3.1.1 Monomers and Polymers

I should be able to...	Revised	Revised	Revised
appreciate that the biochemical basis of life is similar for all living things.			
define the term 'monomer' and recall examples including monosaccharides, amino acids and nucleotides.			
define the term 'polymer'.			
describe what happens in a condensation reaction.			
describe what happens in a hydrolysis reaction.			

Notes

3.1.2 Carbohydrates

I should be able to...	Revised	Revised	Revised
define the term ‘monosaccharide’ and recall examples.			
describe the formation of glycosidic bonds.			
recall examples of disaccharides and the monosaccharides from which they are formed.			
recall the structures of the two isomers of glucose: α-glucose and β-glucose.			
describe the formation and basic structure of the polysaccharides glycogen, starch and cellulose.			
relate the structure of glycogen, starch and cellulose to their functions in animal cells and plant cells.			
describe biochemical tests using Benedict's solution for reducing sugars and non-reducing sugars and iodine/ potassium iodide for starch.			

Notes

3.1.3 Lipids

I should be able to...	Revised	Revised	Revised
state the names of two groups of lipids.			
describe the formation of triglycerides by a condensation reaction.			
name the type of bond formed in a condensation reaction between glycerol and a fatty acid molecule.			
recall what the R-group of a fatty acid is made of.			
recall the structure of phospholipids.			
explain the different properties of triglycerides and phospholipids.			
relate the different properties of triglycerides and phospholipids to their different structures.			
describe the emulsion test for lipids.			
recognise, from diagrams, saturated and unsaturated fatty acids.			

Notes

3.1.4 Proteins

I should be able to...	Revised	Revised	Revised
describe the structure of amino acids.			
describe condensation reactions to form peptide bonds.			
describe the role of hydrogen bonds, ionic bonds and disulfide bridges in the structure of proteins.			
describe the relationship between primary, secondary, tertiary and quaternary structure, and protein function.			
describe the biuret test for proteins.			
relate the structure of proteins to properties of proteins named throughout the specification.			
explain the role of enzymes in reactions.			
relate the properties of an enzyme to the tertiary structure of its active site and its ability to combine with complementary substrate(s) to form an enzyme-substrate complex.			
explain the effects of the following factors on the rate of enzyme-controlled reactions: • enzyme concentration; • substrate concentration; • concentration of competitive and of non-competitive inhibitors; • pH; • temperature.			
appreciate how models of enzyme action have changed over time.			
appreciate that enzymes catalyse a wide range of intracellular and extracellular reactions that determine structures and functions from cellular to whole-organism level.			
(Required Practical 1) describe an investigation into the effect of a named variable on the rate of an enzyme-controlled reaction.			

3.1.5 Nucleic Acids Are Important Information-Carrying Molecules

I should be able to...	Revised	Revised	Revised
recall the role of deoxyribonucleic acid (DNA) in all living cells.			
recall the role of ribonucleic acid (RNA).			
recall the structure of ribosomes.			
describe the composition of a DNA nucleotide.			
describe the composition of an RNA nucleotide.			
name the type of bond formed by a condensation reaction between two nucleotides.			
describe the structure of a DNA molecule.			
describe the structure of an RNA molecule.			
appreciate that the relative simplicity of DNA led many scientists to doubt that it carried the genetic code.			
explain how the semi-conservative replication of DNA ensures genetic continuity between generations of cells.			
describe the process of semi-conservative replication of DNA in terms of: • unwinding of the double helix; • breakage of hydrogen bonds between complementary bases in the polynucleotide strands; • the role of DNA helicase in unwinding DNA and breaking its hydrogen bonds; • attraction of new DNA nucleotides to exposed bases on template strands and base pairing; • the role of DNA polymerase in the condensation reaction that joins adjacent nucleotides.			
evaluate the work of scientists in validating the Watson–Crick model of DNA replication.			

3.1.6 ATP

I should be able to...	Revised	Revised	Revised
describe the structure of an adenosine triphosphate (ATP) molecule.			
recall the role of ATP hydrolase.			
recall that the hydrolysis of ATP can be coupled to energy-requiring reactions within cells.			
describe how the inorganic phosphate released during the hydrolysis of ATP can be used.			
describe how ATP is resynthesised.			
recall the role of ATP synthase during photosynthesis, or during respiration.			

