

FIRST SEMESTER (CLINICAL ENZYMOLOGY)



FACTORS AFFECTING ENZYME ACTIVITY

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قسم تقنيات المختبرات الطبية

four Stage

المرحلة الرابعة

محاضرة رقم 8

الجانب النظري

Lecture No. 8

Theoretical

تدريسي المادة : م. م احمد صبوري ساجت

FACTORS AFFECTING ENZYME ACTIVITY

TEMPERATURE

Temperature affects enzyme-catalysed reactions by influencing the rate at which they occur.

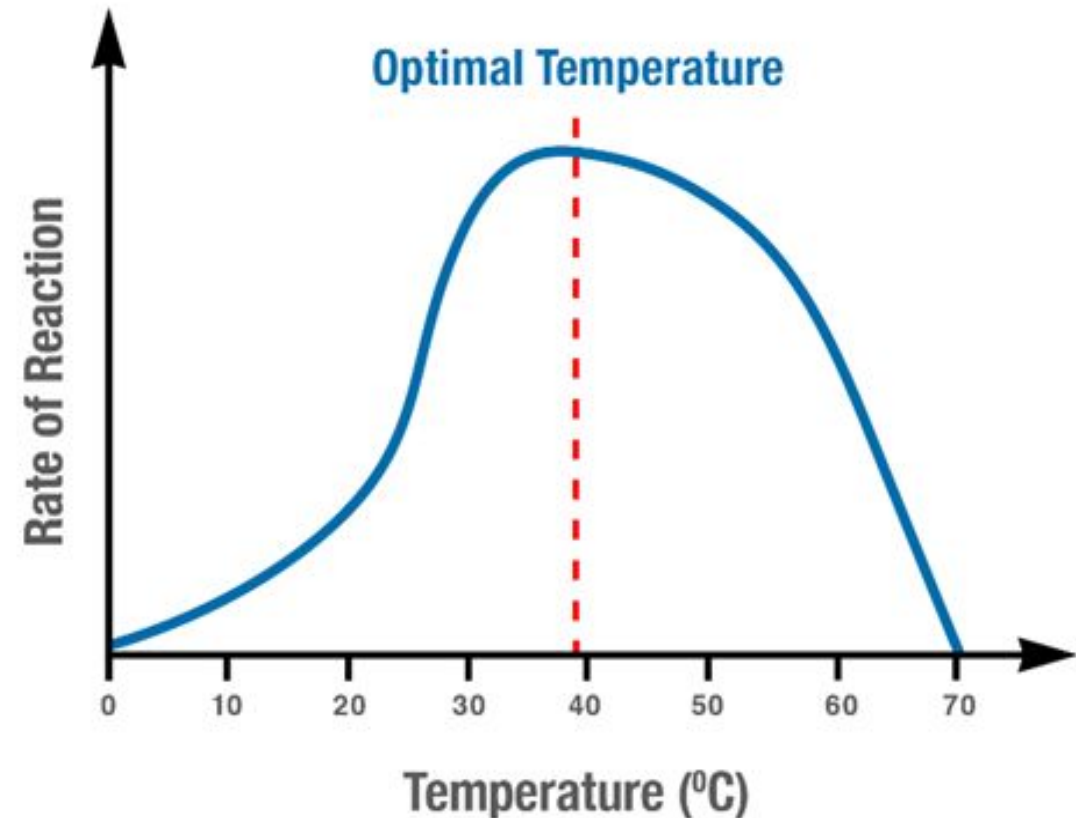
For a reaction to occur between an enzyme and substrate the two molecules need to collide.

At **lower temperatures** the reaction rate is low as the enzymes and substrates do not collide frequently. As temperature increases, reaction rates generally rise due to more frequent collisions between enzyme and substrate molecules.

FACTORS AFFECTING ENZYME ACTIVITY

Once the temperature exceeds an enzyme's optimal range, the enzyme can denature, **losing its structure and function**, which significantly decreases or stops the reaction.

The graph below shows this relationship between temperature and rate of reaction. Human enzymes have an optimal activity at about 37 degrees Celsius.



