The key areas are from the course specification. The depth of knowledge required provides further detail of the key areas and an outline of the level of demand.

Note: The key areas **and** the depth of knowledge required **can be assessed in the question paper**.

Suggested learning activities are also provided. It is not compulsory that all are covered. The contexts for each key area are open to personalisation and choice, so centres may also devise their own learning activities. However, candidates must be given the opportunity to experience the use of the apparatus and the techniques listed below **as these can be assessed in the question paper**.

Cell biology		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
1 Cell structure		
a Cell ultrastructure and functions — cell wall, mitochondrion, chloroplast, cell membrane, cytoplasm, vacuole, nucleus, ribosome and plasmid using examples from typical plant, animal, fungal and bacterial cells.	Fungal structure in terms of similarity to plant and animal cells but with a different cell wall structure. Structure of bacteria — absence of organelles and a different cell wall structure to plant and fungal cells.	♦ Examine slides of a range of plant, animal and microbial cells using a light microscope/bioviewer, eg onion/rhubarb epidermis, cheek epithelium, yeast and prepared slides of bacterial cells.
b Cell wall is made of cellulose in plant cells but of different materials in fungal and bacterial cells.	Chemical composition of cell walls for fungi and bacteria not required.	♦ Numeracy activities on cell size to investigate cell length and breadth.

Cell biology (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
2 Transport across cell membranes		
a The cell membrane consists of phospholipids and proteins and is selectively permeable.		♦ Investigate the structure of the fluid mosaic model, eg examine electron micrographs of cell membranes or make models. ♦ Investigate the effect of ethanol and temperature on cells, eg beetroot.
b Passive transport occurs down a concentration gradient and does not require energy. Examples of passive transport are diffusion and osmosis.	Different concentrations of substances exist between cells and their environment.	
c Diffusion is the movement of molecules down a concentration gradient from a higher to a lower concentration.	Explain diffusion of important substances such as glucose, carbon dioxide and oxygen in terms of their concentration gradients.	♦ Investigate diffusion and osmosis using visking tubing, osmosis in potato cells, bleeding in plant cells (eg beetroot), plant cell plasmolysis, mass changes in egg (shell removed by soaking in vinegar) in syrup/water.
d Osmosis is the movement of water molecules from a higher water concentration to a lower water concentration through a selectively permeable membrane.		
e Animal cells can burst or shrink and plant cells can become turgid or plasmolysed. Relationship between different concentrations of solutions and their effect on cells.	Details of the terms hypotonic, hypertonic and isotonic are not required.	

Cell biology (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
2 Transport across cell membranes (continued)		
f Active transport requires energy for membrane proteins to move molecules and ions against the concentration gradient.	Details of how active transport takes place are not required.	♦ Research appropriate examples for active transport, eg sodium and potassium in nerve cells, or iodine in seaweeds.
3 DNA and the production of proteins		
a Structure of DNA: double-stranded helix held by complementary base pairs. DNA carries the genetic information for making proteins. The four bases: adenine, cytosine, guanine and thymine (A, C, G and T) make up the genetic code. A is always paired with T and C is always paired with G. The base sequence determines amino acid sequence in proteins. A gene is a section of DNA which codes for a protein.		♦ Research the relationship between chromosomes, genes, DNA and protein to illustrate that genes are located on chromosomes. ♦ Construction of 2D or 3D DNA models. Paper models of base pairing or DNA sections. ♦ Carry out numeracy activities to determine base pair numbers from given information.
b Messenger RNA (mRNA) is a molecule which carries a complementary copy of the genetic code from the DNA, in the nucleus, to a ribosome, where the protein is assembled from amino acids.	Knowledge of uracil as a base in mRNA is not required. Further details of transcription and translation are not required.	

