





# What are enzymes?

# ENZYMES ARE A SPECIAL TYPE OF **PROTEIN!**

- Enzymes are Biological **catalysts** that **increase** the rate of metabolic reactions.

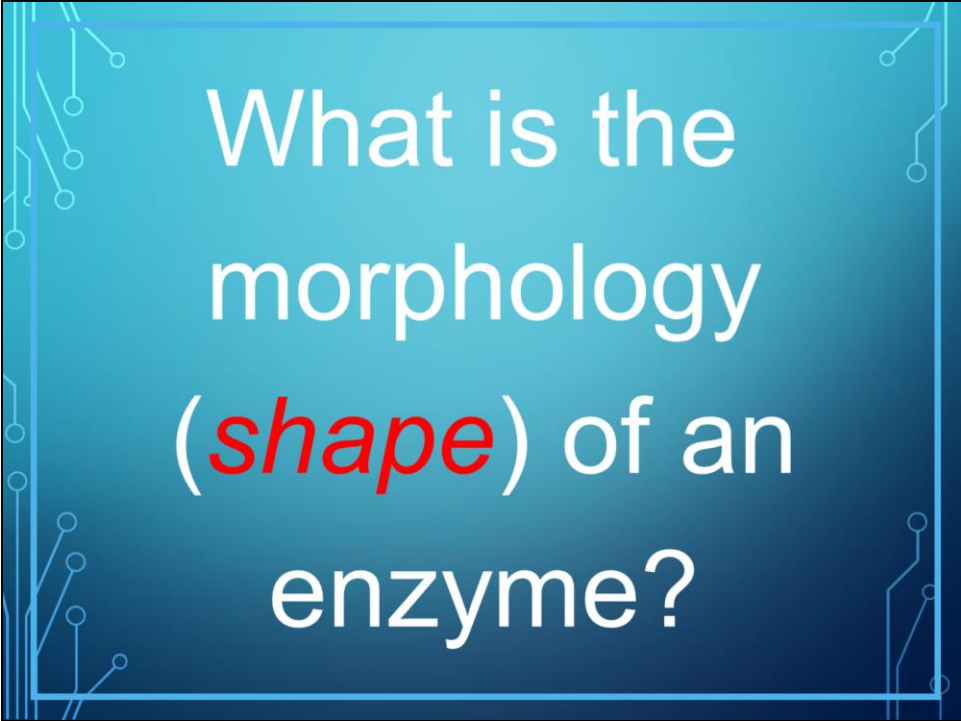


What is a  
catalyst?