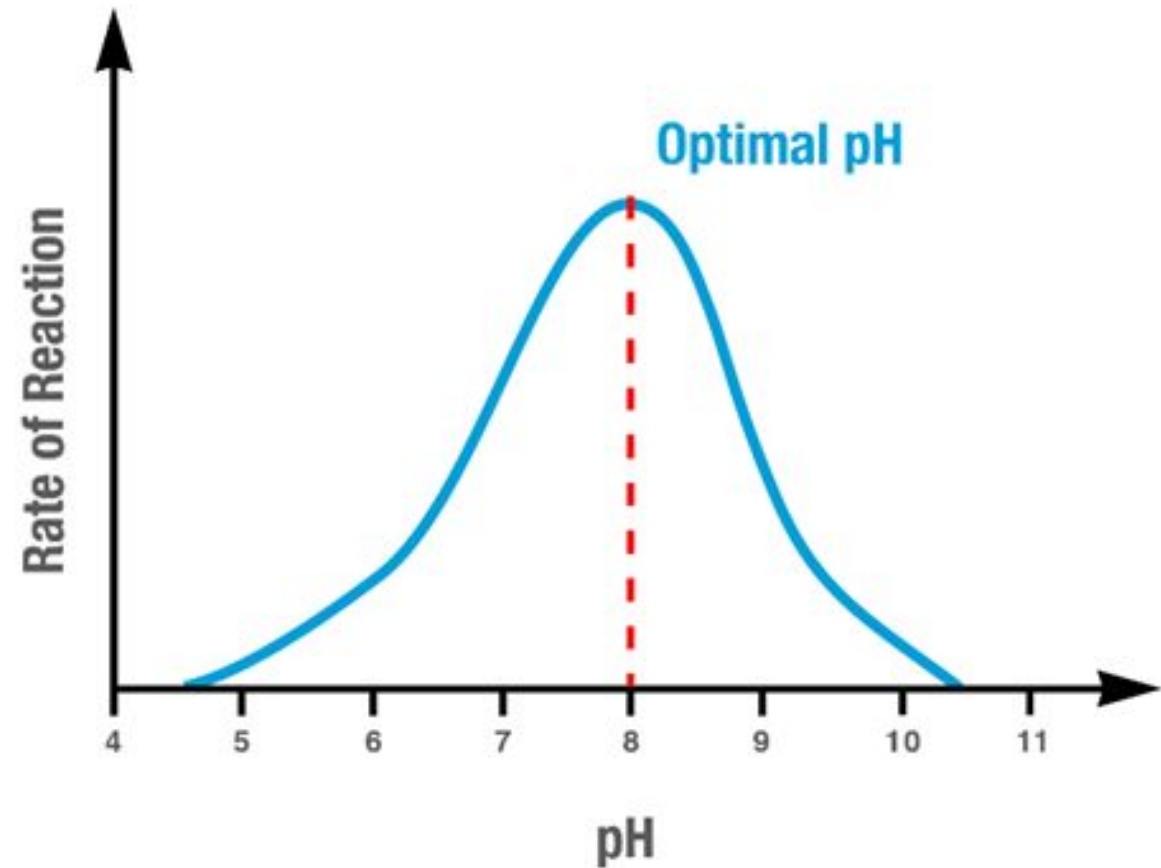
PH

Each enzyme has an optimal pH range in which it functions most effectively, and deviations from this range can lead to reduced activity or denaturation of the enzyme.

Extremely high or low pH levels can cause enzymes to denature, meaning they lose **their three-dimensional structure, changing the shape of the active site and resulting** in the enzyme being ineffective. This loss of structure can prevent the substrate from binding properly.