Notes

3.1.7 Water

I should be able to...	Revised	Revised	Revised
explain the importance of water as a metabolite in many metabolic reactions.			
explain the importance of water as an important solvent.			
explain the importance of water having a relatively high heat capacity.			
explain the importance of water having a relatively large latent heat of vaporisation.			
explain the importance of strong cohesion between water molecules.			

Notes

3.1.8 Inorganic Ions

I should be able to...	Revised	Revised	Revised
recall where inorganic ions occur in organisms.			
recognise the role of ions in the following topics: hydrogen ions and pH; iron ions as a component of haemoglobin; sodium ions in the co-transport of glucose and amino acids; and phosphate ions as components of DNA and of ATP.			

Notes

3.2.1 Cell Structure

I should be able to...	Revised	Revised	Revised
describe the structure and function of a: cell-surface membrane; nucleus; mitochondria; chloroplast; Golgi apparatus and Golgi vesicle; lysosome; ribosome; rough endoplasmic reticulum and smooth endoplasmic reticulum; cell wall; cell vacuole.			
apply knowledge of the features listed above to explain adaptations of eukaryotic cells.			
describe differences between prokaryotic and eukaryotic cells.			
describe the structure of virus particles as comprising of genetic material, capsid and attachment protein.			
describe the principles and limitations of optical microscopes, transmission electron microscopes and scanning electron microscopes.			
explain the difference between magnification and resolution.			
use the formula: magnification = $\frac{\text{size of image}}{\text{size of real object}}$			
describe how cell fractionation and ultracentrifugation are used to separate cell components.			
appreciate that there was a considerable period of time during which the scientific community distinguished between artefacts and cell organelles.			

Notes

3.2.2 All Cells Arise from Other Cells

I should be able to...	Revised	Revised	Revised
describe the behaviour of chromosomes during interphase, prophase, metaphase, anaphase and telophase of mitosis.			
recognise the stages of the cell cycle: interphase, prophase, metaphase, anaphase and telophase (including cytokinesis).			
explain the appearance of cells in each stage of mitosis.			
recall what can form as a result of uncontrolled cell division.			
describe the stages of binary fission in prokaryotic cells.			
describe the process of virus particle replication.			
(Required Practical 2) set-up and use an optical microscope to identify the stages of mitosis in stained squashes of plant root tips and calculate a mitotic index. measure the apparent size of cells in the root tip and calculate their actual size using the formula: $\text{actual size} = \frac{\text{size of image}}{\text{magnification}}$			

Notes

3.2.3 Transport across Cell Membranes

I should be able to...	Revised	Revised	Revised
describe limitations imposed by the nature of the phospholipid bilayer in simple diffusion.			
describe the roles of carrier proteins and channel proteins in facilitated diffusion.			
explain osmosis in terms of water potentials.			
explain the role of carrier proteins and the importance of the hydrolysis of ATP in active transport.			
describe co-transport as illustrated by the absorption of sodium ions and glucose by cells lining the mammalian ileum.			
explain the adaptations of specialised cells in relation to the rate of transport across their internal and external membranes.			
explain how surface area, number of channel or carrier proteins and differences in gradients of concentration or water potential affect the rate of movement across cell membranes.			
(Required Practical 3) describe how to produce a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue.			

Notes

3.2.4 Cell Recognition and the Immune System

I should be able to...	Revised	Revised	Revised
recall what the immune system can identify: pathogens; cells from other organisms of the same species; abnormal body cells; and toxins.			
define the term 'antigen'.			
describe phagocytosis and the subsequent destruction of ingested pathogens by lysozymes.			
describe the response of T lymphocytes to a foreign antigen (the cellular response).			
describe the response of B lymphocytes to a foreign antigen, clonal selection and the release of monoclonal antibodies (the humoral response).			
define 'antibody'.			
describe the structure of antibodies.			
describe agglutination and phagocytosis of bacterial cells.			
describe the roles of plasma cells and of memory cells in producing primary and secondary immune responses.			
describe the use of vaccines to provide protection for individuals and populations against disease and the concept of herd community.			
explain the difference between active and passive immunity.			
describe the structure of the human immunodeficiency virus (HIV).			
explain how HIV causes symptoms of AIDS and why antibiotics are ineffective against viruses.			
describe the use of monoclonal antibodies in treatments and diagnoses.			

