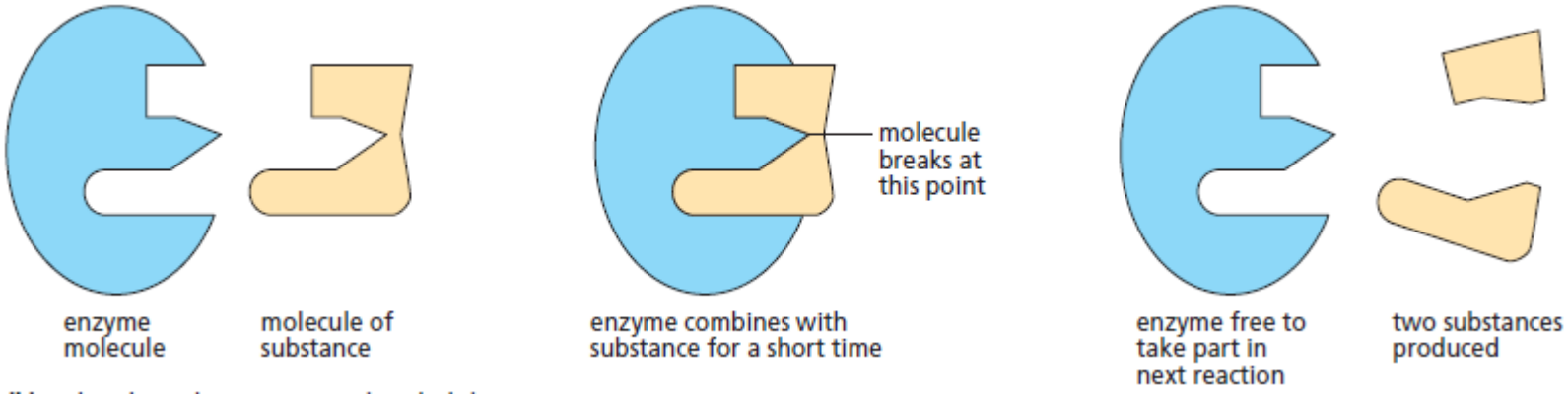
Chapter 5

Enzymes

- Enzymes are proteins that act as biological catalysts;
- A catalyst is a molecule, which speeds up a chemical reaction, but remains unchanged at the end of the reaction;
- It is biological since enzymes are made by living cells.
- Names of enzymes usually end with ase and they are named according to the substance on which they act. e.g. Protease acts on proteins
- The substance on which an enzyme acts is called substrate.

Enzymes specificity

- Each type of enzyme will act on only one type of substrate molecule. This is because the shape of the active site will only allow one shape of molecule to fit.



Possible explanation of enzyme action

Mechanism of enzyme action, The lock and key hypothesis

- The random movement of enzyme and substrate brings the substrate into the active site. An enzyme-substrate complex is temporarily formed.
- When the reaction is complete, the product or products leave the active site. The enzyme is unchanged by this process, so it is now ready to receive another substrate molecule.

Factors affecting the rate of enzyme reactions

1. *Temperature*

- A rise in temperature increases the rate of chemical reaction till a point (the optimum temperature) where it reaches a maximum rate, and then slows down again as the temperature increases.

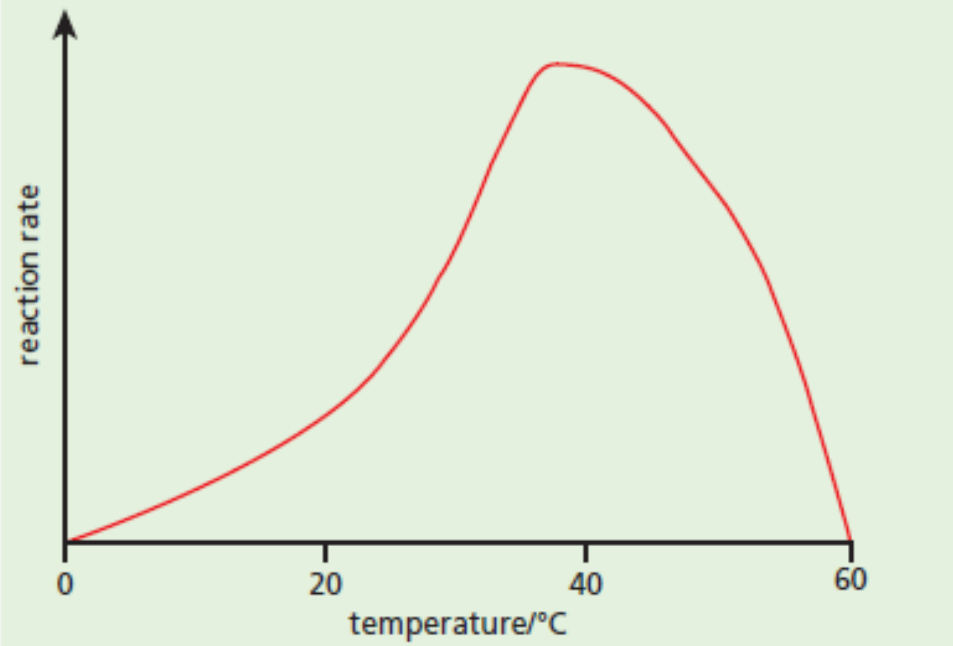


Figure 5.4 Graph showing the effect of temperature on the rate of an enzyme-controlled reaction

Explanation

- As temperature rises, the enzyme and substrate molecules move faster, as they gained energy. Collisions happen more frequently, so the substrate molecules enter the active site more often. This makes for bonds to be broken/made so that the reaction can occur.

