

CHAPTER 9

CELLULAR RESPIRATION: HARVESTING CHEMICAL ENERGY

Learning objectives:

The Principles of Energy Harvest

1. In general terms, distinguish between fermentation and cellular respiration.
2. Write the summary equation for cellular respiration. Write the specific chemical equation for the degradation of glucose.
3. Define oxidation and reduction.
4. Explain in general terms how redox reactions are involved in energy exchanges.
5. Describe the role of NAD^+ in cellular respiration.
6. In general terms, explain the role of the electron transport chain in cellular respiration.

The Process of Cellular Respiration

7. Name the three stages of cellular respiration and state the region of the eukaryotic cell where each stage occurs.
8. Describe how the carbon skeleton of glucose changes as it proceeds through glycolysis.
9. Explain why ATP is required for the preparatory steps of glycolysis.
10. Identify where substrate-level phosphorylation and the reduction of NAD^+ occur in glycolysis.
11. Describe where pyruvate is oxidized to acetyl CoA, what molecules are produced, and how this process links glycolysis to the citric acid cycle.
12. List the products of the citric acid cycle. Explain why it is called a cycle.
13. Describe the point at which glucose is completely oxidized during cellular respiration.
14. Distinguish between substrate level phosphorylation and oxidative phosphorylation.
15. In general terms, explain how the exergonic “slide” of electrons down the electron transport chain is coupled to the endergonic production of ATP by chemiosmosis.
16. Explain why ATP synthase is considered a molecular rotary motor.
17. Explain where and how the respiratory electron transport chain creates a proton gradient. Explain why this gradient is described as a proton motive force.
18. Summarize the net ATP yield from the oxidation of a glucose molecule by constructing an ATP ledger.
19. Calculate the efficiency of respiration in generating ATP.
20. Explain why it is not possible to state an exact number of ATP molecules generated by the oxidation of a molecule of glucose.

Related Metabolic Processes

21. Distinguish between fermentation and anaerobic respiration.
22. State the basic function of fermentation.
23. Compare the fate of pyruvate in alcohol fermentation and lactic acid fermentation.
24. Compare the processes of fermentation and cellular respiration.
25. Distinguish between obligate and facultative anaerobes.
26. Describe the evidence that suggests that glycolysis is an ancient metabolic pathway.

27. Describe how food molecules other than glucose can be oxidized to make ATP.
28. Explain how glycolysis and the citric acid cycle can contribute to anabolic pathways.
29. Explain how ATP production is controlled by the cell. Describe the role that the allosteric enzyme phosphofructokinase plays in this feedback control.