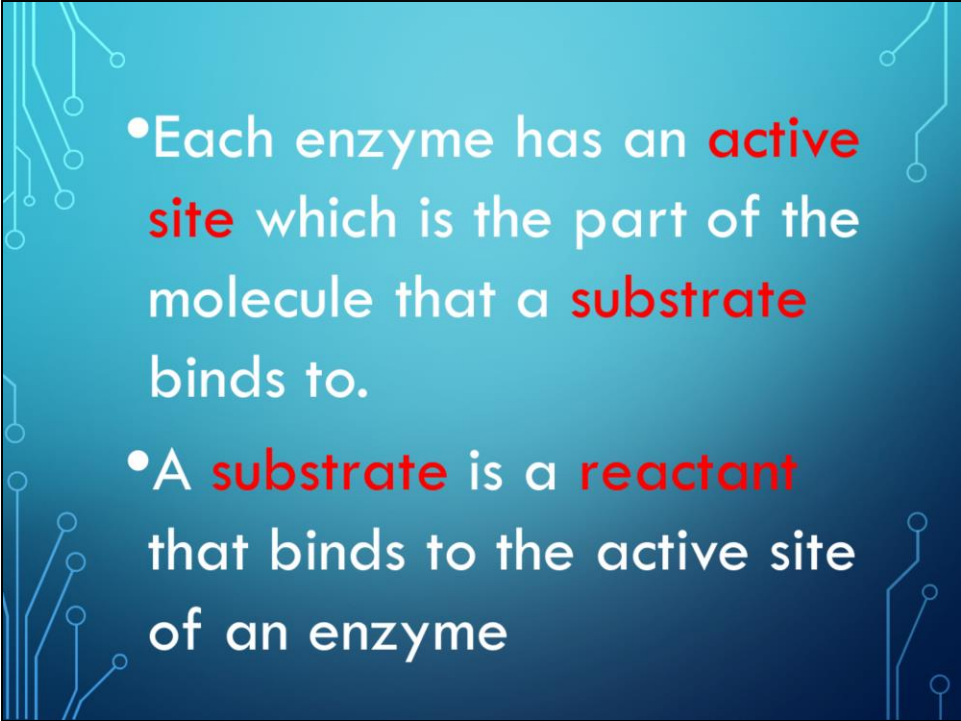
## Catalyst-

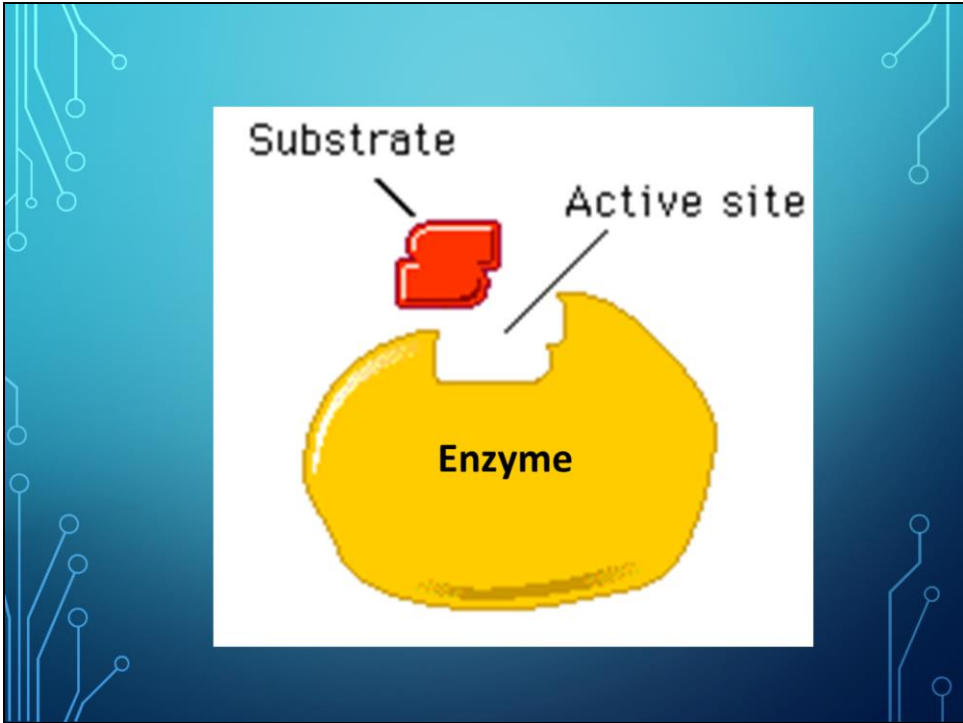
A substance that **speeds** up the rate of a reaction without being used up during it. (they are **reusable**)



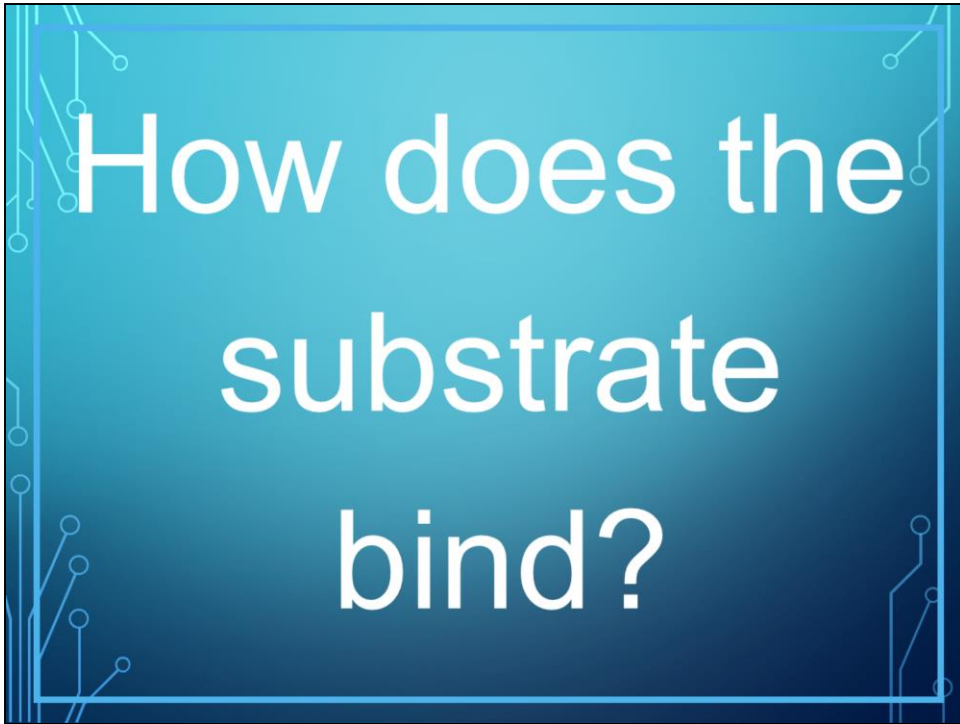


What is the  
morphology  
(*shape*) of an  
enzyme?

