SCOTTISH QUALIFICATIONS AUTHORITY

BIOLOGY
Advanced Higher

Sixth edition – published January 2006

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NOTE OF CHANGES TO ADVANCED HIGHER ARRANGEMENTS SIXTH EDITION PUBLISHED JANUARY 2006

COURSE TITLE: Biology (Advanced Higher)

COURSE NUMBER: C007 13

National Course Specification

Course Details

One minor clarification to Notes in the Unit: Cell and Molecular Biology.

a (ii) Abnormal cell division: cancer cells. Notes amended to read "Normal proliferation genes are known as proto-oncogenes which may give rise to mutation to dominant oncogenes".

National Unit Specification

All Units

No change

National Course Specification

BIOLOGY (ADVANCED HIGHER)

COURSE NUMBER C007 13

COURSE STRUCTURE

The course has two mandatory 40-hour units, a 20-hour investigation unit and one optional 20-hour unit from a choice of three units. In common with all courses, this course includes a further 40 hours over and above the 120 hours for the component units. This may be used for induction, extending the range of learning and teaching approaches, support, consolidation, integration of learning and preparation for external assessment. This time is an important element of the course and advice on its use is included in the course details.

The units cover the following content areas:

Mandatory units		
D032 13	*Cell and Molecular Biology (AH)*	*1 credit (40 hours)*
D033 13	*Environmental Biology (AH)*	*1 credit (40 hours)*
D034 13	*Biology Investigation (AH)*	*0.5 credit (20 hours)*
Optional units		
D035 13	*Biotechnology (AH)*	*0.5 credit (20 hours)*
D036 13	*Animal Behaviour (AH)*	*0.5 credit (20 hours)*
D037 13	*Physiology, Health and Exercise (AH)*	*0.5 credit (20 hours)*

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained an award in Higher Biology or Higher Human Biology.

Administrative Information

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Version: 06

National Course Specification: general information (cont)

COURSE Biology (Advanced Higher)

CORE SKILLS

Core skills for this qualification remain subject to confirmation and details will be available at a later date.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

CREDIT VALUE

SCQF points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification is allocated a number of SCQF Credit Points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.

Course	SCQF Level	SCQF Credit points
Advanced Higher	7	24

National Course Specification: course details

COURSE Biology (Advanced Higher)

RATIONALE

The course provides a broad-based, integrated study of a wide range of biological topics which build on the concepts developed in both Higher Biology and Higher Human Biology. The content of the two mandatory units reflects the importance of cell and molecular biology and environmental biology as fundamental areas of science, which form the basis for study in applied fields of biology. The course provides a general basis for further study or employment in areas related to biology and develops an understanding of the way in which biological principles can be applied to the issues facing the individual and society and fosters positive attitudes to others and the environment. The study of biology at Advanced Higher level contributes to the candidate's general and vocational education through the acquisition of relevant biological knowledge and skills, and to the development of the more general attitudes and abilities related to the processes of science.

The course provides opportunities for candidates to acquire:

- knowledge and understanding of biological concepts, facts, ideas and techniques and of the applications of biology in society and industry
- skills in problem solving
- practical abilities associated with biology
- investigative and reporting skills associated with project work
- positive attitudes such as being open-minded and being willing to recognise alternative points of view, having an interest in biology, in themselves and their environment, being aware that they can make decisions which affect the well-being of themselves and others, and the quality of their environment

The course content provides clear articulation with both Higher Biology and Higher Human Biology. The topics emphasise the socially and economically relevant applications of cell and molecular biology and environmental biology such as applications of DNA technology and the impact of humans on the environment. The optional units provide the opportunity to select an area of study which could be of economic importance or of intrinsic interest and relevance to the candidate. The investigation is designed to capitalise on the skills that have been developed by the candidate in problem solving and practical abilities to produce an extended piece of scientific work.

COURSE CONTENT

The Advanced Higher course comprises two mandatory 40 hour units and one optional 20 hour unit together with a 20 hour investigation unit. The course provides for the development of a theoretical understanding deeper than that possible at Higher level and further develops the outcomes of knowledge and understanding, problem solving and practical abilities. In addition, the investigation provides the opportunity to study a selected topic in depth.

Knowledge and understanding

Candidates should develop the ability to recall and understand facts and principles detailed in the course statements and supplementary notes in the following tables.

Problem solving

Problem solving skills should be developed so that candidates can generally:

- select relevant information from texts, tables, charts, keys, graphs and diagrams
- present information appropriately in a variety of forms, including written summaries, extended writing, tables and graphs
- process information accurately using calculations where appropriate
- plan, design and evaluate experimental procedures
- draw valid conclusions and give explanations supported by evidence
- make predictions and generalisations based on available evidence.

Practical abilities

Practical work is essential in providing the contexts for the development of scientific problem solving skills. Practical work is necessary to underpin theoretical work and to develop skills. It fosters familiarity with apparatus, equipment and how it works as a useful preparation for further study or employment. As a result of engaging in practical work candidates can generally:

- describe experimental procedures accurately
- record relevant measurements and observations in appropriate formats
- analyse and present experimental information in appropriate formats
- draw valid conclusions
- evaluate experimental procedures with supporting arguments.

Investigation

As a result of engaging in investigative work candidates, in addition to the above problem solving and practical abilities, can generally:

- select, analyse and present relevant information through experimental, observational or survey work
- write in a scientific manner.

The following tables contain the content and suggested learning activities through which knowledge and understanding, problem solving and practical abilities are to be developed. The content statements and the supplementary notes which provide amplification and give an indication of depth of treatment are required for the purpose of assessment. The content for each unit is prefaced by a short summary of content with an indication given to the links with Higher Biology and Higher Human Biology.

National Course Specification: course details (cont)

COURSE Biology (Advanced Higher)

Cell and Molecular Biology (AH)

Introduction

The biology of cells and the interaction of molecules within them show remarkable similarities across species and so this makes the study of cell and molecular biology fundamental to all aspects of biology. The features and ultrastructure of prokaryotic and eukaryotic cells are compared and the cell cycle in eukaryotic cells, differentiation of cells into tissues and organs and cell and tissue culture are explored. The chemistry of the cell molecules is studied to help candidates understand how molecules interact and how this is important to the functioning of the cell as a whole. Membrane structure and function is further developed from Higher level study to help candidates come to an understanding of membranes as dynamic structures that have many functions which can be attributed to the many types of proteins found as components of the cell membrane. Candidates' understanding of cell ultrastructure and function is further developed by study of the cytoskeleton. The theme of molecular interactions in cell biology is developed by a study of three of the molecular interactions found in cells: the importance of enzymes in the control of cell metabolism is introduced as an example of an interaction found in the cytosol, the sodium-potassium pump as an interaction associated with membranes, and cell signalling as a communication interaction. Finally, the great advances made in DNA technology are explored and legal, social, moral and ethical issues raised in the many applications of the technology are discussed.

Candidates undertaking this unit should have a clear understanding of the topics covered in the units: Cell Biology (H) or Cell Function and Inheritance (H).

National Course Specification: course details (cont)

Unit: Cell and Molecular Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
a) Structure, function and growth of prokaryotic and eukaryotic cells		
i Comparison of features and ultrastructure of prokaryotic and eukaryotic cells.	Comparison of DNA, presence or absence of nucleus and functions of organelles present, membranes and cytosol organisation. Prokaryotes: single circular DNA molecule, nucleoid, ribosomes, cell wall with peptidoglycan, capsule, pili, flagella, plasmids. Eukaryotes: plant cells and animal cells. Plant cells: cell walls with cellulose, plasmodesmata, middle lamella, vacuole, nucleus, nuclear membrane (envelope), endoplasmic reticulum, ribosomes, Golgi apparatus, chloroplasts, mitochondria, lysosomes. Animal cells: nucleus, nucleosomes, Golgi apparatus, endoplasmic reticulum, mitochondria, microvilli, centrioles, endomembranes, microbodies, lysosomes, cytoskeleton.	
ii Cell growth and the cell cycle. Interphase: G1, S and G2 phases (G: growth, S: synthesis).	Between divisions cells are at interphase, which is an active period of growth and metabolism. The cells grow throughout interphase but DNA is replicated only during the S phase.	

National Course Specification: course details (cont)

Unit: Cell and Molecular Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
Mitosis: the M phase.	A dynamic continuum of sequential changes described as prophase, metaphase, anaphase and telophase. Role of spindle fibres in the movement of chromosomes, alignment of chromosomes on metaphase plate, separation of sister chromatids and formation of daughter nuclei. Cytokinesis.	
	Mitotic index: percentage of cells in a sample undergoing mitosis.	Calculate mitotic index in onion root tips from photomicrographs.
Control of the cell cycle.	Position and purpose of checkpoints in relation to cell size, success of DNA replication and exit from mitosis and cytokinesis.	
	Mitosis promoting factor (MPF): protein complex controlling entry of cells into mitosis.	
Abnormal cell division: cancer cells.	Proliferation genes encode proteins that promote cell division. Mutations cause excessive cell growth characteristic of cancer, resulting in tumour formation. Normal proliferation genes are known as proto-oncogenes which may give rise by mutation to dominant oncogenes.	

National Course Specification: course details (cont)

Unit: Cell and Molecular Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
	Antiproliferation genes (tumour-suppressor genes) help to restrict cell division at cell checkpoints. Mutations are recessive and when both copies mutate control of cell division is lost due to loss of inhibition.	
iii Differentiation of cells into tissues and organs.	Cells undergo differentiation to become specialised cells that are organised into tissues and organs. Cellular differentiation depends on changes in gene expression resulting in genes being switched on and off (similar depth of treatment to Higher Biology).	
iv Cell and tissue culture.	The ability of stem cells to differentiate, unlike specialised cells. The *lac* operon in *E.coli*. Repressor molecule, regulator gene, inducer, operator and structural gene (as in Higher Biology).	
Mammalian cell culture.	Requirement of aseptic conditions, solid surface, growth factors and nutrients in complex growth media.	Use case studies to illustrate the applications of cell culture.

National Course Specification: course details (cont)

Unit: Cell and Molecular Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
	The addition of animal serum such as fetal bovine serum (FBS) to promote cell proliferation and antibiotics to prevent bacterial growth. Use of proteolytic enzymes to release cells from source tissue. Cells adhere to the surface, spread out and divide until a monolayer is formed and the cells are confluent. Difficulty in maintaining cultures of mammalian cells due to cells dying after a finite number of divisions in culture. Cell lines prepared from cells which undergo a genetic change that makes them immortal or from cancer cells. A clone is the result of cell cloning in which a single cell is isolated and allowed to proliferate to form a large colony.	
Bacterial and fungal cultures.	The advantages of the simpler growth media requirements and culture conditions for bacteria and fungi compared to mammalian cells.	Carry out an experiment to demonstrate culturing techniques using bacterial or fungal cultures.

National Course Specification: course details (cont)

Unit: Cell and Molecular Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
v Plant tissue culture.	Techniques used (including requirement for aseptic conditions and suitable growth medium). Growth of explants on suitable media to produce a callus. The use of growth regulators such as auxins and cytokinins to cause tissue differentiation. Production of pathogen-free plantlets and plants, generation of new varieties of plants and use in plant propagation. Use of terms protoplast and totipotent.	Set up cultures of eg *Brassica oleracea* (cauliflower curds) or *Sinapis alba* (white mustard) seedlings. Examine photographs of protoplasts at different stages of culture and as fusion products.
b) Structure and function of cell components		
i Carbohydrates.		
Structure of the monomer glucose.	Glucose is studied in terms of a building block of carbohydrate macromolecules. Equilibrium between linear and ring forms of the glucose molecule, alpha and beta glucose ring structure.	Carry out an experiment to determine the percentage glucose in prepared solutions.
Dehydration (condensation) to form 1-4 linkages between alpha and beta forms.	Disaccharides joined by glycosidic bonds.	
Polysaccharide structure.	Comparison of polysaccharide structures of starch (amylose and amylopectin), cellulose and glycogen (in relation to linkage of glucose monomers and degree of branching).	Carry out an experiment to compare the reaction of iodine with starch, cellulose and glycogen.

National Course Specification: course details (cont)

Unit: Cell and Molecular Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
Functions of carbohydrates: role in energy budget, storage, cell structures.	Significance of storage to osmoregulation.	
ii Lipids. Structure of glycerol, saturated and unsaturated fatty acids.		
Dehydration (condensation) of glycerol and fatty acids to form ester linkages in fats.		
Triglyceride and phospholipid structure.	Comparison of structure in terms of hydrophobic and hydrophilic nature. Type of lipid related to acid component in ester. Natural tendency for phospholipids to form bilayer.	Carry out an experiment to compare the solubility of lipids in a variety of solvents.
Structure of steroids.	Steroids have a common four ring structure. Different steroids vary in their side chains attached to the rings as illustrated by cholesterol and testosterone.	
Functions of lipids: structural, storage, hormones.		

National Course Specification: course details (cont)

Unit: Cell and Molecular Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
iii Proteins.		
Structure of amino acids.	Identification of main classes: polar, non-polar, acidic, basic, ie by functional groups. Individual amino acid names and structures are not required.	
Dehydration (condensation) synthesis and peptide bonds.	The covalent peptide bond that links amino acid residues is a very strong bond.	
Primary, secondary, tertiary and quaternary structure.	Weaker inter- and intra-molecular bonding important in protein structure. Non-covalent bonds, hydrogen bonds, ionic bonds, van der Waals attraction and hydrophobic interactions. α -helix, β -sheet arrangements (parallel and antiparallel) in secondary structure; covalent disulphide bond in tertiary structure; subunits in quaternary structure. Presence of prosthetic groups eg haem in haemoglobin.	Carry out an experiment to determine the isoelectric point of a protein to relate amino acid composition to structure.
Functions of proteins. Examples to include catalytic, structural, messenger, carriers.	In covering the functions of proteins, reference should be made to the variety of proteins encountered in Standard Grade, Intermediate 2 and Higher level courses.	

National Course Specification: course details (cont)

Unit: Cell and Molecular Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
iv Nucleic acids. Structure of DNA and RNA.	In addition to the same depth of treatment as at Higher level, classification, pairing (A-T by 2 hydrogen bonds, G-C by three hydrogen bonds) and use of terms purine (double-ring structure) and pyrimidine (single-ring structure). Detailed structures not required. Anti-parallel DNA strands which run in opposite directions with respect to their 5'-3' polarity.	Isolate DNA from plant and animal tissues.
Functions of the enzymes polymerase and ligase.	Polymerase enzymes involved in DNA replication and transcription. DNA ligase forms phosphodiester bonds to join DNA molecules together.	
v Membranes. Membrane composition and organisation.	Fluid mosaic model of membrane structure: proteins immersed in a lipid bilayer, held together by hydrophobic interactions.	Examine electron micrographs of animal and plant cell membranes and junctions.
Types of membrane proteins.	Integral (intrinsic) and peripheral (extrinsic) proteins.	View and discuss video material.
Functions of membrane proteins.	Attachment to cytoskeleton and extracellular matrix, intercellular junctions, transport, enzymes, receptors sites.	

