Standards covered in the first unit

Membrane structure	1.3	**Understandings:** ■ Phospholipids form bilayers in water due to the amphipathic properties of phospholipid molecules ■ Membrane proteins are diverse in terms of structure, position in the membrane and function ■ Cholesterol is a component of animal cell membranes **Applications:** ■ Cholesterol in mammalian membranes reduces membrane fluidity and permeability to some solutes **Skills:** ■ Drawing of the fluid mosaic model ■ Analysis of evidence from electron microscopy that lead to the proposal of the Davson-Danielli model ■ Analysis of the falsification of the Davson-Danielli model that lead to the Singer-Nicolson model ●
Membrane transport	1.4	**Understandings:** ■ Particles move across membranes by simple diffusion, facilitated diffusion, osmosis and active transport ■ The fluidity of membranes allows materials to be taken into cells by endocytosis or released by exocytosis ■ Vesicles move materials within cells **Applications:** ■ Structure and function of sodium-potassium pumps for active transport and potassium channels for facilitated diffusion in axons

		■ Tissues or organs to be used in medical procedures must be bathed in a solution with the same osmolarity as the cytoplasm to prevent osmosis **Skills:** ■ Estimation of osmolarity in tissues by bathing samples in hypotonic and hypertonic solutions

Molecules to metabolism	2.1	**Understandings:** ■ Molecular biology explains living processes in terms of the chemical substances involved ■ Carbon atoms can form four covalent bonds allowing a diversity of stable compounds to exist ■ Life is based on carbon compounds including carbohydrates, lipids, proteins and nucleic acids ■ Metabolism is the web of all the enzyme-catalysed reactions in a cell or organism ■ Anabolism is the synthesis of complex molecules from simpler molecules including the formation of macromolecules from monomers by condensation reactions ■ Catabolism is the breakdown of complex molecules into simpler molecules including the hydrolysis of macromolecules into monomers **Applications:** ■ Urea as an example of a compound that is produced by living organisms but can also be artificially synthesized **Skills:** ■ Drawing molecular diagrams of glucose, ribose, a saturated fatty acid and a generalised amino acid ■ Identification of biochemicals such as sugars, lipids or amino acids from molecular diagrams.

Water	2.2	**Understandings:** ■ Water molecules are polar and hydrogen bonds form between them ■ Hydrogen bonds and bipolarity explain the cohesive, adhesive, thermal and solvent properties of water ■ Substances can be hydrophilic or hydrophobic **Applications:** ■ Comparison of the thermal properties of water with those of methane ■ Use of water as a coolant in sweat ■ Modes of transport of glucose, amino acids, cholesterol, fats, oxygen and sodium chloride in blood in relation to their solubility in water
Carbohydrates and lipids	2.3	**Understandings:** ■ Monosaccharide monomers are linked together by condensation reactions to form disaccharides and polysaccharide polymers ■ Fatty acids can be saturated, monounsaturated or polyunsaturated ■ Unsaturated fatty acids can be *cis* or *trans* isomers ■ Triglycerides are formed by condensation from three fatty acids and one glycerol **Applications:** ■ Structure and function of cellulose and starch in plants and glycogen in humans ■ Scientific evidence for health risks of *trans* fats and saturated fatty acids ■ Lipids are more suitable for long-term energy storage in humans than carbohydrates ■ Evaluation of evidence and the methods used to obtain the evidence for health claims made about lipids

		Skills: ■ Use of molecular visualisation software to compare cellulose, starch and glycogen ■ Determination of body mass index by calculation or use of a nomogram
Proteins	2.4	**Understandings:** ■ Amino acids are linked together by condensation to form polypeptides ■ There are 20 different amino acids in polypeptides synthesised on ribosomes ■ Amino acids can be linked together in any sequence giving a huge range of possible polypeptides ■ The amino acid sequence of polypeptides is coded for by genes ■ A protein may consist of a single polypeptide or more than one polypeptide linked together ■ The amino acid sequence determines the three-dimensional conformation of a protein ■ Living organisms synthesise many different proteins with a wide range of functions ■ Every individual has a unique proteome **Applications:** ■ Rubisco, insulin, immunoglobulins, rhodopsin, collagen and spider silk as examples of the range of protein functions ■ Denaturation of proteins by heat or by deviation of pH from the optimum **Skills:** ■ Drawing molecular diagrams to show the formation of a peptide bond

Enzymes	2.5	**Understandings:** ■ Enzymes have an active site to which specific substrates bind ■ Enzyme catalysis involves molecular motion and the collision of substrates with the active site ■ Temperature, pH and substrate concentration affect the rate of activity of enzymes ■ Enzymes can be denatured ■ Immobilized enzymes are widely used in industry **Applications:** ■ Methods of production of lactose-free milk and its advantages **Skills:** ■ Design of experiments to test the effect of temperature, pH and substrate concentration on the activity of enzymes ■ Experimental investigation of a factor affecting enzyme activity
Structure of DNA and RNA	2.6	**Understandings:** ■ The nucleic acids DNA and RNA are polymers of nucleotides ■ DNA differs from RNA in the number of strands present, the base composition and the type of pentose ■ DNA is a double helix molecule made of two antiparallel strands of nucleotides linked by hydrogen bonding between complementary base pairs **Applications:** ■ Crick and Watson's elucidation of the structure of DNA using model making

		Skills: ■ Drawing simple diagrams of the structure of single nucleotides of DNA and RNA, using circles, pentagons and rectangles to represent phosphates, pentoses and bases ●

DNA structure and replication	7.1	**Understandings:** ■ DNA structure suggested a mechanism for DNA replication ■ DNA replication is carried out by a complex system of enzymes ■ DNA polymerase can only add nucleotides to the 3' end of a primer ■ DNA replication is continuous on the leading strand and discontinuous on the lagging strand ■ Some regions of DNA do not code for proteins but have other important functions ■ Nucleosomes help to supercoil the DNA **Applications:** ■ Rosalind Franklin's and Maurice Wilkins' investigation of DNA structure by X-ray diffraction ■ Use of nucleotides containing dideoxyribonucleic acid to stop DNA replication in preparation of samples for base sequencing ■ Tandem repeats are used in DNA profiling **Skills:** ■ Analysis of results of the Hershey and Chase experiment providing evidence that DNA is the genetic material

		■ Utilisation of molecular visualisation software to analyse the association between protein and DNA within the nucleosome

Metabolism	8.1	**Understandings:** ■ Metabolic pathways consist of chains and cycles of enzyme-catalysed reactions ■ Enzymes lower the activation energy of the chemical reactions that they catalyse ■ Enzyme inhibitors can be competitive or non-competitive ■ Metabolic pathways can be controlled by end-product inhibition **Applications:** ■ End-product inhibition of the pathway that converts threonine to isoleucine ■ Use of databases to identify potential new anti-malarial drugs **Skills:** ■ Calculating and plotting rates of reaction from raw experimental results ■ Distinguishing different types of inhibition from graphs at specified substrate concentration