I should be able to...	Revised	Revised	Revised
describe the use of antibodies in the ELISA test.			
discuss ethical issues associated with the use of vaccines and monoclonal antibodies.			
evaluate methodology, evidence and data relating to the use of vaccines and monoclonal antibodies.			

Notes

3.3.1 Surface Area to Volume Ratio

I should be able to...	Revised	Revised	Revised
describe the relationship between the size of an organism or structure and its surface area to volume ratio.			
describe changes to body shape and the development of systems in larger organisms as adaptations that facilitate exchange as the surface area to volume ratio reduces.			
appreciate the relationship between surface area to volume ratio and metabolic rate.			

Notes

3.3.2 Gas Exchange

I should be able to...	Revised	Revised	Revised
describe adaptations of gas exchange surfaces, including body surfaces of single-celled organisms; tracheal systems of insects; gills of fish; leaves of dicotyledonous plants.			
discuss structural and functional compromises between the opposing needs for efficient gas exchange and the limitation of water loss shown by terrestrial insects and xerophytic plants.			
describe the gross structure of the human gas exchange system limited to the alveoli, bronchioles, bronchi, trachea and lungs.			
describe the essential features of the alveolar epithelium as a surface over which gas exchange takes place.			
describe the mechanism of breathing to include the role of the diaphragm and the antagonistic interaction between the external and internal intercostal muscles in bringing about pressure changes in the thoracic cavity.			
interpret information relating to the effects of lung disease on gas exchange and/or ventilation.			
interpret data relating to the effects of pollution and smoking on the incidence of lung disease.			
analyse and interpret data associated with specific risk factors and the incidence of lung disease.			
evaluate the way in which experimental data led to statutory restrictions on the sources of risk factors.			
recognise correlations and causal relationships.			

Notes

3.3.3 Digestion and Absorption

I should be able to...	Revised	Revised	Revised
describe the digestion of carbohydrates by amylases and membrane-bound disaccharidases.			
describe the digestion of lipids by lipase, including the action of bile salts.			
describe the digestion of proteins by endopeptidases, exopeptidases and membrane-bound dipeptidases.			
describe the co-transport mechanisms for the absorption of amino acids and of monosaccharides by cells lining the ileum of mammals.			
describe the role of micelles in the absorption of lipids by cells lining the ileum of mammals.			

Notes

3.3.4 Mass Transport

I should be able to...	Revised	Revised	Revised
describe the structure of haemoglobins.			
describe the role of haemoglobin and red blood cells in the transport of oxygen, including the loading, transport and unloading of oxygen in relation to the oxyhaemoglobin dissociation curve.			
explain the cooperative nature of oxygen binding.			
describe the effects of carbon dioxide concentration on the dissociation of oxyhaemoglobin (the Bohr effect).			
describe how some animals are adapted to their environment by possessing different types of haemoglobin with different oxygen transport properties.			
describe the general pattern of blood circulation in a mammal, including the coronary arteries and the blood vessels entering and leaving the heart, lungs and kidneys.			
describe the gross structure of the human heart.			
describe how pressure and volume changes and associated valve movements during the cardiac cycle maintain a unidirectional flow of blood.			
describe the structure of arteries, arterioles and veins in relation to their function.			
describe the structure of capillaries and the importance of capillary beds as exchange surfaces.			
describe the formation of tissue fluid and its return to the circulatory system.			
analyse and interpret data relating to pressure and volume changes during the cardiac cycle.			
analyse and interpret data associated with specific risk factors and the incidence of cardiovascular disease.			
evaluate conflicting evidence associated with risk factors affecting cardiovascular disease.			

