

**HUMAN BIOLOGY**  
**Higher**

**Fifth edition - published June 2002**

## **NOTE OF CHANGES TO ARRANGEMENTS FIFTH EDITION PUBLISHED JUNE 2002**

**COURSE TITLE:** Human Biology (Higher)

**COURSE NUMBER:** C009 12

### **National Course Specification**

Course Details

Assessment: section inserted which details Instruments for Internal Assessment and emphasises need for only one report for Outcome 3 being required across the course.

### **National Unit Specification:**

All Units

### **Statement of Standards**

Wording of Outcome 3 changed to refer to Higher Human Biology instead of the title of the unit.

Evidence Requirements of Outcome 3 changed to refer to the context of the report being within the contents and notes specified for Higher Human Biology instead of within the context of each unit.

### **Support Notes**

Guidance on Approaches to Assessment for the units includes:

- additional guidance which emphasises the need to produce only one report across the course and that a report from one unit may be used as evidence for Outcome 3 for the other units
- advice on the conditions required to complete the report which indicates that reports may be completed outwith class time provided reasonable measures are taken to ensure that the report is the individual work of the candidate
- advice on the use of IT for production of the Outcome 3 report
- advice on the transfer of evidence.

## National Course Specification

### HUMAN BIOLOGY (HIGHER)

**COURSE NUMBER** C009 12

#### COURSE STRUCTURE

The course has three 40 hour units. The units cover the following content areas:

<b>D043 12</b>	<b><i>Cell Function and Inheritance (H)</i></b>	<b><i>1 credit (40 hours)</i></b>
	<ul style="list-style-type: none"><li><i>The Role of Enzymes in Cell Metabolism</i></li><li><i>Protein Synthesis</i></li><li><i>Energy Transfer</i></li><li><i>Cell Transport</i></li><li><i>Cellular Response in Defence</i></li><li><i>Inheritance</i></li></ul>	
<b>D044 12</b>	<b><i>The Continuation of Life (H)</i></b>	<b><i>1 credit (40 hours)</i></b>
	<ul style="list-style-type: none"><li><i>Reproduction</i></li><li><i>Development</i></li><li><i>Transport Mechanisms</i></li><li><i>Delivery of Materials to Cells</i></li><li><i>Removal of Materials from the Blood</i></li><li><i>Regulating Mechanisms</i></li></ul>	

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#### Administrative Information

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## National Course Specification (cont)

**COURSE** Human Biology (Higher)

### COURSE STRUCTURE (cont)

<b>D045 12</b>	<b><i>Behaviour, Populations and the Environment (H)</i></b>	<b><i>1 credit (40 hours)</i></b>
	<ul style="list-style-type: none"><li>• <i>Nervous System and Memory</i></li><li>• <i>Behaviour</i></li><li>• <i>Population Growth and the Environment</i></li></ul>	

All courses include 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.

In determining course content, careful thought has been given to the maintenance of progression in the course. The contents list provides a suggested sequence which allows for coherent study of the subject, although other approaches are possible.

### RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following:

- Standard Grade Biology with Knowledge and Understanding and Problem Solving at Credit level
- Intermediate 2 Biology.

### 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 Course Specification: course details**

**COURSE**                      Human Biology (Higher)

### **RATIONALE**

The course provides a broad-based, integrated study of a range of biological topics which build on the concepts developed in the Standard Grade Biology and Intermediate 2 Biology courses. The course content considers those aspects of biological science which have more immediate relevance for the biology of the human species and the influence of humankind on the biological world. The study of Higher Human Biology contributes to the candidate's general and vocational education through the acquisition of relevant biological knowledge and skills and provides a general basis for further study or employment in areas related to biology. It also contributes 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 the applications of biology in society and industry
- skills in problem solving
- practical abilities associated with biology
- 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 provides a clear articulation with the areas of study at Standard Grade and at Intermediate 2 through to Advanced Higher. Topics give emphasis to important, developing areas of human biology including molecular biology, genetics, immunology, control mechanisms, human behaviour and the impact of an increasing population on the environment. Health issues are highlighted where appropriate throughout the course, with emphasis being placed on the health of human populations rather than on aspects of personal health.

