Concept 6.3 Carbohydrate Catabolism in the Absence of Oxygen Releases a Small Amount of Energy

Under anaerobic conditions, NADH is reoxidized by **fermentation**.

There are many different types of fermentation, but all operate to regenerate NAD^+.

The overall yield of ATP is only two—the ATP made in glycolysis.

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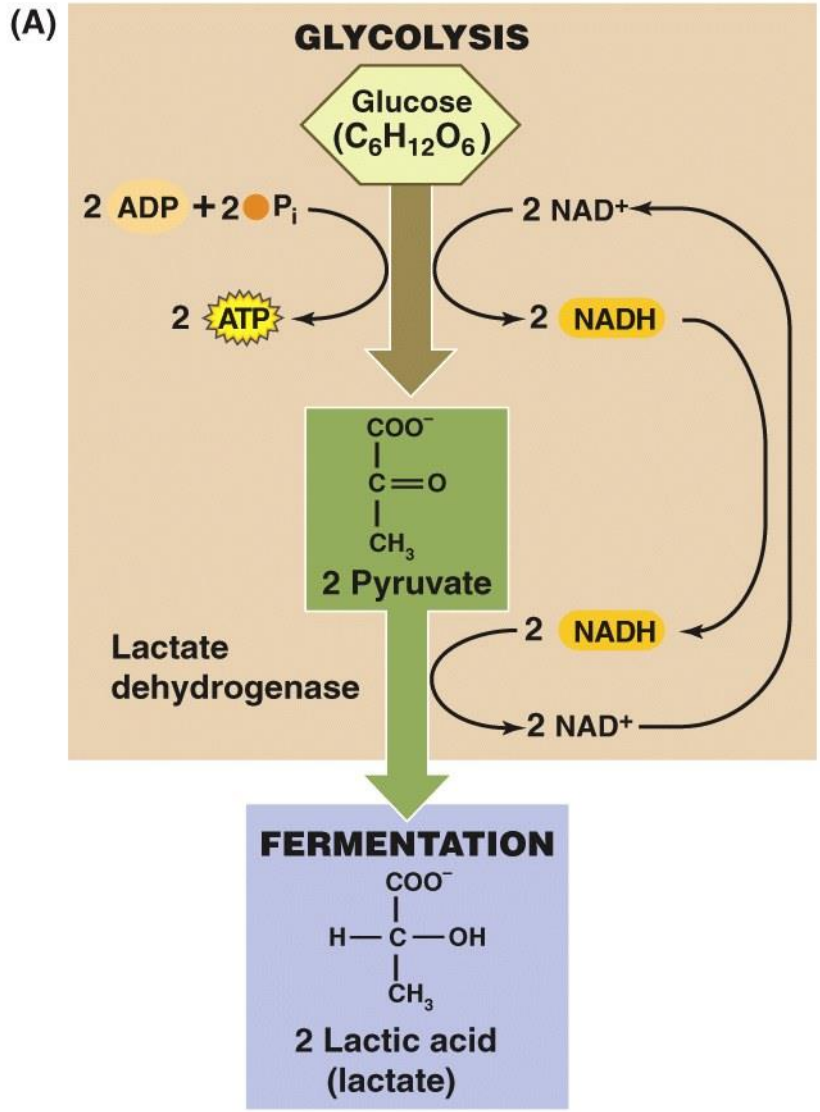
Lactic acid fermentation:

End product is lactic acid (lactate).

NADH is used to reduce pyruvate to lactic acid, thus regenerating NAD^+.

Figure 6.13 A Fermentation



Summary of reactants and products:

