Enzymes (HL)

Where can we find ENZYMES?

	Intracellular	Extracellular
Location	Occur within a cell (free or attached)	Occur outside a cell (free or attached)
Example	Glycolysis in cytoplasm & Krebs cycle in mitochondria	Chemical digestion in stomach

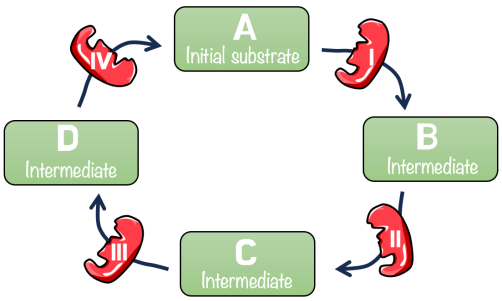
METABOLIC (BIOCHEMICAL) PATHWAYS

1. Linear metabolic pathway

Ex. glycolysis

2. Cyclic metabolic pathway

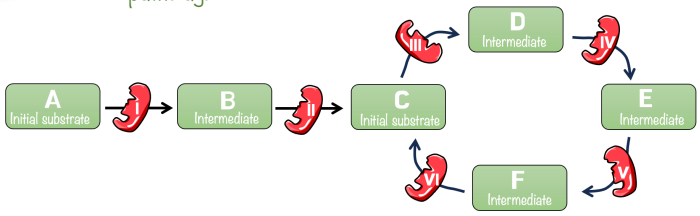
Ex. Krebs cycle (citric acid cycle), Calvin cycle



KEY CONCEPTS

- Different pathways have DIFFERENT lengths.
- Each reaction requires its own UNIQUE ENZYME since enzymes are SPECIFIC.
- Cyclical pathway begins and ends with the SAME substance.
- The final product of one pathway could be the substrate of another pathway.

In this example, C is both the final product in a linear metabolic pathway and the initial substrate in a cyclical metabolic pathway.

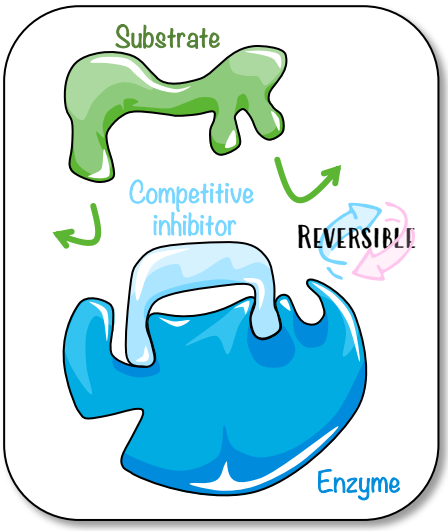


INHIBITOR – Molecule that binds to an enzyme & decreases its activity.

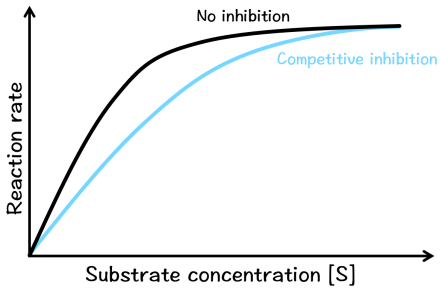
NOTE!

There are 3 types of inhibition:
Competitive inhibition
Non-competitive inhibition
Mechanism-based inhibition

Competitive INHIBITION



The competitive inhibitor **COMPETES DIRECTLY** with the usual substrate for the active site – it has a **SIMILAR STRUCTURE** to that normal substrate and therefore can **BLOCK THE ACTIVE SITE.**



It causes a decrease in rate of the chemical reaction

It is affected by substrate concentration and can be overcome by increasing the substrate concentration

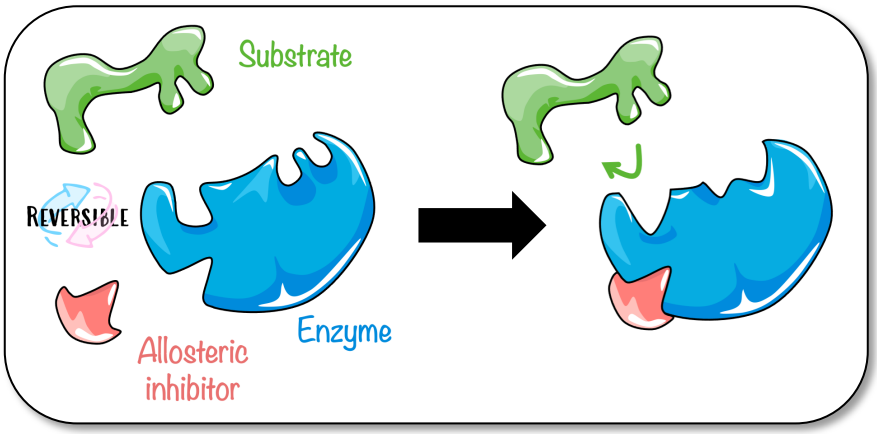
Example – **STATINS** inhibit production of cholesterol