I should be able to...	Revised	Revised	Revised
(Required Practical 5) describe the dissection of an animal or plant gas exchange system or mass transport system or of an organ within such a system.			
describe the role of xylem and phloem tissue in plants.			
describe the cohesion-tension theory of water transport in the xylem.			
describe the mass flow hypothesis for the mechanism of translocation in plants.			
recognise correlations and causal relationships.			
interpret evidence from tracer and ringing experiments and to evaluate the evidence for and against the mass flow hypothesis.			

Notes

3.4.1 DNA, Genes and Chromosomes

I should be able to...	Revised	Revised	Revised
describe the arrangement of DNA in prokaryotic cells.			
describe the arrangement of DNA in eukaryotic cells.			
define the term 'gene'.			
define the term 'locus'.			
recall that the genetic code is universal, non-overlapping and degenerate, and explain the meaning of these terms.			
describe what exons and introns are and their roles within a DNA molecule.			

Notes

3.4.2 DNA and Protein Synthesis

I should be able to...	Revised	Revised	Revised
define the terms ‘genome’ and ‘proteome’.			
describe the structure of messenger RNA (mRNA) and transfer RNA (tRNA) molecules.			
describe the process of transcription in prokaryotes and eukaryotes.			
describe the process of translation, including the role of ribosomes, tRNA and ATP.			
relate the base sequence of nucleic acids to the amino acid sequence of polypeptides, when provided with suitable data about the genetic code.			
interpret data from experimental work investigating the role of nucleic acids.			

Notes

3.4.3 Genetic Diversity Can Arise as a Result of Mutation or during Meiosis

I should be able to...	Revised	Revised	Revised
describe what a gene mutation is.			
describe how gene mutations may arise.			
explain why all genetic mutations do not result in a change in the sequence of encoded amino acids.			
recall the effect of some mutagenic agents.			
describe the process of meiosis including: the formation of four haploid daughter cells; the formation of genetically different daughter cells from independent segregation; and further genetic variation among daughter cells as a result of crossing over.			
complete diagrams showing the chromosome content of cells after the first and second meiotic division, when given the chromosome content of the parent cell.			
explain the different outcome of mitosis and meiosis.			
recognise where meiosis occurs when given information about an unfamiliar life cycle.			
explain how random fertilisation of haploid gametes further increases genetic variation within a species.			

Notes

3.4.4 Genetic Diversity and Adaptation

I should be able to...	Revised	Revised	Revised
define the term 'genetic diversity'.			
describe the principles of natural selection in the evolution of populations.			
describe directional selection, exemplified by antibiotic resistance in bacteria.			
describe stabilising selection, exemplified by human birth weights.			
explain how natural selection results in species that are better adapted to their environment.			
state examples of adaptations which are anatomical, physiological or behavioural.			
use unfamiliar information to explain how selection produces changes within a population of a species.			
interpret data relating to the effect of selection in producing change within populations.			
show understanding that adaptation and selection are major factors in evolution and contribute to the diversity of living organisms.			
(Required Practical 6) describe the use of aseptic techniques to investigate the effect of antimicrobial substances on microbial growth.			

Notes

3.4.5 Species and Taxonomy

I should be able to...	Revised	Revised	Revised
define the term 'species'.			
describe simple and complex courtship behaviours.			
explain the role of courtship behaviours in successful mating.			
explain how a phylogenetic classification system arranges species into groups.			
recall a hierarchy of taxa.			
recall that each species is universally identified by a binomial consisting of the name of its genus and species.			
appreciate that advances in immunology and genome sequencing help to clarify evolutionary relationships between organisms.			

Notes

3.4.6 Biodiversity within a Community

I should be able to...	Revised	Revised	Revised
understand that biodiversity can relate to a range of habitats, from a small local habitat to the Earth.			
define the term 'species richness'.			
describe what an index of diversity shows.			
calculate an index of diversity (d) from the formula $d = \frac{N(N-1)}{\sum n(n-1)}$ where N = total number of organisms of all species and n = total number of organisms of each species.			
describe how farming techniques reduce biodiversity.			
describe the balance between conservation and farming.			