$C_6H_{12}O_6 + 2\ ADP + 2\ P_i \rightarrow 2$ lactic acid + 2 ATP

***PRINCIPLES OF LIFE,* Figure 6.13 (Part 1)**

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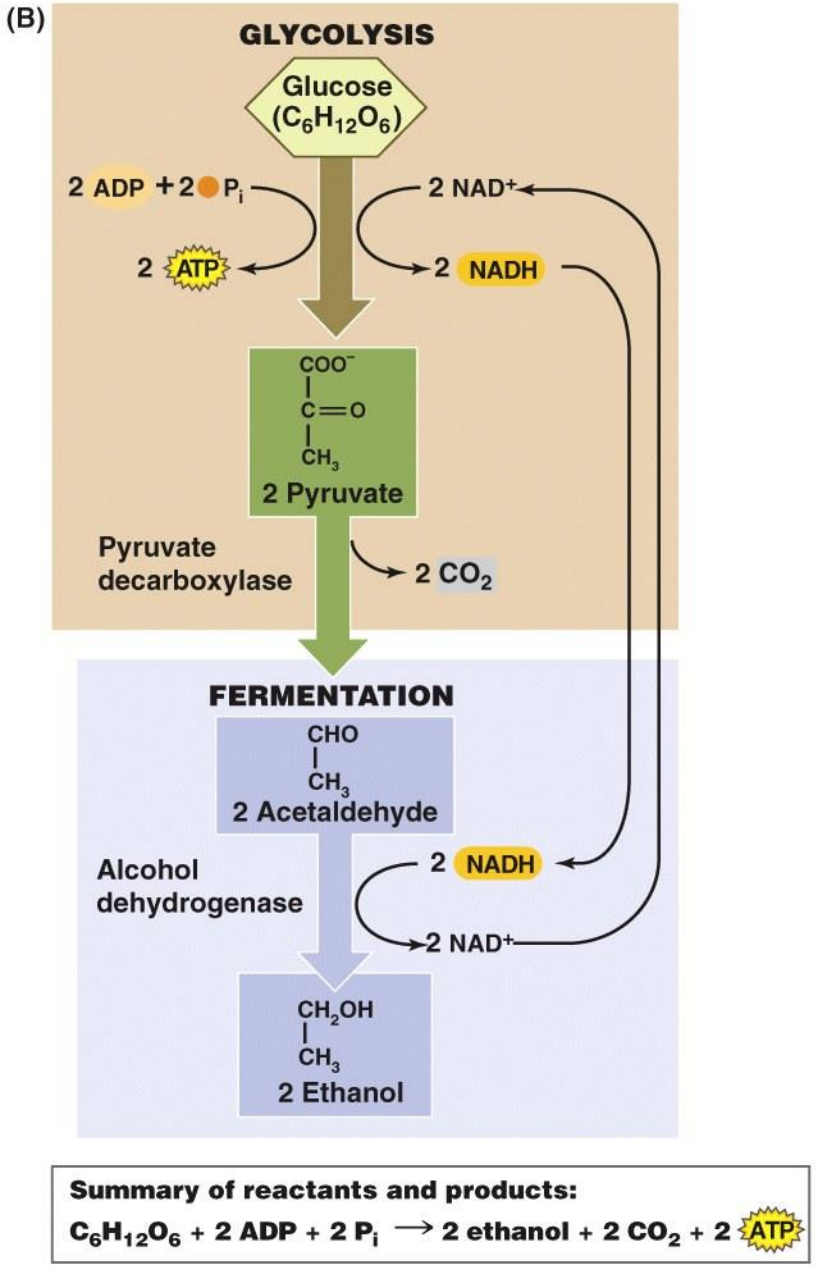
Alcoholic fermentation:

End product is ethyl alcohol (ethanol).

Pyruvate is converted to acetaldehyde, and CO_2 is released. NADH is used to reduce acetaldehyde to ethanol, regenerating NAD^+ for glycolysis.