National Course Specification: course details (cont)

Unit: Cell and Molecular Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
	Importance of glycoproteins in cell-cell recognition.	
vi Cytoskeleton.		
Composed of fibres as illustrated by microtubules.	Microtubules are straight, hollow rods made of globular proteins called tubulins. Microtubules are found in all eukaryotic cells and radiate from a centrosome (the microtubule organising centre) which is located near the nucleus.	Examine electron micrographs of the cytoskeleton.
Function.	To give mechanical support and shape to cells. The cytoskeleton extends throughout the cytoplasm and governs the location of membrane-bound organelles and other cell components.	
c) Molecular interactions in cell events		
i Catalysis.	Functions of proteases, nucleases, ATPases, kinases. Synthesis (anabolic) and degradation (catabolic) reactions involving condensation and hydrolysis.	
Specificity of enzyme activity related to induced fit.	Change in shape of the active site when correct substrate binds.	

National Course Specification: course details (cont)

Unit: Cell and Molecular Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
Control of enzyme activity by competitive and non-competitive inhibitors, enzyme modulators and covalent modifications.	Binding of inhibitor to active site prevents the substrate binding in competitive inhibition. Inhibitor binds to a second site which results in a change in shape of enzyme in non-competitive inhibition. Positive modulators (activators) and negative modulators (inhibitors) bind to a second site on allosteric enzymes and result in shape changes. Covalent modifications including phosphorylation and dephosphorylation, and conversion of inactive enzyme to active enzyme as exemplified by trypsinogen and trypsin.	Design and carry out an investigation into the effects of competitive and non-competitive inhibition on enzyme activity, eg thiourea and iodine on urease.
Role of end-product inhibition in the control of metabolic pathways.	End-product binds to first enzyme in pathway to control the whole pathway as the supply of intermediates is restricted. This is a form of negative feedback.	
ii The sodium-potassium pump (a specific case of active transport).	Ions pumped against a steep concentration gradient. The transport protein pumps sodium ions out of the cell as potassium ions are pumped into the cell. ATP powers the pump by transferring a phosphate group to the protein (ie the transport protein is phosphorylated) resulting in a change in conformation (shape) of the protein. The two conformational states differ in affinity for sodium and potassium.	

National Course Specification: course details (cont)

Unit: Cell and Molecular Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
iii Cell signalling		
Extracellular hydrophobic signalling molecules.	As illustrated by steroid hormones eg testosterone. These diffuse across the plasma membrane of the target cell and activate gene regulatory proteins which regulate the transcription of specific genes.	
Extracellular hydrophilic signalling molecules.	As illustrated by peptide hormones eg insulin and neurotransmitters eg noradrenalin and acetylcholine. These activate receptor proteins on the surface of the target cell. The receptors act as transducers, converting the extracellular binding event into intracellular signals which alter the behaviour of the target cell.	
d) Applications of DNA technology		
i The Human Genome Project.		
Genetic linkage mapping. Location of genetic markers to allow testing of genetic linkage to known markers.	Techniques used include: using a nucleic acid probe to identify a cloned gene; isolation of overlapping DNA segments obtained by cutting two samples of the original DNA with restriction endonuclease enzymes; amplification of DNA by the PCR (polymerase chain reaction).	Discuss moral and ethical issues related to the Human Genome Project.
Physical mapping. Determination of order of genes on each chromosome.		Carry out an experiment to demonstrate gel electrophoresis of DNA treated with restriction enzymes.

National Course Specification: course details (cont)

Unit: Cell and Molecular Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
	PCR involves DNA heated to 95°C, DNA is denatured, primer (short length of DNA) binds (anneals) to template strands, complementary DNA strands form. Advances in automation and electronic technology have greatly enhanced the speed of the project.	
DNA Sequencing. Determining the order of nucleotide pairs of each chromosome.		Use computer simulation for DNA sequencing.
Analysing the genomes of other species. Comparison of the human genome with other species reveals remarkable similarities.		
ii Human therapeutics.		
Detecting genetic disorders.	The use of DNA probes and hybridisation to locate specific sequences, genes and gene mutations as illustrated by cystic fibrosis and Duchennes muscular dystrophy. The discovery of a defective gene and the development of a screening test. The importance of counselling.	Analyse data and discuss case studies of cystic fibrosis and Duchennes muscular dystrophy.
Gene therapy: the replacement of a faulty gene with a normal gene; the insertion of an extra gene with the intention that the gene product will play a therapeutic role.	Difficulty of gene therapy in practical terms.	Analyse the results of gene therapy trials on cystic fibrosis and discuss the legal, moral and ethical issues for the future.

National Course Specification: course details (cont)

Unit: *Cell and Molecular Biology (Advanced Higher)*

CONTENT	NOTES	LEARNING ACTIVITIES
iii Forensic uses.	DNA profiling: relies on repetitive, hypervariable DNA and not genes *per se*. Stages involved: DNA isolation, restriction enzyme digestion, gel electrophoresis, blotting DNA onto a filter, hybridisation with a probe. Use of single locus probe.	Use case studies from, eg CD ROM, newspapers, library.
iii Agriculture.		
Transgenic plants.	Transgenic plants are engineered by using a plasmid from *Agrobacterium*. Foreign DNA carrying genes for the desired characteristics inserted into bacterial plasmid. Plant cell protoplasts incubated with bacteria containing genetically engineered plasmid in medium which allows only those plant cells which have taken up the foreign DNA to grow. Illustrate application by transgenic tomato plants: gene for bacteria toxin transferred to plants resulting in effective protection from insect damage. Moral and ethical issues relating to the use of transgenics.	Inoculate plant tissue with *A. tumefaciens* and observe growth and development. Discuss moral and ethical issues relating to the use of transgenic animals and plants. View and discuss material on gene ethics.
Production of bovine somatotrophin (BST) by genetic engineering and its use in cattle.	Gene for BST cloned into a bacterial system. Product purified and administered to cattle by injection or in feed. BST increases milk production.	

National Course Specification: course details (cont)

COURSE Biology (Advanced Higher)

Environmental Biology (AH)

Introduction

The environment, together with its ecosystems, has political, economic and ethical dimensions because of the impact it has for the human species. It is the study of environmental biology that provides the scientific basis for the understanding of these issues and for the stewardship of our environment. As the resources of the environment are finite, this unit considers the biological processes which result in the flow of energy and circulation of materials in ecosystems. Emphasis is placed on the process of decomposition because of its key role in recycling materials. The interactions within ecosystems are studied by consideration of inter-specific and intra-specific relationships between organisms in the ecosystems as well as environmental factors. These interactions should be approached from the point of view of ecological advantage and evolution based on the costs and benefits of the interaction. The principle of change in ecosystems is considered in conjunction with the influences of the human species on the environment. Throughout the unit ecosystems should be studied to illustrate the content of the course. Although it is recommended that local ecosystems should be studied to provide fieldwork experience, it should be remembered that other ecosystems are of global significance and concern and so also merit study. Information technology now brings statistical analysis within the scope of classwork and opportunities should be taken to analyse collected and received information using such facilities.

Candidates undertaking this unit should have a clear understanding of the topics covered in the units: Genetics and Adaptation (H) and Control and Regulation (H); or Behaviour, Populations and the Environment (H).

National Course Specification: course details (cont)

Unit: Environmental Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
a) Circulation in ecosystems		
1 Energy		
i Energy fixation.	The fixation of energy in autotrophs by photosynthesis. Primary productivity measured by rate of accumulation of biomass in the ecosystem. Gross primary productivity (GPP) as total yield of organic matter from photosynthesis. Net primary productivity (NPP) as biomass remaining after energy consumption in producer respiration.	Carry out an experiment to measure productivity by increase in biomass of growing plants.
ii Energy flow.	Roles of producers (autotrophs), consumers (heterotrophs) and decomposers (saprotrophs) in the flow of energy. Primary consumers/herbivores; secondary and tertiary consumers/carnivores; omnivores; detritivores.	Carry out an investigation into respiratory activity in soils.

National Course Specification: course details (cont)

Unit: Environmental Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
	Transfer of energy between trophic levels. Ecological efficiency as percentage of energy transferred from one trophic level to the next. Major reasons for low transfer values. Pyramids of numbers and biomass and their limitations. Pyramids of productivity. Increasing complexity of energy flow in food webs. Ultimate loss of energy as heat in respiration.	
2 Circulation of nutrients i Decomposition.	The importance of the soil organisms in the decomposition of organic matter (mineralisation). The role of invertebrate detritivores in the production of humus. Breakdown of organic matter by decomposers (bacteria and fungi). Decomposer respiration as the ultimate releaser of energy and carbon dioxide fixed in photosynthesis. Available nitrogen as limiting factor in decomposition.	Carry out an assay of cellulase activity in different soils. Demonstrate the effect of compost accelerators. Carry out an experiment to identify invertebrates in leaf litter or seaweed strand line litter samples.

National Course Specification: course details (cont)

Unit: Environmental Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
ii Nutrient cycling.	The importance of nutrient cycling in ecosystems. Fixation, loss and transformation in nutrient cycles.	Isolate *Rhizobium* bacteria from root nodules.
The nitrogen cycle.	Chemical transformations in the nitrogen cycle: nitrogen fixation in free living cyanobacteria and mutualistic *Rhizobium* in root nodules in legumes, functions of nitrogenase and leghaemoglobin, decomposition of proteins to produce ammonium (ammonification), roles of nitrifying bacteria *Nitrosomonas* and *Nitrobacter* in nitrification to produce available nitrate, assimilation of nitrate and ammonia into proteins and nucleic acids, loss by leaching and free-living denitrifying bacteria including *Pseudomonas*. The influence of water saturation and anaerobic conditions on the cycling of nitrogen in ecosystems.	
The phosphorus cycle.	Only in relation to low solubility of phosphate as a limiting factor in the productivity of aquatic ecosystems. Problems of phosphate enrichment.	
b) Interactions in ecosystems		
1 Biotic interactions	Distinction between biotic and abiotic components of ecosystem; density-dependent and density-independent factors. Interspecific and intraspecific interactions.	

National Course Specification: course details (cont)

Unit: Environmental Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
i Predation.	Predator/prey population cycles. The role of predators in maintaining diversity in ecosystems by reducing the population density of prey species allowing weaker competitors to survive. Defences against predation; camouflage (crypsis and disruptive coloration); warning (aposematic) coloration. Batesian and Mullerian mimicry.	Analyse data on predator/prey population cycles.
ii Grazing.	The effect of grazing on plant communities: effects on diversity and the dominance of grasses and other plants with basal meristems.	Carry out an investigation on species diversity in mowed and unmowed swards or grazed and ungrazed swards.
iii Competition.	Exploitation competition and interference competition. The concept of fundamental niche as a set of resources a species is capable of using. Realised niche as the set of resources actually used due to competition. Resource partitioning. The competitive exclusion principle.	Analyse data on colonisation of rocks by barnacle species.
	The damaging effects of exotic species.	Analyse information on the effects of exotic species, eg *Rhododendron ponticum*, mink, New Zealand platyhelminth.
	The importance of survival of weaker competitors and their potential for growth in changing conditions.	

National Course Specification: course details (cont)

Unit: Environmental Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
2 Symbiotic relationships	Symbiosis refers to relationships between organisms of different species that show an intimate association with each other. Symbiotic relationships provide at least one of the participating species with a nutritional advantage.	
i Parasitism.	Parasitism as a biotic interaction beneficial to one species (parasite) and detrimental to the other (host). Obligate and facultative parasites. The balance between parasitic damage and host defence resulting in a relatively stable relationship. Transmission of parasites to new hosts using direct contact, resistant stages, and secondary hosts (vectors). Host-parasite specificity as evidence of evolutionary adaptation.	Isolate and examine cysts of potato cyst eelworm. Carry out an experiment to satisfy Koch's postulates using *Botrytis* and geranium.
ii Commensalism.	Commensalism as a biotic interaction beneficial to one species (commensal), leaving the other (host) unaffected. Examples difficult to establish with certainty but usually involve feeding benefits to one species.	View audio-visual material on commensal feeding relationships.
iii Mutualism.	Mutualism as a biotic interaction beneficial to both species. The exchange of metabolites and complementarity of structures and behaviours found between symbionts in mutualism.	Examine mycorrhizae. Analyse data on species interaction in coral reefs.

National Course Specification: course details (cont)

Unit: Environmental Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
3 The costs, benefits and consequences of interactions		
i Interaction between species.	Positive, negative and neutral interspecific interactions. Competition as a negative interaction for both species (-/-). Predation as +/- interaction. Positive effects of symbiotic relationships for at least one species involved; parasitism (+/-), commensalism (+/0), mutualism (+/+). The effects of host health and environmental factors in changing the balance in symbiotic relationships. The management of symbiotic relationships in the promotion of human, animal and plant health. The use of drugs and pesticides in this management. The use of herbicides in the management of plant competition.	Carry out an investigation into the effect of relative humidity on the development of *Botrytis* infection in plants. Carry out an investigation into the influence of selective herbicides on grasses and broad-leaved species.

National Course Specification: course details (cont)

Unit 2: Environmental Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
ii Interactions with the environment.	Two major types of responses of organisms to variation in environmental conditions are conformation and regulation. Conformation as exemplified by osmoconformers and poikilotherms. Tolerance and resistance. Restricted habitat occupation of conformers. Dormancy as a means of resisting or tolerating environmental adversity. Predictive and consequential dormancy. Forms of dormancy: resting spores, diapause, hibernation, aestivation. Regulation: homeostatic control in regulators as illustrated by osmoregulators and homeotherms. The ability of regulators to occupy a wide range of habitats. Energy costs of homeostasis.	Design and carry out an investigation on the activity of woodlice that have been held in wet and dry environments. Design and carry out an investigation on wilting in plants. Examine life table data and survivorship curves. Design and carry out an investigation into invertebrate activity at different temperature regimes. Analyse data on salinity control in estuarine species.

National Course Specification: course details (cont)

Unit: Environmental Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
c) Human impact on the environment		
Changes to ecosystems		
i Changes in complexity.	Autogenic succession (primary and secondary succession). The increase in complexity of ecosystems from pioneer through to climax communities. Facilitation of change in early stages. Increase in complexity shown by increase in: diversity of species, variety of habitats and niches, complexity of food webs. Changes in stability and productivity through succession. Reference to effects of external factors in allogenic succession and relatively short-term nature of degradative (heterotrophic) successions. Loss of complexity through human activity as illustrated by monoculture, eutrophication (algal bloom and its consequences), toxic pollution, and habitat destruction.	
ii Effects of intensive food production.	Monoculture and its effect on soil condition, field size, shelter and habitats. Environmental impact of increased use of pesticides and chemical fertilisers in relation to species diversity and loss of stability.	Carry out an experiment to sample and compare invertebrate life from field and hedgerow.