Notes

3.4.7 Investigating Diversity

I should be able to...	Revised	Revised	Revised
recall the comparisons by which genetic diversity within, or between species, can be made.			
interpret data relating to similarities and differences in the base sequences of DNA and in the amino acid sequences of proteins to suggest relationships between different organisms within a species and between species.			
appreciate that gene technology has caused a change in the methods of investigating genetic diversity.			
recall what is involved in the quantitative investigations of variation within a species.			

Notes

3.5.1 Photosynthesis

I should be able to...	Revised	Revised	Revised
describe the light-dependent reaction, including the following stages: • photoionisation of chlorophyll; • conservation of energy via production of ATP and reduced NADP; • production of ATP (chemiosomotic theory); • photolysis of water.			
describe the light-independent reaction, including the following stages: • carbon dioxide reacts with ribulose bisphosphate (RuBP), catalysed by the enzyme rubisco; • reduction of glycerate 3-phosphate (GP) to triose phosphate; • regeneration of RuBP in the Calvin cycle; • conversion of some triose phosphate to useful organic substances.			
identify environmental factors that limit the rate of photosynthesis.			
evaluate data relating to common agricultural practices used to overcome the effect of these limiting factors.			
(Required Practical 7) describe the use of chromatography to investigate the pigments isolated from leaves of different plants, e.g. leaves from shade-tolerant and shade-intolerant plants or leaves of different colours.			
(Required Practical 8) describe an investigation into the effect of a named factor on the rate of dehydrogenase activity in extracts of chloroplasts.			

Notes

3.5.2 Respiration

I should be able to...	Revised	Revised	Revised
describe the stages of glycolysis, including: phosphorylation of glucose; production of triose phosphate; and oxidation of triose phosphate.			
describe how pyruvate is converted to ethanol or lactate during anaerobic respiration.			
describe what happens to pyruvate, reduced NAD and ATP during aerobic respiration.			
describe the process of aerobic respiration, including: • oxidation of pyruvate to acetate, producing reduced NAD; • the combination of acetate with coenzyme A in the link reaction to produce acetylcoenzyme A; • reaction of acetylcoenzyme A with a four-carbon molecule, releasing coenzyme A and producing a six-carbon molecule that enters the Krebs cycle; • generation of reduced coenzymes and ATP via a series of oxidation-reduction reactions, during the Krebs cycle by substrate-level phosphorylation, and the loss of carbon dioxide; • synthesis of ATP by oxidative phosphorylation associated with the transfer of electrons down the electron transfer chain and passage of protons across inner mitochondrial membranes catalysed by ATP synthase embedded in these membranes (chemiosomotic theory); • the roles of other respiratory substrates such as the breakdown products of lipids and amino acids, which enter the Krebs cycle.			
(Required Practical 9) describe an investigation into the effect of a named variable on the rate of respiration of cultures of single-celled organisms.			

Notes

3.5.3 Energy and Ecosystems

I should be able to...	Revised	Revised	Revised
describe how plants use the sugars they synthesise during photosynthesis.			
describe how biomass is measured.			
define gross primary production (*GPP*).			
define net primary production (*NPP*).			
calculate net primary production (*NPP*) using the formula: $NPP = GPP - R$ where *GPP* represents gross production and *R* represents respiratory losses to the environment.			
describe how the net primary production is used by other plants and trophic levels in the ecosystem.			
calculate the net production of consumers (*N*), such as animals, using the formula: $N = I - (F + R)$ where *I* represents the chemical energy store in ingested food, *F* represents the chemical energy lost to the environment in faeces and urine and *R* represents the respiratory losses to the environment.			
define primary productivity.			
define secondary productivity.			
calculate primary productivity and include the correct units.			
calculate secondary productivity and include the correct units.			

I should be able to...	Revised	Revised	Revised
appreciate the ways in which production is affected by farming practices designed to increase the efficiency of energy transfer by: • simplifying food webs to reduce energy losses to non-human food chains; • reducing respiratory losses within a human food chain.			

