Section Summary

All cells use cellular respiration to generate ATP. The energy stored in the bonds of organic molecules such as glucose is used to drive the synthesis of ATP. The breakdown occurs through a series of chemical reactions called redox reactions. NAD^+ and FAD function as electron shuttles to the site ATP synthesis. There are two processes of ATP synthesis during cellular respiration: substrate-level phosphorylation and oxidative phosphorylation through the process of chemiosmosis.

Exercises

1. During _____ reactions electrons are donated, whereas in _____ reactions electrons are accepted.
    a. ATP; glucose
    b. reduction; oxidation
    c. glucose; ATP
    d. oxidation; reduction
2. The energy currency used by cells is _____.
    a. ATP
    b. water
    c. AMP
    d. oxygen
3. When NAD^+ accepts an electron, it is _____ to NADH.
    a. lowered
    b. oxidized
    c. reduced
    d. none of the above
4. Compare and contrast substrate level phosphorylation and chemiosmosis of oxidative phosphorylation.

Answers

1. (d)
2. (a)
3. (c)
4. In both processes, ATP is synthesized from ADP and inorganic phosphate. Substrate level does not require oxygen, whereas oxidative phosphorylation does.

Glossary

aerobic cellular respiration: the use of oxygen as an electron acceptor to complete metabolism

anaerobic cellular respiration: the use of an electron acceptor other than oxygen to complete metabolism

ATP: (also, adenosine triphosphate) the cell's energy currency

oxidation reaction: a chemical reaction that consists of an electron being donated by an atom

oxidative phosphorylation: production of ATP using the process of chemiosmosis in the presence of oxygen

phosphorylation: addition of a high-energy phosphate to a compound, usually a metabolic intermediate, a protein, or ADP

redox reaction: a chemical reaction that consists of the coupling of an oxidation reaction and a reduction reaction

reduction reaction: a chemical reaction that consists of an electron being gained by an atom

substrate-level phosphorylation: production of ATP from ADP using the excess energy from a chemical reaction and a phosphate group from a reactant

6.2 Glycolysis

Learning objectives

By the end of this section, you will be able to:

- *Describe the basic steps of glycolysis*
- *Know the starting reactants and final products of glycolysis*
- *Know which organisms are capable of glycolysis and where they carry these reactions out within the cell*
- *Be able to define and explain all bolded terms*

The carbohydrate, glucose, supplies much of the energy used by living cells. Glucose is catabolized in a series of chemical reactions called cellular respiration (Figure 6.10). This section will focus on glycolysis, the process where glucose is oxidized to produce small amounts of ATP.

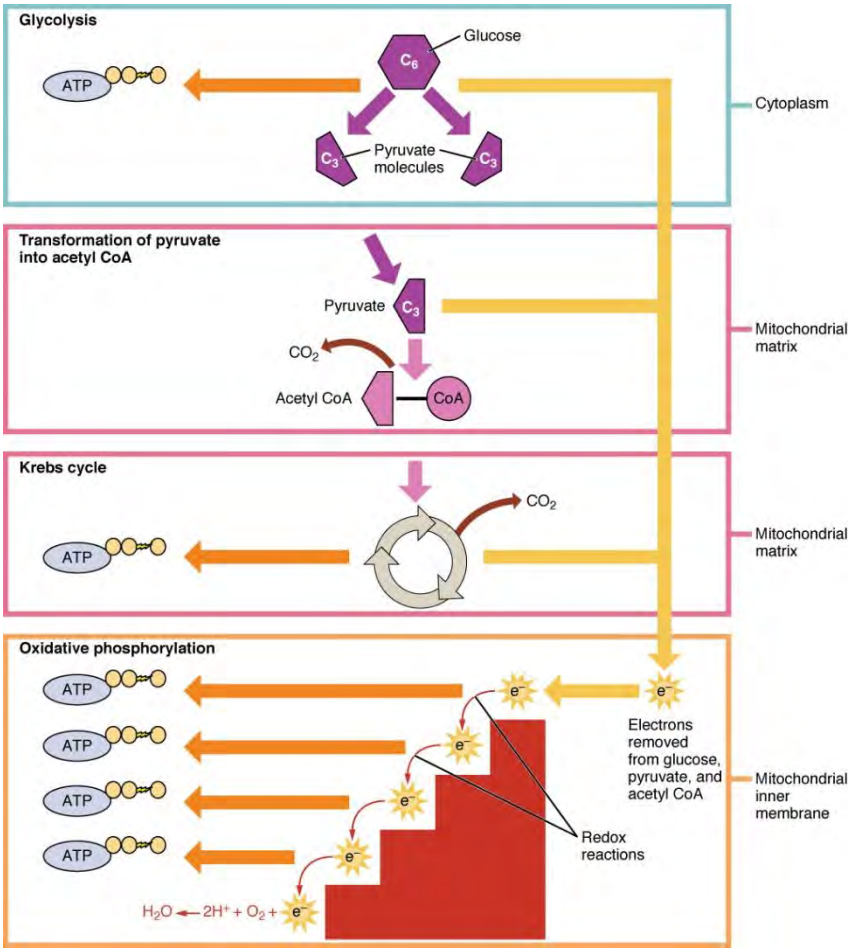

Figure 6.10 Cellular respiration oxidizes glucose molecules through glycolysis, Krebs cycle (citric acid cycle), and oxidative phosphorylation to produce ATP. (credit: Betts et al. / Anatomy and Physiology OpenStax)