

Topic 3.1

Enzyme Structure

Learning Objectives

- Learn about enzymes
- Understand the interactions between an enzyme's active site and the substrate

Topic Questions

- What are enzymes?
- What is an active site?
- What is necessary for an enzymatic reaction to proceed?

3.1.01 Function of the Active Site

[ENE-1.D.1]

Catalysts are molecules that increase the rate of a chemical reaction without being used up or **permanently changed** in the **overall reaction**. **Enzymes** are catalysts made in living organisms (or made in a laboratory to copy the catalysts made in living organisms). Most enzymes are **proteins**, but some RNA molecules can also act as enzymes.

An enzyme-catalyzed, or **enzymatic**, reaction occurs when reactant molecules (called **substrates**) bind a specific part of an enzyme and are converted to **products** (see Figure 3.1). The specific enzyme part to which substrates bind is called the **active site**. The function of the active site is to help in the conversion of substrates into products by lowering the **activation energy**, which is the amount of energy required by substrate molecules for a reaction to occur.

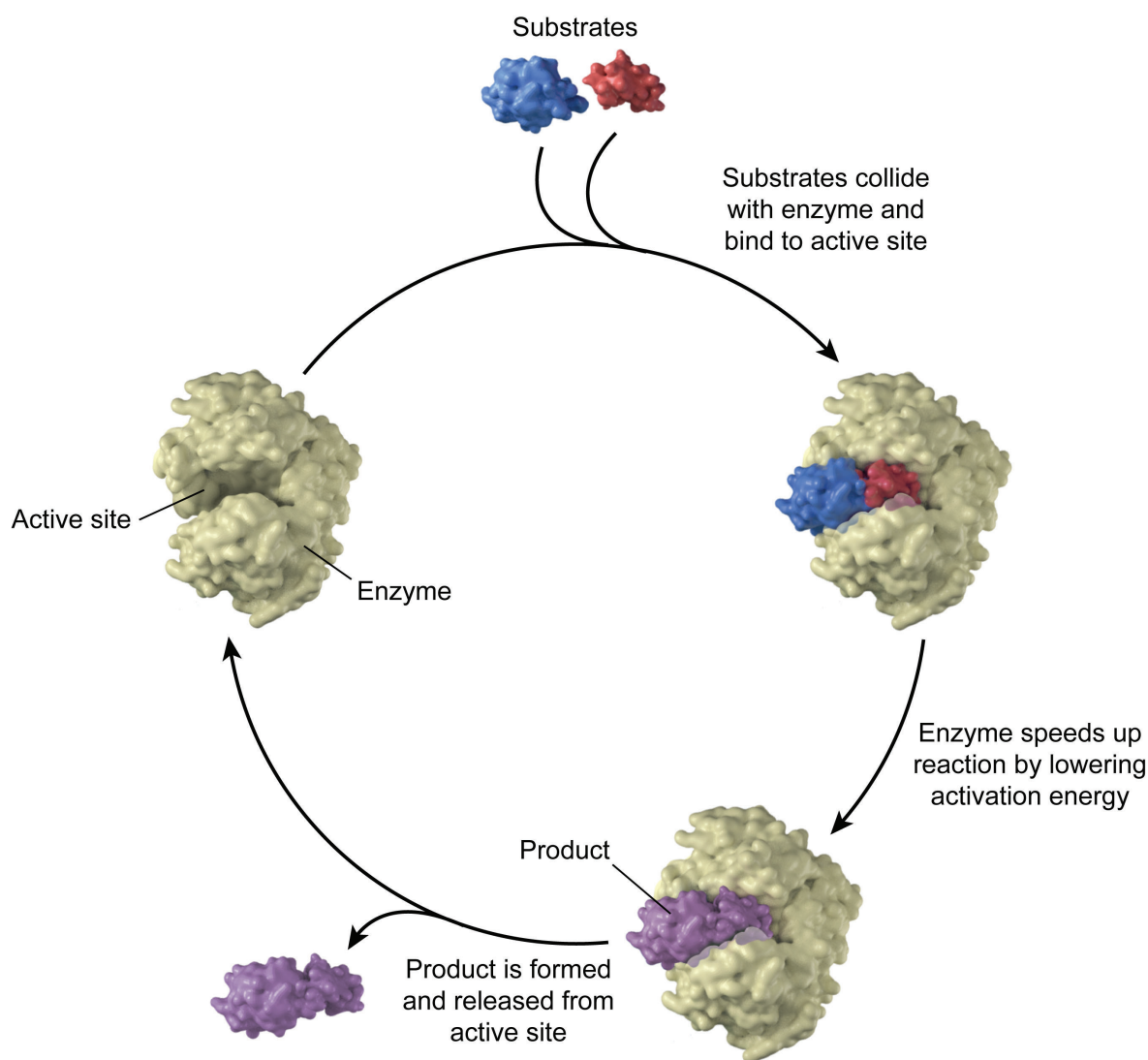


Figure 3.1 An enzyme's active site is where substrates are converted to products during an enzymatic reaction.

3.1.02 Interactions between the Active Site and the Substrate

[ENE-1.D.2]

As discussed in Sub-Topic 3.1.01, the region on an enzyme where the substrate binds to go through a reaction is the enzyme's **active site**. An active site's specific qualities, such as its **shape** and **charge**, decide the type of molecule that can bind. For correct binding, the substrate must have a shape and charge complementary to the enzyme's active site; therefore, enzymes can differentiate between closely related molecules (eg, various sugars) to catalyze specific reactions.