Cell biology (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
4 Proteins		
a The variety of protein shapes and functions arises from the sequence of amino acids. Proteins have many functions such as structural, enzymes, hormones, antibodies and receptors.	Levels of protein structure such as secondary/tertiary not required.	
b Enzymes function as biological catalysts and are made by all living cells. They speed up cellular reactions and are unchanged in the process. The shape of the active site of an enzyme molecule is complementary to its specific substrate(s). Enzyme action results in product(s). Enzymes can be involved in degradation and synthesis reactions. Examples should relate enzymes to their specific substrate(s) and product(s).	An enzyme-substrate complex forms, facilitating the reaction. Diagrams to illustrate the stages in degradation and synthesis reactions. Substrate —(Enzyme)→ Product	♦ Experiments to investigate the specificity of enzymes. ♦ Investigate the action of potato phosphorylase.
c Each enzyme is most active in its optimum conditions. Enzymes, and other proteins, can be affected by temperature and pH. Enzymes can be denatured, resulting in a change in their shape which will affect the rate of reaction.		♦ Enzyme experiments with, eg pepsin/ lipase/amylase/catalase to investigate the effect of temperature/pH on activity. ♦ Effect of temperature and pH on egg white as a model for effect on proteins.

Cell biology (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
5 Genetic engineering Genetic information can be transferred from one cell to another by genetic engineering. Stages of genetic engineering: identify section of DNA that contains required gene from source chromosome; extract required gene; extract plasmid from bacterial cell; insert required gene into bacterial plasmid; insert plasmid into host bacterial cell to produce a genetically modified (GM) organism. Use of enzymes in this process.	Names of particular enzymes are not required.	♦ Research current genetic foods/issues such as golden rice, less toxic rapeseed oil, bird resistance to bird flu, tomatoes with longer shelf life, blight resistant potatoes, production of medicines for human use, eg insulin and growth hormone.
6 Respiration a The chemical energy stored in glucose must be released by all cells through a series of enzyme-controlled reactions called respiration. b The energy released from the breakdown of glucose is used to generate ATP. The energy transferred by ATP can be used for cellular activities such as muscle cell contraction, cell division, protein synthesis and transmission of nerve impulses.	How ATP is generated is not required. Examples of energy uses given are not exhaustive.	♦ Burning of food to show energy release. ♦ Use of hydrogen carbonate indicator to show respiration in living organisms. ♦ Use of simple respirometers to measure rate of respiration in, eg small invertebrates, germinating peas. ♦ Use of immobilised yeast and hydrogen carbonate indicator, resazurin or gas sensors and data loggers to investigate rate of respiration.

Cell biology (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
6 Respiration (continued) c Glucose is broken down to two molecules of pyruvate, releasing enough energy to yield two molecules of ATP. Further breakdown depends upon the presence/absence of oxygen. If oxygen is present, aerobic respiration takes place, and each pyruvate is broken down to carbon dioxide and water, releasing enough energy to yield a large number of ATP molecules. In the absence of oxygen, the fermentation pathway takes place. In animal cells, the pyruvate molecules are converted to lactate and in plant and yeast cells they are converted to carbon dioxide and ethanol. The breakdown of each glucose molecule via the fermentation pathway yields only the initial two molecules of ATP. d Respiration begins in the cytoplasm. The process of fermentation is completed in the cytoplasm whereas aerobic respiration is completed in the mitochondria.	Overall number of ATP molecules generated by aerobic respiration not required. Word summaries of the process of respiration: Glucose + oxygen → carbon dioxide + water + energy Glucose → carbon dioxide + ethanol + energy Glucose → lactate + energy The higher the energy requirement of a cell the greater the number of mitochondria present in that cell.	

Biology: multicellular organisms		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
1 Producing new cells		
a Sequence of events of mitosis. Understanding of the terms chromatids, equator and spindle fibres.	Names of the phases are not required.	♦ Select and present information using mitosis stage cards. Create model chromosomes. ♦ Observe prepared root tip cell slides/bioviewer.
b Mitosis provides new cells for growth and repair of damaged cells and maintains the diploid chromosome complement.	Diploid cells have two matching sets of chromosomes, which are replicated during mitosis.	♦ Carry out numeracy activities based on cell growth graphs/curves.
c Stem cells in animals are unspecialised cells which can divide in order to self-renew. They have the potential to become different types of cell. Stem cells are involved in growth and repair.	Stem cells can be obtained from the embryo at a very early stage. In addition, tissue stem cells can be found in the body throughout life. The terms pluripotent, totipotent and multipotent are not required.	♦ Use a variety of media to investigate the potential uses of stem cells and discuss ethical issues associated with their use.
d Specialisation of cells leads to the formation of a variety of cells, tissues and organs. Groups of organs which work together form systems. A hierarchy exists: cells → tissues → organs → systems	Multicellular organisms have more than one cell type and are made up of tissues and organs. Organs perform different functions. The cells in organs are specialised for their function and work together to form systems. Details of organs which make up individual systems are not required.	♦ Examine a variety of cells from different tissues to relate their structure to function.

