

3.1 Enzyme Structure

The top left diagram shows a red substrate fitting into a yellow active site of an enzyme. The top right diagram shows an enzyme with ionic regions and hydrophobic regions. The bottom left diagram shows a substrate binding to an enzyme, with the active site wrapped around the substrate molecule, labeled as 'INDUCED FIT'. The bottom right diagram is a detailed view of the active site showing a zinc binding site with a Zn²⁺ ion, H-bonding, hydrophobic binding sites, and an ionic binding site. It also shows a water molecule (H₂O) and a base (:B).

ENDURING UNDERSTANDING

ENE-1 The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules

The diagram illustrates the flow of energy and matter in an ecosystem. The SUN (Solar Energy) provides energy to Plants (Photosynthesis). Plants are consumed by Herbivores (Consumption). Herbivores are consumed by Carnivores (Consumption). Both Herbivores and Carnivores contribute to Detritivores (Decomposition). Detritivores release nutrients and water into the SOIL (Nutrients and Water). The SOIL provides nutrients and water to Plants. The SOIL also releases O₂, CO₂, and Water into the ATMOSPHERE. The ATMOSPHERE provides O₂, CO₂, and Water to Plants.

ENE-1.D Describe the properties of enzymes

- The structure of enzymes includes the active site that specifically interacts with substrate molecules.
 - Substrates are reactants in an enzymatic reaction.
 - Active site binds to specific substrate(s)

The diagram shows a red substrate fitting into a yellow active site of an enzyme.

ENE-1.D Describe the properties of enzymes

- Enzymes are catalytic proteins
- Speed chemical reactions without being changed
- Every enzyme catalyzes only one reaction or one type of reaction.

The diagram shows a substrate (food particle) being broken down by an enzyme into products (nutrients). The enzyme is not changed in the process.

Substrate = H₂O₂

Molecular model of catalase

How enzymes break down food into nutrients

ENE-1.D Describe the properties of enzymes

- For an enzyme-mediated chemical reaction to occur, the shape and charge of the substrate must be compatible with the active site of the enzyme.
 - Active site is a microenvironment
 - Lock and Key Model

The top left diagram shows an enzyme with ionic regions and hydrophobic regions. The top right diagram shows a substrate binding to an enzyme, with the active site wrapped around the substrate molecule, labeled as 'INDUCED FIT'. The bottom right diagram is a detailed view of the active site showing a zinc binding site with a Zn²⁺ ion, H-bonding, hydrophobic binding sites, and an ionic binding site. It also shows a water molecule (H₂O) and a base (:B).

ENE-1.D Describe the properties of enzymes

- Induced-fit model
 - Slight change in enzyme shape when substrate binds
 - Facilitates the reaction
- When all enzymes are filled (saturated) reaction can't go faster
- Most enzymes named adding the ending "-ase."

The diagram shows the induced-fit model where the enzyme's shape changes slightly to accommodate the substrate. The graph shows the initial reaction rate (V_i) increasing with substrate concentration ([S]) until it reaches a maximum velocity (V_m). The enzyme is saturated when the reaction rate is at V_m.

Enzyme is saturated: far more substrate than it can deal with

Cofactors and Coenzymes

- Many enzymes require an inorganic ion or nonprotein cofactor to function
- The enzyme may only become active when all the appropriate cofactors or coenzymes are present and bind to the appropriate sites on the enzyme.
- Cofactors- inorganic ions (iron,zinc, copper)
- Coenzymes- Organic cofactors (vitamins)

