

Living Cells

Part C Enzyme Action

To start a chemical reaction we need to supply energy. This is known as the activation energy.

Catalysts are special chemicals that reduce the amount of energy required to start a chemical reaction - the activation energy. The catalyst speeds up the chemical reaction but is not used up during the chemical reaction. Therefore, at the end of the chemical reaction the same mass of catalyst remains as was present at the start.

Enzymes are biological catalysts. They are found in every living cell and are necessary to allow chemical reactions to occur at environmental conditions.

e.g. The breakdown of toxic hydrogen peroxide is catalysed by the enzyme catalase. This reaction occurs at 36.8 °C and 1 atmosphere (pressure).

Each enzyme is only able to act on a specific chemical. The chemical an enzyme acts on is known as the enzyme's substrate. Each enzyme is specific to its substrate.

An enzyme molecule is made up of at least one protein molecule that is folded to make a specific molecular shape. Within the shape of the molecule is an active site. The substrate molecule binds to the active site, it is this binding or holding of the substrate molecule(s) in a particular orientation that reduces the activation energy required to start the chemical reaction. When the products leave the active site, the enzyme molecule is of an identical shape to that which it was before the chemical reaction.

Some enzymes promote the break down or degradation of larger molecules into smaller molecules.

e.g. Pepsin breaks large protein molecules down into individual small amino acids.

Amylase breaks large starch molecules down into small maltose molecules.

Other enzymes promote the building up or synthesis of smaller molecules into larger molecules.

e.g. Phosphorylase is responsible for the synthesis of a large starch molecule from smaller glucose-1-phosphate molecules.

Each enzyme has a set of condition that it is able to work best at. These are known as the optimum conditions.

e.g. The optimum temperature for amylase found in our saliva is 36.8 °C or body temperature.

At very low temperatures enzyme molecules are inactive. The enzyme and substrate molecules are moving very slowly towards each other. Very few successful bindings of the substrate to the active site occur.

As the temperature of the reaction mixture is increased, then the enzyme and substrate molecules are moving towards each other at a faster rate. This results in more successful bindings of the substrate to the active site, so the rate of reaction increases.

Above a predetermined temperature, usually around 50 °C, the shape of the enzyme molecule is permanently changed resulting in the substrate no longer being able to bind to the active site. Once this has happened the enzyme is said to be denatured.

Similarly, enzymes only work within a range of pH values. Outwith the range of pH values, the shape of the enzyme molecule is changed, preventing the binding of substrate molecules to the active site. The enzyme molecules are denatured.

The pH value at which the enzyme works best is known as the optimum pH.