Biology: multicellular organisms (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
2 Control and communication a **Nervous control**	A response to a stimulus can be a rapid action from a muscle or a slower response from a gland.	
i Nervous system consists of central nervous system (CNS) and other nerves. CNS consists of brain and spinal cord. Structure and function of parts of the brain — cerebrum, cerebellum and medulla. Neurons are of three types: sensory, inter and motor. Receptors detect sensory input/stimuli. Electrical impulses carry messages along neurons. Chemicals transfer these messages between neurons, at synapses.	Sensory neurons pass the information to the CNS. Inter neurons operate within the CNS, which processes information from the senses that require a response. Motor neurons enable a response to occur at an effector (muscle or gland).	♦ Investigate reaction time in humans.
ii Structure and function of reflex arc.	Reflexes protect the body from harm.	♦ Research/investigate examples of human reflex activities, eg blinking, iris reflex, response to pain.
b **Hormonal control**		
i Endocrine glands release hormones into the bloodstream. Hormones are chemical messengers. A target tissue has cells with complementary receptor proteins for specific hormones, so only that tissue will be affected by these hormones.	Names and locations of individual endocrine glands, other than those mentioned in these course notes (pancreas, testes, ovaries), are not required.	
ii Blood glucose regulation. The roles of insulin, glucagon, glycogen, pancreas and liver.	Detail of negative feedback is not required.	♦ Investigate the causes and treatment of type 1 and type 2 diabetes, with reference to trends in Scottish health statistics.

Biology: multicellular organisms (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
3 Reproduction		
a Cells are diploid, except gametes, which are haploid.	Knowledge of polyploidy is not required.	
b The types of gametes, the organs that produce them, and where these are located in plants and animals. The basic structure of sperm and egg cells.	Recognition of cells and organs involved from diagrams.	
c Fertilisation is the fusion of the nuclei of the two haploid gametes to produce a diploid zygote, which divides to form an embryo.		
4 Variation and inheritance		
a Comparison of discrete variation (single gene inheritance) and continuous variation (polygenic inheritance).	Combining genes from two parents contributes to variation within a species. Single gene inheritance of characteristics showing discrete variation where measurements fall into distinct groups. Polygenic inheritance of characteristics showing continuous variation where there is a range of values between a minimum and a maximum.	♦ Investigate a variety of discrete and continuous characteristics in organisms, eg long and short hair in cats, dry and wet earwax in humans, height in humans, leaf length in plants.

Biology: multicellular organisms (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
4 Variation and inheritance (continued)		
b Understanding of genetic terms: gene; allele; phenotype; genotype; dominant; recessive; homozygous; heterozygous and P, F_1 and F_2.	Family trees and the identification of phenotypes and genotypes from them.	
c Monohybrid crosses from parental generation through to F_2 generation.	Carry out monohybrid crosses. Use Punnett squares to explain inheritance.	
d Reasons why predicted phenotype ratios among offspring are not always achieved.		
5 Transport systems — plants	.	
a Plant organs are roots, stems and leaves. Leaf structure diagram showing upper epidermis, palisade mesophyll, spongy mesophyll, vein (consisting of xylem and phloem), lower epidermis, guard cells and stomata.		♦ Stomatal models and use of leaf peels and microscopes to view stomata. ♦ Investigate number or distribution of stomata from different leaves/species. ♦ Microscope slides showing sections through leaf.
b Parts of the plant involved in water transport. Water and minerals enter the plant through the root hairs and are transported in dead xylem vessels.		♦ Germination of seeds to show root hairs.
Structure of xylem vessels.	Xylem cells are lignified to withstand the pressure changes as water moves through the plant.	♦ Stain xylem vessels in celery using food colouring. ♦ Examine slides showing xylem structure.

