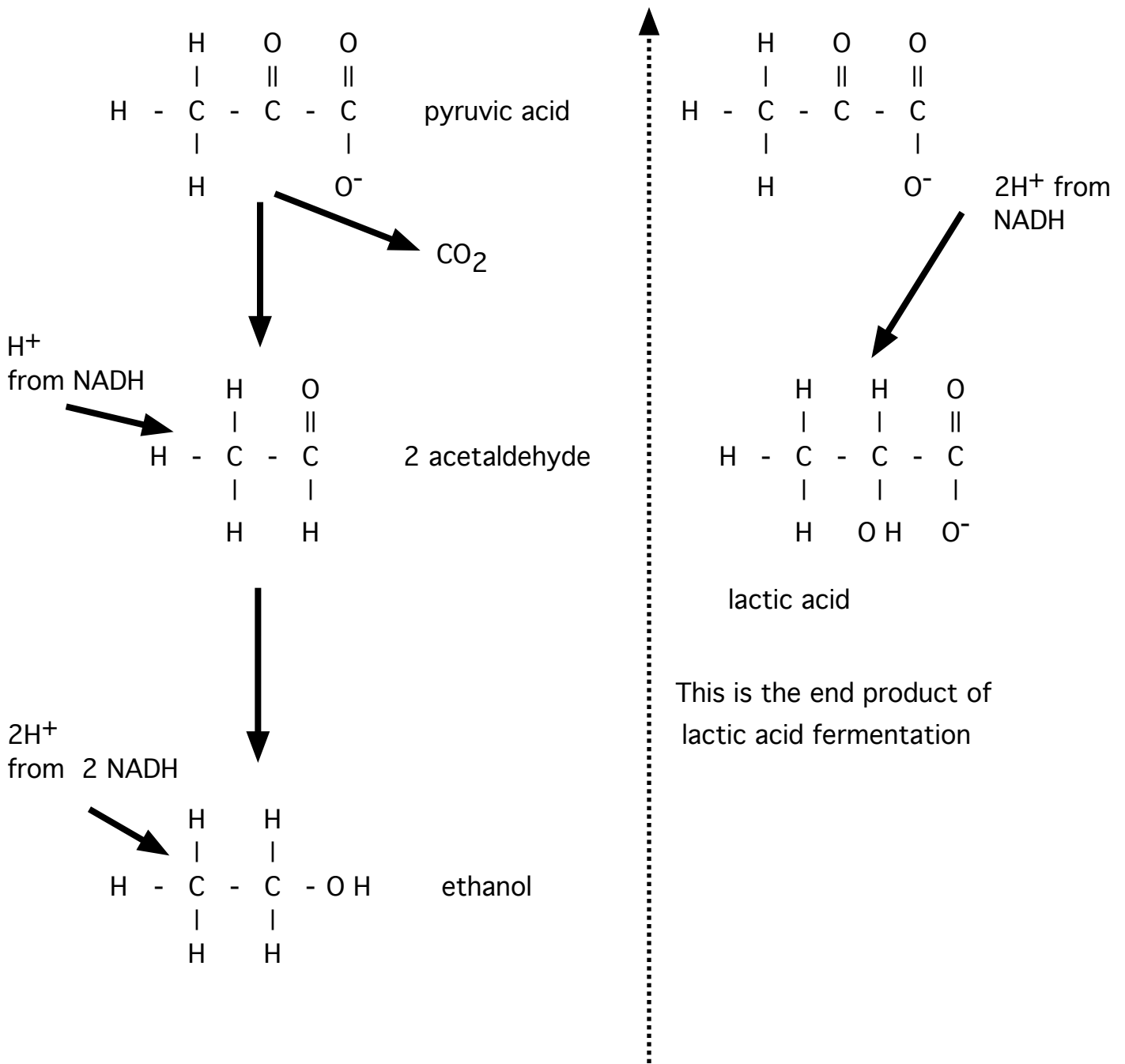
4. This is the start of the citric acid cycle (also known as the Krebs's cycle). The 2-C acetic acid combines with a 4-C compound (oxaloacetic acid) to form a 6-C compound called citric acid.
5. By enzyme action citric acid gives off a molecule of CO_2 , and while in the presence of NAD^+ releases 2 hydrogen atoms, forming NADH and H^+ . The oxygen for the CO_2 comes from a water molecule. This forms a 5-C molecule.
6. This 5-C molecule is ketoglutaric acid which gives off a molecule of CO_2 to form a 4-C molecule succinic acid and one ATP molecule is formed.
7. FAD (flavin adenine dinucleotide) and NAD^+ each removed (by enzyme action) more hydrogen forming NADH and FADH_2 , and the 4-C compound resulting is oxaloacetic acid. This completes the cycle.