National Course Specification: course details (cont)

Unit: Environmental Biology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
iii Effects of increased energy production.	Fossil fuels as finite energy resources. Need for conservation and use of alternative sources of energy. Air pollution from fossil fuels: acidic gases (sulphur dioxide, nitrous oxide, carbon dioxide) and greenhouse gases (carbon dioxide and water) produced. Other greenhouse gases include methane and CFCs. Enhanced greenhouse effect and effects of global warming on abundance and distribution of species as exemplified by zooxanthellae and 'coral bleaching'.	
iv Pollution.	Biodegradable organic pollutants and changes in biochemical oxygen demand (BOD).	Measure BOD of a variety of water samples.
	Major types of toxic pollutants and their sources as exemplified by DDT and heavy metals. Bioaccumulation. Consequences of biological magnification in food chains. Biotransformation. Toxicity and persistent/non-biodegradable nature of DDT.	Carry out an investigation to determine levels of pollution using indicator species. Examine data on biological magnification of DDT and mercury in food chains.
	Susceptible and favoured species as exemplified by the use of indicators in the monitoring of quality of fresh water ecosystems.	

National Course Specification: course details (cont)

COURSE Biology (Advanced Higher)

Biotechnology (AH)

Introduction

This unit explores the use of micro-organisms, the industrial production of enzymes and tissue culture as basic biotechnological techniques. The application of these techniques to agriculture, the food industry and medicine is further developed by the study of silage production, enhancing nitrogen fixation, fermented dairy products as functional foods, yeast extracts, fruit products, antibiotic production and the use of monoclonal antibodies.

Candidates undertaking this unit should have a clear understanding of the topics covered in the units: Cell Biology (H) or Cell Function and Inheritance (H).

National Course Specification: course details (cont)

Unit: Biotechnology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
a) Biotechnological techniques		
1 Use of micro-organisms		
i Growing micro-organisms.	Containment by aseptic techniques. Obtaining pure cultures as a source of inoculum. The need for growth conditions and their control in laboratory culture and fermenters. Factors taken into account in scaling up from Petri dish to full scale production. Product formation and recovery.	Prepare and inoculate cultures of micro-organisms in liquid and solid media. Analyse flow charts showing industrial micro-organisms' growth and production.
ii Stages of growth.	Stages of growth of micro-organisms in culture. Measurement of growth using cell counts, dilution plating and turbidometric methods using haemocytometers and colorimeters to obtain direct, indirect, total and viable counts. Calculation of growth rate constants.	Carry out serial dilutions and dilution plating. Carry out an experiment to measure growth rates using haemocytometers or colorimeters.
iii Diauxic growth.	Growth in two phases due to catabolite repression as shown by the lac operon. The terms repressor molecule, regulator gene, inducer, operator and structural gene should be known. Negative control by the lac suppressor and positive control by CAP.	Analyse growth rate curves of micro-organisms using substrates of lactose and glucose.

National Course Specification: course details (cont)

Unit: Biotechnology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
2 Industrial production of enzymes		
Use of micro-organisms.	Sources of cellulases, pectinases and amylases from naturally occurring micro-organisms. Manipulation of micro-organisms as exemplified by chymosin as an alternative to traditional sources of rennet.	Analyse flow charts showing methods of industrial enzyme production. Carry out an investigation into the effects of different rennet enzymes on cheese production.
Production of enzymes.	Fermentation conditions to include sterility, nutrients, oxygen, pH, temperature, anti-foaming agents, time and the need to control these.	
Product recovery.	Production of primary and secondary metabolites. Separation by flocculation, filtration and centrifugation. Concentration by ultrafiltration and vacuum evaporation; purification by chromatography.	
3 Tissue cultures		
i Animal cell culture.	Animal cell culture. Aseptic procedures, growth conditions, lifetime of primary cell lines and cancer cells in culture.	
ii Plant cell culture.	Plant cell culture. Growth of explants and plant cell lines in a fermenter. Protoplast isolation using cellulases and pectinases. Osmotic sensitivity of protoplasts.	

National Course Specification: course details (cont)

Unit: Biotechnology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
	Hybridisation to form the new varieties of plants by fusion of protoplasts from sexually incompatible species using polyethylene glycol (PEG). Characteristics of both parents such as high yield and disease resistance displayed in hybrid. Use of tissue culture in plant propagation. The need to control light, temperature and humidity to produce plantlets.	Examination of protoplasts at different stages of culture and fusion products. Set up cultures of cauliflower curd.
b) Applications of biotechnological processes 1 Agriculture i Silage production.	Silage production in silos by inoculating bacteria and enzymes. Reasons for using *Enterococcus* and *Lactobacillus*. Pectinases and cellulases and their functions. Production of lactic acid and anaerobic conditions preventing the growth of spoilage organisms.	

National Course Specification: course details (cont)

Unit: Biotechnology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
ii Enhancing nitrogen fixing.	Mutualistic relationship of *Rhizobium* species of bacteria in root nodules in legumes. Function of nitrogenase and leghaemoglobin. The need for anaerobic conditions. *Rhizobium* specificity due to plasmids. The mechanism of nitrogen fixing including (*Nif*) genes. The effect of high nitrogen concentrations on nitrogen fixing. Gene expression and plasmid transfer in improved *Rhizobium* strains.	Grow *Rhizobium* on agar.
2 Food industry		
i Fermented dairy products.		
Traditional products.	Naturally occurring bacteria in milk as a source of inocula and effect of pasteurisation. Two stage fermentation process; first involving production of lactic acid, second gives product type.	
Novel products (probiotics).	Functional foods provide health benefits beyond basic nutrition. Role as nutraceuticals. Nature and effects of probiotics in competing with pathogens, anti-cancer activity, reducing blood cholesterol and improving lactose intolerance.	Carry out an investigation into the effects of different substrates on growth of *K. lactis*. Carry out an experiment to demonstrate the use of lactase enzyme to convert milk products.

National Course Specification: course details (cont)

Unit: Biotechnology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
ii Yeast extracts.	Use of yeast biomass to provide hydrolysed extracts, vitamins and flavour ingredients. Autolysis of yeast by enzymes to produce a number of flavours dependent on enzyme present, stage of life cycle or age of culture during degradation.	Carry out an experiment to test the viability of yeast at different stages of the yeast extraction process.
iii Fruit products.	Reasons for problems associated with production of fruit juice drinks including viscosity, clarity, low yield, haze and extraction. Sources and use of cellulases, arabanase, pectinases and amylases to overcome these problems.	Carry out an investigation into the production of fruit juice by different combinations of enzymes and treatments.
Genetic modification of *flavr savr* tomato.	Gene for polygalacturonase (a pectinase which softens fruit) is cloned to produce RNA complementary to mRNA for the enzyme. Prevents gene being expressed. Production of fruit with less bruising and increased shelf life. Social and economic issues related to safety, production and use of GM foods.	
3 Medicines		
i Antibiotic production.	Type of organism used, growth conditions, control measures, secondary metabolites in microbial fermentation. Made from cheap feedstock, waste materials, starch and plant oils.	Obtain and present information on the processes involved in the production of an antibiotic eg penicillin.

National Course Specification: course details (cont)

Unit: Biotechnology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
ii Nature and production of monoclonal antibodies.	Product recovery by downstream processing including extraction, recovery, separation and purification of product. Mode of action of antibiotics on bacteria – bacteriostatic/bacteriocidal. Named examples of antibiotics to include penicillin, streptomycin and erythromycin. Protein nature of antibodies produced in response to specific antigens by B lymphocytes. Site and production of B lymphocytes. Preparation of polyclonal sera and its disadvantages. Monoclonals produced form a single B line secreting one specific antibody. Nature of myeloma cells and their hybridisation with lymphocytes using polyethylene glycol (PEG) to produce hybridomas. Use of selective media and screening. Hybridomas only produce one particular monoclonal. Batch culture of secreting hybridomas in fermenters and extraction of pure antibody.	Visit antibiotic production plant.
Uses of monoclonal antibodies.	Use of monoclonal antibodies in diagnosis and detection of disease.	

National Course Specification: course details (cont)

Unit: Biotechnology (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
	Use of immunoassay (Elisa) techniques involving monoclonal antibodies joined to enzyme; coloured product used to quantify presence of antigen specific to pathogen eg AIDS, meningitis, *Botrytis*. Treatment of disease: tumour-specific antibodies joined to toxins, combine with tumour cells and kill them.	Carry out an experiment to demonstrate the use of the Elisa technique to identify specific antigens.

National Course Specification: course details (cont)

COURSE Biology (Advanced Higher)

Animal Behaviour (AH)

Introduction

Much of behaviour consists of observable activities. This unit considers a scientific approach to describing observable behaviour. The development of behaviour is studied through the interaction of genetic and environmental influences. Behavioural interactions are considered in relation to feeding, sexual and social behaviour.

Candidates undertaking this unit should have a clear understanding of the topics covered in the units: Genetics and Adaptation (H); Control and Regulation (H); or Behaviour, Populations and the Environment (H).

National Course Specification: course details (cont)

Unit: Animal Behaviour (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
a) Measuring behaviour		
1 Observation of behaviour	To include: latency, frequency, duration and intensity. The difference between events and states.	Observe video or live animals to establish basic principles of observation and recording.
2 Recording and interpretation of behaviour	Problems of recording behaviour. Establish factual and objective requirements. The use of ethograms.	Construct ethograms for a variety of organisms.
i Anthropomorphisms.	Problems of relating behaviour to human experience.	Compare different methods of monitoring behaviour: direct, video, computer aided, telemetry.
ii Proximate and ultimate causes of behaviour.	As illustrated by the reasons for nest building in spring by birds. Proximate: response to day length. Ultimate: improved chances of survival of young.	
b) Development of behaviour		
1 Innate and learned behaviour	Nature versus nurture. Development of behaviour depends on interaction between genetic and environmental influences. Innate behaviour (genetically determined, stereotypical response) and its adaptive significance. Learning as modification of behaviour by experience. Ability to learn genetically determined and environmentally influenced. Variability of response within a species.	

National Course Specification: course details (cont)

Unit: Animal Behaviour (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
	The role of both innate and learned behaviour in examples of invertebrates and vertebrates as exemplified by foraging in honey bees and bird song development.	View and discuss video on development of bird song.
i The influence of parental care on learned behaviour.	Compare short life span of many adult invertebrates with long life span of primates and relate to time to learn new behaviour.	
ii Imprinting.	Irreversible learning process with environmental component. Critical time period of attachment after hatching. Object of attachment followed to exclusion of others. Adaptive significance in relation to protection of young and sexual behaviour.	View and discuss video on imprinting.
iii Sign stimuli and fixed action patterns.	Sign stimuli (releasers) elicit stereotyped responses called fixed action patterns which are species-specific. As exemplified by feeding of young by parent birds. Fixed action patterns under genetic control, once initiated go to completion, resistant to change by experience, some variability between individuals and can produce complex behaviour patterns. As exemplified by stickleback behaviour.	Observe sticklebacks live or on film.

National Course Specification: course details (cont)

Unit: Animal Behaviour (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
2 Evolution of behaviour		
i Natural selection of behaviour patterns.	Behaviour patterns show variation and are inherited ie determined by genes. Some behaviours have greater reproductive success resulting in favourable adaptations accumulating in populations. As illustrated by extended phenotype in nest building in birds, by shoaling in fish and herding in mammals.	Carry out an investigation to compare maze running or corner seeking behaviour in small mammals.
ii Single gene effect on behaviour.	As illustrated by *Drosophila* period (*per*) gene. This gene controls a 24 hour cycle of activity and inactivity. Different forms of the gene alter production of protein which alters the period of hours taken to complete the daily cycle.	Study genetic data on 'hygienic' behaviour in bees.
iii Behavioural adaptation to human influence.	Human activity results in rapid environmental change. Some species are intrinsically adaptable and can change diet, foraging behaviour and habitat preference. As illustrated by foxes and herring gulls.	View and discuss video on animal adaptations to city life.

National Course Specification: course details (cont)

Unit: Animal Behaviour (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
b) Behavioural interactions		
1 Feeding behaviour		
i Predation strategies.	Comparison of solitary and co-operative hunting.	
ii Foraging behaviour.	Modification of behaviour to optimise gain and minimise energy expenditure. Significant aspects to include encounter rate and handling time of prey by predator and energy content of prey. As illustrated by optimum mussel size for a foraging crab; optimal territory size in robin and humming bird: more resources within larger territory set against increased cost of defence.	Carry out an investigation into foraging behaviour in insects, birds or mammals.
iii Defence strategies.	Mimicry; camouflage, including crypsis, masquerading and disruptive camouflage/coloration, vigilance and escape responses.	Record vigilance behaviour in birds.

National Course Specification: course details (cont)

Unit: Animal Behaviour (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
2 Sexual behaviour		
i Male and female investment.	Comparison of sperm and egg production in relation to number and energy store. External and internal fertilisation, parental investment. Cost of parental investment; compared to increased probability of production and survival of young. Greater investment by females; sexual dimorphism as product of sexual selection. Generally females inconspicuous.	
ii Courtship and display.	Male-male rivalry: increased access to female through fighting. Female choice: males have more conspicuous markings, structures, and behaviours to attract females.	Carry out an investigation into courtship and mate choice in *Drosophila.* Observe and discuss film on courtship in birds.
iii Avoidance of inbreeding.	High levels of homozygosity in inbred populations. Heterozygosity in outbred populations. Inbreeding increases expression of disadvantageous or lethal recessive genes resulting in lower fitness and reduced breeding success. Benefits of polygamy and male dispersal in social mammals. Monogamy, male territoriality and female dispersal in birds.	Observe and discuss film on social mammals.

National Course Specification: course details (cont)

Unit: Animal Behaviour (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
3 Social behaviour		
i Agonistic and appeasement behaviour.	Ritualised display and appeasement as a means of reducing risk of injury and energy expenditure.	Observe film on breeding behaviour in red deer.
ii Selfish and altruistic behaviour.		
The concept of the 'selfish' gene.	'Selfish' gene combinations are self-preserving; assist survival and pass on more copies to next generation resulting in increased frequency. Genes survive through natural selection.	Observe and discuss film on selfish and altruistic behaviour in social insects and mammals, including humans.
Kin selection.	Natural selection that favours behaviour which helps relatives. Close relatives share larger proportion of genes. Coefficient of relatedness and Hamilton's rule.	
Altruism.	Altruism has costs since it improves survival chance of others while decreasing own chances. Benefits of mutual self-interest outweigh costs. Reciprocal altruism involves providing help to another and being repaid later. Co-operators leave more offspring.	

National Course Specification: course details (cont)

Unit: Animal Behaviour (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
iii Social organisation.	Social organisation in primates. Establishment of social hierarchy by threat and display. Dominance hierarchy as system of social ranking. Rank determines access to food, shelter and mates. Social interaction, communication and behaviour of dominant individuals and subordinates. Grooming to reinforce close relationships, and lower dominance threat. Sexual presentation as appeasement gesture. Benefits to group related to survival due to increased protection, co-operative hunting, and division of labour. Best adapted contribute more to gene pool.	Observe and discuss film material on social structure in primates.

Physiology, Health and Exercise (AH)

Introduction

The unit deals with the beneficial effects of exercise both on the general health of the individual and in the prevention or rehabilitation of individuals with certain disease conditions eg cardiovascular disease, obesity, non-insulin dependent diabetes and osteoporosis.