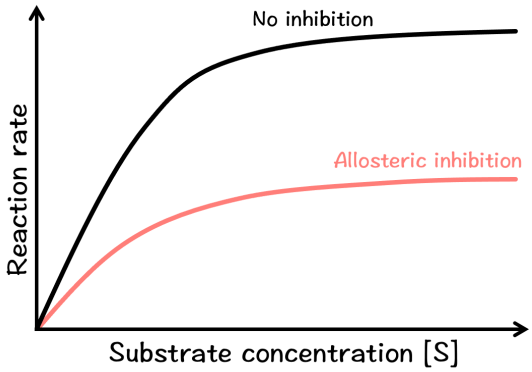
Enzymes (HL)

Non-competitive INHIBITION (allosteric)

The non-competitive inhibitor Instead binds to **ALLOSTERIC SITE** (AKA allosteric inhibition) – either on free-enzyme or enzyme-substrate complex.

It causes a change in the shape (**CONFORMATIONAL CHANGE**) of an enzymes active site, making it non-functional.





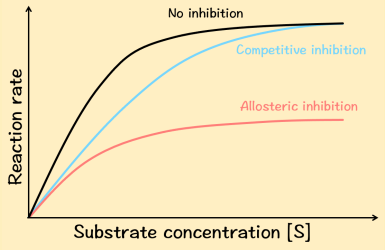
It causes a decrease in rate of the chemical reaction. Lower maximum rate

They are not influenced by the concentration of the substrate

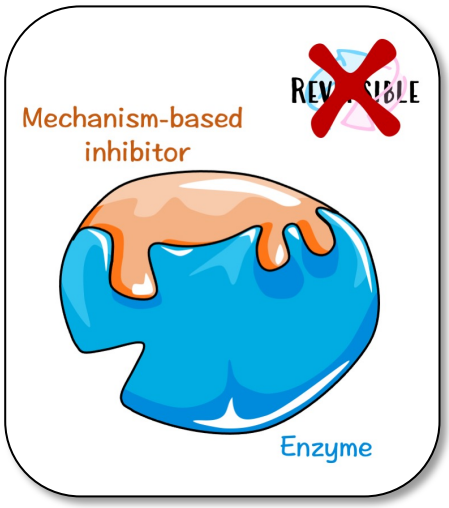
Rate can increase if enzyme concentration is increased

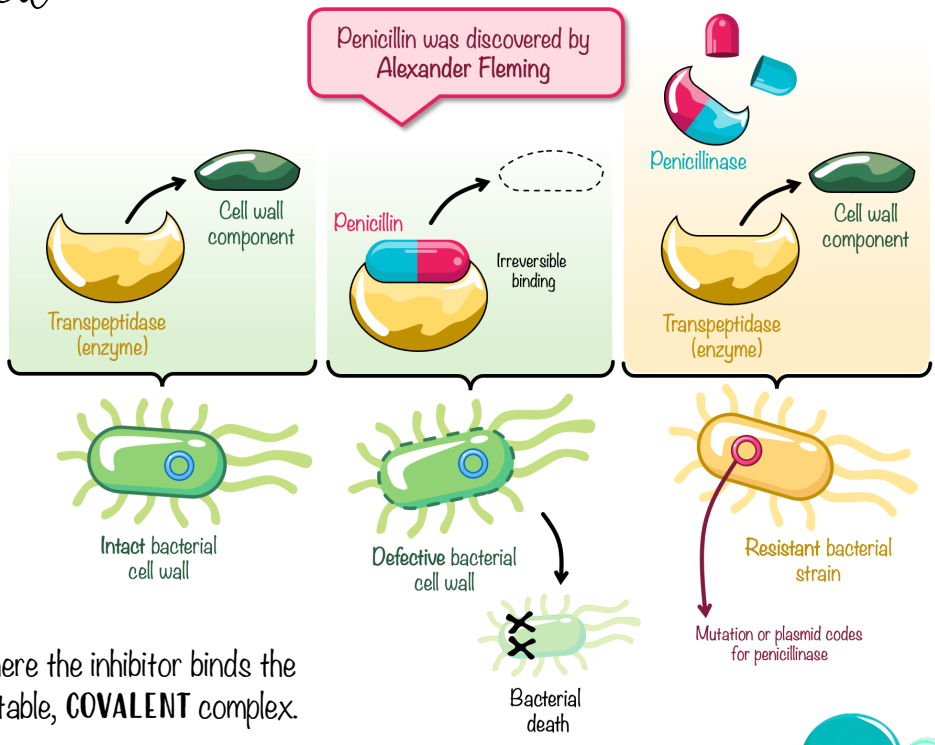
NOTE!

Make sure you can recognize the graphs for competitive and non-competitive inhibition in comparison to no inhibition.



