Semester-III

Biochemistry Notes

CARBOHYDRATE

by

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GLYCOLYSIS: UNIVERSAL PATHWAY FOR CELLULAR ENERGY PRODUCTION

- In most organisms, glycolysis occurs in the cytosol. The most common type of glycolysis is the Embden–Meyerhof–Parnas (EMP) pathway

➢ **Types of Glycolysis**
There are two types of glycolysis.

✓ **Aerobic Glycolysis:** From the word aerobic, meaning with the presence of oxygen. It occurs when oxygen is sufficient. Final product is pyruvate along with the production of Eight ATP molecules.

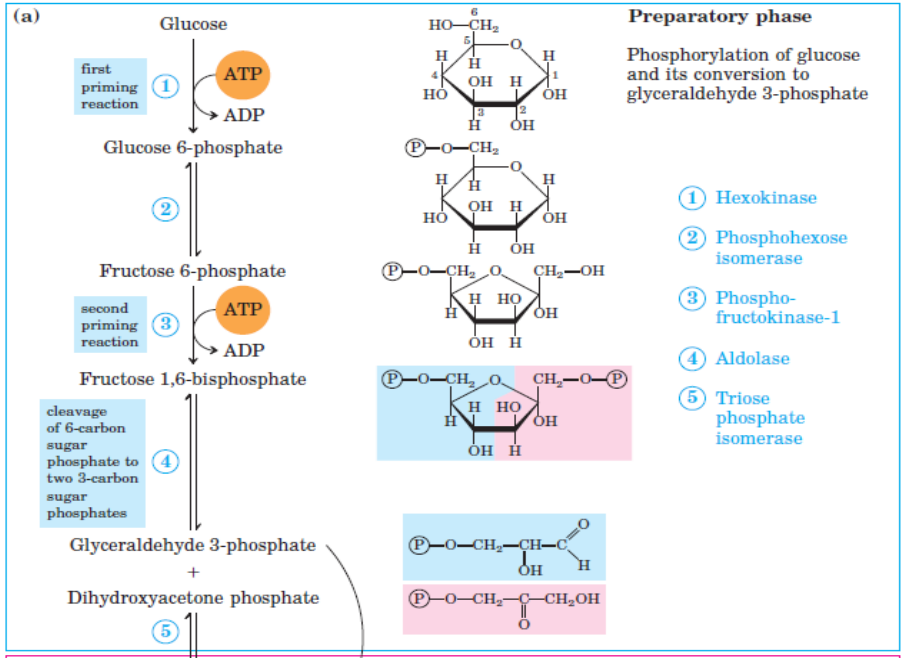
✓ **Anaerobic Glycolysis:** This type of glycolysis takes place in the absence of oxygen. Final product is lactate along with the production of two ATP molecules.

