

## Unit 3.2 - Enzymes (HL and SL)

### Syllabus Statements

- B1.2.5—Effect of pH and temperature on protein structure. Include the term “denaturation”.
- C1.1.1—Enzymes as catalysts - “Students should understand the benefit of increasing rates of reaction in cells.”
- C1.1.2—Role of enzymes in metabolism - “Students should understand that metabolism is the complex network of interdependent and interacting chemical reactions occurring in living organisms. Because of enzyme specificity, many different enzymes are required by living organisms, and control over metabolism can be exerted through these enzymes.”
- C1.1.3—Anabolic and catabolic reactions - “Examples of anabolism should include the formation of macromolecules from monomers by condensation reactions including protein synthesis, glycogen formation and photosynthesis. Examples of catabolism should include hydrolysis of macromolecules into monomers in digestion and oxidation of substrates in respiration.”
- C1.1.4—Enzymes as globular proteins with an active site for catalysis - “Include that the active site is composed of a few amino acids only, but interactions between amino acids within the overall three-dimensional structure of the enzyme ensure that the active site has the necessary properties for catalysis.”
- C1.1.5—Interactions between substrate and active site to allow induced-fit binding. Students should recognize that both substrate and enzymes change shape when binding occurs.
- C1.1.6—Role of molecular motion and substrate-active site collisions in enzyme catalysis. “Movement is needed for a substrate molecule and an active site to come together. Sometimes large substrate molecules are immobilized while sometimes enzymes can be immobilized by being embedded in membranes.”
- C1.1.7—Relationships between the structure of the active site, enzyme–substrate specificity and denaturation - “Students should be able to explain these relationships.”
- C1.1.8—Effects of temperature, pH and substrate concentration on the rate of enzyme activity. The effects should be explained with reference to collision theory and denaturation. Students should be able to interpret graphs showing the effects.
- C1.1.9—Measurements in enzyme-catalysed reactions - “Students should determine reaction rates through experimentation and using secondary data.”
- C1.1.10—Effect of enzymes on activation energy. “Students should appreciate that energy is required to break bonds within the substrate and that there is an energy yield when bonds are made to form the products of an enzyme catalysed reaction. Students should be able to interpret graphs showing this effect. Students should appreciate that energy is required to break bonds within the substrate and that there is an energy yield when bonds are made to form the products of an enzyme catalysed reactions. Students should be able to interpret the graphs showing this effect. ”

- *C1.1.11 (HL)—Intracellular and extracellular enzyme-catalysed reactions*
- *C1.1.12 (HL) —Generation of heat energy by the reactions of metabolism - "Include the idea that heat generation is inevitable because metabolic reactions are not 100% efficient in energy transfer. Mammals, birds and some other animals depend on this heat production for maintenance of constant body temperature."*
- *C1.1.13 (HL)—Cyclical and linear pathways in metabolism - "Use glycolysis, the Krebs cycle and the Calvin cycle as examples."*
- *C1.1.14 (HL)—Allosteric sites and non-competitive inhibition -"Students should appreciate that only specific substances can bind to an allosteric site. Binding causes interactions within an enzyme that lead to conformational changes, which alter the active site enough to prevent catalysis. Binding is reversible. "*
- *C1.1.15 (HL)—Competitive inhibition as a consequence of an inhibitor binding reversibly to an active site - "Use statins as an example of competitive inhibitors. Include the difference between competitive and noncompetitive inhibition in the interactions between substrate and inhibitor and therefore in the effect of substrate concentration."*
- *C1.1.16 (HL) —Regulation of metabolic pathways by feedback inhibition - "Use the pathway that produces isoleucine as an example of an end product acting as an inhibitor."*