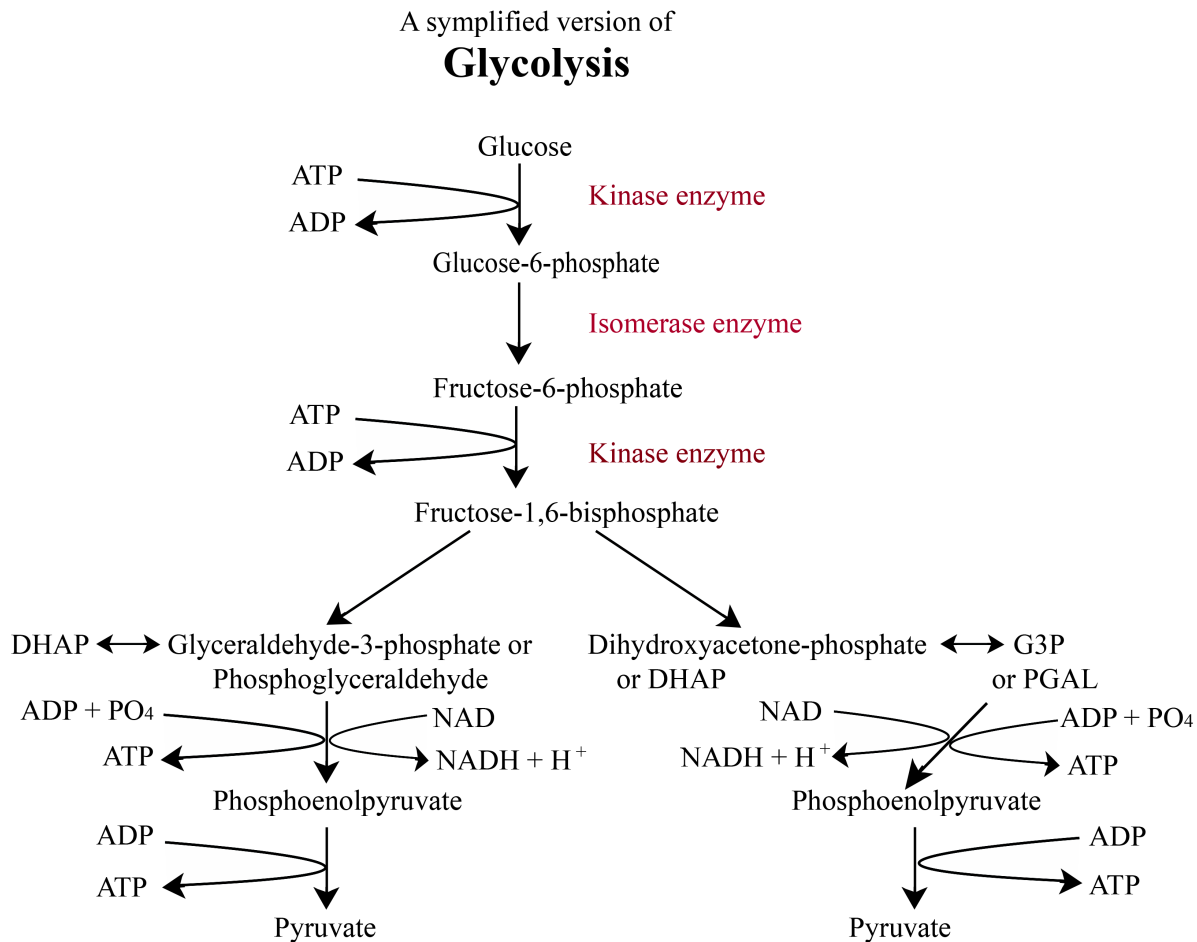


# Glycolysis and Fermentation

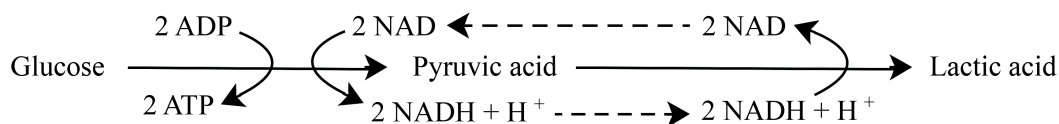
**Glycolysis** – The term glycolysis (glyco = sugar, lysis = to split) means literally the breakdown of sweets, but glycolysis has a more specific definition. It is the catabolism of glucose forming two molecules of pyruvic acid, with the resulting production of two ATP molecules (net yield), and the reduction of two molecules of NAD to NADH + H<sup>+</sup>.

Glycolysis is an important metabolic pathway, but is incomplete in that it must be associated with additional reactions in order to continue. Cells contain limited quantities of NAD, and if all the NAD available is reduced to NADH + H<sup>+</sup>, glycolysis will stop.

**Fermentation** – Fermentation is the anaerobic decomposition of organic compounds (primarily carbohydrates) that involves an organic compound (usually pyruvic acid) as the final electron acceptor. Fermentative organisms often use glycolysis to catabolize glucose, and then use the pyruvate formed as a final electron acceptor.



## Fermentation Pathway of Homofermentative Organisms



Here the pyruvate picks up two electrons and two hydrogen protons, and is converted into **lactic acid**, the only fermentation product of **homofermentative** bacteria such as *Lactococcus lactis*.

When glycolysis is a part of fermentation, the  $\text{NADH} + \text{H}^+$  produced can be oxidized by passing its extra electrons (and associated hydrogen protons) to pyruvic acid. Pyruvic acid is the final electron acceptor and in the process is converted into some other type of organic compound. Organisms that are **homofermentative** (homo = same) produce only lactic acid, while organisms that are **heterofermentative** (hetero = different) can often form a wide variety of fermentations products.

*Lactococcus lactis* (formerly *Streptococcus lactis*) is a type of homofermentative bacteria as are several species in the genera *Lactobacillus* and *Leuconostoc*. *Saccharomyces cerevisiae* is a type of yeast that is heterofermentative (producing primarily ethanol and carbon dioxide), and commonly used in the production of various foods (beer, wine, champagne, rootbeer, breads, etc.). When *Saccharomyces* is used in brewing, ethanol is of primary importance, but when it is used in baking, carbon dioxide is.

The ability of organisms to ferment various carbohydrates and the types of fermentation products they form can be useful in their identification, e.g., during physiological unknown #1 (PUNK1).

### Fermentation Pathways of Heterofermentative Organisms

