*This is the **Foundation Combined** version — Higher Tier and Separate-only content removed.*

Enzymes are biological catalysts — protein molecules that speed up chemical reactions in the body without being used up.

Required Practical: Investigating the effect of pH on amylase activity using starch-iodine method — timing how long it takes for starch to be fully digested at different pH values.

- Enzymes are specific: each has an active site with a specific shape that only fits one type of substrate (lock and key model).
- Substrate binds to active site → enzyme-substrate complex forms → products released → enzyme unchanged and reused.
- Effect of temperature: as temperature rises, rate increases (more kinetic energy, more collisions). At OPTIMUM temperature, rate is maximum. Above optimum, enzyme DENATURES — active site permanently changes shape. Cannot be reversed.
- Effect of pH: each enzyme has an optimum pH. Extreme pH denatures the enzyme. E.g. pepsin: optimum pH 2 (stomach). Amylase: optimum pH 7 (mouth).
- Digestive enzymes: amylase → starch to sugars; protease → proteins to amino acids; lipase → fats to fatty acids + glycerol.

Key Terms

Enzyme	A biological catalyst — a protein that speeds up chemical reactions without being used up
Active site	The region of the enzyme where the substrate binds — has a specific complementary shape
Substrate	The molecule(s) an enzyme acts on — binds to the active site
Denaturation	Irreversible change in enzyme shape due to high temperature or extreme pH — active site destroyed
Optimum	The temperature or pH at which an enzyme works at its maximum rate

■ **Exam Tip:** Denaturation is PERMANENT — the enzyme cannot be "un-denatured" by cooling. At low temperatures the enzyme is just slow (not denatured). Many students confuse these. Remember: cold = slow; hot = denatured.