

METABOLISM, CELL RESPIRATION AND PHOTOSYNTHESIS

8.1 METABOLISM

Metabolic Pathways

- most chemical changes happen in a sequence of small steps and together form a metabolic pathway.
- metabolic reactions are of 2 types.

chain

phenylalanine



tyrosine



hydroxyphenylpyruvate



homogentisate



4-maleylacetate



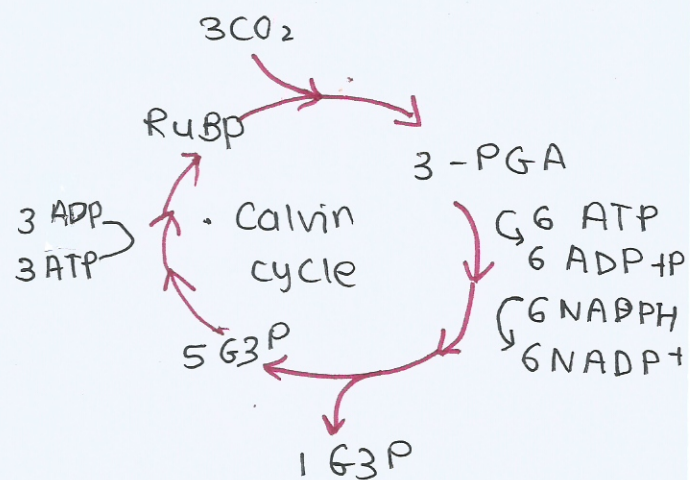
4-fumarylacetate



fumarate + acetate

Eg: glycolysis, coagulation cascade

Cyclic

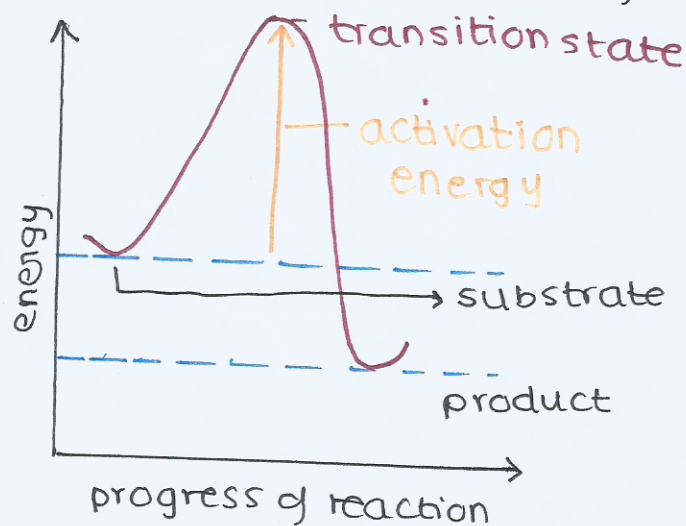


• Kreb's cycle

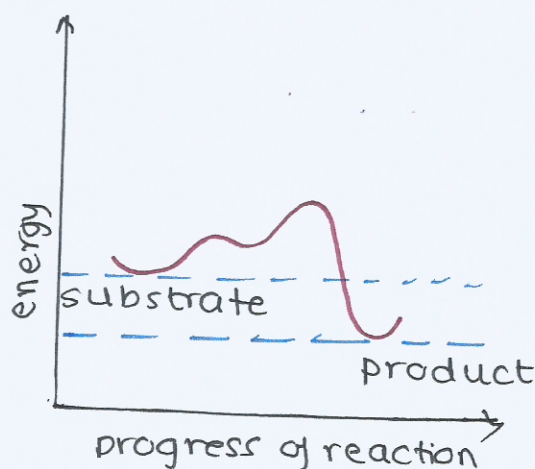
ENZYMES AND ACTIVATION ENERGY

Enzymes lower the activation energy of the chemical reactions they catalyze.

- ▷ The substrates have to pass through a transition state before they get converted into products.
- ▷ Some amount of energy is required to reach the transition state. This energy is known as activation energy.
- ▷ Activation energy is used to break/weaken the bonds in the substrates.
- ▷ When the enzyme binds with the substrate, the overall energy level of the transition state lowers which results in a decrease in the activation energy.
- ▷ Activation energy ↓ Rate of Reaction ↑



activation energy without enzyme

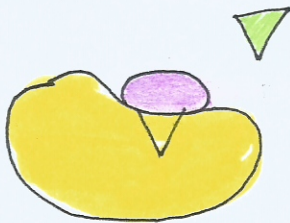


ENZYME INHIBITORS

- Chemicals that bind to enzymes and reduce the activity of the enzyme are known as enzyme inhibitors.