For example, many enzymes recognize substrates with a very specific structure, as shown in Figure 3.2. Similarly, if an enzyme's active site and substrate are both charged, the charges must be opposite so the molecules are attracted to each other.

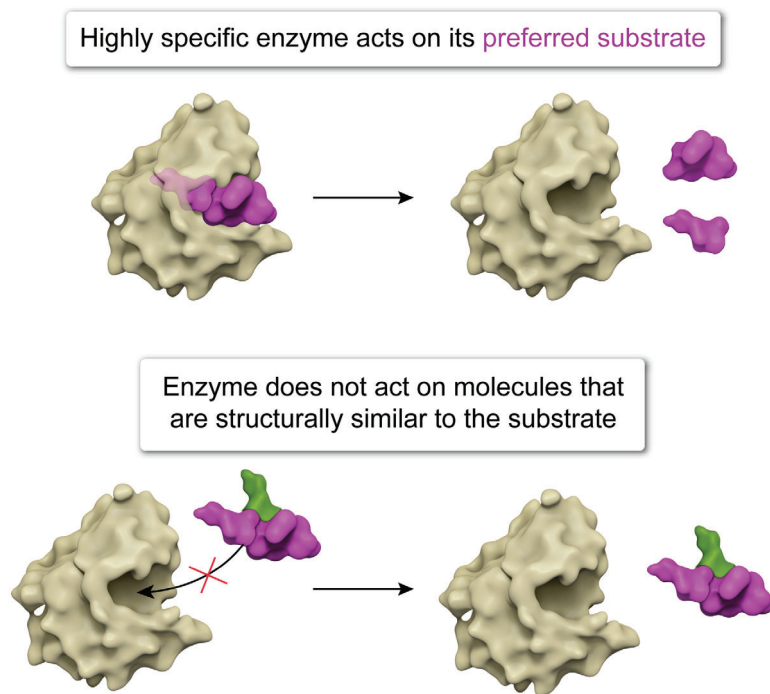


Figure 3.2 Enzyme specificity.

The active site serves as a **template** in which bound substrate molecules are set in a way that puts tension on specific bonds to help make and break the bonds involved in product formation. The fit of an active site around its substrate can contribute to this process in addition to strengthening substrate binding.

Topic 3.1 Enzyme Structure

Check for Understanding Quiz

1. Which of the following best describes the substrate in an enzymatic reaction?
 - A. The substrate is the reactant molecule that participates in the reaction.
 - B. The substrate is the molecule formed after an enzymatic reaction.
 - C. The substrate is the amount of energy needed for the reaction to occur.
 - D. The substrate is the molecule that increases the rate of the reaction without being changed.

2. An enzyme has more positive than negative charges in its active site and is known to have charge interactions with its substrate. Which of the following predictions about the enzyme's substrate is most likely true?
 - A. The portion of the substrate that interacts with the active site has a higher proportion of positive charges than negative charges.
 - B. The portion of the substrate that interacts with the active site has a higher proportion of negative charges than positive charges.
 - C. The portion of the substrate that interacts with the active site has an equal proportion of positive and negative charges.
 - D. The portion of the substrate that interacts with the active site does not have any positive or negative charges.

Note: Answers to this quiz are in the back of the book (appendix).