

Enzymes

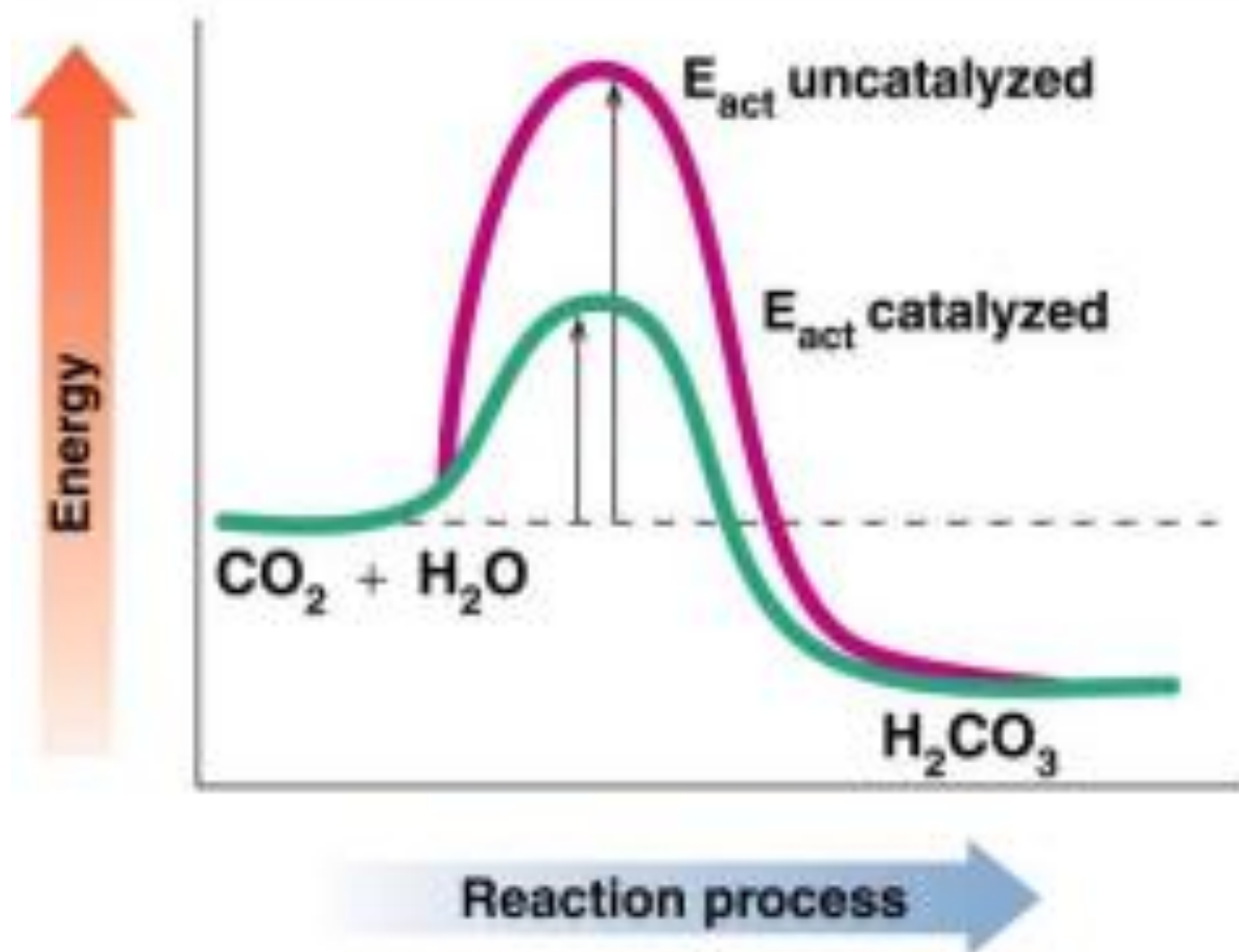
Enzymes

- An enzyme is a type of protein found within a cell.
- Enzymes are proteins that act as biological catalysts (biocatalysts).
- Catalysts accelerate chemical reactions.
- The molecules upon which enzymes may act are called substrates.
- The enzyme converts the substrates into different molecules known as products.