Biology: multicellular organisms (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
5 Transport systems — plants (continued)		
c The process of transpiration and how the rate of transpiration is affected by wind speed, humidity, temperature and surface area.	Transpiration is the process of water moving through a plant and its evaporation through the stomata. The structures and processes involved as water moves through the plant from the soil to the air. Details of mechanism for opening/closing of stomata are not required. Details of transpiration pull and the forces involved are not required. External factors can increase or decrease rate of transpiration. Details of how this takes place are not required.	♦ Transpiration experiments to show water loss using a weight or a bubble photometer. ♦ Investigate the effect of wind speed, humidity, temperature or surface area on transpiration.
d Sugar is transported up and down the plant in living phloem. Structure of phloem tissue.	Phloem cells have sieve plates and associated companion cells.	♦ Microscope slides showing phloem structure.

Biology: multicellular organisms (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
6 Transport systems — animals		
a In mammals the blood contains plasma, red blood cells and white blood cells. It transports nutrients, oxygen and carbon dioxide.	Information about platelets is not required.	♦ Use of diagrams/models to illustrate the structure of blood cells.
b Red blood cells are specialised by being biconcave in shape, having no nucleus and containing haemoglobin. This allows them to transport oxygen efficiently in the form of oxyhaemoglobin.	oxygen + haemoglobin → oxyhaemoglobin	
c White blood cells are part of the immune system and are involved in destroying pathogens. There are two main types of cells involved. Phagocytes carry out phagocytosis by engulfing pathogens. Some lymphocytes produce antibodies which destroy pathogens. Each antibody is specific to a particular pathogen.	Pathogens are disease-causing micro-organisms (bacteria, viruses, fungi). Process of phagocytosis — engulfing and digestion. Detail of lysis/lysosomes not required. Detail of antibody structure not required.	
d Pathway of oxygenated and deoxygenated blood through heart, lungs and body. Diagram of heart to show the right and left atria, ventricles, location of four valves, location of associated blood vessels (aorta, vena cava, pulmonary artery, pulmonary vein and coronary arteries). Function of each of these parts.	Names of individual valves are not required.	♦ Investigate heart structure through the use of dissection, models or films.

Biology: multicellular organisms (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
6 Transport systems — animals (continued) e Arteries have thick, muscular walls, a narrow central channel and carry blood under high pressure away from the heart. Veins have thinner walls, a wider channel and carry blood under low pressure back towards the heart. Veins contain valves to prevent backflow of blood. Capillaries are thin walled and have a large surface area, forming networks at tissues and organs to allow efficient exchange of materials. **7 Absorption of materials** a Oxygen and nutrients from food must be absorbed into the bloodstream to be delivered to cells for respiration. Waste materials, such as carbon dioxide, must be removed from cells into the bloodstream. b Tissues contain capillary networks to allow the exchange of materials at cellular level. c Surfaces involved in the absorption of materials have certain features in common: large surface area, thin walls, extensive blood supply. These increase the efficiency of absorption.		♦ Use of diagrams/models to illustrate the structure of arteries, veins and capillaries.

Biology: multicellular organisms (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
7 Absorption of materials (continued)		
d Lungs are gas exchange organs. They consist of a large number of alveoli providing a large surface area. Oxygen and carbon dioxide are absorbed through the thin alveolar walls to or from the many blood capillaries.		♦ Investigate lung structure through the use of dissection, models or films.
e Nutrients from food are absorbed into the villi in the small intestine. The large number of thin walled villi provides a large surface area. Each villus contains a network of capillaries to absorb glucose and amino acids and a lacteal to absorb fatty acids and glycerol.		♦ Investigate villus structure through the use of models and films.

Biology: life on Earth		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
1 Ecosystems a Definitions of ecological terms: species, biodiversity, population, producer, consumer, herbivore, carnivore, omnivore, predator, prey, food chain, food web. b An ecosystem consists of all the organisms (the community) living in a particular habitat and the non-living components with which the organisms interact. Interactions of organisms in food webs. c A niche is the role that an organism plays within a community. It relates to the resources it requires in its ecosystem, such as light and nutrient availability and its interactions with other organisms in the community. It involves competition and predation and the conditions it can tolerate such as temperature.	Effects of removal of organism(s) from a food web.	♦ Research a variety of ecosystems and the organisms found in them. ♦ Investigate examples of niches of Scottish wildlife, eg wildcat, red squirrel, red grouse, Scottish crossbill, brown trout, and bracken. ♦ Analyse data related to distribution of barnacles on rocky shores, native woodland and red deer numbers, distribution of ptarmigan.

