Concept of aerobic respiration, anaerobic respiration and fermentation

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Metabolism

- **Metabolism is the total** of all chemical reactions occurring in the cell.
- The flow of energy and the participation of enzymes make metabolism possible.
- Metabolism may be divided into two major parts.
  - In **catabolism** larger and more complex molecules are broken down into smaller, simpler molecules with the release of energy.
  - Some of this energy is trapped and made available for work; the remainder is released as heat.
- The trapped energy can then be used in anabolism, the second area of metabolism. **Anabolism** is the synthesis of complex molecules from simpler ones with the input of energy.
- An anabolic process uses energy to increase the order of a system.

Energy Source

- In a broader sense, microorganisms usually use one of three sources of energy.
- Phototrophs capture radiant energy from the sun.
- Chemoorganotrophs oxidize organic molecules to liberate energy.
- Chemolithotrophs employ inorganic nutrients as energy sources.

Electron Acceptors

- Microorganisms vary not only in their energy sources, but also in the electron acceptors used by chemotrophs**.**
- Three major kinds of acceptors are employed.
- In **fermentation** *the energy substrate* is oxidized and degraded without the participation of an exogenous or externally derived electron acceptor.

Or

- Fermentation also may be defined as an energy-yielding process in which organic molecules serve as both electron donors and acceptors.
- Usually the catabolic pathway produces an intermediate such as pyruvate that acts as the electron acceptor.
- Fermentation normally occurs under anaerobic conditions, but also occurs sometimes when oxygen is present.

Respiration

- Energy-yielding metabolism can also make use of exogenous or externally derived electron acceptors.
- This metabolic process is called **respiration** and **divided into two** different types.
- In **aerobic respiration, the final electron acceptor** is oxygen.
- Whereas the acceptor in **anaerobic respiration is a** different exogenous acceptor.
  - Most often the acceptor in anaerobic respiration is inorganic (e.g., NO_3^- , SO_4^{-2}, CO_2, Fe^{3+}, SeO_4^{2-}, and many others), but organic acceptors such as fumarate may be used.

Or

- Respiration is an energy-yielding process in which the acceptor is an inorganic molecule, either oxygen (aerobic respiration) or another inorganic acceptor (anaerobic respiration).
- Most respiration involves the activity of an electron transport chain.

Fermentation vs. Respiration

- The amount of available energy is quite different for fermentation and respiration.
- The electron acceptor in fermentation is at the same oxidation state as the original nutrient and there is no overall net oxidation of the nutrient.
- Thus only a limited amount of energy is made available.
- The acceptor in respiratory processes has reduction potential much more positive that the substrate and thus considerably more energy will be released during respiration.
- *In* both aerobic and anaerobic respiration, ATP is formed as a result of electron transport chain activity.

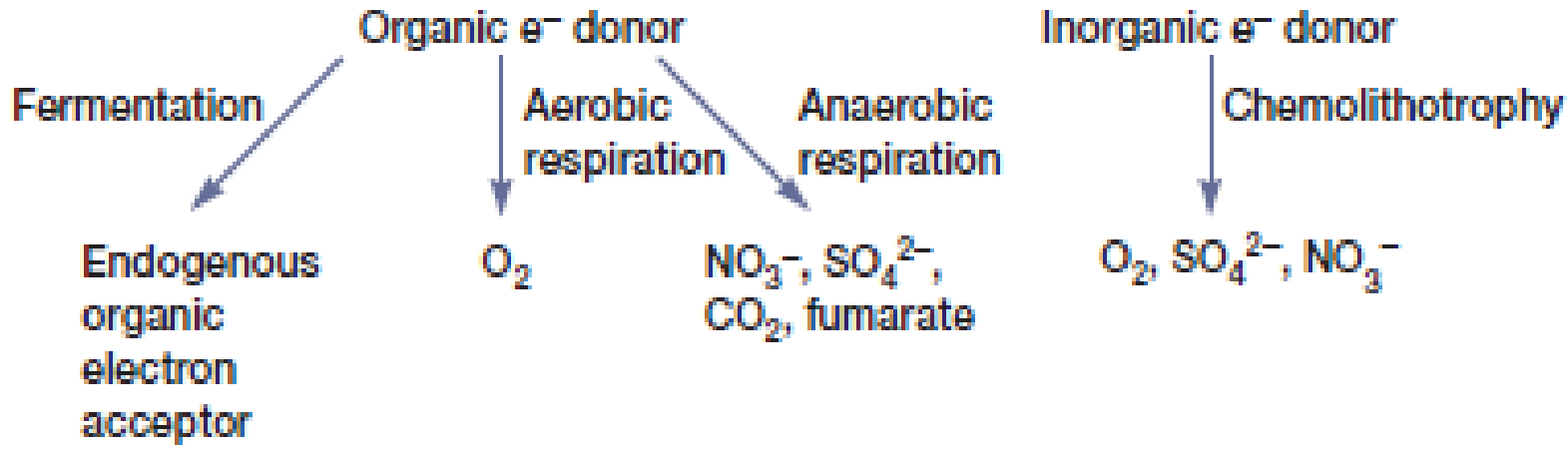

Figure 9.2 Patterns of Energy Release. Fermentation is the energy-yielding process in which an organic electron donor gives electrons to an endogenous acceptor, usually an intermediate derived from catabolism of the nutrient. In respiration, the electrons are donated to an exogenous acceptor, either oxygen (aerobic respiration) or some other acceptor such as nitrate or sulfate (anaerobic respiration). Reduced inorganic compounds also can serve as electron donors in energy production (chemolithotrophy).