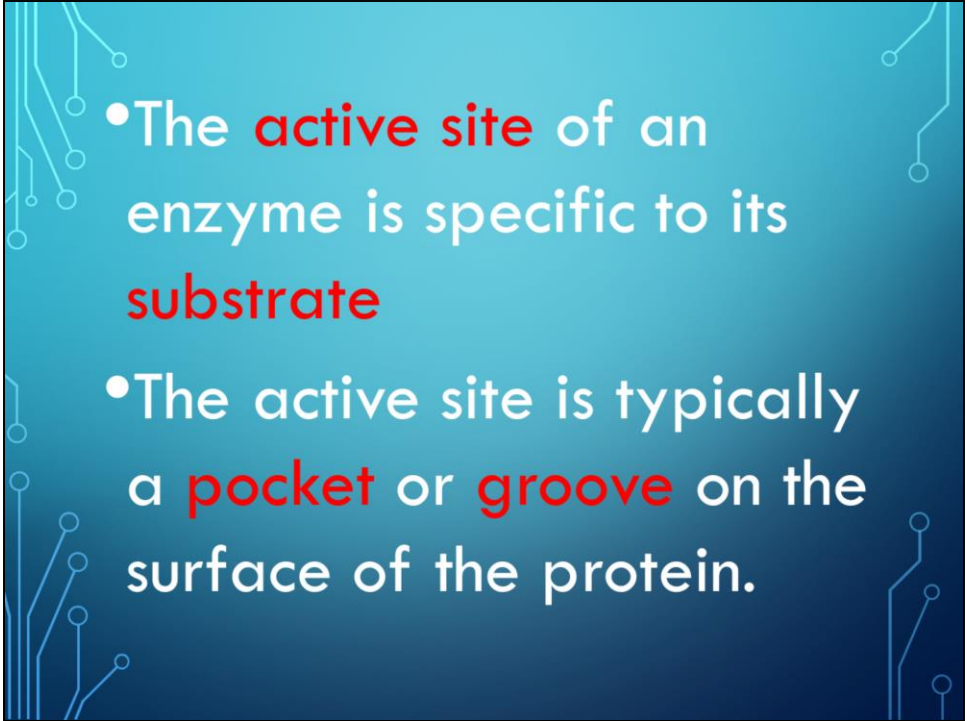
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- A decorative graphic of a circuit board with white lines and circles on a blue gradient background, framing the text.
- Each enzyme has an **active site** which is the part of the molecule that a **substrate** binds to.
  - A **substrate** is a **reactant** that binds to the active site of an enzyme







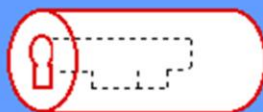
# How does the substrate bind?

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- A decorative graphic of a circuit board with white lines and circles on a blue gradient background, framing the text.
- The **active site** of an enzyme is specific to its **substrate**
  - The active site is typically a **pocket** or **groove** on the surface of the protein.