There is now world wide consensus that physical activity is protective against coronary heart disease and a low level of physical activity is an independent risk factor for coronary heart disease along with smoking, high blood pressure and high cholesterol levels. The unit reviews the physiology of the cardiovascular system and describes some aspects of the basic pathophysiology of heart disease. The role of exercise in the prevention of coronary heart disease is discussed. Some well established tests for aerobic fitness are described.

The concept of energy balance is also explored in relation to the increasing incidence of excess body fat and obesity in the UK. The need to measure body composition and some commonly used measurements of body fats are outlined. The importance of exercise and diet in the prevention and treatment of obesity are discussed as is the possible protective role of physical activity in osteoporosis and diabetes.

It would be an advantage if candidates undertaking this unit had a clear understanding of the topics covered in the unit: The Continuation of Life (H).

National Course Specification: course details (cont)

Unit: Physiology, Health and Exercise (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
a) Exercise and the cardiovascular system		
i Structure and function of the cardiovascular system (CVS).	Components of the CVS. Normal values for blood pressure, heart rate, stroke volume and cardiac output.	Measure resting heart rate and blood pressure.
ii Pathology of cardiovascular disease.	Pathophysiology of atherosclerosis, thrombosis, angina pectoris, myocardial infarction (heart attack), hypertension, stroke. Incidence in UK and other countries.	Examine league tables for coronary heart disease world wide. Examine trends in coronary heart disease over last 10 years. View and discuss video on cardiovascular disease.
iii Role of exercise in prevention and treatment of cardiovascular disease.		
Risk factors and prevention of cardiovascular disease.	Modifiable: diet, smoking, activity, obesity. Non-modifiable: age, gender, heredity, race.	
Effect of exercise on the CVS.	Effect on heart rate, systolic and diastolic blood pressure, cardiac output and recovery time. Distribution of blood to tissues during exercise.	Carry out an experiment to measure heart rate and blood pressure at three levels of exercise. Measure post-exercise recovery time. Carry out an experiment to calculate heart rate at rest and during exercise using ECGs.

National Course Specification: course details (cont)

Unit: Physiology, Health and Exercise (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
The 'athletic heart'.	Cardiac hypertrophy as a fundamental adaptation to increased workload imposed by exercise training. Endurance training increases left ventricle mass. A significantly larger stroke volume allows an endurance athlete to pump more blood from the heart than an untrained individual. Improves maximal heart rate and cardiac output. Reduces heart rate at rest and recovery time.	
The protective effects of exercise.	Improving myocardial circulation to protect heart from lack of oxygen; enhancing contractile properties of myocardium; improving blood lipid profile ie increasing High Density Lipoproteins (HDLs) and decreasing Low Density Lipoproteins (LDLs); lowering heart rate and blood pressure so that work of heart is reduced at rest and during exercise; decreasing body fat.	Obtain and present information on the effects of exercise on the cardiovascular system.
Principles of exercise testing.	Use of maximal and sub-maximal tests. Maximal oxygen uptake ($VO_{2\ max}$) as a measure of the maximum amount of oxygen that a person can use which is used to measure fitness. Exercise stress testing and cardiac patient rehabilitation.	Perform simple exercise test eg step-test, shuttle-run.

National Course Specification: course details (cont)

Unit: Physiology, Health and Exercise (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
b) Exercise and metabolism		
i Energy. The need for energy.	Food energy from carbohydrates, lipids and proteins. Potential energy in food used to synthesise ATP. Energy measured in kilojoules (kJ).	Measure all food and drink for a day and calculate energy intake from tables.
Energy balance.	Energy balance should be considered as energy in –energy out = change in energy stores.	
Dietary recommendations for health.	Link between diet, coronary heart disease and obesity.	Compare diet with current recommendations.
Energy expenditure and its measurement.	Basal metabolic rate (BMR) and its measurement, physical activity, dietary-induced thermogenesis, factors affecting total energy expenditure to include: body size and composition, age, sex, nutritional status, pregnancy and lactation, activity and climate. Measurement: direct calorimetry, indirect calorimetry, heart rate recording.	Keep activity diary for a day and calculate energy output from published values. Compare energy expenditure during resting, walking, running and swimming from published data. Carry out an experiment to compare energy expenditure during walking and running using a pedometer.

National Course Specification: course details (cont)

Unit: Physiology, Health and Exercise (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
ii Body composition and weight control.		
Measurement of body composition.	Methods to include: densitometry, skinfold thicknesses, bioelectrical impedance analysis, body mass index (BMI), waist/hip ratio, mid-upper arm circumference. Limitations of methods.	Perform simple measurements of body composition.
Weight control and obesity.	Importance of differentiating between 'overweight' related to large muscle mass or bone mass and that due to excess fat. Problem of rising incidence of obesity in UK, possible causes of obesity, possible treatments of obesity.	Use case studies of subjects on weight-reducing regimens.
Effect of exercise on body composition and weight control.	The place of exercise in increased energy expenditure as part of weight-control programmes. Exercise increases energy output relative to input, increases fat loss, preserves lean tissue and helps prevent obesity. The effect of frequency, intensity, duration and type of exercise. The impact of exercise on body composition decreases as fat decreases.	Analyse data which illustrates the effect of exercise on body composition.

National Course Specification: course details (cont)

Unit: Physiology, Health and Exercise (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
iii Osteoporosis. Osteoporosis and bone growth.	Bone density increases from late adolescence and peaks at age 30 then decreases with age. Osteoporosis is caused by loss of minerals such as calcium from the bones, making them porous and brittle and liable to fracture. Affects men, women and children but is most common in post-menopausal women.	
Effect of exercise.	Regular weight-bearing exercise of moderate intensity can maintain bone mass and increase bone strength. Individuals who maintain physically active lifestyles have significantly greater bone mass than their counterparts. Women should maximise bone density before age related loss.	Examine data which illustrates the effects of exercise on osteoporosis.
iv Diabetes mellitus.	Role of insulin and glucagon.	
Control of blood glucose levels.	Role of pancreas. Effect of changes in blood glucose levels. Non-insulin dependent diabetes mellitus (NIDDM) is generally associated with obesity. Plasma insulin levels are normal but cells have become less sensitive to insulin, resulting in a reduced uptake of glucose into the cells. This is thought to be due to a decrease in the number of insulin receptors on the cell membrane.	

National Course Specification: course details (cont)

Unit: Physiology, Health and Exercise (Advanced Higher)

CONTENT	NOTES	LEARNING ACTIVITIES
Effect of exercise on diabetes mellitus.	Exercise improves uptake of glucose in subjects with NIDDM and this is thought to be due to an increase in the sensitivity of the receptors and an increase in the actual number of functionally active insulin receptors. Exercise increases blood flow to skeletal muscle and an increase in enzyme activity associated with glucose storage.	Discuss case studies on the effect of exercise on diabetes subjects.

National Course Specification: course details (cont)

COURSE Biology (Advanced Higher)

ASSESSMENT

To gain the award of the course, the candidate must pass all unit assessments as well as the external assessment. External assessment will provide the basis for grading attainment in the course award.

When units are taken as component parts of a course, candidates will have the opportunity to achieve at levels beyond that required to attain each of the unit outcomes. This attainment may, where appropriate, be recorded and used to contribute towards course estimates and to provide evidence for appeals. Additional details are provided where appropriate with the exemplar assessment materials. Further information on the key principles of assessment are provided in the paper *Assessment*, (HSDU, 1996) and in *Managing Assessment* (HSDU, 1998).

DETAILS OF THE INSTRUMENTS FOR EXTERNAL ASSESSMENT

The instruments of assessment will be an externally set examination of 2 hours 30 minutes duration and a completed investigation report.

The assessment of knowledge and understanding, problem solving and practical abilities is based on the course content described for the five units:

- Cell and Molecular Biology
- Environmental Biology
- Biotechnology
- Animal Behaviour
- Physiology, Health and Exercise

The content statements and the supplementary notes will be sampled in the course examination which will include familiar contexts as well as less familiar and more complex contexts than in the unit assessments. While there are no compulsory practicals for the purposes of external assessment, there will be questions set in the examination on practical work in contexts less familiar to candidates.

Examination

The examination will contribute 80% of the total marks. The paper will carry 100 marks in total and will consist of three sections:

Section A

This section will contain 25 multiple choice questions based on the two mandatory units. Of these 8-10 will test problem solving and/or practical abilities, the remainder will test knowledge and understanding. Section A will have an allocation of 25 marks. Candidates will be expected to answer all the questions.

Section B

This section will contain structured questions, data handling questions and extended response questions based on the two mandatory units with an allocation of 55 marks. Between 13-16 marks will test problem solving and/or practical abilities, the remainder will test knowledge and understanding. Candidates will be expected to answer all the questions.

National Course Specification: course details (cont)

COURSE Biology (Advanced Higher)

Section C

This section will contain structured questions, extended response questions and data handling questions based on each of the optional units with an allocation of 20 marks. Candidates will be expected to answer questions on one of the optional units. For each unit 4-6 marks will test problem solving and/or practical abilities, the remainder will test knowledge and understanding.

Investigation Report

The final investigation report will be worth 20% of the total marks. The investigation report will be based on the work carried out in the component unit, *Biology Investigation (AH)*.

A total of 25 marks will be allocated to the investigation report which should be around 2000-2500 words in length excluding contents page, tables, graphs etc.

The investigation report will be externally assessed using the following assessment categories:

(a)	Introduction	(4 marks)
(b)	Procedures	(6 marks)
(c)	Results	(5 marks)
(d)	Discussion	(7 marks)
(e)	Presentation	(3 marks)

It is expected that approximately 10 hours of the 'additional 40 hours' will be required for the candidate to complete the report for the course award.

Grade

The grade awarded for the course will depend on the marks obtained by the candidate (out of 125) for the examination and the investigation report. The certificate will record an award for overall attainment.

National Course Specification: course details (cont)

COURSE Biology (Advanced Higher)

GRADE DESCRIPTIONS

Grade description for C

Candidates at Grade C will have demonstrated success in achieving the component units of the course. In the course assessment candidates will generally have demonstrated the ability to:

- retain knowledge and skills over an extended period of time
- integrate knowledge and understanding, problem solving and practical abilities acquired across component units
- apply knowledge and understanding, problem solving and practical abilities in contexts similar to those in the component units
- select, analyse and present relevant information collected through experimental, observational or survey work in the investigation
- write in a scientific manner which reveals the biological significance of the subject chosen for the investigation.

Grade description for A

In addition candidates at Grade A will generally have demonstrated the ability to:

- retain an extensive range of knowledge and skills over an extended period of time
- integrate an extensive range of knowledge and understanding, problem solving and practical abilities acquired across component units
- apply knowledge and understanding, problem solving and practical abilities in contexts less familiar and more complex than in the component units
- show particular proficiency in selecting, analysing and presenting relevant information collected through experimental, observational or survey work in the investigation
- show particular proficiency in writing in a scientific manner which reveals the significance of the findings of the investigation by analysing and interpreting the results in a critical and scientific manner and demonstrating knowledge and understanding of the biological basis of the investigation.

Testing of the course outcomes

The following gives advice on how the course outcomes will be assessed.

Knowledge and understanding

Candidates should be tested on their ability to recall learning and understand facts and principles detailed in the content statements and supplementary notes in the content tables in the course specification.

National Course Specification: course details (cont)

COURSE Biology (Advanced Higher)

Problem solving and practical abilities

Questions relating to each of the following points may be included in the course examination in order to test the candidates' ability to:

1 Select relevant information from texts, tables, charts, keys, graphs and/or diagrams.
2 Present information appropriately in a variety of forms, including written summaries, extended writing, flow charts, keys, diagrams, tables and/or graphs.
3 Process information accurately using calculations where appropriate. Calculations to include percentages, averages and/or ratios. Significant figures, units and scientific notation should be used appropriately. A range of units will be used in accordance with IOB recommendations. Candidates will be expected to be able to convert between eg μg and mg.
4 Plan and design experimental procedures to test given hypotheses or to illustrate particular effects. This could include identification of variables, controls and measurements or observations required.
5 Evaluate experimental procedures in situations that are unfamiliar, by commenting on the purpose or approach, the suitability and effectiveness of procedures, the control of variables, the limitations of equipment, possible sources of error and/or suggestions for improvement.
6 Draw valid conclusions and give explanations supported by evidence or justification. Conclusions should include reference to the overall pattern to readings or observations, trends in results or comment on the connection between variables and controls.
7 Make predictions and generalisations based on available evidence.

Complexity of Data

The following advice is intended as general guidelines in setting the complexity of data to be used in problem solving questions.

At Advanced Higher typically three sources of data (text, tables, charts, keys, diagrams or graphs) should be provided from which the problem has to be solved. It is however recognised that extracting data from one source could be more demanding depending upon the nature of the data.

Where there are not three separate sources of data, the provided data should normally have three to four patterns, trends, conditions, variables or sets of results from which information has to be selected and presented, or which have to be used as sources of evidence for conclusions, explanations, predictions or generalisations. The analysis of data should involve comparisons between two or more of these sets of data. Presented data could require account to be taken of central tendencies and significant differences. Data could be presented with error bars.

The planning, designing and evaluation of experimental procedures should involve up to two of the following: one or two treatments, adequate controls, limitations of equipment, sources of error, and possible improvements as appropriate.

National Course Specification: course details (cont)

COURSE Biology (Advanced Higher)

DETAILS OF THE INSTRUMENTS FOR INTERNAL ASSESSMENT

Cell and Molecular Biology, Environmental Biology and the Optional Units

Outcomes 1 and 2

Outcomes 1 and 2 for each unit are assessed by a single holistic closed-book test with questions covering all the performance criteria for knowledge and understanding and problem solving. The ratio of the marks allocated to Outcomes 1 and 2 is 3:2.

Outcome 3

A report of one experimental activity is required covering all the performance criteria set out in the unit specifications.

Candidates are only required to produce one report for Outcome 3 which relates to the contents and notes specified for Advanced Higher Biology. This report can then be used as evidence for Outcome 3 in all other units of the course excluding the Biology Investigation Unit.

Biology Investigation Unit

Outcomes 1 and 2

Candidates are required to provide a record of their investigation covering all the performance criteria for Outcomes 1 and 2.

APPROACHES TO LEARNING AND TEACHING

Suggestions for appropriate learning activities are contained within the tables of course content. An investigative approach should be taken to the learning and teaching of biology. Such an approach not only draws heavily on experimental work, but should provide opportunities to develop individual and group research using a variety of resources alongside the more traditional approaches of whole class teaching.

Practical work should contain a balance of illustrative experimental work and investigative practical work. Practical work can provide one way of delivering theoretical knowledge related to knowledge and understanding performance criteria. Fieldwork can also provide an opportunity for practical work using first hand experience of an ecosystem to develop knowledge and understanding and problem solving. Practical investigations should be used to develop both problem solving and practical skills and not just to provide reports for the purposes of internal assessment. For example, investigative work provides opportunities to develop the skills required by the problem solving performance criteria of planning and designing an investigation and presents opportunities to make predictions and generalisations which can then be tested in practical contexts.

Laboratory practical work should include the use of instrumentation and equipment that reflects current scientific use. Opportunities should be taken to capture data through computer interfacing, data loggers or videos. Such data may then be analysed by information technology (IT) or used for control technology.