Notes

3.5.4 Nutrient Cycles

I should be able to...	Revised	Revised	Revised
describe the stages of the nitrogen cycle.			
describe the stages of the phosphorus cycle.			
describe the role of saprobionts in decomposition.			
describe the role of mycorrhizae in facilitating the uptake of water and inorganic ions by plants.			
describe the role of bacteria in the nitrogen cycle in sufficient detail to illustrate the processes of saprobiotic nutrition, ammonification, nitrification, nitrogen fixation and denitrification.			
describe how natural and artificial fertilisers are used to replace the nitrates and phosphates lost by harvesting plants and removing livestock.			
discuss the environmental issues arising from the use of fertilisers including leaching and eutrophication.			
describe and explain the sequence of events involved in transmission across a cholinergic synapse.			
compare transmission across a cholinergic synapse and across a neuromuscular junction.			
use information provided to predict and explain the effects of specific drugs on a synapse.			

Notes

3.6.1 Stimuli, Both Internal and External, Are Detected and Lead to a Response

I should be able to...	Revised	Revised	Revised
explain why it is an advantage for organisms to be able to respond to changes in their environment.			
describe how specific growth factors regulate growth in response to directional stimuli in flowering plants.			
explain gravitropism and phototropism in flowering plants with respect to the concentration of indoleacetic acid (IAA) and cell elongation.			
describe how taxes and kineses can maintain a mobile organism in a favourable environment.			
explain the protective effect of a simple reflex, exemplified by a three-neurone simple reflex.			
(Required Practical 10) describe an investigation into the effect of an environmental variable on the movement of an animal using either a choice chamber or a maze.			
use the Pacinian corpuscle as an example of a receptor to illustrate that receptors respond only to specific stimuli and stimulation of a receptor leads to the establishment of a generator potential.			
describe the structure of a Pacinian corpuscle.			
describe how deformation of stretch-mediated sodium ion channels in a Pacinian corpuscle leads to the establishment of a generator potential.			
explain how differences in sensitivity to light, sensitivity to colour and visual acuity are related to different pigments found in rods and cones in the retina and the connections rods and cones make in the optic nerve.			
describe myogenic stimulation of the heart and transmission of a subsequent wave of electrical activity.			
describe the roles of the sinoatrial node (SAN), atrioventricular node (AVN) and Purkyne tissue in the bundle of His.			

I should be able to...	Revised	Revised	Revised
describe the roles and locations of chemoreceptors and pressure receptors and the roles of the autonomic nervous system and effectors in controlling heart rate.			

Notes

3.6.2 Nervous Coordination

I should be able to...	Revised	Revised	Revised
describe the structure of a myelinated motor neurone.			
describe the establishment of a resting potential in terms of differential membrane permeability, electrochemical gradients and the movement of sodium ions and potassium ions.			
describe how changes in membrane permeability lead to depolarisation and the generation of an action potential.			
explain what is meant by the all-or-nothing principle.			
describe the passage of an action potential along non-myelinated and myelinated axons, resulting in nerve impulses.			
describe the nature and importance of the refractory period.			
explain how the speed of conductance is affected by: myelination and saltatory conduction; axon diameter; and temperature.			
describe the detailed structure of a synapse and of a neuromuscular junction.			
describe and explain the sequence of events involved in transmission across a cholinergic synapse.			
compare transmission across a cholinergic synapse and across a neuromuscular junction.			
use information provided to predict and explain the effects of specific drugs on a synapse.			

Notes

3.6.3 Skeletal Muscles Are Stimulated to Contract by Nerves and Act as Effectors

I should be able to...	Revised	Revised	Revised
describe the action of muscles.			
describe the gross and microscopic structure of skeletal muscle.			
describe the ultrastructure of a myofibril.			
explain the roles of actin, myosin, calcium ions and ATP in myofibril contraction.			
explain the roles of calcium ions and tropomyosin in the cycle of actinomyosin bridge formation.			
explain the roles of ATP and phosphocreatine in muscle contraction.			
describe the structure, location and general properties of slow and fast skeletal muscle fibres.			