Electron Transport Chain

1. FADH_2 , NADH and H^+ give up $2e^-$ to form FAD and NAD . These are high energy electrons. Transport molecules called electron acceptors carry the electrons through a series of reactions.
2. Energy is gradually transferred to form 32 ATP molecules in this electron transport chain.
3. The final lower energy electrons combine with hydrogen ions H^+ and oxygen to form water.
4. The overall reaction is:



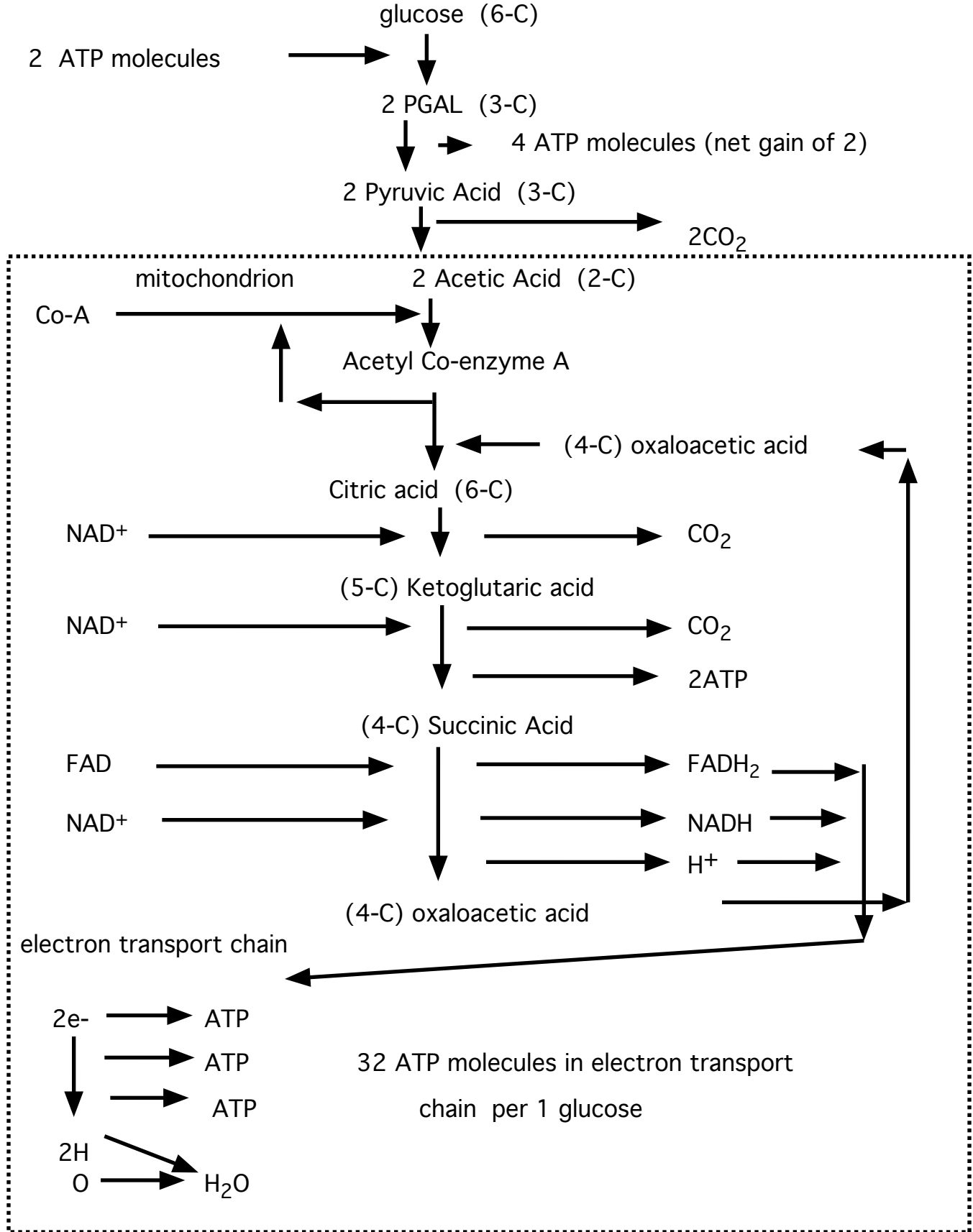
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 Fermentation from pyruvic acid



This is the end product of alcoholic fermentation.

This is the end product of lactic acid fermentation

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