Interactions between molecules affect their structure and function. (4.B.1)

1. For an **enzyme-mediated chemical reaction** to occur, the substrate must be complementary to the surface properties (shape and charge) of the active site. In other words, the **substrate must fit into the enzyme's active site**.

   ![Diagram of Enzyme Action](image1)

   - **The catalytic cycle of an enzyme**. The enzyme **sucrase** accelerates the **hydrolysis** of sucrose into glucose and fructose. Acting as a catalyst, the **sucrase** protein is not consumed during the cycle, but remains available for further catalysis.

2. Cofactors and coenzymes affect enzyme function; this interaction relates to a structural change that alters the **activity rate of the enzyme**. 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 of some enzymes are **inorganic**, such as the metal atoms **zinc**, **iron**, and **copper** in ionic form. If the cofactor is an **organic molecule**, then it is more specifically called a **coenzyme**. Most **vitamins** are important in nutrition because they act as coenzymes or raw materials from which coenzymes are made. Cofactors function in various ways, but in all cases where they are used, they perform a crucial function in catalysis.

   - **Heme** - cofactor which contains an **iron** (inorganic). Hemes are most commonly recognized as a component of **hemoglobin**, the red pigment in blood.
   - **Thiamine** - coenzyme (Vitamin B1). All living organisms use thiamine. It is synthesized in bacteria, fungi and plants. Animals must obtain it from their diet (essential nutrient). Deficiency results in Korsakoff's syndrome, optic neuropathy, and a disease called beriberi.
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3. **Allosteric Regulation of Enzymes**

   - **Allosteric regulation** is the term used to describe any case in which a protein's function at one site is affected by the binding of a regulatory molecule to a separate site. It may result in either inhibition or stimulation of an enzyme's activity.
   - **Allosteric activators and inhibitors**. In the cell, activators and inhibitors dissociated when at low concentrations. The enzyme can then oscillate (move between two different shapes- one catalytically active and the other inactive) again.

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- Change in the **structure** of a molecular system may result in a change of the **function** of the system. b. The **shape** of enzymes, active sites and interaction with specific molecules are essential for basic **functioning** of the enzyme.
**Effects of Local Condition of Enzyme Activity**

- The activity of an enzyme - how efficiently the enzyme functions - is affected by general environmental factors, such as temperature and pH.
- The three-dimensional structures of proteins are sensitive to their environment. Each enzyme works better under some conditions than under others, because these optimal conditions favor the most active shape for the enzyme molecule.

Most human enzymes have optimal temperature of about 37°F, body temperature. The optimal pH values for most enzymes fall in the range of pH 6-8, but there are exceptions. Pepsin, a digestive enzyme in the human stomach, works best at pH 2.

**Catalase**

Catalase is a common enzyme found in nearly all living organisms exposed to oxygen. It catalyzes the decomposition of hydrogen peroxide and can convert millions of molecules of hydrogen peroxide to water and oxygen each second.

\[ 2 \text{H}_2\text{O}_2 \xrightarrow{\text{catalase}} 2 \text{H}_2\text{O} + \text{O}_2 \]

- Reaction is limited by the amount of substrate.
- Rate of the reaction is influenced by the type of inhibitor.

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d. The change in function of an enzyme can be interpreted from data regarding the concentrations of product or substrate as a function of time. These representations demonstrate the relationship between an enzyme’s activity, the disappearance of substrate, and/or presence of a competitive inhibitor.

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- Uninhibited
- Competitive Inhibitor
- Noncompetitive Inhibitor

- Reaction is limited by the amount of substrate.
- Rate of the reaction is influenced by the type of inhibitor.