They are of 2 types:

Competitive inhibitor



→ They bind with the active site so that the substrate cannot bind with it.

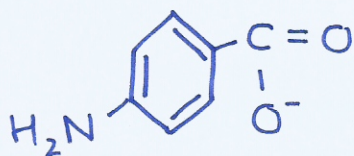
→ The inhibitor is chemically and structurally similar to the substrate.

→ ENZYME

dihydropteroate synthetase

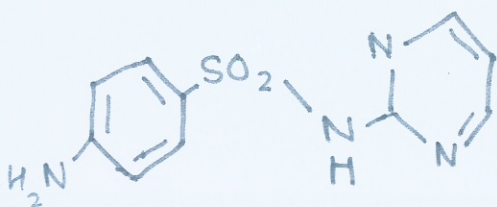
→ SUBSTRATE

para-aminobenzoate



→ INHIBITOR

sulfadiazine



Non-competitive inhibitor



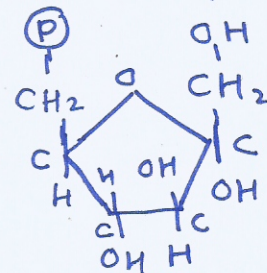
→ Binds with a location other than the active site but it results in a change of shape in the enzyme. This doesn't allow the substrate to bind with the active site.