## Lock and Key Analogy



key = substrate



lock = enzyme



correct fit,  
will react

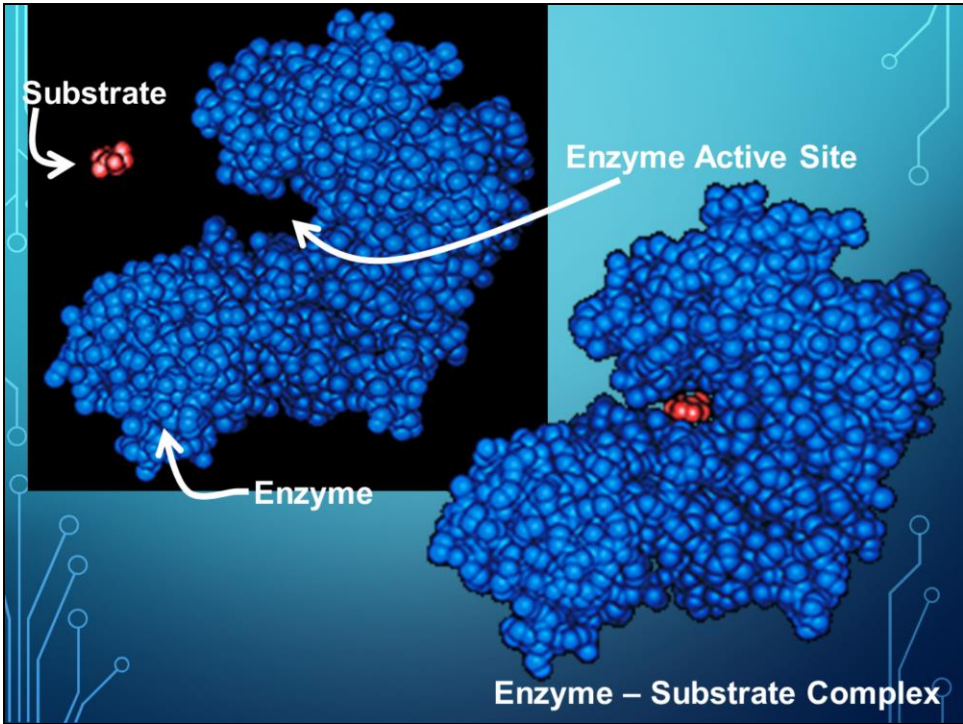


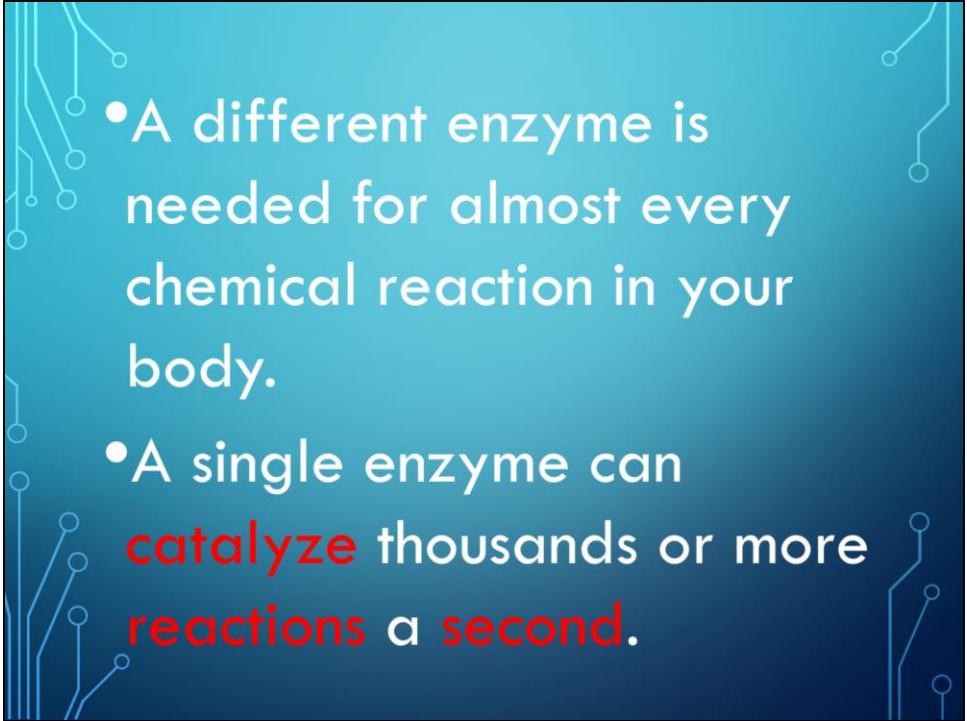
incorrect substrate



no reaction

C. Ophardt, c. 2003



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- A decorative graphic of a circuit board with white lines and circles on a blue gradient background, framing the text.
- A different enzyme is needed for almost every chemical reaction in your body.
  - A single enzyme can **catalyze** thousands or more **reactions** a **second**.

Enzymes are responsible for **metabolism** (*sum of all chemical reactions in the body*).

- Anabolic reactions- **build-up** (synthesize) molecules and **require** energy.

(**Dehydration** Synthesis)

- Catabolic reactions- **break-down** (lyse) and **release** energy. (**Hydrolysis**)

A decorative graphic of a circuit board with white lines and circles on a blue gradient background, framing the text.

