Anaerobic and Aerobic Respiration

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CONCEPT 1

Anaerobic and Aerobic Respiration

- Compare the advantages of aerobic and anaerobic respiration.

Why oxygen?

Oxygen is the final electron acceptor at the end of the electron transport chain of aerobic respiration. In the absence of oxygen, only a few ATP are produced from glucose. In the presence of oxygen, many more ATP are made.

Aerobic vs. Anaerobic Respiration: A Comparison

Aerobic respiration, which takes place in the presence of oxygen, evolved after oxygen was added to Earth's atmosphere. This type of respiration is useful today because the atmosphere is now 21% oxygen. However, some anaerobic organisms that evolved before the atmosphere contained oxygen have survived to the present. Therefore, **anaerobic respiration**, which takes place without oxygen, must also have advantages.

Advantages of Aerobic Respiration

A major advantage of aerobic respiration is the amount of energy it releases. Without oxygen, organisms can split glucose into just two molecules of pyruvate. This releases only enough energy to make two ATP molecules. With oxygen, organisms can break down glucose all the way to carbon dioxide. This releases enough energy to produce up to 38 ATP molecules. Thus, aerobic respiration releases much more energy than anaerobic respiration. The amount of energy produced by aerobic respiration may explain why aerobic organisms came to dominate life on Earth. It may also explain how organisms were able to become multicellular and increase in size.

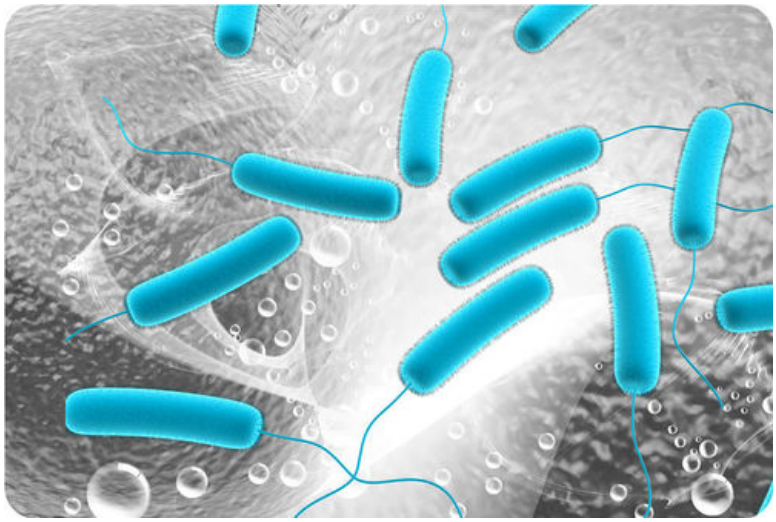

FIGURE 1.1

E. coli bacteria are anaerobic bacteria that live in the human digestive tract.

Advantages of Anaerobic Respiration

One advantage of anaerobic respiration is obvious. It lets organisms live in places where there is little or no oxygen. Such places include deep water, soil, and the digestive tracts of animals such as humans (see **Figure** 1.1).

Another advantage of anaerobic respiration is its speed. It produces ATP very quickly. For example, it lets your muscles get the energy they need for short bursts of intense activity (see **Figure** 1.2). Aerobic respiration, on the other hand, produces ATP more slowly.

FIGURE 1.2

The muscles of these hurdlers need to use anaerobic respiration for energy. It gives them the energy they need for the short-term, intense activity of this sport.

Vocabulary

- **aerobic respiration**: Type of cellular respiration that requires oxygen.
- **anaerobic respiration**: Type of cellular respiration that does not require oxygen.

Summary

- Aerobic respiration produces much more ATP than anaerobic respiration.
- Anaerobic respiration occurs more quickly than aerobic respiration.

Practice

Use this resource to answer the questions that follow.

- http://www.hippocampus.org/Biology → Biology for AP* → Search: **The Fate of Pyruvate and NADH**

1. What is the role of oxygen under aerobic conditions?
2. How is NAD^+ regenerated under anaerobic conditions?
3. Which metabolism is faster, aerobic or anaerobic?
4. Which cells have more mitochondria, those that metabolize aerobically or anaerobically?
5. Which metabolism produces more energy, aerobic or anaerobic? Why?

Review

1. What is the main advantage of aerobic respiration? Of anaerobic respiration?

2. Tanya is on the high school track team and runs the 100-meter sprint. Marissa is on the cross-country team and runs 5-kilometer races. Explain which type of respiration the muscle cells in each runner's legs use.