Figure 6.13 B Fermentation

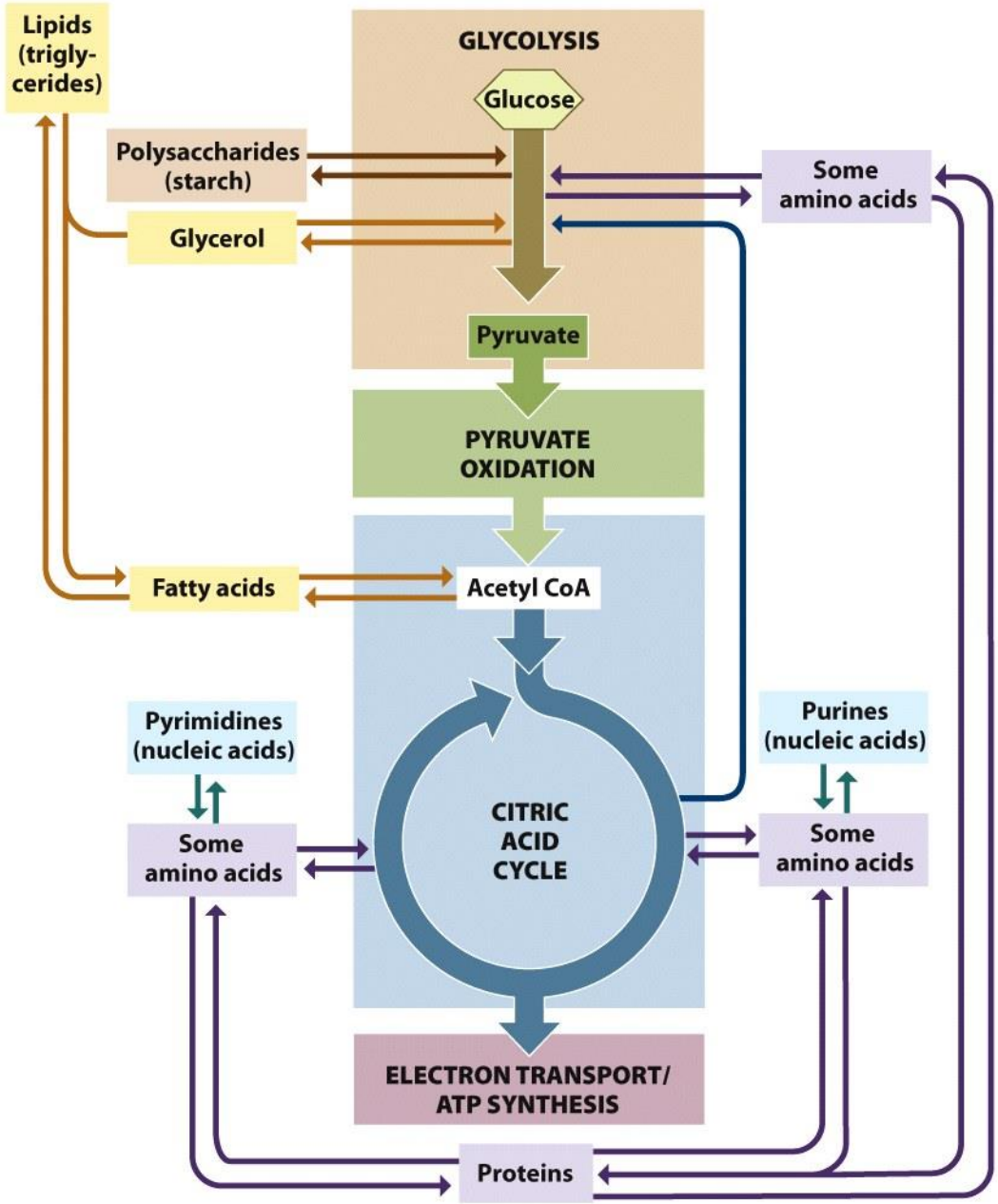


***PRINCIPLES OF LIFE,* Figure 6.13 (Part 2)**

Metabolic pathways are linked.

Carbon skeletons (molecules with covalently linked carbon atoms) can enter catabolic or anabolic pathways.

Figure 6.14 Relationships among the Major Metabolic Pathways of the Cell



***PRINCIPLES OF LIFE*, Figure 6.14**

Catabolism:

Polysaccharides are hydrolyzed to glucose, which enter glycolysis.

Lipids break down to fatty acids and glycerol. Fatty acids can be converted to acetyl CoA.

Proteins are hydrolyzed to amino acids that can feed into glycolysis or the citric acid cycle.

Anabolism:

Many catabolic pathways can operate in reverse.

Gluconeogenesis—citric acid cycle and glycolysis intermediates can be reduced to form glucose.

Acetyl CoA can be used to form fatty acids.

Some citric acid intermediates can form nucleic acids.

Amounts of different molecules are maintained at fairly constant levels—the *metabolic pools*.

This is accomplished by regulation of enzymes—allosteric regulation, feedback inhibition.

Enzymes can also be regulated by altering the transcription of genes that encode the enzymes.