→ ENZYME

phosphofructokinase

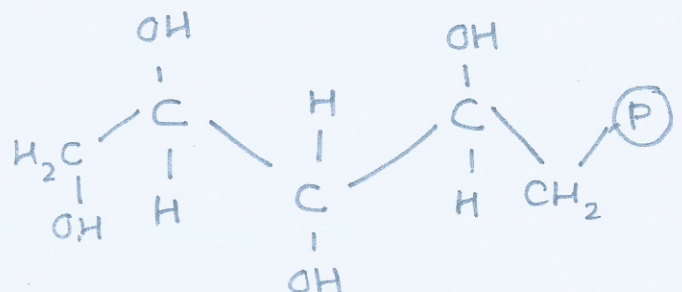
→ SUBSTRATE

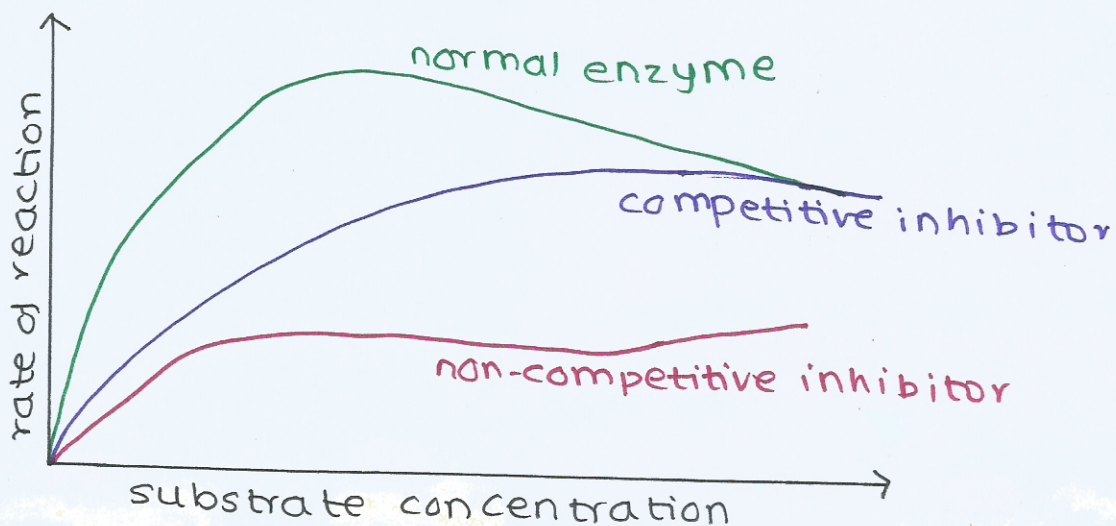
fructose-6-phosphate



→ INHIBITOR

xylitol-5-phosphate

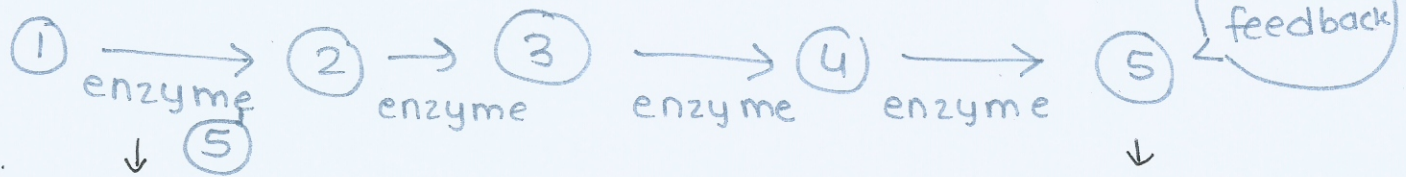




- **green:** effect of substrate concentration on enzyme activity. (no inhibitor)
- **purple:** effect of substrate concentration on the rate of reaction when a **competitive inhibitor** is present.
 - ▶ When the concentration of substrate begins to exceed the amount of inhibitor ↓
the **same rate** of the **enzyme without any inhibitors** can be achieved. ↓
it takes a **high concentration of substrate** to achieve the maximum rate.
- **red:** effect of substrate concentration on enzyme activity when a **non-competitive inhibitor** is present.
 - ▶ the enzyme **does not reach the maximum rate** as it prevents some enzymes from binding with the active site.
the **maximum rate** when the **substrate concentration is increased** is **lower than the enzyme with no inhibitors**.

END PRODUCT INHIBITION

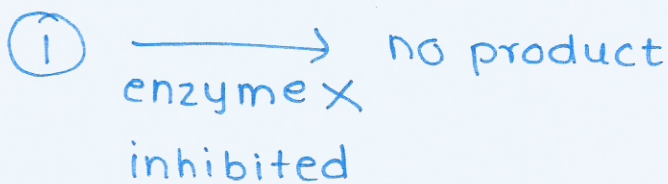
It is a form of negative feedback by which metabolic pathways can be controlled.



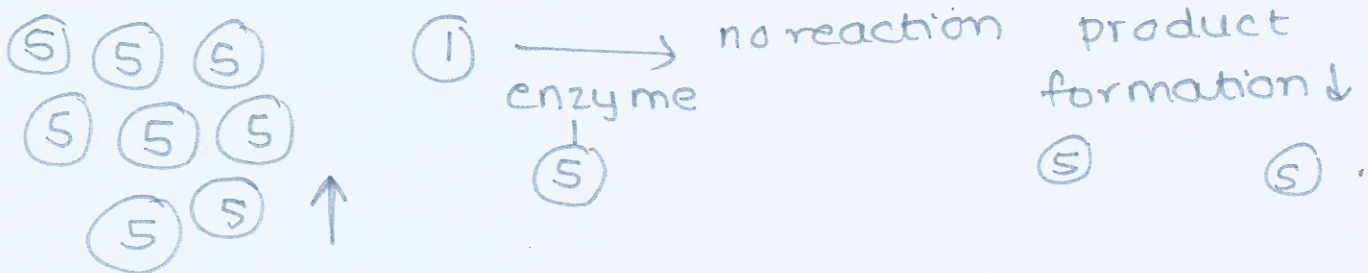
The end product binds to the allosteric (active site) & deactivates the enzyme temporarily by non-competitive inhibition.

The final product in a series of reactions inhibits an enzyme from an earlier step in the sequence.

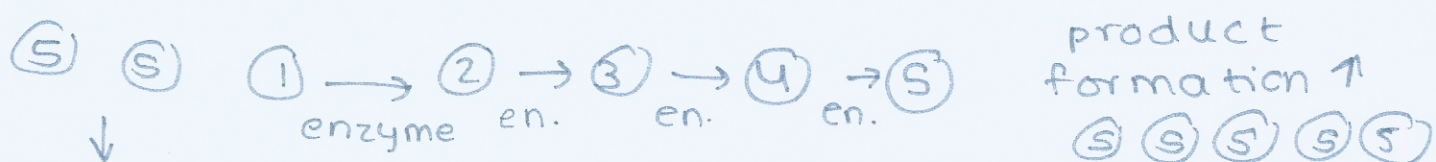
The enzyme no longer functions and the rate of product formation decreases temporarily.



When the product level increases, the final product inhibits the reaction and the rate of product formation decreases.



When the product level decreases, the reaction will happen normally without any inhibitors and the rate of product formation increases.



Example: Threonine $\rightarrow$ Isoleucine Pathway