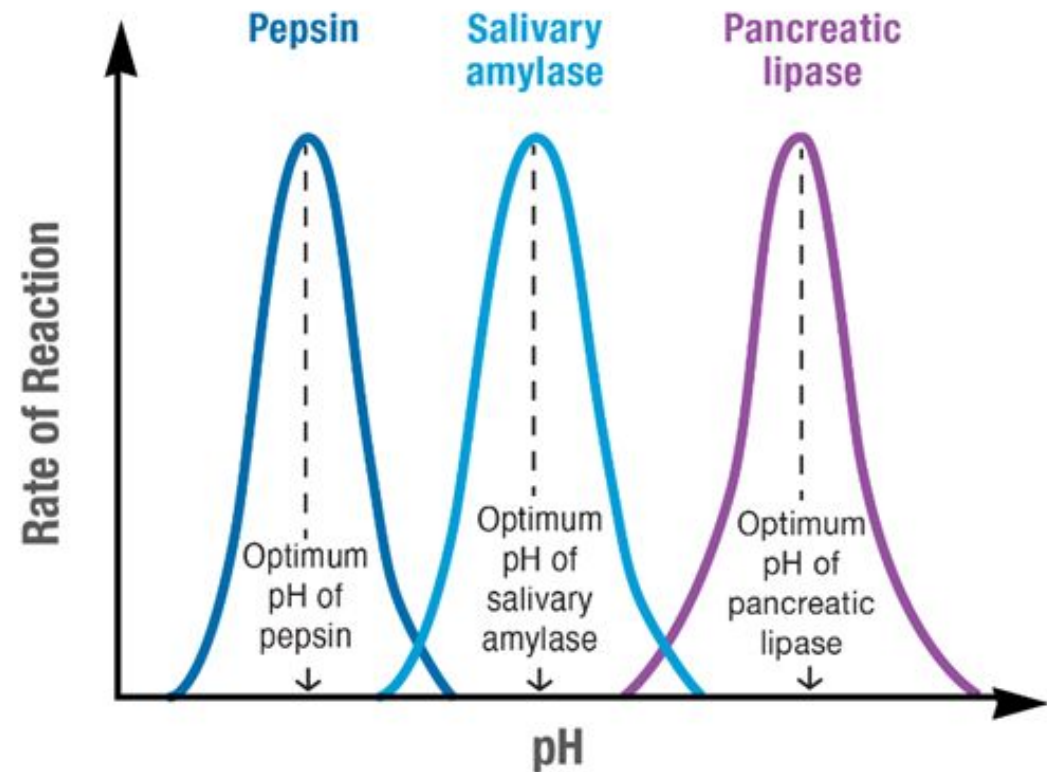
This relationship between pH and rate of reaction is shown in the graph below.

At a low pH the rate of reaction is low. It is high around the enzyme's optimal pH and then decreases as the pH above the optimal pH



The diagram below shows the activity of three enzymes that are found in different parts of our body, showing their optimum pH

- **Pepsin** is found in the stomach, which has a low pH due to the hydrochloric acid.
- **Salivary amylase** is found in the mouth, which is neutral.
- **Pancreatic lipase** acts in the small intestine, which has a high pH due to bicarbonate, which neutralises the stomach acid.