- Examples of Enzymes:

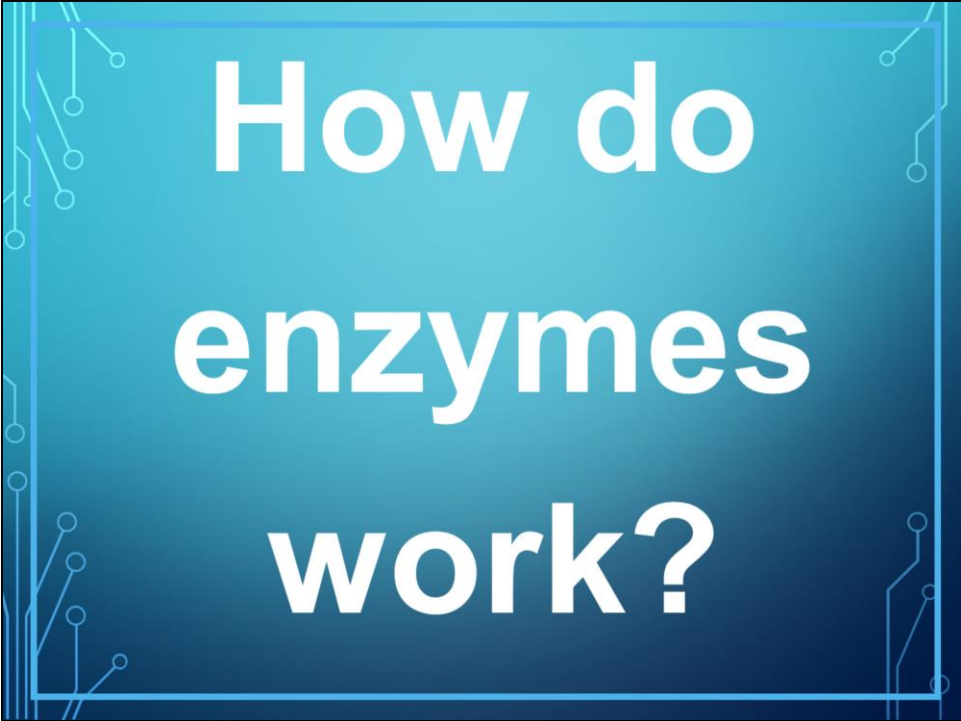
- Remember, enzymes usually end in

- ase.**

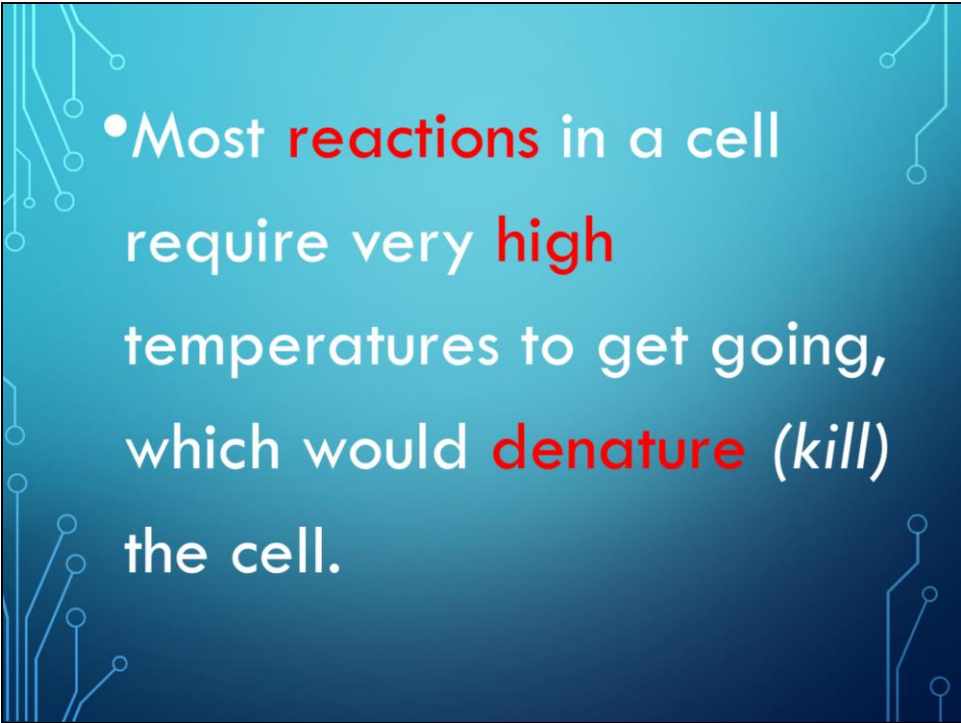
- Each enzyme is the specific helper to a specific reaction