## **National Course Specification: course details (cont)**

**COURSE** Human Biology (Higher)

### **COURSE CONTENT**

The Higher Human Biology course comprises three units and provides for a more thorough understanding of the basic concepts which are covered in the Standard Grade and Intermediate 2 Biology courses and further develops the Standard Grade elements and Intermediate 2 outcomes of knowledge and understanding, problem solving and practical abilities.

#### **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 demonstrate an ability to:

- 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 and is necessary to underpin theoretical work and to develop skills. It fosters familiarity with apparatus and 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 argument.

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 purposes of assessment. The content for each unit is prefaced by a short summary of content with an indication given to the links with Standard Grade and Intermediate 2 Biology.

## National Course Specification: course details (cont)

### COURSE Human Biology (Higher)

#### UNIT 1: CELL FUNCTION AND INHERITANCE (H)

##### Introduction

The body consists of a vast population of many kinds of cells together with many extracellular substances. The cells are involved not only in the synthesis and secretion of these extracellular substances but also in the elaboration of substances for their own internal use. Cells need to take in substances, process them and at the same time obtain energy to allow this metabolism to take place. Knowledge of the activities taking place within the living cell is fundamental to an understanding of the functioning of the whole body.

This unit explores certain areas of cell function and concentrates on the many roles of proteins in the body economy. First the function of proteins as enzymes is explored as the basis of all biochemical pathways. Discussion of some of the other roles of protein in the body leads to a consideration of the intracellular mechanisms involved in protein production, followed by the cellular processes concerned in the release of energy from various substrates. Cell transport covers some of the mechanisms whereby substances enter or leave cells and are moved within cells. Consideration is then given to the role of proteins as antigens and to the secretion of antibodies by immunologically competent cells of the body. The relevance of immunological mechanisms as a defence strategy is developed, as are topics of recent medical immunological importance such as tissue transplantation and acquired immune deficiency syndrome. The ability of viruses to enter cells and alter metabolic pathways to produce more virus particles is introduced as an example of naturally occurring genetic engineering. A study of genes, chromosomes and the process of meiosis as part of gamete production leads to a consideration of the phenotypic expression of the genome. The concepts of dominance, recessiveness, co-dominance and incomplete dominance as applicable to gene expression are explored, as is polygenic inheritance. Reference is made to gene mutations and chromosomal abnormalities. This naturally leads to a consideration of the procedures adopted in genetic counselling, genetic screening and risk evaluation.

It is desirable that candidates understand that the cell is a functional living unit in its own right. Cell organelles are introduced only when a knowledge of their structure is appropriate to an understanding of that function.

Within the unit, there are many areas impinging on religious or moral sensitivities and these or other areas may also raise important ethical and legal questions. It is important to stress that the role of the biologist is to provide knowledge of these processes, on the basis of which individuals, families or societies may make informed and often crucial decisions.

Candidates should have a clear understanding of the following content areas from Standard Grade Biology:

Topic 3 Animal Survival: carbohydrates; proteins; fats.

Topic 4 Investigating Cells: cell structure; cell respiration; osmosis; enzymes; mitosis.

Topic 6 Inheritance: chromosomes; monohybrid inheritance; sex determination.

Topic 7 Biotechnology: the nature of microbes; the action of antibiotics.

Alternatively, candidates should have achieved the units: *Living Cells (Int 2)* and *Environmental Biology and Genetics (Int 2)*.