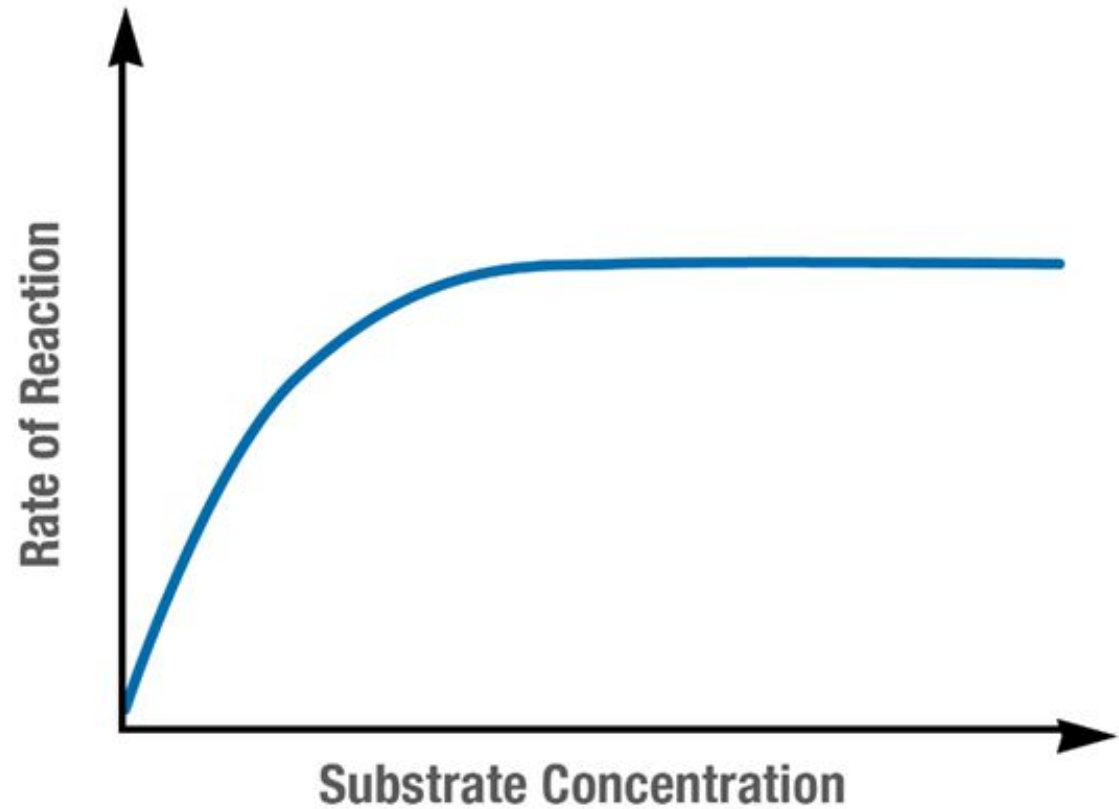


SUBSTRATE CONCENTRATION

As Substrate Concentration Increases, The Rate Of An Enzyme-catalysed Reaction Initially Rises As More Substrate Molecules Are Available To Bind To Enzyme Active Sites.

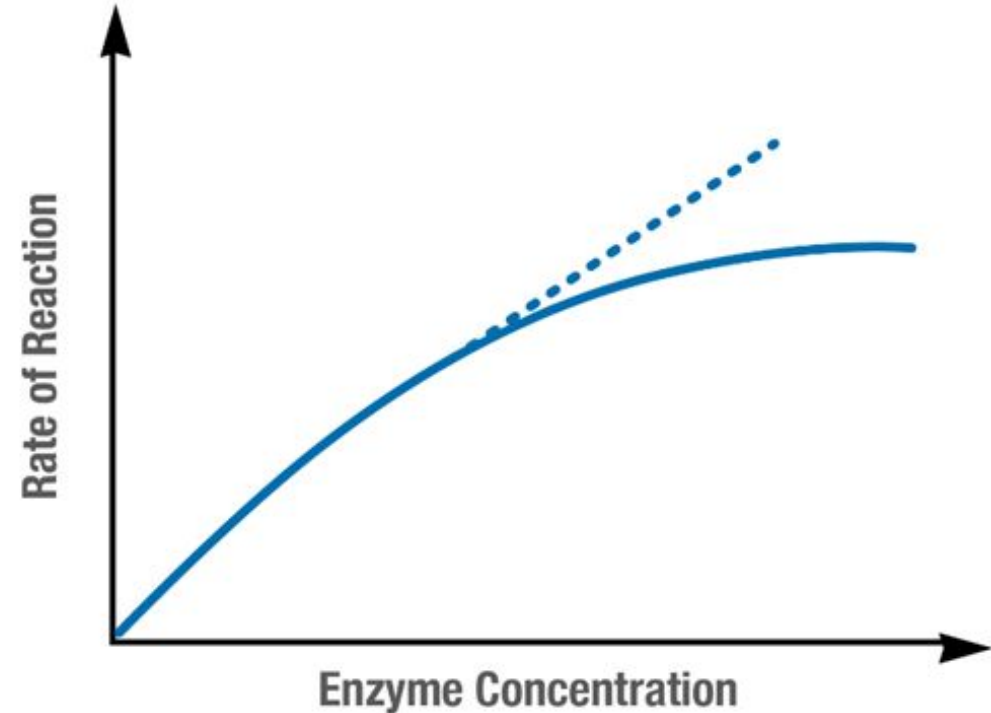
However, If The Amount Of Enzyme Is **Limited**, Then The Reaction Will Proceed Until All Enzymes Become Saturated With Substrate. At This Point The Rate Of Reaction Will Plateau, As All Active Sites Are Occupied And Unable To Process Additional Substrate Molecules Any Faster.

This plateau in reaction rate can continue until the substrate is exhausted and rate falls again, eventually to zero.