Effect of heat – denaturation

Above optimum temperature, the speed of movement of the substrate and enzyme molecules continues to increase, but the structure of the enzyme molecule vibrates with more energy so that hydrogen bonds begin to break.

The substrate no longer fits at all, because the enzyme molecule has lost its shape and activity and is said to be denatured.

2. pH

- Under conditions of constant temperature, every enzyme functions most efficiently over a particular pH range.

- Optimum pH: is the pH at which the maximum rate of reaction occurs.
- For example: the optimum pH for amylase is about 7 and for pepsin 2.

- Any change in pH above or below the optimum value reduces the rate of enzyme activity.
- Most enzymes work best at a particular level of acidity or alkalinity.
- Extreme pH changes denature enzymes.

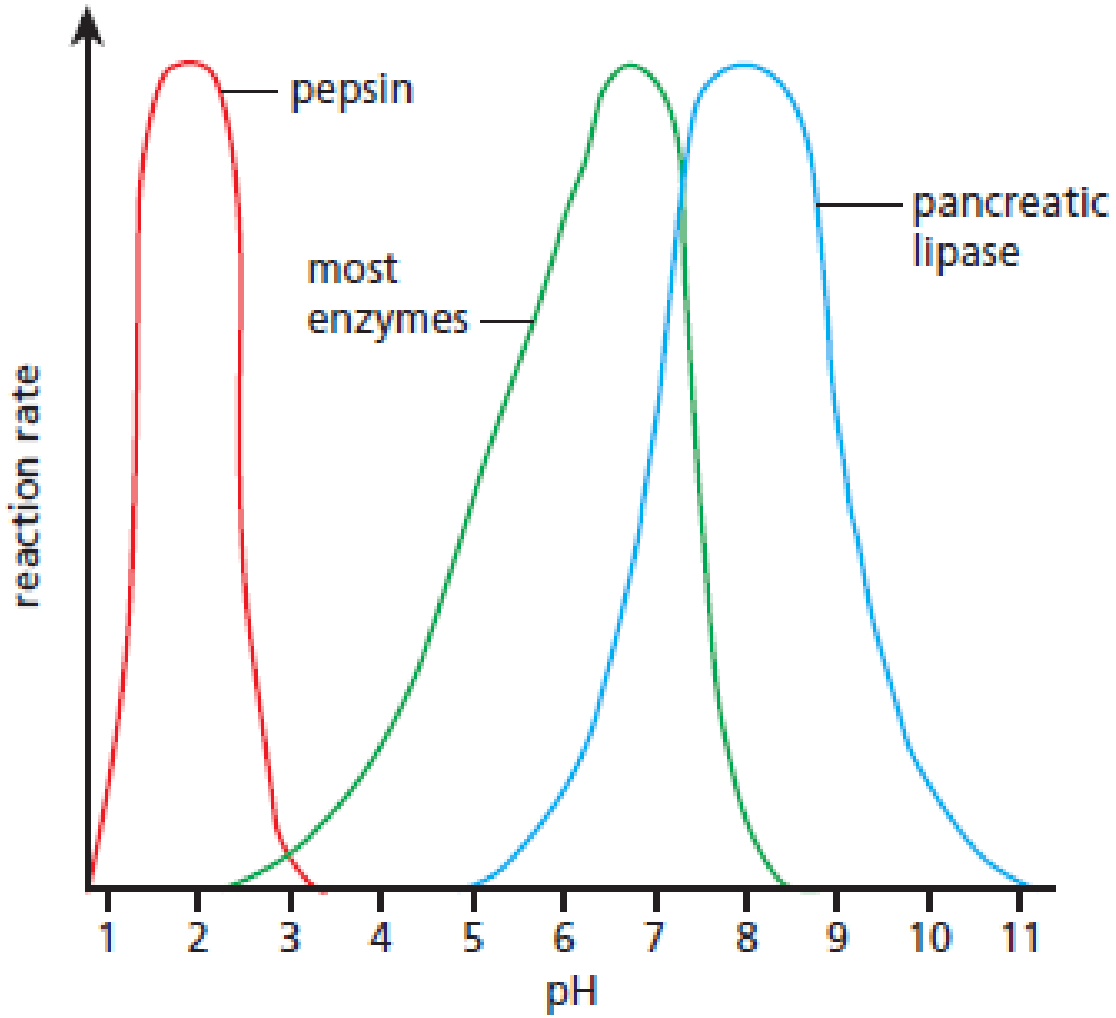


Figure 5.3 The effect of pH on digestive enzymes

Cavity	Chemical medium	pH
Mouth	Neutral/slightly basic	7-7.2
Stomach	Acidic (provided by HCL)	2
Small intestine	Alkaline (provided by sodium hydrogen carbonate and bile)	8.5

Practical Work

Action of catalase on hydrogen peroxide

- Catalase is an enzyme found in tissues of most living things and catalyses the breakdown of hydrogen peroxide into water and oxygen.

  Oxygen that is released can be collected and measured.

Action of amylase on starch

- Amylase is an enzyme that catalyses the break down of starch into maltose.