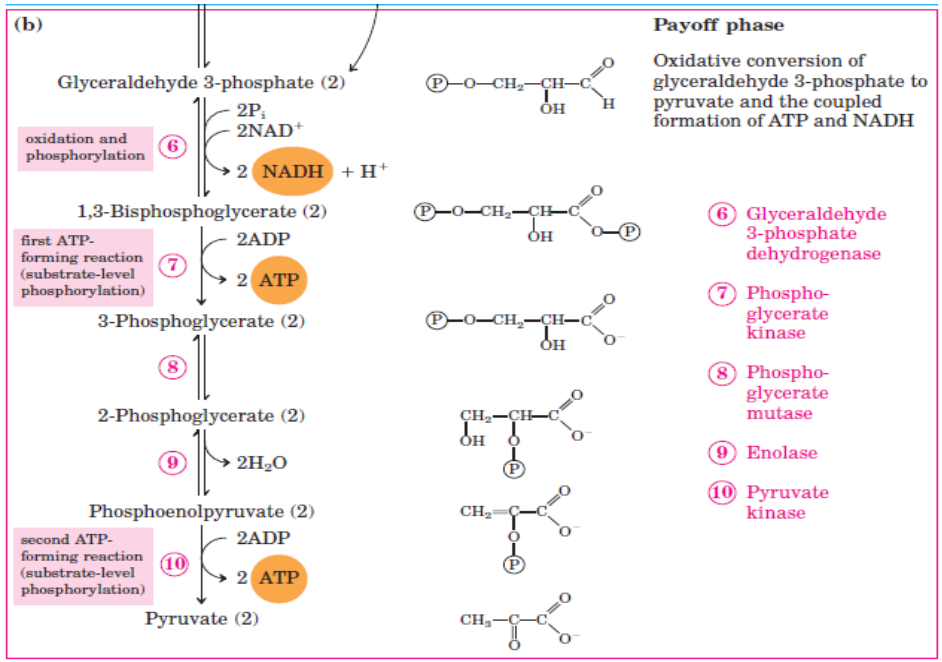
Steps of Glycolysis

Phases of Glycolysis

Preparatory Phase

Pay off Phase



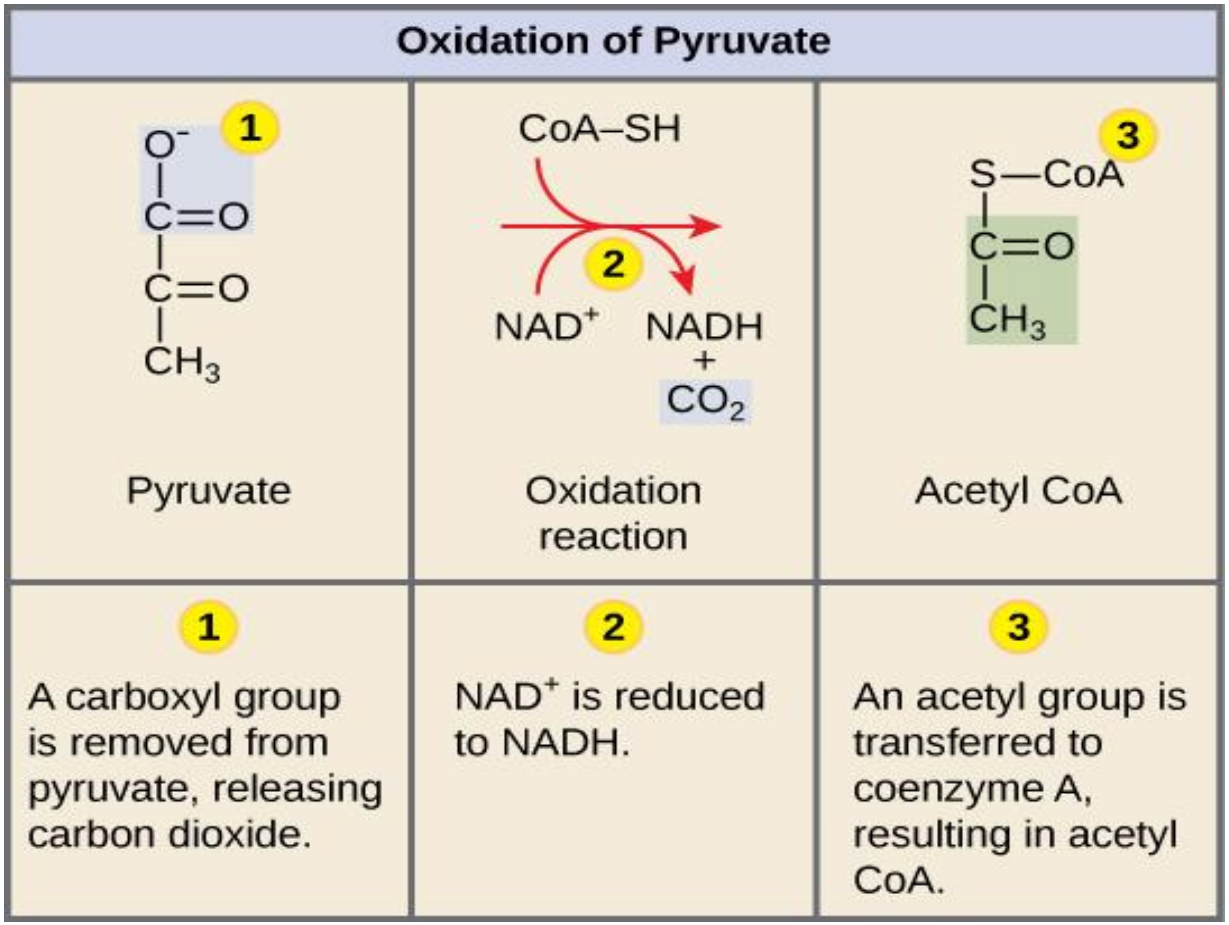


Significance of the Glycolysis Pathway

- Glycolysis is the only pathway that is takes place in all the cells of the body.
- Glycolysis is the only source of energy in erythrocytes.
- When performing physically-demanding tasks, muscle tissues may experience an insufficient supply of oxygen, the anaerobic glycolysis serves as the primary energy source for the muscles.
- The glycolytic pathway may be considered as the preliminary step before complete oxidation.
- It provides carbon skeletons for non-essential amino acid synthesis including the glycerol portion of fat.
- The majority of glycolytic pathway reactions are reversible, which is essential for gluconeogenesis or the formation of new glucose.

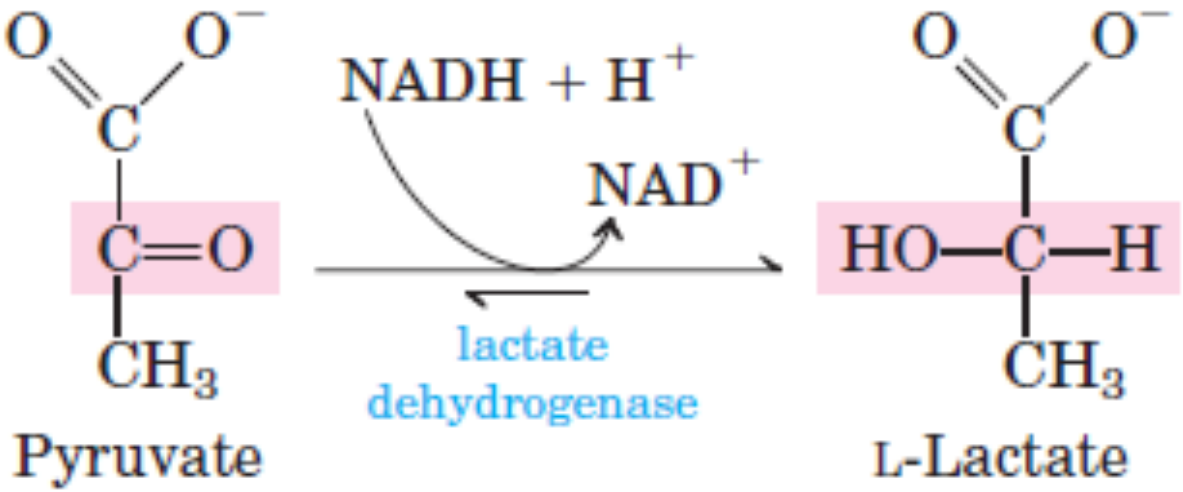
Fate of Pyruvate

Pyruvate produced from glycolysis undergoes oxidation phase to form acetyl CoA. The enzyme involved in this process is *Pyruvate Dehydrogenase Complex (PDH complex)*. Thus 2 acetyl CoA produced after glycolysis of one molecule of glucose. Acetyl CoA enters in mitochondria and initiates TCA cycle to produce more energy in the cell.



Additional Step in Anaerobic Condition

When animal tissues cannot be supplied with sufficient oxygen to support aerobic oxidation of the pyruvate and NADH produced in glycolysis, NAD+ is regenerated from NADH by the reduction of pyruvate to lactate.



Qsn & Ans

- ✓ **How many ATP are produced in glycolysis ?**

  At the end of the glycolysis process, a total of two (2) ATP is produced.

- ✓ **Where does glycolysis occur?**

  It occurs in the cell's cytoplasm.

- ✓ **What is the end product of glycolysis?**

  The end products of glycolysis are two ATP, two NADH, and two pyruvates.

