2.3 ENZYMES

Enzymes are globular proteins, which act as catalysts (i.e speed up) in chemical reactions, without being used up.

Active site A small portion of the enzyme which comes into direct contact with the substrate in the enzyme/ substrate complex.

Substrates are the reactants that take place in the reactions catalyzed by enzymes. In chemical reactions, one or more reactants are converted into one or more products.

Substrate + Enzyme → Enzyme / Substrate complex → Enzyme + Products

Metabolism

It is the web of all the enzyme – catalyzed reactions in a cell or organism.

Metabolic pathways

Chains of reactions or cycles of reactions

Anabolism

The synthesis of molecules from simpler molecules (monomers to polymers through condensation)

Catabolism

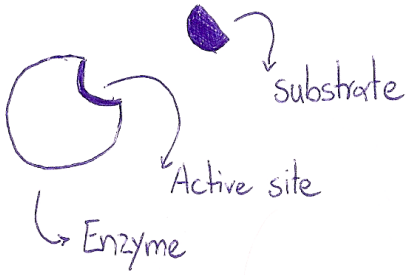
The breaking down of complex molecules to simpler ones (polymers to monomers through hydrolysis)

ENZYME – SUBSTRATE SPECIFICITY

Most enzymes are specific which means that they will catalyze a single reaction. Enzymes will therefore, have a very small number of possible substrates.

The active site of an enzyme has a precise shape and certain chemical properties. Hence, the active site of an enzyme will match the shape and chemical properties of a substrate.

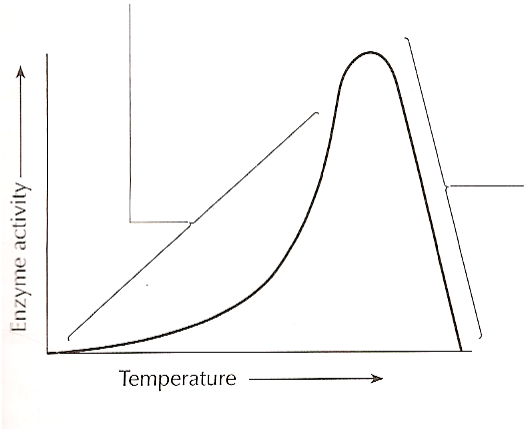
This is known as the **"Lock and Key"** model:



THE EFFECTS OF TEMPERATURE, pH AND SUBSTRATE CONCENTRATION ON ENZYME ACTIVITY

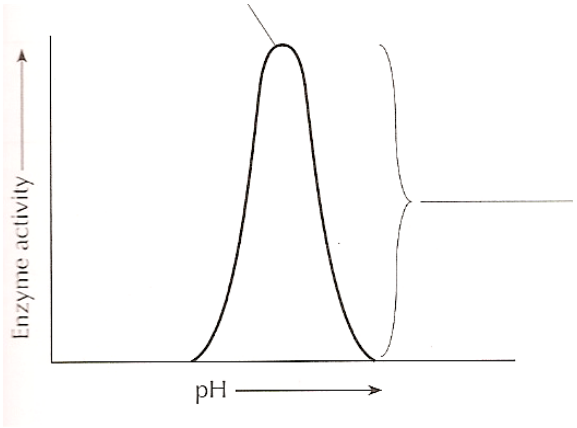
Temperature:

As temperature increases, enzyme activity increases too. For every 10 C rise, the rate of enzyme activity is doubled. At very high temperatures, enzymes become denaturated (i.e bonds break).



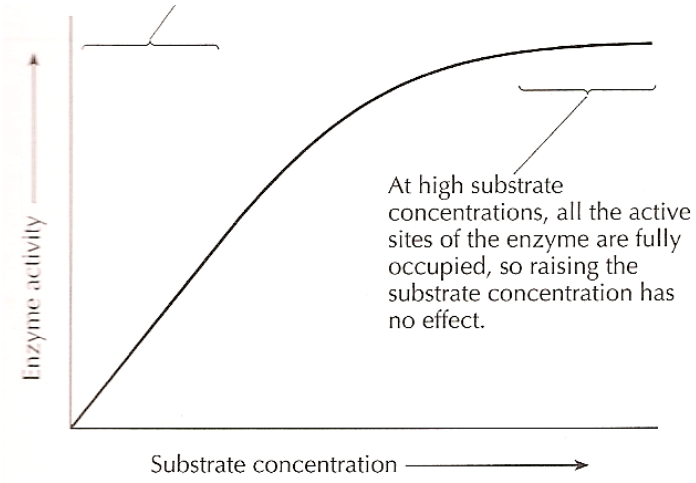
pH:

The optimum pH at which enzyme activity is fastest is pH 7. If pH decreases or increases, enzyme activity is reduced. Both acids and alkalis can denature enzymes.



Substrate concentration:

For a given enzyme concentration, the rate of enzymatic reaction increases with increasing substrate concentration. If there is a further increase in substrate concentration there is no significant reaction rate increase because all of the active sites are saturated with a substrate.



DENATURATION:

It is the changing of enzyme structure, hence it can no longer perform its function due to the breaking of bonds (e.g temperature increase and changes in pH).

The use of lactase in the production of lactose – free milk:

Lactose is a component of milk. It is not necessary for adults, therefore biotechnologists have managed to switch on (whenever necessary) the gene responsible for lactase production in order to break down lactose. These methods are of huge economic importance since more dietary problems affect modern societies. Another easy method is to add free lactase obtained from microorganisms (*K. lactis*) to the milk.

lactase

Lactose ----------> glucose + galactose

Immobilized enzymes:

Enzymes are used in industry for catalyzing specific reactions. These enzymes are usually immobilized, by attachment of enzymes to another material or in aggregations to restrict their movement. Enzyme immobilization has several benefits:

1. These enzymes can be reused
2. Enzyme concentrations can be higher
3. Catalysis can be controlled by adding or removing them promptly from the reaction mixture
4. Products are not contaminated by the addition of enzymes

How do we immobilize enzymes?

1. Attachment to surfaces, called adsorption (eg glass)
2. Entrapment in a membrane or a gel (eg alginate)