Section Summary

Enzymes are chemical catalysts that speed up chemical reactions by lowering their activation energy. Enzymes have an active site that fits particular chemical reactants for that enzyme, called substrates. Enzymes and substrates are thought to bind according to an induced-fit model. Enzyme action is regulated to conserve resources and respond optimally to the environment.

Exercises

1. Which of the following analogies best describes the induced-fit model of enzyme-substrate binding?
    a. a hug between two people
    b. a key fitting into a lock
    c. a square peg fitting through the square hole and a round peg fitting through the round hole of a children's toy
    d. the fitting together of two jigsaw puzzle pieces
2. An allosteric inhibitor:
    a. Binds to the enzyme in a location other than the active site, increasing its affinity for substrate binding.
    b. Binds to the active site and blocks it from binding substrate.
    c. Binds to the enzyme in a location other than the active site, decreasing its affinity for the substrate.
    d. Binds directly to the active site and mimics the substrate.
3. Which of the following is NOT true about enzymes?
    a. They are consumed by the reactions they catalyze.
    b. They are usually made of amino acids.
    c. They lower the activation energy of chemical reactions.
    d. Each one is specific to the particular substrate(s) to which it binds.
4. Concerning enzymes, why are vitamins and minerals necessary for good health? Give examples.

Answers

1. (a)
2. (c)
3. (a)
4. Most vitamins and minerals act as cofactors and coenzymes for enzyme action. Many enzymes require the binding of specific cofactors or coenzymes to be able to catalyze their reactions. Since enzymes catalyze many vital reactions, it is critical to obtain sufficient vitamins and minerals from diet and supplements. Vitamin C (ascorbic acid) is a coenzyme necessary for the action of enzymes that build collagen.

Glossary

activation energy: the amount of initial energy necessary for reactions to occur

active site: a specific region on the enzyme where the substrate binds

allosteric activation: the mechanism for activating enzyme action in which a regulatory molecule binds to a second site (not the active site) and initiates a conformation change in the active site, allowing binding with the substrate

allosteric inhibition: the mechanism for inhibiting enzyme action in which a regulatory molecule binds to a second site (not the active site) and initiates a conformation change in the active site, preventing binding with the substrate

catalyst: substances that speed up the rate of chemical reactions

coenzyme: small organic molecules, such as a vitamin or its derivative, which is required to enhance an enzyme's activity

cofactor: inorganic ion, such as iron and magnesium ions, required for optimal enzyme activity regulation

competitive inhibition: a general mechanism of enzyme activity regulation in which a molecule other than the enzyme's substrate can bind the active site and prevent the substrate itself from binding, thus inhibiting the overall rate of reaction for the enzyme

denature: loss of shape in a protein that may be a result of changes in temperature, pH, or chemical exposure

enzyme: a molecule that catalyzes a biochemical reaction

feedback inhibition: a mechanism of enzyme activity regulation in which the product of a reaction or the final product of a series of sequential reactions inhibits an enzyme for an earlier step in the reaction series

noncompetitive inhibition: a general mechanism of enzyme activity regulation in which a regulatory molecule binds to a site other than the active site and prevents the active site from binding the substrate; thus, the inhibitor molecule does not compete with the substrate for the active site; allosteric inhibition is a form of noncompetitive inhibition

substrate: a molecule on which the enzyme acts