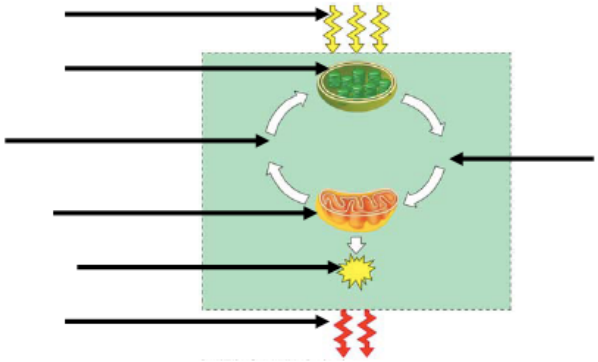
Chapter 9: Cellular Respiration

Overview: Before getting involved with the details of cellular respiration and photosynthesis, take a second to look at the big picture. Photosynthesis and cellular respiration are key ecological concepts involved with energy flow. Use Figure 9.2 to label the missing parts below.



Concept 9.1 Catabolic pathways yield energy by oxidizing organic fuels

1. Explain the difference between fermentation and cellular respiration.

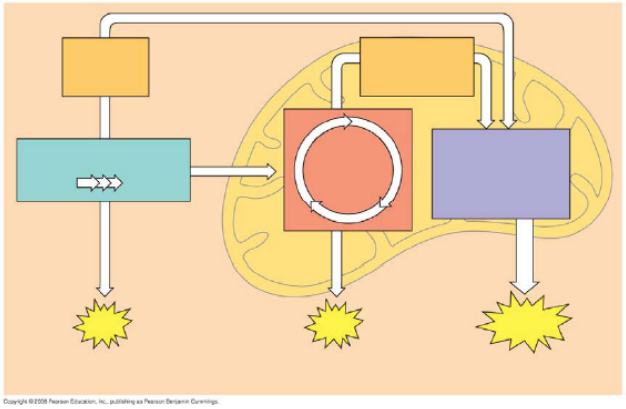
2. Give the formula (with names) for the catabolic degradation of glucose by cellular respiration.

3. Both cellular respiration and photosynthesis are *redox reactions*. In redox, reactions pay attention to the flow of electrons. What is the difference between oxidation and reduction?

4. When compounds lose electrons, they _____ energy; when compounds gain electrons, they _____ energy.

5. What is the function of the *electron transport chain* in cellular respiration?

6. Understanding the overall map of how cellular respiration works will make the details easier to learn. Use Figure 9.2 to label the missing information in the figure.



7. Three types of phosphorylation (adding a phosphate) are covered in the text, and two of these occur in cellular respiration. What is the difference between *oxidative phosphorylation* and *substrate level phosphorylation*?

Concept 9.2 Glycolysis harvests chemical energy by oxidizing glucose to pyruvate

8. Why is glycolysis an appropriate term for this step of cellular respiration?

9. The starting product of glycolysis is the six-carbon sugar _____, and the ending product is two _____ carbon compounds termed _____.

10. Glycolysis not only generates two molecules of pyruvate but also produces a few other compounds. List the compounds and state their roles.

Concept 9.3 The citric acid cycle completes the energy-yielding oxidation of organic molecules

11. To enter the citric acid cycle, pyruvate must enter the mitochondria by active transport. Three things are necessary to convert pyruvate to acetyl CoA.

(1) (2) (3)

12. How many times does the citric acid cycle occur for each molecule of glucose?

13. Use Figure 9.11 to help you answer the following summary questions about the citric acid cycle. For 1 pyruvate…

a. How many NADHs are formed?

b. How many total carbons are lost as pyruvate is oxidized?

c. The carbons have been lost in the molecule _____ _____ .

d. How many FADH2 have been formed?

e. How many ATPs are formed?

14. The diagram covers only one pyruvate, although two pyruvates are formed from a single glucose. How many molecules of the following are formed from the breakdown of glucose?

a. NADH = _____

b. FADH2 = _____

c. ATP = _____

15. Explain what has happened to the six-carbon atoms found in the original glucose molecule.

Concept 9.4 During oxidative phosphorylation, chemiosmosis couples electron transport to ATP synthesis

16. Explain why oxygen is the ultimate electron acceptor. Oxygen stabilizes the electrons by combining with two hydrogen ions to form what compound?

17. The two electron carrier molecules that feed electrons into the electron transport system are _____ and _____.

18. Using Figure 9.14, explain the overall concept of how ATP synthase uses the flow of hydrogen ions to produce ATP.

19. What is the role of the electron transport chain in forming the H+ gradient across the inner mitochondrial membrane?

20. Describe *chemiosmosis*.

21. At this point, you should be able to account for the total number of ATPs that could be formed from a glucose molecule. To accomplish this, we have to add the substrate-level ATPs from glycolysis and the citric acid cycle to the ATPs formed by chemiosmosis. Each NADH can form a maximum of _____ ATP molecules. Each FADH2, which donates electrons that activate only two proton pumps, makes _____ ATP molecules.

Concept 9.5 Fermentation enables some cells to produce ATP without the use of oxygen

22. Fermentation allows for the production of ATP without using either _____ or any _____ _____.

23. For aerobic respiration to continue, the cell must be supplied with oxygen—the ultimate electron acceptor. What is the electron acceptor in fermentation?

24. Explain how alcohol fermentation starts with glucose and yields ethanol. Be sure to stress how NAD+ is recycled.

25. Explain how lactic acid fermentation starts with glucose and yields lactate. Be sure to stress how NAD+ is recycled.