National Course Specification: course details (cont)

COURSE Biology (Advanced Higher)

Where appropriate, arrangements should be made to ensure that there are no artificial barriers to learning and assessment. The nature of the candidate's should be taken into account when planning learning experiences and selecting assessment instruments. Alternative arrangements can be made where necessary.

Use of the additional 40 hours

This time should be distributed throughout the duration of the course. It should be used:

- to provide an introduction to the course and assessment methods
- to allow more practical work to be undertaken by the candidates
- for support in particular aspects of work in which candidates require to be re-assessed
- for consolidation and integration of learning
- to practice applying knowledge and understanding, problem solving and practical abilities in contexts more complex than in the units
- to complete the investigation report (10 hours)
- to complete Outcome 3 reports.

SPECIAL NEEDS

This course specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September 2003).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Cell and Molecular Biology (Advanced Higher)

NUMBER D032 13

COURSE Biology (Advanced Higher)

SUMMARY

This unit provides the opportunity to develop knowledge and understanding, problem solving and practical abilities in the context of the structure, function and growth of prokaryotic and eukaryotic cells, structure and function of cell components, molecular interactions in cell events and applications of DNA technology. This is a component unit of Advanced Higher Biology.

OUTCOMES

1 Demonstrate knowledge and understanding related to cell and molecular biology.
2 Solve problems related to cell and molecular biology.
3 Collect and analyse information related to Advanced Higher Biology obtained by experiment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained Higher Biology or Higher Human Biology. In particular, candidates should have a clear understanding of the topics covered in the units: Cell Biology (H) or Cell Function and Inheritance (H).

CREDIT VALUE

1 credit at Advanced Higher.

Administrative Information

Superclass: RH

Publication date: June 2002

Source: Scottish Qualifications Authority

Version: 04

National Unit Specification: general information (cont)

UNIT Cell and Molecular Biology (Advanced Higher)

CORE SKILLS

Core skills for this qualification remain subject to confirmation and details will be available at a later date.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Cell and Molecular Biology (Advanced Higher)

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Demonstrate knowledge and understanding related to cell and molecular biology.

Performance criteria

(a) Prokaryotic and eukaryotic cells are described correctly in relation to their structure, function and growth.
(b) Cell components are described correctly in relation to their structure and function.
(c) Cell events are described correctly in relation to their molecular interactions.
(d) DNA technology is described correctly in relation to its applications.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria.

OUTCOME 2

Solve problems related to cell and molecular biology.

Performance criteria

(a) Relevant information is selected and presented in an appropriate format.
(b) Information is accurately processed using calculations where appropriate.
(c) Conclusions drawn are valid and explanations given are supported by evidence.
(d) Experimental procedures are planned, designed and evaluated appropriately.
(e) Predictions and generalisations made are based on available evidence.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria with problems in the context of the structure, function and growth of prokaryotic and eukaryotic cells, structure and function of cell components, molecular interactions in cell events or applications of DNA technology.

National Unit Specification: statement of standards (cont)

UNIT Cell and Molecular Biology (Advanced Higher)

OUTCOME 3

Collect and analyse information related to Advanced Higher Biology obtained by experiment.

Performance criteria

(a) The information is collected by active participation in the experiment.
(b) The experimental procedures are described accurately.
(c) Relevant measurements and observations are recorded in an appropriate format.
(d) Recorded experimental information is analysed and presented in an appropriate format.
(e) Conclusions drawn are valid.
(f) The experimental procedures are evaluated with supporting argument.

Evidence requirements

A report of one experimental activity is required, covering the above performance criteria and related to the contents and notes specified for Advanced Higher Biology.

The teacher/lecturer responsible must attest that the report is the individual work of the candidate derived from active participation in an experiment involving the candidate in planning the experiment; deciding how it is managed; identifying and obtaining the necessary resources, some of which must be unfamiliar; and carrying out the experiment. Depending on the activity, the collection of the information may be group work.

Evidence submitted in support of attainment of PC(d) must be in the format of a table or graph(s) as appropriate. Conclusions drawn should be justified by reference to supporting evidence.

The evaluation should cover all stages of the experiment, including the initial analysis of the situation and planning and organising the experimental procedure.

National Unit Specification: support notes

UNIT Cell and Molecular Biology (Advanced Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

Outcome 1

a) ***Structure, function and growth of prokaryotic and eukaryotic cells***

i Comparison of features and ultrastructure of prokaryotic and eukaryotic cells.
ii Cell growth and the cell cycle.
Interphase: G1, S and G2 phases (G: growth, S: synthesis).
Mitosis: the M phase
Control of the cell cycle
Abnormal cell division: cancer cells.
iii Differentiation of cells into tissues and organs.
iv Cell and tissue culture.
Mammalian cell culture.
Bacterial and fungal cultures.
v Plant tissue culture.

b) ***Structure and function of cell components***

i Carbohydrates.
Structure of the monomer glucose.
Dehydration (condensation) to form 1-4 linkages between alpha and beta forms.
Polysaccharide structure.
Functions of carbohydrates: role in energy budget, storage, cell structures.
ii Lipids.
Structure of glycerol, saturated and unsaturated fatty acids.
Dehydration (condensation) of glycerol and fatty acids to form ester linkages in fats.
Triglyceride and phospholipid structure.
Structure of steroids.
Functions of lipids: structural, storage, hormones.
iii Proteins.
Structure of amino acids.
Dehydration (condensation) synthesis and peptide bonds.
Primary, secondary, tertiary and quaternary structure.
Functions of proteins. Examples to include catalytic, structural, messenger, carriers.
iv Nucleic acids.
Structure of DNA and RNA.
Functions of the enzymes polymerase and ligase.
v Membranes.
Membrane composition and organisation.
Types of membrane proteins.
Functions of membrane proteins.

vi Cytoskeleton.
Composed of fibres as illustrated by microtubules.
Function.

c) ***Molecular interactions in cell events***

i Catalysis.
Specificity of enzyme activity related to induced fit.
Control of enzyme activity by competitive and non-competitive inhibitors, enzyme modulators and covalent modifications.
Role of end-product inhibition in the control of metabolic pathways.
ii The sodium-potassium pump (a specific case of active transport).
iii Cell signalling.
Extracellular hydrophobic signalling molecules.
Extracellular hydrophilic signalling molecules.

d) ***Applications of DNA technology***

i The Human Genome Project.
Genetic linkage mapping.
Location of genetic markers to allow testing of genetic linkage to known markers.
Physical mapping.
Determination of order of genes on each chromosome.
DNA Sequencing.
Determining the order of nucleotide pairs of each chromosome.
Analysing the genomes of other species.
Comparison of the human genome with other species reveals remarkable similarities.
ii Human therapeutics.
Detecting genetic disorders.
Gene therapy: the replacement of a faulty gene with a normal gene; the insertion of an extra gene with the intention that the gene product will play a therapeutic role.
iii Forensic uses.
iv Agriculture.
Transgenic plants.
Production of bovine somatotrophin (BST) by genetic engineering and its use in cattle.

Further detail is given in the supplementary notes in the course content section of the course specification.

Outcome 2

Examples of learning activities which provide suitable contexts for the development of problem solving skills include:

- calculate mitotic index in onion root tips from photomicrographs
- design and carry out an investigation into the effects of competitive and non competitive inhibition on enzyme activity
- use computer simulation for DNA sequencing
- analyse data from gene therapy trials.

Outcome 3

Suitable experiments in the context of this unit include:

- carry out an experiment to determine the percentage glucose in prepared solutions
- carry out an experiment to compare the reaction of iodine with starch, cellulose and glycogen
- carry out an experiment to compare the solubility of lipids in a variety of solvents
- carry out an experiment to determine the isoelectric point of a protein
- design and carry out an investigation into the effects of competitive and non competitive inhibition on enzyme activity
- carry out an experiment to demonstrate gel electrophoresis of DNA treated with restriction enzymes.

Candidates or centres could devise other appropriate experiments in the context of structure, function and growth of prokaryotic and eukaryotic cells, structure and function of cell components, molecular interactions in cell events or applications of DNA technology.

The experiments chosen should allow all the performance criteria for this outcome to be achieved within any single report.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Details of suitable approaches are provided in the course specification.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

It is recommended that a holistic approach is taken to assessment, eg Outcomes 1 and 2 could be assessed by an integrated end of unit test with questions covering all the performance criteria for knowledge and understanding and problem solving. Opportunities to generate evidence of attainment of Outcome 3 will arise during practical work related to the suggested learning activities.

Outcome 2

Test items should be constructed to allow candidates to generate evidence relating to the performance criteria as follows:

a) Selecting and presenting information:

- sources of information to include: texts, tables, charts, graphs and diagrams
- formats of presentation to include: written summaries, extended writing, tables and graphs.

b) Calculations to include: percentages, averages, ratios. Significant figures and units should be used appropriately.

c) Conclusions drawn should include some justification.

d) Candidates could plan and design procedures to test given hypotheses or to illustrate particular effects. This could include identification of variables, controls and measurements or observations required. The evaluation of given experimental procedures may include situations which are unfamiliar to candidates and could test the candidate's ability to comment on the purpose of approach or the suitability of given experimental procedures. Candidates could comment on the limitations of the set-up, apparatus, suggested measurements or observations, limitations of equipment, appropriateness of controls, sources of error and possible improvements.

e) Candidates could make predictions and generalisations from given experimental results or, given situations, predict what the results might be.

Outcome 3

Type of experimental activity

The teacher/lecturer should ensure that the experimental activity to be undertaken in connection with Outcome 3 affords opportunity for the candidate to demonstrate the ability to undertake the planning and organising of an experimental activity at an appropriate level of demand. The activity must relate to the Course content and candidates should be made aware of the range of skills which must be demonstrated to ensure attainment of Outcome 3.

Assessment of Outcome 3

Candidates are only required to produce one report for Outcome 3 in relation to the contents and notes specified for Advanced Higher Biology. This report can then be used as evidence for Outcome 3 for any of the other units in the course, excluding the Biology Investigation Unit.

In relation to PC (a), the teacher/lecturer checks by observation that the candidate participates in the collection of experimental information by playing an active part in planning the experiment, deciding how it will be managed, identifying and obtaining resources (some of which must be unfamiliar to the candidate), carrying out the experiment, and evaluating all stages of the experiment, including the initial analysis of the situation, and planning and organising the experimental procedures.

National Unit Specification: support notes (cont)

UNIT Cell and Molecular Biology (Advanced Higher)

Candidates should provide a report with an appropriate title. The report should relate to the performance criteria as follows:

(b)	The experimental procedures are described accurately.	A clear statement of the aim of the experiment. A few brief concise sentences including as appropriate: • a labelled diagram or brief description of apparatus or instruments used • how the independent variable was altered • control measure used • how measurements were taken or observations made There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the performance criteria.
(c)	Relevant measurements and observations are recorded in an appropriate format.	Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/readings entered correctly.
(d)	Recorded experimental information is analysed and presented in an appropriate format.	Data should be analysed and presented in a tabular, graphical format or scatter diagram or equivalent, as appropriate: • for tabular presentation this may be an extension of the table used for PC (c) above, and must include: suitable heading and units showing averages or other appropriate computations • for graphical presentation this must include: data presented as a histogram, bar chart, connected points or line of best fit as appropriate, with suitable scales and axes labelled with variable and units and with data correctly plotted
(e)	Conclusions drawn are valid.	Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included: • overall pattern to readings or observations (raw data) • trends in analysed information or results • connection between variables and controls
(f)	The experimental procedures are evaluated with supporting argument.	The evaluation could cover all stages of the activity including preparing for the activity, analysis of the activity and the results of the activity. The evaluation must include a supporting argument in at least one of the following: • effectiveness of procedures • control of variables • limitations of the equipment • possible sources of error • possible improvements

National Unit Specification: support notes (cont)

UNIT Cell and Molecular Biology (Advanced Higher)

The bullet points under each performance criterion give an indication of what should be addressed to achieve a pass. The relevance of the bullet points will vary according to the experiment. These bullet points are intended as helpful guidance. The decision of pass or fail is to be made by the professional judgement of the presenting centre (subject to moderation) against the performance criteria. It is appropriate to support candidates in producing a report to meet the performance criteria. Re-drafting of a report after necessary supportive criticism is to be encouraged both as part of the learning and teaching process and to produce evidence for assessment. Redrafting and resubmission is only required for the specific performance criterion identified in need of further attention ie the entire report does not need to be rewritten.

Conditions required to complete the reports

Candidates may complete their reports outwith class time provided reasonable measures are taken to ensure that the report is the individual work of the candidate.

Teachers and lecturers may wish candidates to write up reports under their direct supervision so that they can provide appropriate advice and support. However, they may feel confident that any redrafting required need not be undertaken under such close supervision as it will be evident in the candidate's response that it is his or her unaided work. Under such circumstances it would be acceptable for such redrafting to take place outwith class time.

Use of IT

Candidates may, if they wish, present their reports in a word-processed format. Candidates may use Excel (or any other suitable data analysis software) when tackling Outcome 3. However, candidates must not be given a spreadsheet with pre-prepared column headings nor formulae, as they are being assessed on their ability to enter quantities and units into a table and to make decisions about appropriate scales and labels on graph axes. Excel may be used to analyse large amounts of experimental data and to plot error bars charts. The use of clip art or images captured by digital camera may also be used in recording details of experimental methods.

Transfer of evidence

Candidates, who are repeating a course, may carry forward evidence of an appropriate standard, generated in a previous year.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September 2003).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Environmental Biology (Advanced Higher)

NUMBER D033 13

COURSE Biology (Advanced Higher)

SUMMARY

This unit provides the opportunity to develop knowledge and understanding, problem solving and practical abilities in the context of circulation in ecosystems, interactions in ecosystems and the impact of the human species on the environment. This is a component unit of Advanced Higher Biology.

OUTCOMES

1 Demonstrate knowledge and understanding related to environmental biology.
2 Solve problems related to environmental biology.
3 Collect and analyse information related to Advanced Higher Biology obtained by experiment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained Higher Biology or Higher Human Biology. In particular, candidates should have a clear understanding of the topics covered in the units: Genetics and Adaptation (H) and Control and Regulation (H), or Behaviour, Populations and the Environment (H).

CREDIT VALUE

1 credit at Advanced Higher.

Administrative Information

Superclass: RH

Publication date: June 2002

Source: Scottish Qualifications Authority

Version: 03

National Unit Specification: general information (cont)

UNIT Environmental Biology (Advanced Higher)

CORE SKILLS

Core skills for this qualification remain subject to confirmation and details will be available at a later date.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Environmental Biology (Advanced Higher)

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Demonstrate knowledge and understanding related to environmental biology.

Performance criteria

(a) Circulation in ecosystems is explained correctly in terms of energy and circulation of nutrients.
(b) Interactions in ecosystems are explained correctly in terms of biotic interactions, symbiotic relationships and the costs, benefits and consequences of interactions.
(c) Human impact on the environment is described correctly in relation to changes to ecosystems.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria.

OUTCOME 2

Solve problems related to environmental biology.