- ✓ **Is glycolysis aerobic or anaerobic?**

  The glycolysis process itself is anaerobic, but after finishing the glycolysis process, the cell will continue respiration, which can move in the direction of aerobic or anaerobic. The choice primarily depends on the circumstances of the cell.

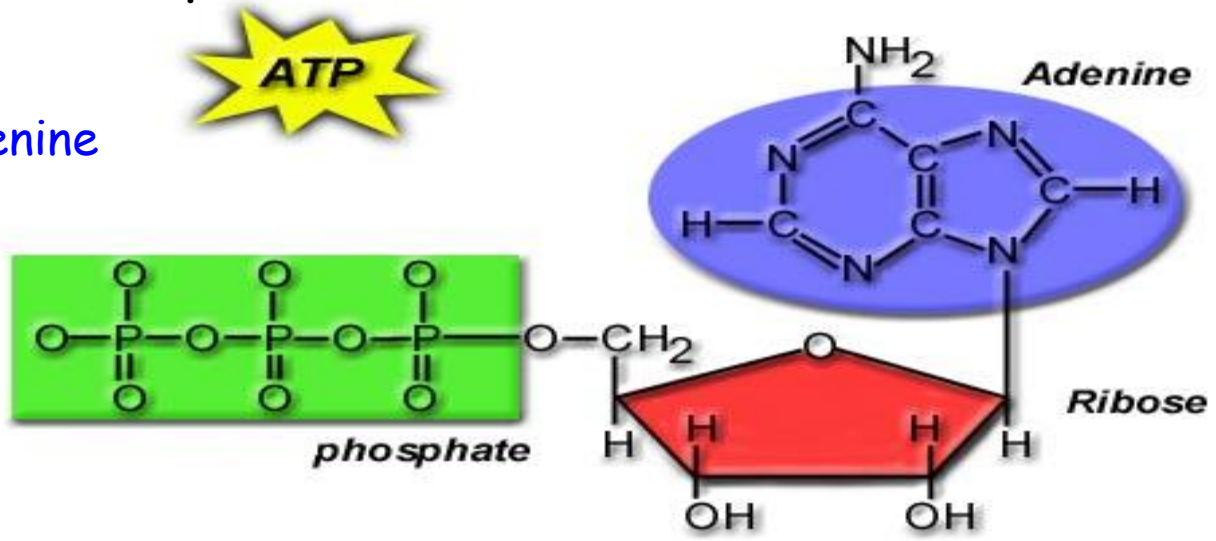
- ✓ **What is the function of glycolysis?**
  - It is the pathway of all cells in the body.
  - It is the main source of energy for the red blood cells.
  - It supplies the cells ample level of oxygen when performing strenuous activities.
  - It gives carbon skeletons for non-essential amino acid synthesis.
  - It is vital for the formation of new glucose.

- ✓ **Does glycolysis occur in all cells?**

  Glycolysis occurs in both eukaryotic and prokaryotic cells.

What Is ATP?