Enzymes are Biological Catalysts

Enzymes are proteins that:

- Increase the rate of reaction by lowering the energy of activation.
- Catalyze nearly all the chemical reactions taking place in the cells of the body.
- Have unique three dimensional shapes that fit the shapes of reactants.



The Six Classes

- EC 1. Oxidoreductases
- EC 2. Transferases
- EC 3. Hydrolases
- EC 4. Lyases
- EC 5. Isomerases
- EC 6. Ligases

Enzyme activity

- Enzyme activity/catalytic activity: Moles of substrate converted per unit time.
- **Specific activity:** This is the activity of an enzyme per milligram of total protein (expressed in $\text{mol min}^{-1} \text{mg}^{-1}$).

Units of enzymes

1. International Unit: The enzyme unit, or international unit for enzyme (symbol U, sometimes also IU) is a unit of enzyme's catalytic activity.
2. Katal is the enzyme activity that converts one mole of substrate per second under specified assay conditions.

Enzyme Specificity

- Enzyme specificity refers to the tendency for enzymes to catalyze a specific set of chemical reactions.
- Specificity is the ability of an enzyme to choose exact substrate from a group of similar chemical molecules.
- Enzymes may recognize and catalyze:
 - A single substrate.
 - A group of similar substrates.
 - A particular type of bond.

Lock-and-Key Model

- In this model, the **shape** of the active site and substrate complement in such a way that the substrate fits into the binding site perfectly.
- enzymes have active sites, which need to be filled with a substrate through non-covalent interactions.
- The Lock and Key model explains that the enzyme needs to bind substrate, but once the reaction progresses to the transition state and product formation, the active site would not be able to accommodate this change.
- The enzyme needs to bind the substrate slightly imperfectly in order to be able to **turn it over**, that is, convert it to the product.

Induced Fit model

- In the Induced Fit model, the enzyme active site **forms** in response to substrate binding.
- In this diagram, sites **a**, **b** and **c** move in response to the binding substrate.
- Though the active site is not perfect initially, upon binding, it is able to move, which puts the active site under strain.
- This strain is then able to elicit the energy that's required for the reaction to occur by stabilizing the transition state and not just binding of the substrate.
- The enzyme carries out its work by inducing the substrate to take up a transition state on the path to the required product.

Apoenzyme

- An **apoenzyme** is an inactive enzyme, activation of the enzyme occurs upon binding of an organic or inorganic cofactor.
- **Apoenzyme** or apoprotein is an enzymatically inactive protein part of an enzyme, which requires a cofactor for its activity.

Coenzymes

- A **coenzyme** is an organic non-protein compound that binds with an enzyme to catalyze a reaction.
- **Coenzymes** are often broadly called cofactors, but they are chemically different.
- A **coenzyme** cannot function alone, but can be reused several times when paired with an enzyme.

Zymogen

- A zymogen, also called a proenzyme, is an inactive precursor of an enzyme.
- A zymogen requires a biochemical change (such as a hydrolysis reaction revealing the active site, or changing the configuration to reveal the active site) for it to become an active enzyme.

Enzyme assays

- Laboratory method for measuring enzyme activity.
- Vital for study of enzyme kinetics and enzyme inhibition.
- The assay is the act of measuring how fast a given amount of enzyme will convert substrate to product.
- Enzyme assays measure either the disappearance of substrate over time or the appearance of product over time.
- An assay requires to determine the concentration of a product or substrate at a given time after starting the reaction.

Kinetic assay

- An enzyme-based assay that measures the amount of substrate present by correlation of the rate of reaction.
- Measurement of concentration of analyte or product in initial stages of the reaction.

Enzyme inhibition

- Some molecules very similar to the substrate for an enzyme may be bound to the active site but be unable to react.
- Enzyme inhibition refers to a decrease in enzyme-related processes, enzyme production or enzyme activity.