Notes

3.6.4 Homeostasis Is the Maintenance of a Stable Internal Environment

I should be able to...	Revised	Revised	Revised
explain the importance of maintaining a stable core temperature, stable blood pH and stable blood glucose concentration.			
describe negative feedback mechanisms and explain the advantage of controlling internal environments in this way.			
interpret information relating to examples of negative and positive feedback.			
recall the factors that influence blood glucose concentration.			
describe the role of the liver in glycogenesis, glycogenolysis and gluconeogenesis.			
explain the action of insulin, glucagon and adrenaline in glucoregulation.			
describe the second messenger model of adrenaline and glucagon action, involving adenylate cyclase, cyclic AMP (cAMP) and protein kinase.			
describe the causes of types I and II diabetes and their control by insulin and/or manipulation of the diet.			
evaluate the positions of health advisers and the food industry in relation to the increased incidence of type II diabetes.			
(Required Practical 11) describe how to produce a dilution series of a glucose solution and describe a colorimetric technique to produce a calibration curve with which to identify the concentration of glucose in an unknown 'urine' sample.			
describe the roles of the hypothalamus, posterior pituitary and antidiuretic hormone (ADH) in osmoregulation.			

I should be able to...	Revised	Revised	Revised
describe the structure of the nephron and its role in: • the formation of glomerular filtrate; • reabsorption of glucose and water by the proximal convoluted tubule; • maintaining a gradient of sodium ions in the medulla by the loop of Henle; • reabsorption of water by the distal convoluted tubule and collecting ducts.			

Notes

3.7.1 Inheritance

I should be able to...	Revised	Revised	Revised
define key terms including gene, allele, genotype, phenotype, diploid, haploid, locus, homozygous, heterozygous, dominant, recessive and codominant.			
use fully labelled genetic diagrams to interpret, or predict, the results of: • monohybrid and dihybrid crosses involving dominant, recessive and codominant alleles; • crosses involving sex-linkage, autosomal linkage, multiple alleles and epistasis.			
use the chi-squared (X^2) test to compare the goodness of fit of observed phenotypic ratios with expected ratios.			

Notes

3.7.2 Populations

I should be able to...	Revised	Revised	Revised
define the term 'population'.			
explain what is meant by a gene pool and allele frequency.			
explain the Hardy-Weinberg principle and recall the conditions under which the principle applies.			
calculate the frequency of alleles, genotypes and phenotypes in a population using the Hardy–Weinberg equation: $p^2 + 2pq + q^2 = 1$ where p is the frequency of one (usually the dominant) allele and q is the frequency of the other (usually recessive) allele of the gene.			

Notes

3.7.3 Evolution May Lead to Speciation

I should be able to...	Revised	Revised	Revised
recall the primary source of genetic variation and describe how further genetic variation is produced.			
describe the effects of stabilising, directional and disruptive selection on allele frequencies.			
define evolution.			
explain the difference between allopatric and sympatric speciation.			
explain why individuals within a population of a species may show a wide range of variation in phenotype.			
explain why genetic drift is important only in small populations.			
explain how natural selection and isolation may result in a change in the allele and phenotype frequency and lead to the formation of a new species.			
explain how evolutionary change over a long period of time has resulted in a great diversity of species.			

Notes

3.7.4 Populations in Ecosystems

I should be able to...	Revised	Revised	Revised
define the terms 'community' and 'ecosystem'.			
explain what a niche is.			
explain what is meant by the carrying capacity of an ecosystem.			
describe the abiotic and biotic factors which can affect the size of a population.			
describe how the size of a population of a slow moving or non-mobile organism can be estimated using random placement of quadrats or quadrats along a belt transect.			
describe how the size of a population of mobile organisms can be estimated using the mark-release-recapture method and describe the assumptions made when using this method.			
understand the process of succession from pioneer species to climax community.			
understand that changes organisms produce in their abiotic environment can result in a less hostile environment and change biodiversity.			
suggest why it might be necessary to manage succession in the conservation of habitats.			
understand the need to manage the conflict between human needs and conservation in order to maintain the sustainability of natural resources.			
evaluate evidence and data concerning issues relating to the conservation of species and habitats and consider conflicting evidence.			
use given data to calculate the size of a population estimated using the mark-release-recapture method.			
(Required Practical 12) describe an investigation into the effect of a named environmental factor on the distribution of a given species.			