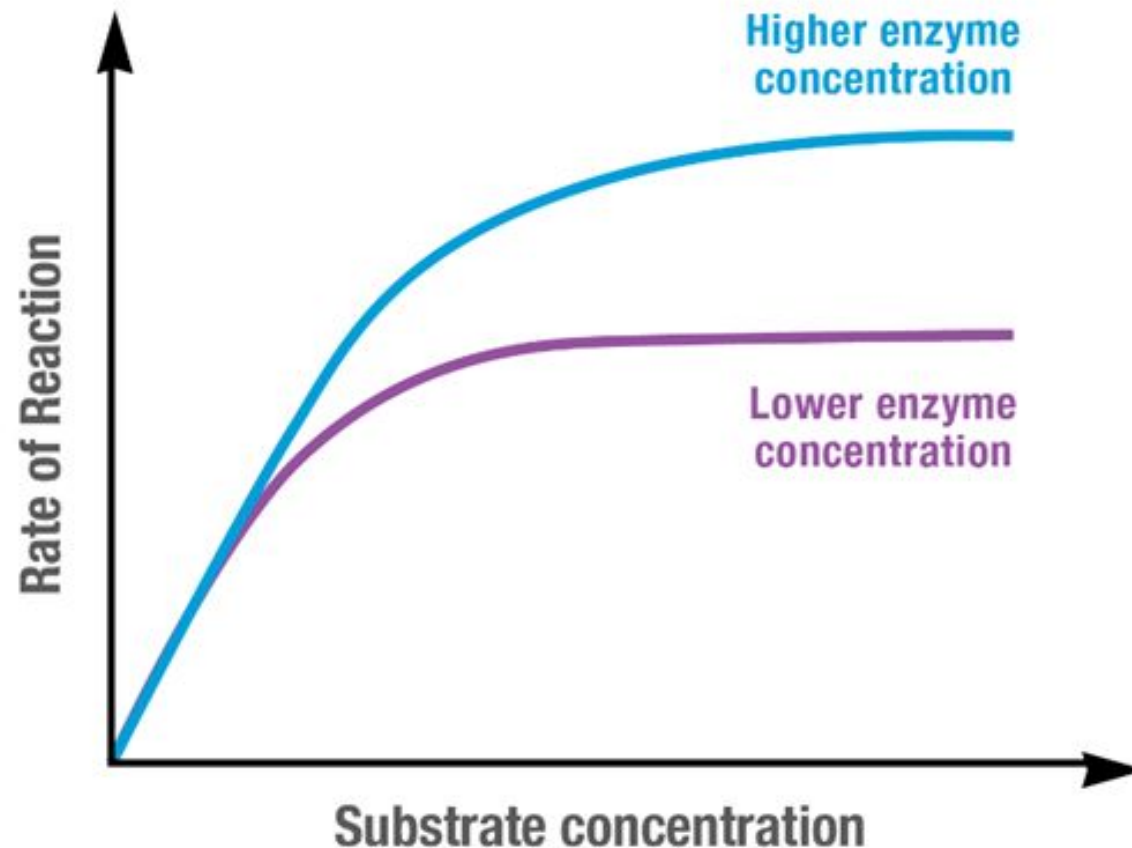


ENZYLE CONCENTRATION

Increasing enzyme concentration can increase the rate of reaction, as there are more enzyme molecules available to catalyse the reaction, leading to more frequent enzyme-substrate interactions. This is shown in the graph below by the dotted line.



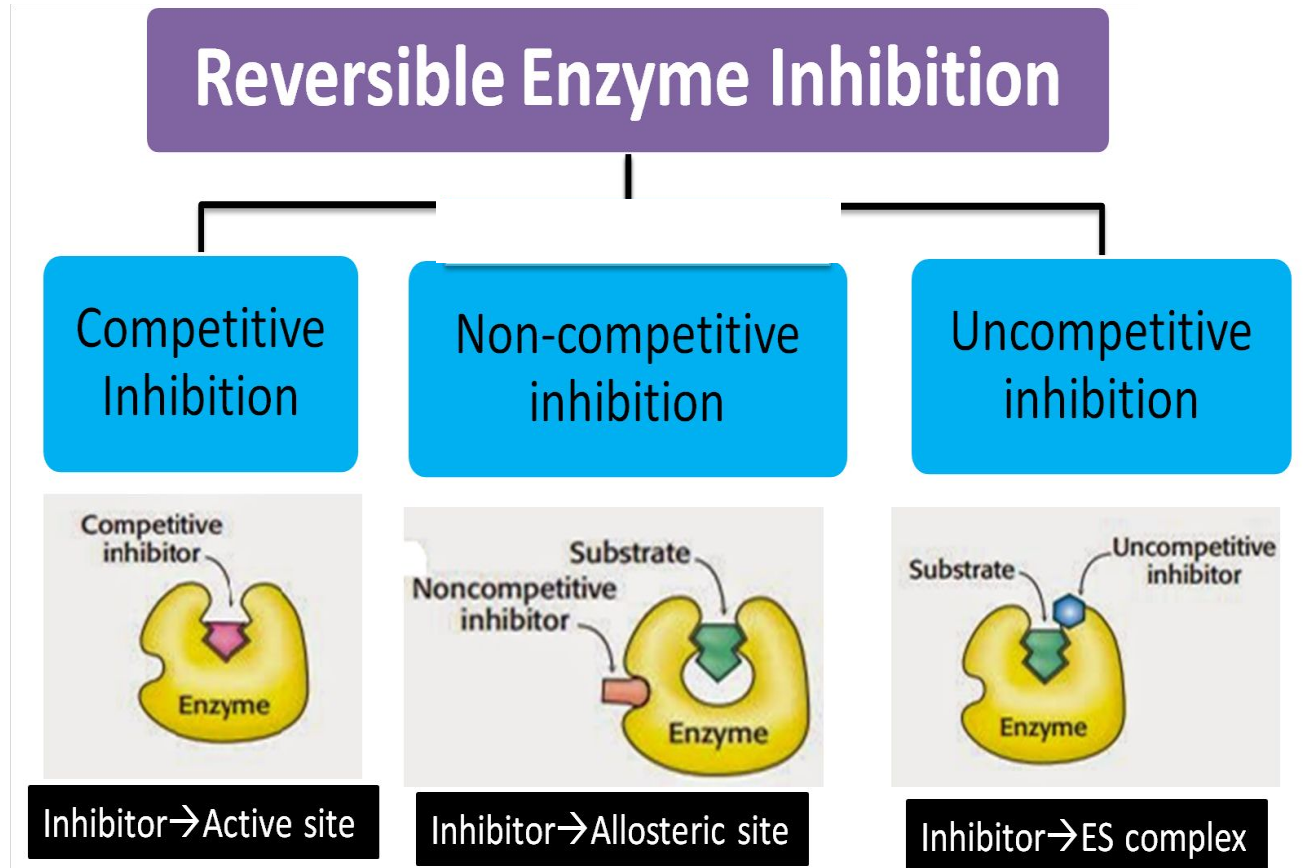
However, this rarely occurs as
and more often something such
as the substrate concentration
becomes the **limiting factor**.
This leads to first a plateau in
reaction rate and, when all the
substrate molecules are
consumed, an eventual zero
reaction rate.