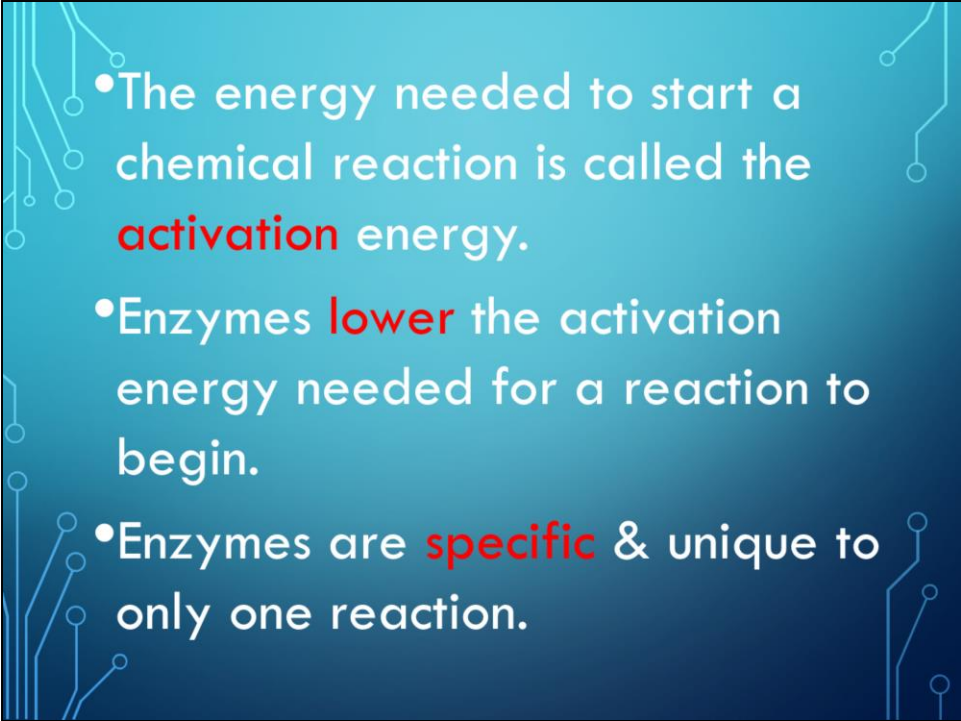
- Lipase: breaks down lipids
- Protease: breaks down proteins.
- Sucrase: breaks down sucrose.
- Amylase: in human saliva, breaks down starch (amylose).
- Catalase: breaks Hydrogen Peroxide down into water and oxygen.
- DNA polymerase builds DNA