Biology: life on Earth (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
1 Ecosystems (continued)		
d Competition in ecosystems occurs when resources are in short supply. Interspecific competition occurs amongst individuals of different species for one or a few of the resources they require. Intraspecific competition occurs amongst individuals of the same species and is for all resources required. Intraspecific competition is therefore more intense than interspecific competition.		♦ Investigate interspecific competition in animals, eg red and grey squirrels, brown and rainbow trout. ♦ Investigate interspecific competition in plants, eg a variety of different seeds grown together. ♦ Investigate intraspecific competition, eg cress seedling density, trees of the same species growing close together.
2 Distribution of organisms		
a Competition for resources, disease, food availability, grazing and predation are biotic factors. Light intensity, moisture, pH and temperature are abiotic factors.		♦ Interpret predator prey interaction graphs.
b Measuring abiotic factors such as light intensity, soil moisture, pH and temperature. Possible sources of error and how to minimise them.		♦ Use of techniques for abiotic factors: temperature using thermometer or temperature probes, light using light meters, moisture using moisture meters, pH using pH meters or chemical test. ♦ Use of probes linked to appropriate data logging software.

Biology: life on Earth (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
2 Distribution of organisms (continued)		
c Sampling of plants and animals using quadrats and pitfall traps. Evaluation of limitations and sources of error in their use.	The need for representative sampling and adequate replication.	♦ Investigate the abundance of plants/invertebrates in an area. ♦ Investigate the distribution of a species in an ecosystem using a line transect.
d Using and constructing paired-statement keys to identify organisms.		
e The effect of biotic and abiotic factors on biodiversity and the distribution of organisms.	Factors which can cause an increase or a decrease in biodiversity.	♦ Investigate the effect of light/moisture on the abundance of plants in an area. ♦ Investigate a range of human influences that affect environments such as: pollution of air and water, habitat destruction by, eg deforestation (tropical rain forest), desertification, overfishing. ♦ Research human activities which cause species to become endangered.
f Indicator species are species that by their presence or absence indicate environmental quality/levels of pollution.		♦ Investigate the effect of air pollution on lichens. ♦ Investigate the effect of organic pollution on freshwater organisms.

Biology: life on Earth (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
3 Photosynthesis a Photosynthesis is a two-stage process: i Light reactions: the light energy from the sun is trapped by chlorophyll in the chloroplasts and is converted into chemical energy which is used to generate ATP. Water is split to produce hydrogen and oxygen. Oxygen diffuses from the cell. ii Carbon fixation: a series of enzyme-controlled reactions, which use hydrogen and ATP (produced by the light reactions) with carbon dioxide to produce sugar.	Word summary of the process of photosynthesis: Carbon dioxide + water $\xrightarrow{\text{Light energy}}$ sugar + oxygen	
b The chemical energy in sugar is available for respiration or the sugar can be converted into other substances, such as starch (storage) and cellulose (structural).		♦ Factors affecting starch production can be investigated through iodine testing in leaves.
c Limiting factors: carbon dioxide concentration, light intensity and temperature and their impact on photosynthesis and plant growth. Analysis of limiting factors graphs.		♦ Investigate limiting factors through experiments with *Elodea*, immobilised algae or the use of IT simulations.

Biology: life on Earth (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
4 Energy in ecosystems a In transfers from one level to the next in a food chain, the majority of the energy is lost as heat, movement or undigested materials. Only a very small quantity is used for growth and is therefore available at the next level in a food chain. b Definitions and comparisons of pyramids of numbers and energy.	Irregular shapes of pyramids of numbers based on different body sizes can be represented as true pyramids of energy.	♦ Investigate examples of pyramid of energy (as measured in kJ/m^2/year) and pyramid of numbers. ♦ Investigate irregular pyramids of number, eg a tree as a producer, presence of parasites.