PRESENCE OF INHIBITORS

Enzyme function can be regulated by inhibitors in a number of ways:

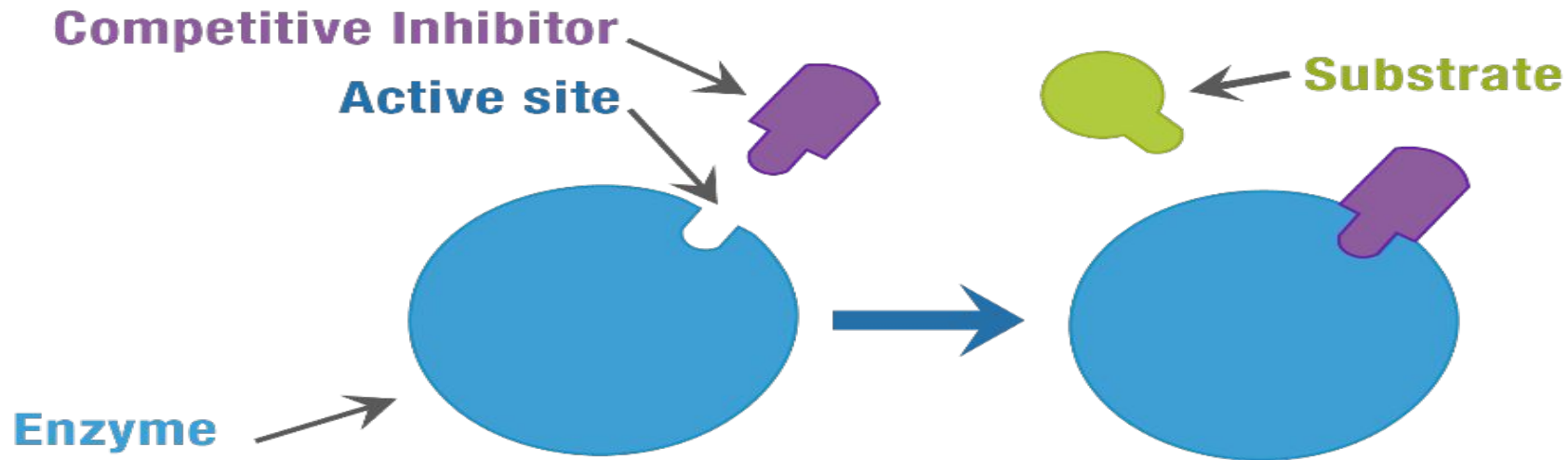
- **Competitive inhibitors** that bind to the active site and block the substrate from binding
- **Non-competitive inhibitors** that bind to a different site on the enzyme and alter its shape, reducing its activity
- **Feedback inhibition** is a regulatory mechanism where the end product of a metabolic pathway binds to an enzyme involved early in the pathway, reducing its activity to prevent overproduction.