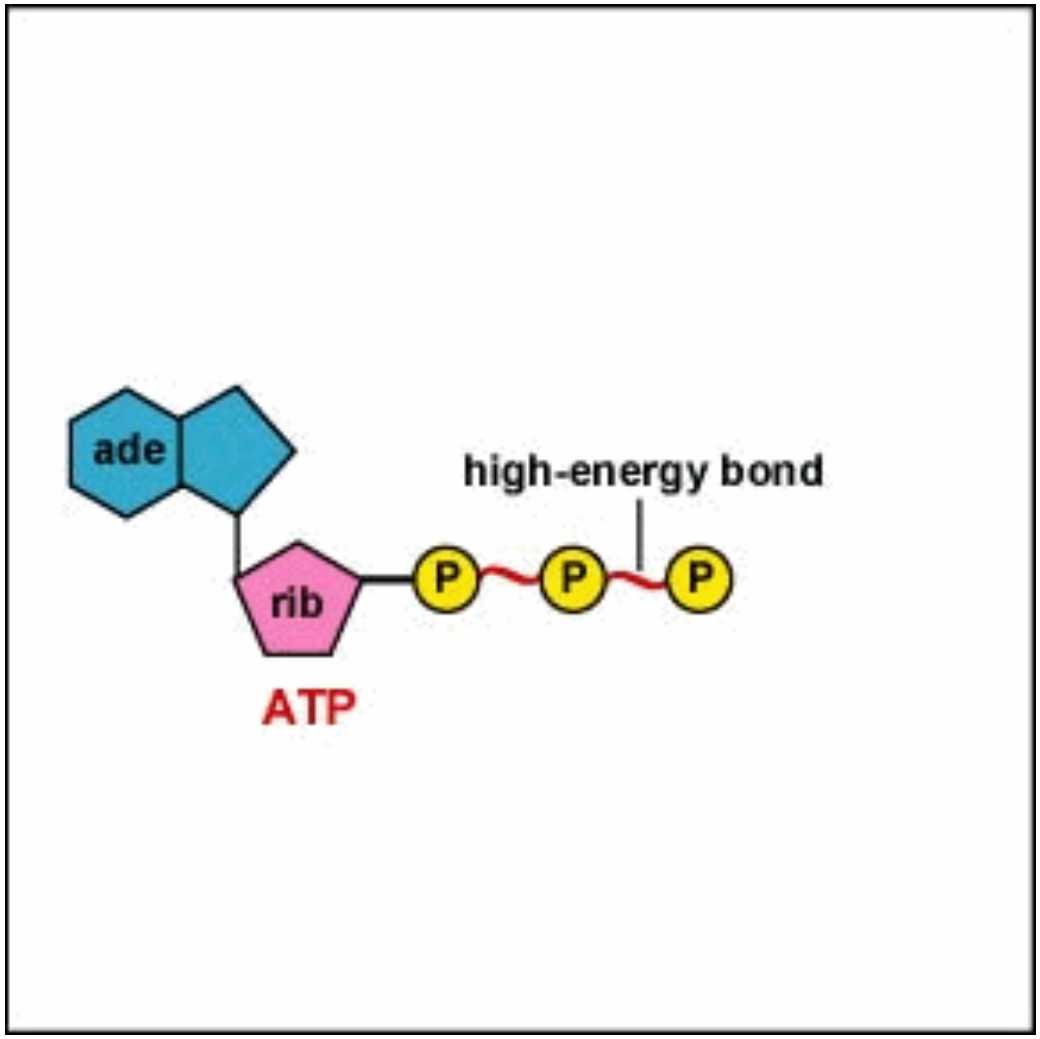
- Adenosine Triphosphate
- ATP is the energy currency of all cells (including plants and animals). It supplies you with energy
- ATP is a type of nucleic acid (like DNA and RNA)
- ATP contains high energy phosphate bonds that store and release energy
- Molecules of carbohydrates (glucose) and lipids are broken down through the process of cellular respiration to produce ATP



How Do We Get Energy From ATP?

Cells break phosphate bonds between the last two phosphate groups in a molecule of ATP as needed to supply energy for most cellular functions, when this happens a molecule of ADP (adenosine diphosphate) and a phosphate become available for reuse.

How Do We Get Energy From ATP?



ADP-ATP Cycle

When any of the phosphate bonds are broken or formed, energy is involved.

- Energy is released each time a phosphate is removed from the molecule.
- Energy is stored each time a phosphate attaches to the molecule.
- To constantly supply the cell with energy, the ADP is recycled, creating more ATP which carries much more energy than ADP.

- To supply cells with energy, a "high energy" bond in ATP is broken. ADP is formed and a phosphate is released back into the cytoplasm.

$$\text{ATP} \longrightarrow \text{ADP} + \text{phosphate} + \text{energy}$$

- As the cell requires more energy, ADP becomes ATP when a free phosphate attaches to the ADP molecule. Then energy needed to create an ATP molecule is much less than the amount of energy produced when the bond is broken.

$$\text{ADP} + \text{phosphate} + \text{energy} \longrightarrow \text{ATP}$$

The ADP-ATP Cycle