Mechanism-Based INHIBITION





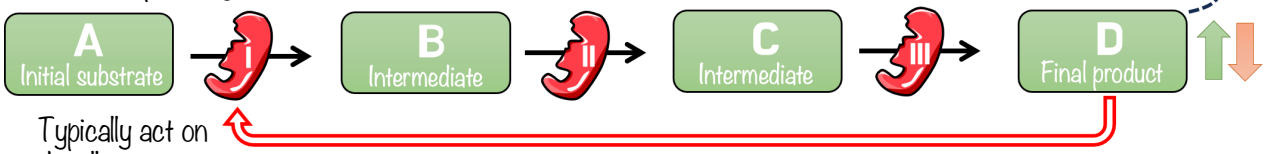
An irreversible form of inhibition where the inhibitor binds the enzymes' active site and forms a stable, **COVALENT** complex.

Enzymes (HL)

Feedback inhibition
(End product inhibition)

Prevents the cell from wasting **chemical resources and energy** by making more of substance than it doesn't need. A form of negative feedback.

Concept: Linear metabolic pathway



Typically act on the allosteric site

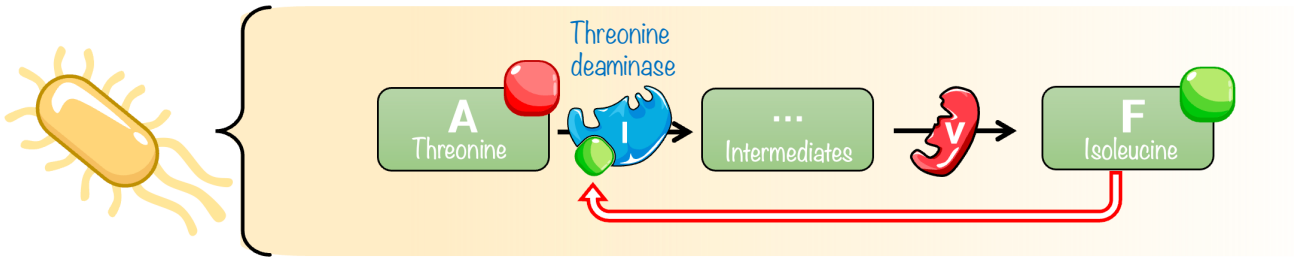
The end-product inhibits the action of the enzyme in the first step of the pathway.

When present in high concentrations, the end-product binds with the allosteric site of the first enzyme, thus bringing about inhibition.

As the existing end-product is used up by the cell, the first enzyme is reactivated.

This is done so that a build of intermediate substrates in the cell does not occur. Energy is also conserved since the following reactions in the pathway would not occur.

Real example:



Big Brain Tip!

Organic matter –
Contain C-H bonds. Includes the 4 macromolecules.

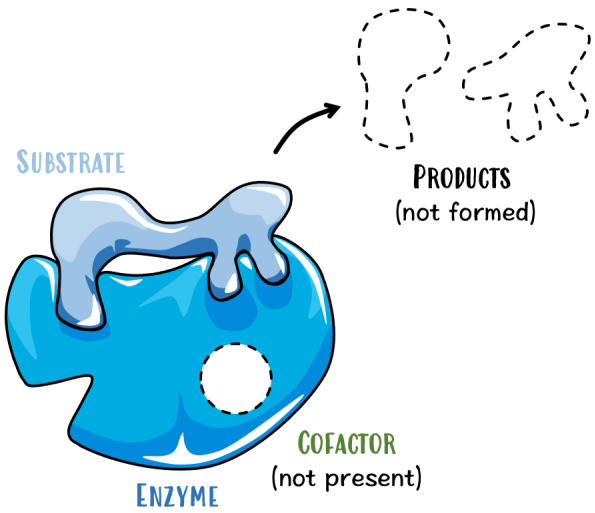
The **4** macromolecules

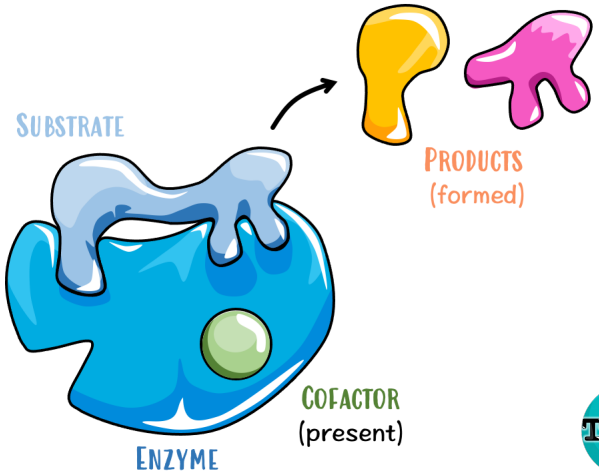
- Carbohydrates
- Nucleic acids
- Lipids
- Proteins

Inorganic matter –
Do not contain C-H bonds but may contain carbon, includes rocks, minerals etc.

Enzymes and cofactors

Many enzyme need an inorganic ion of a non-protein organic molecule to work properly. These are called **cofactors**.
A common example of a cofactor are vitamins.





notes