Competitive inhibition

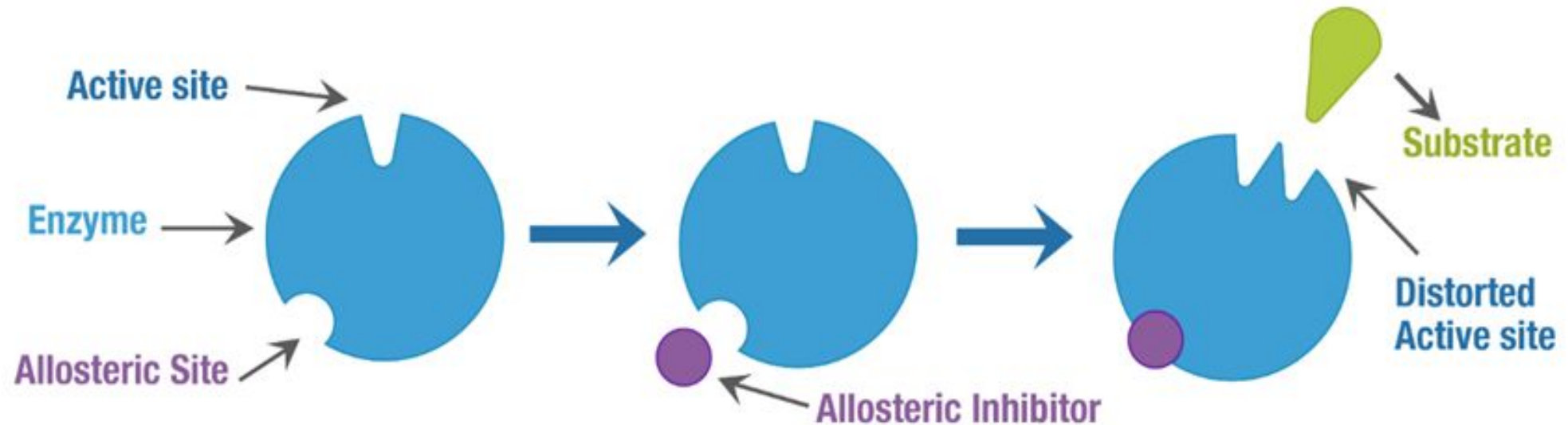
Competitive inhibitors **are molecules that bind to the active site** of an enzyme, directly competing with the substrate and preventing it from attaching.

The shape of the competitive inhibitor is complementary to the active site of the enzyme.



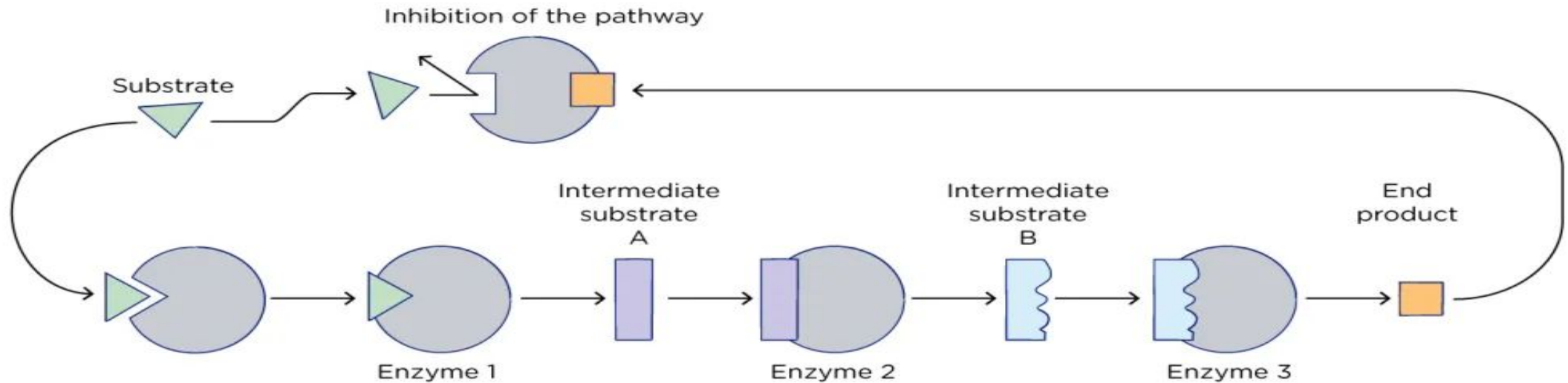
Non-competitive inhibition

Non-competitive inhibitors bind to a site other than the enzyme's active site, called the **allosteric site**, causing a change in the enzyme's shape and reducing its activity regardless of substrate concentration.