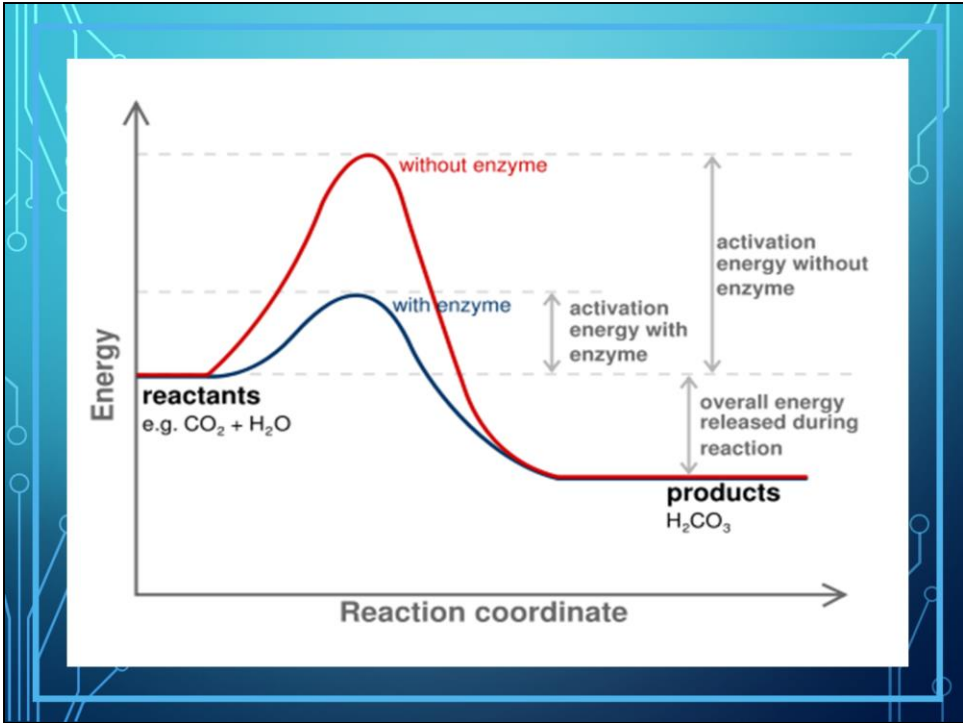


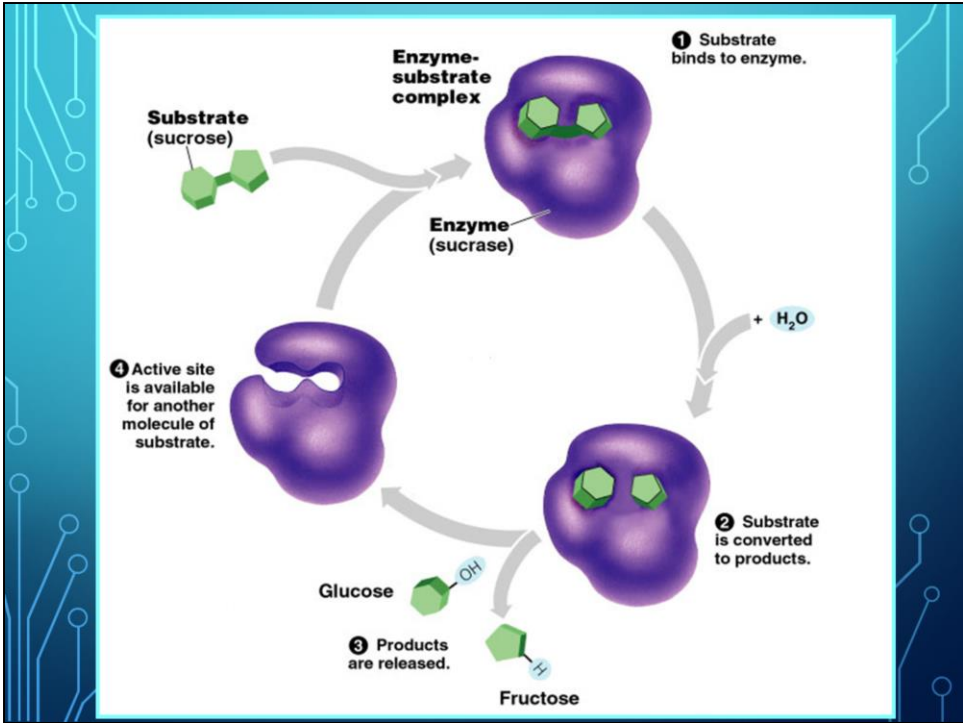


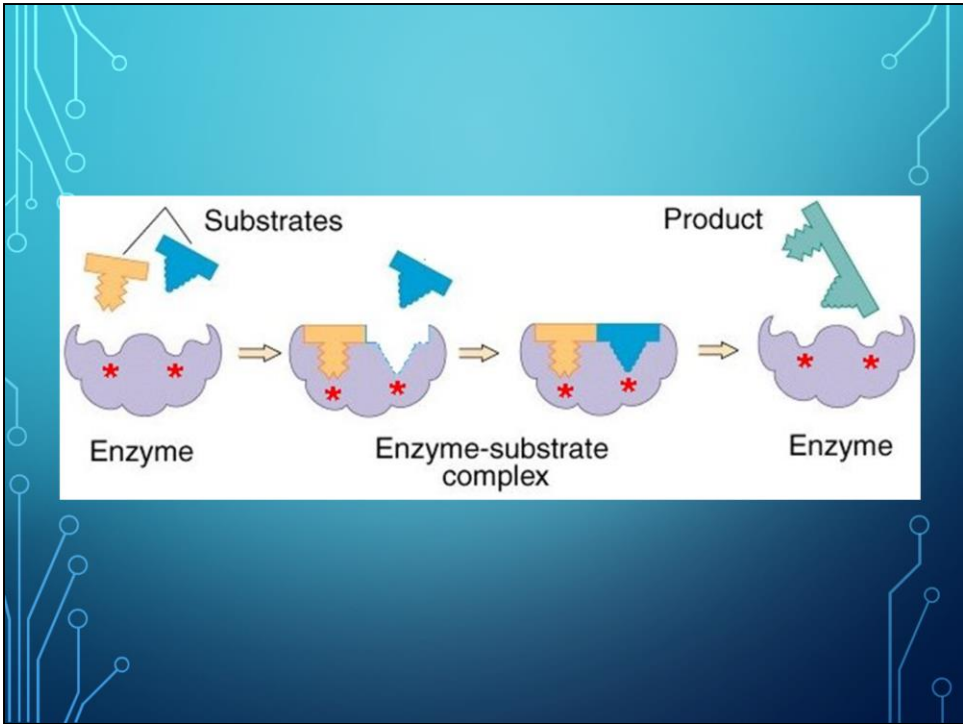
# How do enzymes work?