Biology: life on Earth (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
5 Food production a Increasing human population requires an increased food yield. This can involve the use of fertilisers and pesticides. Fertilisers provide chemicals such as nitrates which increase crop yield. Plants and animals which reduce crop yield can be killed by pesticides. b Nitrates dissolved in soil water are absorbed into plants. Nitrates are used to produce amino acids which are synthesised into plant proteins. Animals consume plants or other animals to obtain amino acids for protein synthesis. Fertilisers can be added to soil to increase the nitrate content of the soil. c Fertilisers can leach into fresh water, adding extra, unwanted nitrates. This will increase algal populations which can cause algal blooms. Algal blooms reduce light levels, killing aquatic plants. These dead plants, as well as dead algae, become food for bacteria which increase greatly in number. The bacteria use up large quantities of oxygen, reducing the oxygen availability for other organisms. Genetically modified (GM) crops can be used to reduce the use of fertilisers.	Details of the full nitrogen cycle are not required.	♦ Investigate the effect of fertilisers on plant growth. ♦ Investigate the effect of fertiliser concentration on algal growth.

Biology: life on Earth (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
5 Food production (continued) d Pesticides sprayed onto crops can accumulate in the bodies of organisms over time. As they are passed along food chains, toxicity increases and can reach lethal levels. The use of biological control and genetically modified (GM) crops as alternatives to the use of pesticides.	The build-up of toxic substances in living organisms is known as bioaccumulation.	♦ Research GM crops which can reduce fertiliser use. ♦ Research bioaccumulation through former use of DDT, lead (from leaded petrol) and mercury. ♦ Research biological control, eg using a virus (eg calicivirus) to kill rabbits; using ladybirds to kill aphids and scale insects; using caterpillar moth (*Cactoblastis*) to kill cacti (*Opuntia*). ♦ Investigate GM rice plants which take up nitrogen more efficiently. ♦ Research Bt toxin in tomatoes as alternative to pesticides.

Biology: life on Earth (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
6 Evolution of species		
a A mutation is a random change to genetic material. Mutations may be neutral, confer an advantage or a disadvantage to survival. Mutations are spontaneous and are the only source of new alleles. Environmental factors, such as radiation and some chemicals, can increase the rate of mutation.		♦ Research different types of mutation — neutral, advantageous or disadvantageous. ♦ Research mutagenic agents.
b New alleles produced by mutation can result in plants and animals becoming better adapted to their environment. Variation within a population makes it possible for a population to evolve over time in response to changing environmental conditions.	An adaptation is an inherited characteristic that makes an organism well suited to survival in its environment/niche.	♦ Investigate examples of adaptations such as desert mammals and plants and Galapagos finches.
c Species produce more offspring than the environment can sustain. Natural selection or survival of the fittest occurs when there are selection pressures. The best adapted individuals in a population survive to reproduce, passing on the favourable alleles that confer the selective advantage. These alleles increase in frequency within the population.		♦ Research consequences of over-prescription of antibiotics.

Biology: life on Earth (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
6 Evolution of species (continued) d Speciation occurs after part of a population becomes isolated by an isolation barrier, which can be geographical, ecological or behavioural. Different mutations occur in each sub-population. Natural selection selects for different mutations in each group, due to different selection pressures. Each sub-population evolves until they become so genetically different that they are two different species.	Examples of each type of barrier, eg ecological — pH, salinity or different habitats.	♦ Research Scottish examples of isolation leading to speciation, eg Arran Whitebeam, St Kilda Wren, Arctic Char. ♦ Research examples of rapid natural selection, eg MRSA, insect resistance to GM crop toxins.

Apparatus and techniques

In addition to the key areas, candidates must have knowledge of the following pieces of apparatus and have opportunities to become familiar with the following techniques.

Apparatus

- beaker
- balance
- measuring cylinder
- dropper/pipette
- test tube/boiling tube
- thermometer
- funnel
- syringe
- timer/stopwatch
- microscope
- petri dish
- quadrat
- pitfall trap
- light/moisture meter
- water bath

Techniques

- measuring enzyme activity
- using a respirometer
- measuring transpiration using a potometer
- measuring abiotic factors
- measuring the distribution of a species
- using a transect line
- measuring the rate of photosynthesis

The course support notes provide a list of suggested learning activities. Choosing from the activities suggested in the course support notes, or carrying out any other appropriate activities, allows candidates to become familiar with the apparatus and techniques listed above. Where it is not possible to carry out a particular technique other resources could be utilised.

Skills, knowledge and understanding included in the course are appropriate to the SCQF level of the course. The SCQF level descriptors give further information on characteristics and expected performance at each SCQF level (www.scqf.org.uk).