

## CHAPTER 3 ESSENTIALS OF METABOLISM

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### BASIC CONCEPTS OF METABOLISM

- ◆ Metabolism is the chemical process that provides or stores energy for organisms
- ◆ Metabolism can be broken down into two parts: catabolism, in which molecules are broken down and energy is released, and anabolism, in which molecules are constructed and energy is consumed
- ◆ Nearly all infectious organisms are chemoheterotrophs, obtaining energy by breaking down organic molecules

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### BASIC CONCEPTS OF METABOLISM

- ◆ Oxidation–reduction (redox) reactions involve the transfer of electrons
- ◆ When a molecule gives up an electron it is oxidized, and when a molecule obtains an electron it is reduced
- ◆ Cellular respiration can be aerobic, in which oxygen is the final acceptor of electrons, or anaerobic, in which oxygen is not involved
- ◆ Nearly all chemical processes consist of a series of chemical reactions known as pathways

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## ENZYMES

- ◆ Enzymes are proteins that work in metabolism by lowering the energy of activation
- ◆ These proteins have a specific three-dimensional shape and bind with the substrate they act upon at a place on the molecule called the active site
- ◆ Enzymes are highly specific and in some cases require cofactors or coenzymes to function

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## ENZYMES

- ◆ Enzyme function can be regulated by competitive inhibition or allosteric inhibition
- ◆ Temperature, pH, and the concentration of substrate, product, and enzymes all affect the function of enzymes

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## CATABOLISM

- ◆ Catabolism is the metabolic process in which organic molecules are broken down to release energy
- ◆ Catabolism can involve glycolysis, which occurs in the cytoplasm, as well as the Krebs cycle and electron transport, which occur at the bacterial plasma membrane
- ◆ When glycolysis is linked to the Krebs cycle and electron transport, and oxygen is the final electron acceptor, 38 ATP molecules are produced for every molecule of glucose that is broken down

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### THE KREBS CYCLE

- ◆ Aerobic cellular respiration uses oxygen as the final electron acceptor, whereas anaerobic cellular respiration uses an inorganic molecule other than elemental oxygen as the final electron acceptor
- ◆ The Krebs cycle involves a series of chemical changes that generate the release of protons and electrons
- ◆ Electrons and protons are carried from the Krebs cycle to the electron transport chain by reduced coenzymes such as NADH and FADH<sub>2</sub>

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### THE ELECTRON TRANSPORT CHAIN

- ◆ In the electron transport chain, the protons and electrons are moved through a series of oxidation–reduction reactions that result in the formation of a concentration gradient called the proton motive force
- ◆ Protons are moved by the proton motive force across the plasma membrane of the bacterial cell, and energy is released
- ◆ The energy produced from protons moving across the plasma membrane is used to form ATP

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