Module 8: Cellular Respiration

Keys to Success & Study Guide

Learning Objectives

By the end of this module, you should be able to:

1. **Map** the stages of cellular respiration to their locations in the cell.
2. **Calculate** the inputs and outputs (ATP, NADH, $FADH_2$) for each stage.
3. **Explain** the function of the Electron Transport Chain and chemiosmosis.
4. **Compare** aerobic respiration, anaerobic respiration, and fermentation.

Key Terminology Checklist

Define these terms in your own words to ensure mastery.

- [ ] **Aerobic vs. Anaerobic**: Requiring oxygen vs. not requiring oxygen.
- [ ] **Oxidation**: Loss of electrons (glucose is oxidized during respiration).
- [ ] **Reduction**: Gain of electrons (oxygen is reduced to water).
- [ ] **Chemiosmosis**: ATP synthesis driven by the flow of H^+ ions down their electrochemical gradient through ATP synthase.
- [ ] **ATP Synthase**: The enzyme complex that synthesizes ATP from ADP and P_i.
- [ ] **Cristae**: Inner mitochondrial membrane folds that increase surface area for the ETC.

Concept Check

1. The Electron Transport Chain

- **Question**: What is the role of the ETC?
- **Key Answer**: The ETC transfers electrons through protein complexes, using the released energy to pump H^+ ions across the inner membrane. The resulting proton gradient drives ATP synthesis via ATP synthase (oxidative phosphorylation).

2. Oxygen's Role

- **Question**: Why is oxygen essential for aerobic respiration?
- **Key Answer**: Oxygen is the final electron acceptor in the ETC. Without it, electrons cannot flow, the proton gradient collapses, and ATP production ceases. Oxygen is reduced to water.

3. Fermentation

- **Question**: Why do cells perform fermentation?
- **Key Answer**: Fermentation regenerates NAD^+ from NADH, allowing glycolysis to continue producing 2 ATP per glucose in the absence of oxygen. The carbon in pyruvate is converted to ethanol (yeast) or lactate (muscle) rather than fully oxidized.