Performance criteria

(a) Relevant information is selected and presented in an appropriate format.
(b) Information is accurately processed using calculations where appropriate.
(c) Conclusions drawn are valid and explanations given are supported by evidence.
(d) Experimental procedures are planned, designed and evaluated appropriately.
(e) Predictions and generalisations made are based on available evidence.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria with problems in the context of circulation in ecosystems, interactions in ecosystems or human impact on the environment.

National Unit Specification: statement of standards (cont)

UNIT Environmental Biology (Advanced Higher)

OUTCOME 3

Collect and analyse information related to Advanced Higher Biology obtained by experiment.

Performance criteria

(a) The information is collected by active participation in the experiment.
(b) The experimental procedures are described accurately.
(c) Relevant measurements and observations are recorded in an appropriate format.
(d) Recorded experimental information is analysed and presented in an appropriate format.
(e) Conclusions drawn are valid.
(f) The experimental procedures are evaluated with supporting argument.

Evidence requirements

A report of one experimental activity is required, covering the above performance criteria and related to the contexts and notes specified for Advanced Higher Biology.

The teacher/lecturer responsible must attest that the report is the individual work of the candidate derived from active participation in an experiment involving the candidate in planning the experiment; deciding how it is managed; identifying and obtaining the necessary resources, some of which must be unfamiliar; and carrying out the experiment. Depending on the activity, the collection of the information may be group work.

Evidence submitted in support of attainment of PC(d) must be in the format of a table or graph(s) as appropriate. Conclusions drawn should be justified by reference to supporting evidence.

The evaluation should cover all stages of the experiment, including the initial analysis of the situation and planning and organising the experimental procedure.

National Unit Specification: support notes

UNIT Environmental Biology (Advanced Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

Outcome 1

a) ***Circulation in ecosystems***

1 Energy
- i Energy fixation.
- ii Energy flow.

2 Circulation of nutrients
- i Decomposition.
- ii Nutrient cycling.
- iii The nitrogen cycle
- iv The phosphorus cycle

b) ***Interactions in ecosystems***

1 Biotic interactions
- i Predation.
- ii Grazing.
- iii Competition.

2 Symbiotic relationships
- i Parasitism.
- ii Commensalism.
- iii Mutualism.

3 The costs, benefits and consequences of interactions
- i Interaction between species
- ii Interactions with the environment.

c) ***Human impact on the environment***

Changes to ecosystems:
- i Changes in complexity.
- ii Effects of intensive food production.
- iii Effects of increased energy production.
- iv Pollution.

Further detail is given in the supplementary notes in the course content section of the course specification.

Outcome 2

Examples of learning activities which provide suitable contexts for the development of problem solving skills include:

- analyse data on predator/prey population cycles
- analyse data on colonisation of rocks by barnacle species
- analyse information on the effects of exotic species, eg *Rhododendron ponticum*, mink, New Zealand platyhelminth
- analyse data on species interaction in coral reefs
- design and carry out an investigation on the activity of woodlice that have been held in wet and dry environments
- design and carry out an investigation on wilting in plants
- examine life table data and survivorship curves
- design and carry out an investigation into invertebrate activity at different temperature regimes
- analyse data on salinity control in estaurine species
- examine data on biological magnification of DDT and mercury in food chains

Outcome 3

Suitable experiments in the context of this unit include:

- investigate the respiratory activity of soils
- assay cellulase activity in different soils
- investigate the species diversity in mowed and unmowed swards or grazed and ungrazed swards
- investigate the effect of relative humidity on the development of *Botrytis* infection in plants
- investigate the influence of selective herbicides on grasses and broad-leaved species
- investigate the activity of woodlice that have been held in wet and dry environments
- compare samples of invertebrate life from field and hedgerow
- use indicator species to determine levels of pollution

Candidates or centres could devise other appropriate experiments in the context of circulation in ecosystems, interactions in ecosystems or human impact on the environment.

The experiments chosen should allow all the performance criteria for this outcome to be achieved within any single report.

National Unit Specification: support notes (cont)

UNIT Environmental Biology (Advanced Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Details of suitable approaches are provided in the course specification.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

It is recommended that a holistic approach is taken to assessment, eg Outcomes 1 and 2 could be assessed by an integrated end of unit test with questions covering all the performance criteria for knowledge and understanding and problem solving. Opportunities to generate evidence of attainment of Outcome 3 will arise during practical work related to the suggested learning activities.

Outcome 2

Type of experimental activity

Test items should be constructed to allow candidates to generate evidence relating to the performance criteria as follows:

a) Selecting and presenting information:
- sources of information include: text, tables, charts, graphs and diagrams
- formats of presentation to include: written summaries, extended writing, tables and graphs.

b) Calculations to include: percentages, averages, ratios. Significant figures and units should be used appropriately.

c) Conclusions drawn should include some justification.

d) Candidates could plan and design procedures to test given hypotheses or to illustrate particular effects. This could include identification of variables, controls and measurements or observations required. The evaluation of given experimental procedures may include situations which are unfamiliar to candidates and could test the candidate's ability to comment on the purpose of approach or the suitability of given experimental procedures. Candidates could comment on the limitations of the set-up, apparatus, suggested measurements or observations, limitations of equipment, appropriateness of controls, sources of error and possible improvements.

e) Candidates could make predictions and generalisations from given experimental results or, given situations, predict what the results might be.

National Unit Specification: support notes (cont)

UNIT Environmental Biology (Advanced Higher)

Outcome 3

Type of experimental activity

The teacher/lecturer should ensure that the experimental activity to be undertaken in connection with Outcome 3 affords opportunity for the candidate to demonstrate the ability to undertake the planning and organising of an experimental activity at an appropriate level of demand. The activity must relate to the Course content and candidates should be made aware of the range of skills which must be demonstrated to ensure attainment of Outcome 3.

Assessment of Outcome 3
Candidates are only required to produce one report for Outcome 3 in relation to the contents and notes specified for Advanced Higher Biology. This report can then be used as evidence for Outcome 3 for any of the other units in the course, excluding the Biology Investigation unit.

In relation to PC (a), the teacher/lecturer checks by observation that the candidate participates in the collection of the experimental information by playing an active part in planning the experiment, deciding how it will be managed, identifying and obtaining resources (some of which must be unfamiliar to the candidate), carrying out the experiment, and evaluating all stages of the experiment, including the initial analysis of the situation, and planning and organising the experimental procedures.

National Unit Specification: support notes (cont)

UNIT Environmental Biology (Advanced Higher)

Candidates should provide a report with an appropriate title. The report should relate to the performance criteria as follows:

(b)	The experimental procedures are described accurately.	A clear statement of the aim of the experiment. A few brief concise sentences including as appropriate: • a labelled diagram or brief description of apparatus or instruments used • how the independent variable was altered • control measure used • how measurements were taken or observations made There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the performance criteria.
(c)	Relevant measurements and observations are recorded in an appropriate format.	Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/readings entered correctly.
(d)	Recorded experimental information is analysed and presented in an appropriate format.	Data should be analysed and presented in a tabular, graphical format or as a scatter diagram or equivalent, as appropriate: • for a tabular presentation this may be an extension of the table used for PC (c) above, and must include: suitable heading and units showing averages or other appropriate computations • for a graphical presentation this must include: data presented as a histogram, bar chart, connected points or line of best fit as appropriate, with suitable scales and axes labelled with variable and units and with data correctly plotted
(e)	Conclusions drawn are valid.	Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included: • overall pattern to readings or observations (raw data) • trends in analysed information or results • connection between variables and controls
(f)	The experimental procedures are evaluated with supporting argument.	The evaluation could cover all stages of the activity including preparing for the activity, analysis of the activity and the results of the activity. The evaluation must include a supporting argument in at least one of the following: • effectiveness of procedures • control of variables • limitations of equipment • possible sources of error • possible improvements

National Unit Specification: support notes (cont)

UNIT Environmental Biology (Advanced Higher)

The bullet points under each performance criterion give an indication of what should be addressed to achieve a pass. The relevance of the bullet points will vary according to the experiment. These bullet points are intended as helpful guidance. The decision of pass or fail is to be made by the professional judgement of the presenting centre (subject to moderation) against the performance criteria. It is appropriate to support candidates in producing a report to meet the performance criteria. Re-drafting of a report after necessary supportive criticism is to be encouraged both as part of the learning and teaching process and to produce evidence for assessment. Redrafting and resubmission is only required for the specific performance criterion identified in need of further attention ie the entire report does not need to be rewritten.

Conditions required to complete the report

Candidates may complete their reports outwith class time provided reasonable measures are taken to ensure that the report is the individual work of the candidate.

Teachers and lecturers may wish candidates to write up reports under their direct supervision so that they can provide appropriate advice and support. However, they may feel confident that any redrafting required need not be undertaken under such close supervision as it will be evident in the candidate's response that it is his or her unaided work. Under such circumstances it would be acceptable for such redrafting to take place outwith class time.

Use of IT

Candidates may, if they wish, present their reports in a word-processed format. Candidates may use Excel (or any other suitable data analysis software) when tackling Outcome 3. However, candidates must not be given a spreadsheet with pre-prepared column headings nor formulae, as they are being assessed on their ability to enter quantities and units into a table and make decisions about appropriate scales and labels on graph axes. Excel may be used to analyse large amounts of experimental data and to plot error bars charts. The use of clip art or images captured by digital camera may also be used in recording details of experimental methods.

Transfer of evidence

Candidates, who are repeating a course, may carry forward evidence of an appropriate standard, generated in a previous year.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September 2003).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Biology Investigation (Advanced Higher)

NUMBER D034 13

COURSE Biology (Advanced Higher)

SUMMARY

This unit is designed to provide opportunities to further develop investigative skills through the completion of an investigation. It also provides the opportunity for self motivation and organisation. This is a component unit of Advanced Higher Biology.

OUTCOMES

1 Develop a plan for an investigation.
2 Collect and analyse information obtained from the investigation.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, the candidate would normally be expected to have attained Higher Biology or Higher Human Biology.

CREDIT VALUE

0.5 credit at Advanced Higher.

Administrative Information

Superclass: RH

Publication date: June 2002

Source: Scottish Qualifications Authority

Version: 03

National Unit Specification: general information (cont)

UNIT Biology Investigation (Advanced Higher)

CORE SKILLS

Core skills for this qualification remain subject to confirmation and details will be available at a later date.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Biology Investigation (Advanced Higher)

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

Note on range for the unit

The biology associated with the investigation must be at a standard commensurate with Advanced Higher Biology level.

OUTCOME 1

Develop a plan for an investigation.

Performance criteria

(a) A record is maintained in a regular manner.
(b) The aims of the investigation are clearly stated.
(c) Hypothesis or questions relevant to the aims of the investigation are formulated.
(d) Experimental, observational and sampling procedures, techniques and apparatus devised are appropriate for the investigation.
(e) The need for controls and replicate treatments or survey samples is considered.
(f) Relevant problems associated with the use of living materials or natural habitats are considered.

Evidence requirements

A record giving brief summaries to indicate the planning stage. Ideas rejected and important contributions made by the teacher/lecturer or other individuals should be included.

OUTCOME 2

Collect and analyse information obtained from the investigation.

Performance criteria

(a) The collection of the experimental information is carried out with due accuracy.
(b) Relevant measurements and observations are recorded in an appropriate format.
(c) Recorded experimental information is analysed and presented in an appropriate format.

Evidence requirements

A record of the collection and analysis of the information, both of which must be the individual work of the candidate.

National Unit Specification: support notes

UNIT Biology Investigation (Advanced Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

The investigation may relate to the planning, collection and analysis of information through experimental, observational or survey work. Candidates can select any suitable topic for investigation provided the biology is at an appropriate level of demand. The topic chosen may be outwith the biology covered in the other units of the Advanced Higher Biology course. Care should be taken that the investigation is sufficiently biological and not a purely technical exercise in, for example, statistics or computing.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Project work is most successful where candidates choose investigations which match personal interests or career intentions. Motivation is often lost where projects are repeated over a number of years or are chosen from a narrow range of content. The candidate should be allowed to consider a variety of approaches. Independent organisation of both time and resources should be encouraged.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Outcome 1

Candidates should provide a completed record with:

- regular entries during the investigation
- notes/comments on ideas rejected
- notes/comments on planning and design
- contributions made by other individuals
- notes/comments on selection of method used.

Outcome 2

Related to performance criteria a. the teacher/lecturer/lecturer checks by observation that the collection of information:

- is the individual work of the candidate
- has been obtained with due accuracy.

Candidates should provide a record of experimental information obtained during the investigation which relates to the performance criteria detailed overleaf.

b) Readings or observation should be recorded in a clear table with: correct headings, appropriate units, readings/observations entered correctly.

c) Data should be analysed and presented in a tabular, graphical format or as a scatter diagram or equivalent, as appropriate:

- for a tabular presentation this may be an extension of the table used for PC (b) above, and must include: suitable headings and units showing averages or other appropriate computations
- for a graphical presentation this must include: data presented as a histogram, bar chart, connected points or line of best fit as appropriate, with suitable scales and axes labelled with variable and units and with data correctly plotted.

The bullet points under each performance criterion give an indication of what should be addressed to achieve a pass. The relevance of the bullet points will vary according to the investigation. These bullet points are intended as helpful guidance. The decision of pass or fail is to be made by the professional judgement of the presenting centre (subject to moderation) against the performance criteria. It is appropriate to give limited support to candidates to meet the performance criteria. The extent of the support should be briefly documented by the candidate in their record.

Candidates may, if they wish, present their records in a word-processed format. Candidates may use Excel (or any other suitable data analysis software) when tackling Outcome 3. However, candidates must not be given a spreadsheet with pre-prepared column headings nor formulae, as they are being assessed on their ability to enter quantities and units into a table. At Advanced Higher, Excel may be used to analyse large amounts of experimental data and to plot error bars charts. The use of clip art or images captured by digital camera may also be used in recording details of experimental methods.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September 2003).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Biotechnology (Advanced Higher)

NUMBER D035 13

COURSE Biology (Advanced Higher)

SUMMARY

This unit provides the opportunity to develop knowledge and understanding, problem solving and practical abilities in the context of biotechnological techniques and the applications of biotechnological processes. This is a component unit of Advanced Higher Biology.

OUTCOMES

1 Demonstrate knowledge and understanding related to biotechnology.
2 Solve problems related to biotechnology.
3 Collect and analyse information related to Advanced Higher Biology obtained by experiment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained Higher Biology or Higher Human Biology. In particular, candidates should have a clear understanding of the topics covered in the units: Cell Biology (H) or Cell Function and Inheritance (H).

CREDIT VALUE

0.5 credit at Advanced Higher.

Administrative Information

Superclass: RH

Publication date: June 2002

Source: Scottish Qualifications Authority

Version: 03

National Unit Specification: general information (cont)

UNIT Biotechnology (Advanced Higher)

CORE SKILLS

Core skills for this qualification remain subject to confirmation and details will be available at a later date.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Biotechnology (Advanced Higher)

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Demonstrate knowledge and understanding related to biotechnology.