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- Most **reactions** in a cell require very **high** temperatures to get going, which would **denature** (*kill*) the cell.

- 
- The energy needed to start a chemical reaction is called the **activation** energy.
  - Enzymes **lower** the activation energy needed for a reaction to begin.
  - Enzymes are **specific** & unique to only one reaction.









# What affects an enzyme?



# Enzymes can be affected by the following:

1. Temperature

2. Substrate Concentration

3. pH

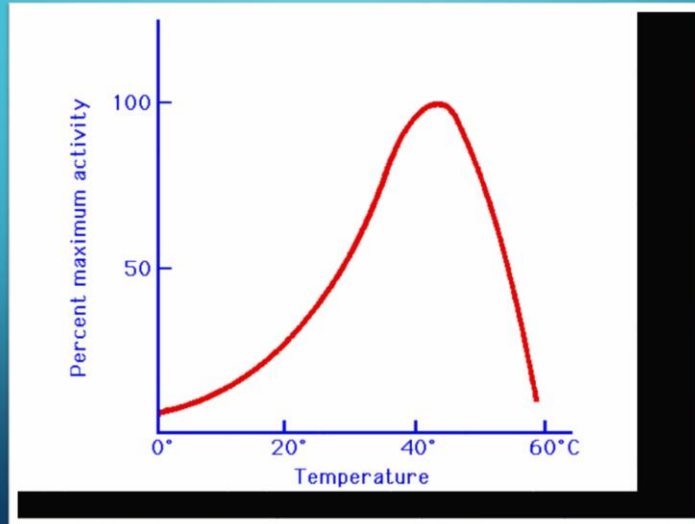


## Temperature Effects:

If an enzyme is not at its **optimal** (best) temperature, it will become denatured.

- Human enzymes have an optimal temperature of around 37 degrees C.

# EFFECT OF TEMPERATURE ON ENZYME ACTIVITY



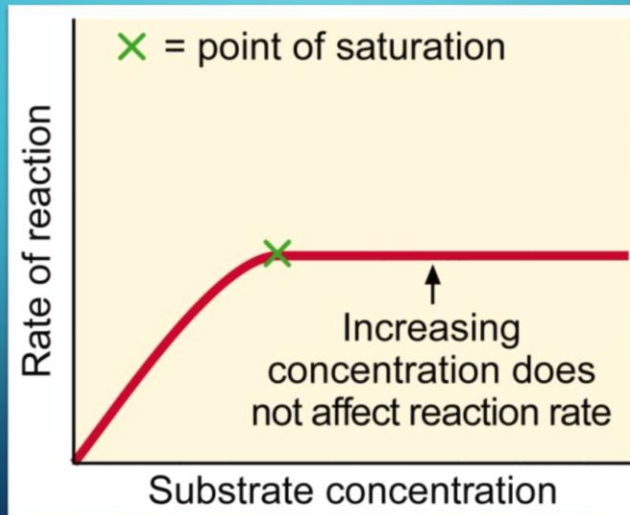
## Substrate Concentration

### Effects:

- When all enzymes have their active sites filled with substrates, it's called **enzyme saturation**.
- At this point, the reaction rate stays constant until more **enzymes** are **added**

Use Bus Analogy: there are only so many seats in a bus... once all seats are taken, the bus is saturated with kids. At this point, no more students can get in until more seats (enzymes) are added.

## THE EFFECT OF SUBSTRATE CONCENTRATION ON ENZYME ACTIVITY



## pH Effects:

- Changes in pH changes the protein's shape (denatures it)

# Enzymes Overview

1. Enzymes speed up reactions by **lowering the activation energy**
2. Each enzyme works for a **specific** substrate
3. A cell's physical and chemical environment affects enzyme activity – **Temperature** and **pH**.
4. The enzyme is **unaffected** by the reaction.