Feedback inhibition

Feedback inhibition is a regulatory mechanism where the **end product** of a **biochemical pathway** **inhibits an enzyme** involved early in the pathway, preventing overproduction and conserving resources.



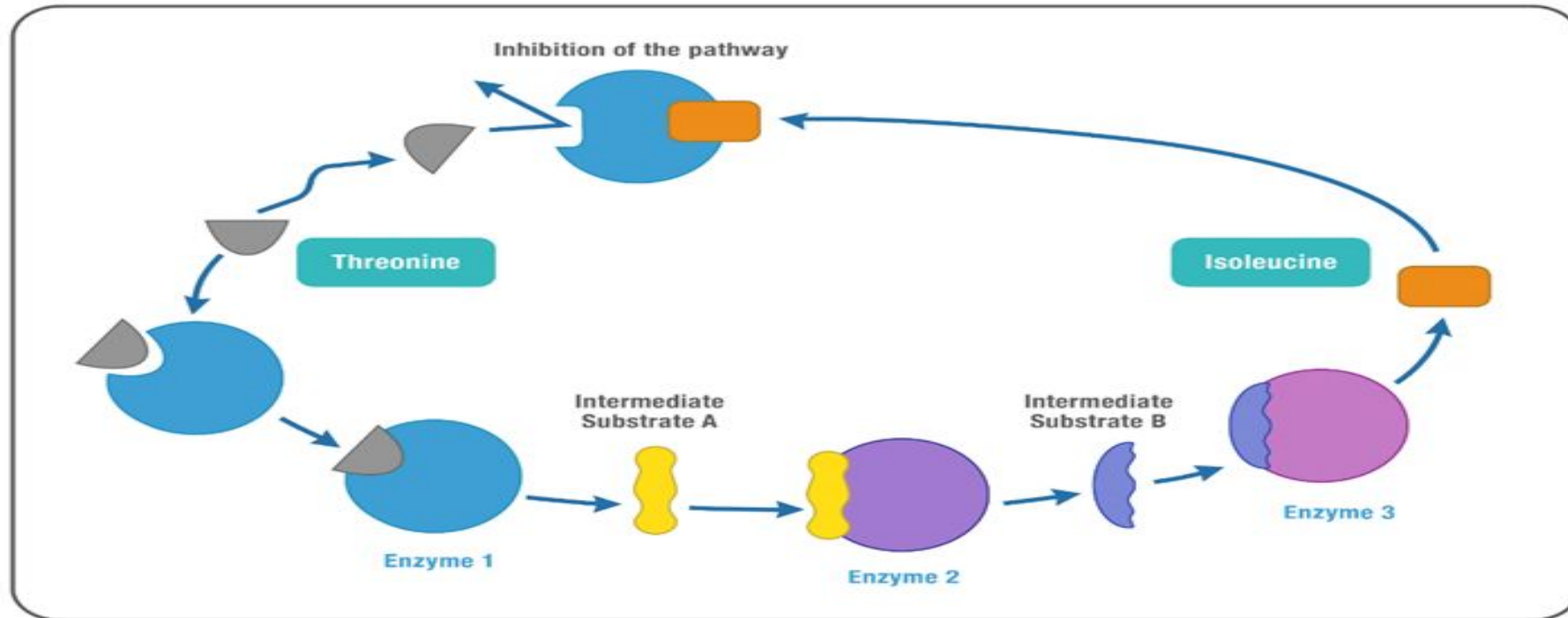
Example

In bacteria, feedback inhibition occurs in the production of the amino acid **isoleucine** from the amino acid **threonine** in a series of enzyme catalysed reactions.

When isoleucine levels become sufficiently high, it acts as an inhibitor by binding to the first enzyme in the pathway, threonine deaminase.

By binding allosterically to threonine deaminase, isoleucine changes the enzyme's shape, reducing its activity and thereby slowing down or stopping the production of more isoleucine.

This ensures that the cell does not produce excess isoleucine, conserving energy and resources.



Any questions?

*Thank
You*