Performance criteria

(a) Biotechnological techniques are described correctly with respect to the use of micro-organisms, the industrial production of enzymes and plant cell cultures.
(b) The applications of biotechnological processes are described correctly with respect to agriculture, the food industry and medicine.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria.

OUTCOME 2

Solve problems related to biotechnology.

Performance criteria

(a) Relevant information is selected and presented in an appropriate format.
(b) Information is accurately processed using calculations where appropriate.
(c) Conclusions drawn are valid and explanations given are supported by evidence.
(d) Experimental procedures are planned, designed and evaluated appropriately.
(e) Predictions and generalisations made are based on available evidence.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria with problems in the context of biotechnological techniques or the applications of biotechnological processes.

National Unit Specification: statement of standards (cont)

UNIT Biotechnology (Advanced Higher)

OUTCOME 3

Collect and analyse information related to Advanced Higher Biology obtained by experiment.

Performance criteria

(a) The information is collected by active participation in the experiment.
(b) The experimental procedures are described accurately.
(c) Relevant measurements and observations are recorded in an appropriate format.
(d) Recorded experimental information is analysed and presented in an appropriate format.
(e) Conclusions drawn are valid.
(f) The experimental procedures are evaluated with supporting argument.

Evidence requirements

A report of one experimental activity is required, covering the above performance criteria and related to the contents and notes specified for Advanced Higher Biology.

The teacher/lecturer responsible must attest that the report is the individual work of the candidate derived from active participation in an experiment involving the candidate in planning the experiment; deciding how it is managed; identifying and obtaining the necessary resources, some of which must be unfamiliar; and carrying out the experiment. Depending on the activity, the collection of the information may be group work.

Evidence submitted in support of attainment of PC(d) must be in the format of a table or graph(s) as appropriate. Conclusions drawn should be justified by reference to supporting evidence.

The evaluation should cover all stages of the experiment, including the initial analysis of the situation and planning and organising the experimental procedure.

National Unit Specification: support notes

UNIT Biotechnology (Advanced Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

Outcome 1

a) ***Biotechnological techniques***

1 Use of micro-organisms
- i Growing micro - organisms.
- ii Stages of growth.
- iii Diauxic growth.

2 Industrial production of enzymes
- Use of micro-organisms.
- Production of enzymes.
- Product recovery.

3 Tissue cultures
- i Animal cell culture
- ii Plant cell culture.

b) ***Applications of biotechnological processes***

1 Agriculture
- i Silage production.
- ii Enhancing nitrogen fixing.

2 Food industry
- i Fermented dairy products.
  - Traditional products
  - Novel products (probiotics).
- ii Yeast extracts.
- iii Fruit products.
  - Genetic modification of *flavr savr* tomato.

3 Medicines
- i Antibiotic production.
- ii Nature and production of monoclonal antibodies.
  - Use of monoclonal antibodies.

Further detail is given in the supplementary notes in the course content section of the course specification.

Outcome 2

Examples of learning activities which provide suitable contexts for the development of problem solving skills include:

- analyse flow charts showing industrial microbe growth and production
- analyse growth rate curves of microbes using substrates of lactose and glucose
- analyse flow charts showing methods of industrial enzyme production
- obtain and present information on the processes involved in the production of penicillin

Outcome 3

Suitable experiments in the context of this unit include:

- carry out an experiment to measure growth rates using haemocytometers, hydrometers or colorimeter
- carry out an experiment to demonstrate the effect of different substrates on the growth of *K. lactis*
- carry out an experiment to demonstrate the use of the lactase enzyme to convert milk products
- carry out an investigation into the effects of different rennet enzymes on cheese production
- carry out an experiment to test the viability of yeast at different stages of the yeast extraction process
- carry out an investigation into the production of fruit juice by different combinations of enzymes and treatments
- carry out an experiment to demonstrate the use of the Elisa technique to identify specific antigens

Candidates or centres could devise other appropriate experiments in the context of biotechnological techniques or the application of biotechnological processes.

The experiments chosen should allow all the performance criteria for this outcome to be achieved within any single report.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Details of suitable approaches are provided in the course specification.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

It is recommended that a holistic approach is taken to assessment, eg Outcomes 1 and 2 could be assessed by an integrated end of unit test with questions covering all the performance criteria for knowledge and understanding and problem solving. Opportunities to generate evidence of attainment of Outcome 3 will arise during practical work related to the suggested learning activities.

National Unit Specification: support notes (cont)

UNIT Biotechnology (Advanced Higher)

Outcome 2

Test items should be constructed to allow candidates to generate evidence relating to the performance criteria as follows:

a) Selecting and presenting information:

- sources of information to include: texts, tables, charts, graphs and diagrams
- formats of presentation to include: written summaries, extended writing, tables and graphs.

b) Calculations to include: percentages, averages, ratios. Significant figures and units should be used appropriately.

c) Conclusions drawn should include some justification.

d) Candidates could plan and design procedures to test given hypotheses or to illustrate particular effects. This could include identification of variables, controls and measurements or observations required. The evaluation of given experimental procedures may include situations which are unfamiliar to candidates and could test the candidate's ability to comment on the purpose of approach or the suitability of given experimental procedures. Candidates could comment on the limitations of the set-up, apparatus, suggested measurements or observations, limitations of equipment, appropriateness of controls, sources of error and possible improvements.

e) Candidates could make predictions and generalisations from given experimental results or, given situations, predict what the results might be.

Outcome 3

Type of experimental activity

The teacher/lecturer should ensure that the experimental activity to be undertaken in connection with Outcome 3 affords opportunity for the candidate to demonstrate the ability to undertake the planning and organising of an experimental activity at an appropriate level of demand. The activity must relate to the Course content and candidates should be made aware of the range of skills which must be demonstrated to ensure attainment of Outcome 3.

Assessment of Outcome 3

Candidates are only required to produce one report for Outcome 3 in relation to the contents and notes specified for Advanced Higher Biology. This report can then be used as evidence for Outcome 3 for any of the other units in the course, excluding the Biology Investigation unit.

In relation to PC (a), the teacher/lecturer checks by observation that the candidate participates in the collection of the experimental information by playing an active part in planning the experiment, deciding how it will be managed, identifying and obtaining resources (some of which must be unfamiliar to the candidate), carrying out the experiment, and evaluating all stages of the experiment, including the initial analysis of the situation, and planning and organising the experimental procedures.

National Unit Specification: support notes (cont)

UNIT Biotechnology (Advanced Higher)

Candidates should provide a report with an appropriate title. The report should relate to the performance criteria as follows:

(b)	The experimental procedures are described accurately.	A clear statement of the aim of the experiment. A few brief concise sentences including as appropriate: • a labelled diagram or brief description of apparatus or instruments used • how the independent variable was altered • control measure used • how measurements were taken or observations made There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the performance criteria.
(c)	Relevant measurements and observations are recorded in an appropriate format.	Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/readings entered correctly.
(d)	Recorded experimental information is analysed and presented in an appropriate format.	Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent, as appropriate: • for a tabular presentation this may be an extension of the table used for PC (c) above, and must include: suitable headings and units showing averages or other appropriate computations • for a graphical presentation this must include: data presented as a histogram, bar chart, connected points or line of best fit as appropriate, with suitable scales and axes labelled with variable and units and with data correctly plotted
(e)	Conclusions drawn are valid.	Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included: • overall pattern to readings or observations (raw data) • trends in analysed information or results • connection between variables and controls
(f)	The experimental procedures are evaluated with supporting argument.	The evaluation could cover all stages of the activity including preparing for the activity, analysis of the activity and the results of the activity. The evaluation must include a supporting argument in at least one of the following: • effectiveness of procedures • control of variables • limitations of equipment • possible sources of error • possible improvements

National Unit Specification: support notes (cont)

UNIT Biotechnology (Advanced Higher)

The bullet points under each performance criterion give an indication of what should be addressed to achieve a pass. The relevance of the bullet points will vary according to the experiment. These bullet points are intended as helpful guidance. The decision of pass or fail is to be made by the professional judgement of the presenting centre (subject to moderation) against the performance criteria. It is appropriate to support candidates in producing a report to meet the performance criteria. Re-drafting of a report after necessary supportive criticism is to be encouraged both as part of the learning and teaching process and to produce evidence for assessment. Redrafting and resubmission is only required for the specific performance criterion identified in need of further attention ie the entire report does not need to be rewritten.

Conditions required to complete the report

Candidates may complete their reports outwith class time provided reasonable measures are taken to ensure that the report is the individual work of the candidate.

Teachers and lecturers may wish candidates to write up reports under their direct supervision so that they can provide appropriate advice and support. However, they may feel confident that any redrafting required need not be undertaken under such close supervision as it will be evident in the candidate's response that it is his or her unaided work. Under such circumstances it would be acceptable for such redrafting to take place outwith class time.

Use of IT

Candidates may, if they wish, present their reports in a word-processed format. Candidates may use Excel (or any other suitable data analysis software) when tackling Outcome 3. However, candidates must not be given a spreadsheet with pre-prepared column headings nor formulae, as they are being assessed on their ability to enter quantities and units into a table and make decisions about appropriate scales and labels on graph axes. Excel may be used to analyse large amounts of experimental data and to plot error bars charts. The use of clip art or images captured by digital camera may also be used in recording details of experimental methods.

Transfer of evidence

Candidates, who are repeating a course, may carry forward evidence of an appropriate standard, generated in a previous year.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September 2003).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Animal Behaviour (Advanced Higher)

NUMBER D036 13

COURSE Biology (Advanced Higher)

SUMMARY

This unit provides the opportunity to develop knowledge and understanding, problem solving and practical abilities in the context of measuring behaviour, the development of behaviour and behavioural interactions. This is a component unit of Advanced Higher Biology.

OUTCOMES

1 Demonstrate knowledge and understanding related to animal behaviour.
2 Solve problems related to animal behaviour.
3 Collect and analyse information related to Advanced Higher Biology obtained by experiment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained Higher Biology or Higher Human Biology. In particular, candidates should have a clear understanding of the topics covered in the units: Genetics and Adaptation (H) and Control and Regulation (H), or Behaviour, Populations and the Environment (H).

CREDIT VALUE

0.5 credit at Advanced Higher.

Administrative Information

Superclass: RH

Publication date: June 2002

Source: Scottish Qualifications Authority

Version: 03

National Unit Specification: general information (cont)

UNIT Animal Behaviour (Advanced Higher)

CORE SKILLS

Core skills for this qualification remain subject to confirmation and details will be available at a later date.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Animal Behaviour (Advanced Higher)

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Demonstrate knowledge and understanding related to animal behaviour.

Performance criteria

(a) Measuring behaviour is described correctly in terms of observation and recording and interpretation of behaviour.
(b) The development of behaviour is explained correctly in terms of innate and learned behaviour and the evolution of behaviour.
(c) Behavioural interactions are described correctly in terms of feeding, sexual and social behaviour.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria.

OUTCOME 2

Solve problems related to animal behaviour.

Performance criteria

(a) Relevant information is selected and presented in an appropriate format.
(b) Information is accurately processed using calculations where appropriate.
(c) Conclusions drawn are valid and explanations given are supported by evidence.
(d) Experimental procedures are planned, designed and evaluated appropriately.
(e) Predictions and generalisations made are based on available evidence.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test or tests with items covering all the above performance criteria with problems in the context of measuring behaviour, the development of behaviour or behavioural interactions.

National Unit Specification: statement of standards (cont)

UNIT Animal Behaviour (Advanced Higher)

OUTCOME 3

Collect and analyse information related to Advanced Higher Biology obtained by experiment.

Performance criteria

(a) The information is collected by active participation in the experiment.
(b) The experimental procedures are described accurately.
(c) Relevant measurements and observations are recorded in an appropriate format.
(d) Recorded experimental information is analysed and presented in an appropriate format.
(e) Conclusions drawn are valid.
(f) The experimental procedures are evaluated with supporting argument.

Evidence requirements

A report of one experimental activity is required, covering the above performance criteria and related to the contents and notes specified for Advanced Higher Biology.

The teacher/lecturer responsible must attest that the report is the individual work of the candidate derived from active participation in an experiment involving the candidate in planning the experiment; deciding how it is managed; identifying and obtaining the necessary resources, some of which must be unfamiliar; and carrying out the experiment. Depending on the activity, the collection of the information may be group work.

Evidence submitted in support of attainment of PC(d) must be in the format of a table or graph(s) as appropriate. Conclusion drawn should be justified by reference to supporting evidence.

The evaluation should cover all stages of the experiment, including the initial analysis of the situation and planning and organising the experimental procedure.

National Unit Specification: support notes

UNIT Animal Behaviour (Advanced Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

Outcome 1

a) ***Measuring behaviour***

1 Observation of behaviour

2 Recording and interpretation of behaviour

- i Anthropomorphisms.
- ii Proximate and ultimate causes of behaviour.

b) ***Development of behaviour***

1 Innate and learned behaviour

- i The influence of parental care on learned behaviour.
- ii Imprinting.
- iii Sign stimuli and fixed action patterns.

2 Evolution of behaviour

- i Natural selection of behaviour patterns.
- ii Single gene effect on behaviour.
- iii Behavioural adaptation to human influence.

c) ***Behavioural interactions***

1 Feeding behaviour

- i Predation strategies.
- ii Foraging behaviour.
- iii Defence strategies.

2 Sexual behaviour

- i Male and female investment.
- ii Courtship and display.
- iii Avoidance of inbreeding.

3 Social behaviour

- i Agonistic and appeasement behaviour.
- ii Selfish and altruistic behaviour.
  - The concept of the ‘selfish’ gene.
  - Kin selection.
  - Altruism
- iii Social organisation.

Further detail is given in the supplementary notes in the course content section of the course specification.

National Unit Specification: support notes (cont)

UNIT Animal Behaviour (Advanced Higher)

Outcome 2

Examples of learning activities which provide suitable contexts for the development of problem solving skills include:

- construct ethograms for a variety of organisms
- study genetic data on 'hygienic' behaviour in bees
- record and present data on vigilance behaviour in birds.

Outcome 3

Suitable experiments in the context of this unit include:

- observe, record and interpret animal behaviour using a variety of methods
- carry out an investigation to compare maze running in small mammals
- carry out an investigation to compare corner seeking behaviour in small mammals
- carry out an investigation into foraging behaviour
- carry out an investigation into courtship and mate choice in *Drosophila.*

Candidates or centres could devise other appropriate experiments in the context of measuring behaviour, the development of behaviour or behavioural interactions.

The experiments chosen should allow all the performance criteria for this outcome to be achieved within any single report.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Details of suitable approaches are provided in the course specification.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

It is recommended that a holistic approach is taken to assessment, eg Outcomes 1 and 2 could be assessed by an integrated end of unit test with questions covering all the performance criteria for knowledge and understanding and problem solving. Opportunities to generate evidence of attainment of Outcome 3 will arise during practical work related to the suggested learning activities.