3.8.1 Alteration of the Sequence of Bases in DNA Can Alter the Structure of Proteins

I should be able to...	Revised	Revised	Revised
recall when gene mutation might arise and the types of alteration which might occur.			
describe the effect of mutagenic agents on mutation rate.			
explain why not all gene mutations result in a change to the encoded amino acid.			
explain what a frame shift is and how it might arise.			
relate the nature of a gene mutation to its effect on the encoded polypeptide.			

Notes

3.8.2 Gene Expression Is Controlled by a Number of Features

I should be able to...	Revised	Revised	Revised
describe totipotent cells, where they are found and how they become specialised.			
describe pluripotent stem cells and where they are found.			
describe the use of pluripotent stem cells in treating human disorders.			
describe unipotent cells, exemplified by the formation of cardiomyocytes.			
describe how induced pluripotent stem cells (iPS cells) can be produced from adult somatic cells.			
evaluate the use of stem cells in treating human disorders.			
explain the role of transcription factors and oestrogen in gene expression.			
describe epigenetic control of gene expression in eukaryotes.			
explain the relevance of epigenetics on the development and treatment of disease, especially cancer.			
interpret data provided from investigations into gene expression.			
evaluate appropriate data for the relative influences of genetic and environmental factors on phenotype.			
describe the main characteristics of benign and malignant tumours.			
describe the role of tumour suppressor genes and oncogenes in the development of tumours.			
describe the abnormal methylation of tumour suppressor genes and oncogenes in the development of tumours.			

I should be able to...	Revised	Revised	Revised
describe the role of increased oestrogen concentrations in the development of some breast cancers.			
evaluate evidence showing correlations between genetic and environmental factors and various forms of cancer.			
interpret information relating to the way in which an understanding of the roles of oncogenes and tumour suppressor genes could be used in the prevention, treatment and cure of cancer.			

Notes

3.8.3 Using Genome Projects

I should be able to...	Revised	Revised	Revised
recall that sequencing projects have read the genomes of a wide range of organisms, including humans.			
recall how sequencing the genome of simpler organisms allows the proteome of the organism to be determined.			
describe applications of proteome sequencing of simple organisms.			
explain why knowledge of the genome cannot easily be translated into the proteome for more complex organisms.			
appreciate that sequencing methods are continuously updated and have become automated.			

Notes

3.8.4 Gene Technologies Allow the Study and Alteration of Gene Function Allowing a Better Understanding of Organism Function and the Design of New Industrial and Medical Processes

I should be able to...	Revised	Revised	Revised
describe what is involved in recombinant DNA technology.			
describe the production of fragments of DNA by: • conversion of mRNA to complementary DNA (cDNA), using reverse transcriptase; • using restriction enzymes to cut a fragment containing the desired gene from DNA; • creating the gene in a 'gene machine'.			
describe the principles of the polymerase chain reaction (PCR) as an *in vitro* method of amplifying DNA fragments.			
describe the use of a culture of transformed host cells as an *in vivo* method of amplifying DNA fragments.			
interpret information relating to the use of recombinant DNA technology.			
evaluate the ethical, financial and social issues associated with the use and ownership of recombinant DNA technology in agriculture, in industry and in medicine.			
balance the humanitarian aspects of recombinant DNA technology with the opposition from environmentalists and anti-globalisation activists.			
relate recombinant DNA technology to gene therapy.			
describe the use of labelled DNA probes and DNA hybridisation to locate specific alleles of genes.			
describe the use of labelled DNA probes to screen patients for heritable conditions, drug responses or health risks.			
evaluate information relating to screening individuals for genetically determined conditions and drug responses.			

I should be able to...	Revised	Revised	Revised
explain the biological principles that underpin genetic fingerprinting techniques.			
interpret data showing the results of gel electrophoresis to separate DNA fragments.			
explain why scientists might use genetic fingerprinting in the fields of forensic science, medical diagnosis, animal and plant breeding.			

Notes