Outcome 2

Test items should be constructed to allow candidates to generate evidence relating to the performance criteria as follows:

a) Selecting and presenting information:

- sources of information to include: texts, tables, charts, graphs and diagrams
- formats of presentation to include: written summaries, extended writing, tables and graphs.

b) Calculations to include: percentages, averages, ratios. Significant figures and units should be used appropriately.

c) Conclusions drawn should include some justification.

d) Candidates could plan and design procedures to test given hypotheses or to illustrate particular effects. This could include identification of variables, controls and measurements or observations required. The evaluation of given experimental procedures may include situations which are unfamiliar to candidates and could test the candidate's ability to comment on the purpose of approach or the suitability of given experimental procedures. Candidates could comment on the limitations of the set-up, apparatus, suggested measurements or observations, limitations of equipment, appropriateness of controls, sources of error and possible improvements.

e) Candidates could make predictions and generalisations from given experimental results or, given situations, predict what the results might be.

Outcome 3

Type of experimental activity

The teacher/lecturer should ensure that the experimental activity to be undertaken in connection with Outcome 3 affords opportunity for the candidate to demonstrate the ability to undertake the planning and organising of an experimental activity at an appropriate level of demand. The activity must relate to the Course content and candidates should be made aware of the range of skills which must be demonstrated to ensure attainment of Outcome 3.

Assessment of Outcome 3

Candidates are only required to produce one report for Outcome 3 in relation to the contents and notes specified for Advanced Higher Biology. This report can then be used as evidence for Outcome 3 for any of the other units in the course, excluding the Biology Investigation unit.

In relation to PC (a), the teacher/lecturer checks by observation that the candidate participates in the collection of the experimental information by playing an active part in planning the experiment, deciding how it will be managed, identifying and obtaining resources (some of which must be unfamiliar to the candidate), carrying out the experiment, and evaluating all stages of the experiment, including the initial analysis of the situation, and planning and organising the experimental procedures.

National Unit Specification: support notes (cont)

UNIT Animal Behaviour (Advanced Higher)

Candidates should provide a report with an appropriate title. The report should relate to the performance criteria as follows:

(b)	The experimental procedures are described accurately.	A clear statement of the aim of the experiment. A few brief concise sentences including as appropriate: • a labelled diagram or brief description of apparatus or instruments used • how the independent variable was altered • control measure used • how measurements were taken or observations made There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the performance criteria.
(c)	Relevant measurements and observations are recorded in an appropriate format.	Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/readings entered correctly.
(d)	Recorded experimental information is analysed and presented in an appropriate format.	Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent, as appropriate: • for a tabular presentation this may be an extension of the table used for PC (c) above, and must include: suitable headings and units showing averages or other appropriate computations • for a graphical presentation this must include: data presented as a histogram, bar chart, connected points or line of best fit as appropriate, with suitable scales and axes labelled with variable and units and with data correctly plotted
(e)	Conclusions drawn are valid.	Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included: • overall pattern to readings or observations (raw data) • trends in analysed information or results • connection between variables and controls
(f)	The experimental procedures are evaluated with supporting argument.	The evaluation could cover all stages of the activity including preparing for the activity, analysis of the activity and the results of the activity. The evaluation must include a supporting argument in at least one of the following: • effectiveness of procedures • control of variables • limitations of the equipment • possible sources of error • possible improvements

National Unit Specification: support notes (cont)

UNIT Animal Behaviour (Advanced Higher)

The bullet points under each performance criterion give an indication of what should be addressed to achieve a pass. The relevance of the bullet points will vary according to the experiment. These bullet points are intended as helpful guidance. The decision of pass or fail is to be made by the professional judgement of the presenting centre (subject to moderation) against the performance criteria. It is appropriate to support candidates in producing a report to meet the performance criteria. Re-drafting of a report after necessary supportive criticism is to be encouraged both as part of the learning and teaching process and to produce evidence for assessment. Redrafting and resubmission is only required for the specific performance criterion identified in need of further attention ie the entire report does not need to be rewritten.

Conditions required to complete the report

Candidates may complete their reports outwith class time provided reasonable measures are taken to ensure that the report is the individual work of the candidate.

Teachers and lecturers may wish candidates to write reports under their direct supervision so that they can provide appropriate advice and support. However, they may feel confident that any redrafting required need not be undertaken under such close supervision as it will be evident in the candidate's response that it is his or her unaided work. Under such circumstances it would be acceptable for such redrafting to take place outwith class time.

Use of IT

Candidates may, if they wish, present their reports in a word-processed format. Candidates may use Excel (or any other suitable data analysis software) when tackling Outcome 3. However, candidates must not be given a spreadsheet with pre-prepared column headings nor formulae, as they are being assessed on their ability to enter quantities and units into a table and make decisions about appropriate scales and labels of graph axes. Excel may be used to analyse large amounts of experimental data and to plot bars charts. The use of clip art or images captured by digital camera may also be used in recording details of experimental methods.

Transfer of evidence

Candidates, who are repeating a course, may carry forward evidence for an appropriate standard, generated in a previous year.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September 2003).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Physiology, Health and Exercise (Advanced Higher)

NUMBER D037 13

COURSE Biology (Advanced Higher)

SUMMARY

This unit provides the opportunity to develop knowledge and understanding, problem solving and practical abilities in the context of exercise and the cardiovascular system and exercise and metabolism. This is a component unit of Advanced Higher Biology.

OUTCOMES

1 Demonstrate knowledge and understanding related to physiology, health and exercise.
2 Solve problems related to physiology, health and exercise.
3 Collect and analyse information related to Advanced Higher Biology obtained by experiment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained Higher Biology or Higher Human Biology. In particular, candidates should have a clear understanding of the topics covered in the unit: The Continuation of Life (H).

CREDIT VALUE

0.5 credit at Advanced Higher.

Administrative Information

Superclass: RH

Publication date: June 2002

Source: Scottish Qualifications Authority

Version: 03

National Unit Specification: general information (cont)

UNIT Physiology, Health and Exercise (Advanced Higher)

CORE SKILLS

Core skills for this qualification remain subject to confirmation and details will be available at a later date.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Physiology, Health and Exercise (Advanced Higher)

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Demonstrate knowledge and understanding related to physiology, health and exercise.

Performance criteria

(a) The effect of exercise is explained correctly in relation to the cardiovascular system.
(b) The effect of exercise is explained correctly in relation to metabolism.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria.

OUTCOME 2

Solve problems related to physiology, health and exercise.

Performance criteria

(a) Relevant information is selected and presented in an appropriate format.
(b) Information is accurately processed using calculations where appropriate.
(c) Conclusions drawn are valid and explanations given are supported by evidence.
(d) Experimental procedures are planned, designed and evaluated appropriately.
(e) Predictions and generalisations made are based on available evidence.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria with problems in the context of exercise and the cardiovascular system or exercise and metabolism.

National Unit Specification: statement of standards (cont)

UNIT Physiology, Health and Exercise (Advanced Higher)

OUTCOME 3

Collect and analyse information related to Advanced Higher Biology obtained by experiment.

Performance criteria

(a) The information is collected by active participation in the experiment.
(b) The experimental procedures are described accurately.
(c) Relevant measurements and observations are recorded in an appropriate format.
(d) Recorded experimental information is analysed and presented in an appropriate format.
(e) Conclusions drawn are valid.
(f) The experimental procedures are evaluated with supporting argument.

Evidence requirements

A report of one experimental activity is required, covering the above performance criteria and related to the contents and notes specified for Advanced Higher Biology.

The teacher/lecturer responsible must attest that the report is the individual work of the candidate derived from active participation in an experiment involving the candidate in planning the experiment; deciding how it is managed; identifying and obtaining the necessary resources, some of which must be unfamiliar; and carrying out the experiment. Depending on the activity, the collection of the information may be group work.

Evidence submitted in support of attainment of PC(d) must be in the format of a table or graph(s) as appropriate. Conclusions drawn should be justified by reference to supporting evidence.

The evaluation should cover all stages of the experiment, including the initial analysis of the situation and planning and organising the experimental procedure.

National Unit Specification: support notes

UNIT Physiology, Health and Exercise (Advanced Higher)

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

Outcome 1

a) ***Exercise and the cardiovascular system***

i Structure and function of the cardiovascular system (CVS).
ii Pathology of cardiovascular disease.
iii Role of exercise in prevention and treatment of cardiovascular disease.
Risk factors and prevention of cardiovascular disease.
Effect of exercise on the CVS.
The 'athletic heart'.
The protective effects of exercise.
Principles of exercise testing.

b) ***Exercise and metabolism***

i Energy.
The need for energy.
Energy balance.
Dietary recommendations for health.
Energy expenditure and its measurement.
ii Body composition and weight control.
Measurement of body composition.
Weight control and obesity.
Effect of exercise on body composition and weight control.
iii Osteoporosis.
Osteoporosis and bone growth
Effect of exercise.
iv Diabetes mellitus
Control of blood glucose levels.
Effect of exercise on diabetes mellitus

Further detail is given in the supplementary notes in the course content section of the course specification.

Outcome 2

Examples of learning activities which provide suitable contexts for the development of problem solving skills include:

- examine league tables for coronary heart disease world wide
- examine trends in coronary heart disease over the last 10 years
- obtain and present information on the effects of exercise on the cardiovascular system
- measure all food and drink for a day and calculate energy intake from tables
- keep activity diary for a day and calculate energy output from published tables
- compare energy expenditure during resting, walking, running and swimming from published data
- analyse data which illustrates the effects of exercise on body composition
- examine data which illustrates the effects of exercise on osteoporosis

Outcome 3

Suitable experiments in the context of this unit include:

- carry out an experiment to measure heart rate and blood pressure at three levels of exercise
- carry out an experiment to calculate heart rate at rest and during exercise using ECGs
- perform simple exercise tests eg step test, shuttle run
- carry out an experiment to compare energy expenditure during walking and running using a pedometer
- perform simple measurements of body composition

Candidates or centres could devise other appropriate experiments in the context of exercise and the cardiovascular system or exercise and metabolism.

The experiments chosen should allow all the performance criteria for this outcome to be achieved within any single report.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Details of suitable approaches are provided in the course specification.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

It is recommended that a holistic approach is taken to assessment, eg Outcomes 1 and 2 could be assessed by an integrated end of unit test with questions covering all the performance criteria for knowledge and understanding and problem solving. Opportunities to generate evidence of attainment of Outcome 3 will arise during practical work related to the suggested learning activities.

National Unit Specification: support notes (cont)

UNIT Physiology, Health and Exercise (Advanced Higher)

Outcome 2

Test items should be constructed to allow candidates to generate evidence relating to the performance criteria as follows:

a) Selecting and presenting information:

- sources of information to include: texts, tables, charts, graphs and diagrams
- formats of presentation to include: written summaries, extended writing, tables and graphs.

b) Calculations to include: percentages, averages, ratios. Significant figures and units should be used appropriately.

c) Conclusions drawn should include some justification.

d) Candidates could plan and design procedures to test given hypotheses or to illustrate particular effects. This could include identification of variables, controls and measurements or observations required. The evaluation of given experimental procedures may include situations which are unfamiliar to candidates and could test the candidate's ability to comment on the purpose of approach or the suitability of given experimental procedures. Candidates could comment on the limitations of the set-up, apparatus, suggested measurements or observations, limitations of equipment, appropriateness of controls, sources of error and possible improvements.

e) Candidates could make predictions and generalisations from given experimental results or, given situations, predict what the results might be.

Outcome 3

Type of experimental activity

The teacher/lecturer should ensure that the experimental activity to be undertaken in connection with Outcome 3 affords opportunity for the candidate to demonstrate the ability to undertake the planning and organising of an experimental activity at an appropriate level of demand. The activity must relate to the Course content and candidates should be made aware of the range of skills which must be demonstrated to ensure attainment of Outcome 3.

Assessment of Outcome 3

Candidates are only required to produce one report for Outcome 3 in relation to the contents and notes specified for Advanced Higher Biology. This report can then be used as evidence for Outcome 3 for any of the other units in the course, excluding the Biology Investigation unit.

In relation to PC (a), the teacher/lecturer checks by observation that the candidate participates in the collection of the experimental information by playing an active part in planning the experiment, deciding how it will be managed, identifying and obtaining resources (some of which must be unfamiliar to the candidate), carrying out the experiment, and evaluating all stages of the experiment, including the initial analysis of the situation, and planning and organising the experimental procedures.

National Unit Specification: support notes (cont)

UNIT Physiology, Health and Exercise (Advanced Higher)

Candidates should provide a report with an appropriate title. The report should relate to the performance criteria as follows:

(b)	The experimental procedures are described accurately.	A clear statement of the aim of the experiment. A few brief concise sentences including as appropriate: • a labelled diagram or brief description of apparatus or instruments used • how the independent variable was altered • control measure used • how measurements were taken or observations made There is no need for a detailed description. The use of the impersonal passive voice is to be encouraged as an example of good practice but this is not mandatory for meeting the performance criteria.
(c)	Relevant measurements and observations are recorded in an appropriate format.	Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/readings entered correctly.
(d)	Recorded experimental information is analysed and presented in an appropriate format.	Data should be analysed and presented in tabular, graphical format or scatter diagram or equivalent, as appropriate: • for a tabular presentation this may be an extension of the table used for PC (c) above, and must include: suitable headings and units showing averages or other appropriate computations • for a graphical presentation this must include: data presented as a histogram, bar chart, connected points or line of best fit as appropriate, with suitable scales and axes labelled with variable and units and with data correctly plotted
(e)	Conclusions drawn are valid.	Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least one of the following should be included: • overall pattern to readings or observations (raw data) • trends in analysed information or results • connection between variables and controls
(f)	The experimental procedures are evaluated with supporting argument.	The evaluation could cover all stages of the activity including preparing for the activity, analysis of the activity and the results of the activity. The evaluation must include a supporting argument in at least one of the following: • effectiveness of procedures • control of variables • limitations of the equipment • possible sources of error • possible improvements

National Unit Specification: support notes (cont)

UNIT Physiology, Health and Exercise (Advanced Higher)

The bullet points under each performance criterion give an indication of what should be addressed to achieve a pass. The relevance of the bullet points will vary according to the experiment. These bullet points are intended as helpful guidance. The decision of pass or fail is to be made by the professional judgement of the presenting centre (subject to moderation) against the performance criteria. It is appropriate to support candidates in producing a report to meet the performance criteria. Re-drafting of a report after necessary supportive criticism is to be encouraged both as part of the learning and teaching process and to produce evidence for assessment. Redrafting and resubmission is only required for the specific performance criterion identified in need of further attention ie the entire report does not need to be rewritten.

Conditions required to complete the report

Candidates may complete their reports outwith class time provided reasonable measures are taken to ensure that the report is the individual work of the candidate.

Use of IT

Candidates may, if they wish, present their reports in a word-processed format. Candidates may use Excel (or any other suitable data analysis software) when tackling Outcome 3. However, candidates must not be given a spreadsheet with pre-prepared column headings nor formulae, as they are being assessed on their ability to enter quantities and units into a table and make decisions about appropriate scales and labels on graph axes.

Excel may be used to analyse large amounts of experimental data and to plot error bar charts. The use of clip art or images captured by digital camera may also be used in recording details of experimental methods.

Transfer of evidence

Candidates, who are repeating a course, may carry forward evidence of an appropriate standard, generated in a previous year.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September 2003).