## National Course Specification: course details (cont)

### Unit 1: Cell Function and Inheritance (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>a) <i>The role of enzymes in cell metabolism</i></p> <p>i Catalytic activity</p> <p>Enzymes as catalysts within and outwith the cell in biochemical pathways.</p> <p>Inborn errors of metabolism involving absence of enzymes.</p> <p>ii Factors affecting enzyme activity</p> <p>The effects of various factors on enzyme activity to include inhibition, substrate concentration and enzyme concentration.</p> <p>Activation of enzymes by mineral ions, vitamins and other enzymes.</p>	<p>Candidates should know about the effects of temperature and pH on enzyme activity from work in Standard Grade Biology or Intermediate 2, and need not carry out further investigations on these factors.</p> <p>The study of the activation of enzymes should be restricted to the knowledge that some mineral ions are important activators and that various activators can convert a number of digestive enzymes from the inactive to the active form in the gut lumen. Some examples should be given. Most vitamins act as co-enzymes.</p>	<p>Carry out an investigation on the effect of enzyme or substrate concentration on enzyme activity.</p> <p>Design and carry out an investigation to measure the effect of an inhibitor on enzyme activity.</p>

## National Course Specification: course details (cont)

### Unit 1: Cell Function and Inheritance (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>b) <i>Protein synthesis</i></p> <p>1 Protein structure and function</p> <p>i The structure of protein</p> <p>ii A brief mention of the many functions of proteins to include: enzymes, some hormones, muscular contraction, transport of substances, antibodies and structural proteins</p> <p>2 Role of DNA, RNA and cellular organelles</p> <p>i Deoxyribonucleic acid (DNA): structure, in particular the double helix; nucleotides and bases; pairing of named bases</p> <p>ii Ribonucleic acid (RNA): single strand structure; the replacement of thymine with uracil and of deoxyribose with ribose; the functions of mRNA and tRNA in the synthesis of proteins; triplet code; codons and anti-codons</p> <p>iii The structure and role of the nucleus and nucleolus in RNA synthesis and transport</p>	<p>The structure of proteins should be given an elementary treatment. Amino acid chains are linked by peptide bonds; further linkages such as hydrogen bonds produce secondary and tertiary structures which are important in the functioning of the protein.</p> <p>The study of muscle proteins, actin and myosin, should include the arrangements of these filaments to produce the striated effect in skeletal muscles. The sliding filament theory need not be dealt with in detail, nor should any of the parts of the sarcomere be named.</p>	<p>Examine slides of muscle fibres to observe striations.</p> <p>Obtain information from a variety of sources on the nature of DNA and RNA and their roles in protein synthesis. Sources may include appropriate models, computer simulations and published materials.</p> <p>Examine published electron micrographs of the nucleus and nucleolus.</p>

## National Course Specification: course details (cont)

### Unit 1: Cell Function and Inheritance (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>iv Ribosomes: their distribution within the cell and function in protein synthesis</p> <p>c) <b>Energy transfer</b></p> <p>The role and production of adenosine triphosphate (ATP):</p> <p>i ATP as a means of transferring chemical energy. Regeneration of ATP from ADP and inorganic phosphate (Pi).</p> <p>ii Glycolysis: the breakdown of glucose to pyruvic acid with a net production of ATP in the cytoplasm.</p> <p>iii Krebs (citric acid, tricarboxylic acid) cycle and cytochrome system. The location of these reactions within the cristae and matrix of the mitochondrion. Relationship of folding of inner membrane to activity of mitochondrion. The production of ATP, carbon dioxide, hydrogen and reduced co-enzyme.</p> <p>iv The distinction between anaerobic and aerobic phases of respiration with reference to location, level of ATP produced and final metabolic products.</p>	<p>In the teaching of energy transfer, the principles of the process should be emphasised. The fact that the quantity of ATP in the body stays more or less constant should be stressed.</p> <p>Only the intermediates pyruvic acid, citric acid and acetyl-CoA need be known by name. It is more important to follow the fate of the carbon atoms and hydrogen in the process. The importance of the cytochrome system in the step-by-step release of energy via transfer of electrons and hydrogen combined with reduced coenzyme (NAD) should be emphasised.</p>	<p>Examine a range of published electron micrographs to interpret degrees of metabolic activity.</p>

## National Course Specification: course details (cont)

### Unit 1: Cell Function and Inheritance (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>v Carbohydrates, lipids and proteins as sources of energy within the cell</p> <p>A brief mention of the many roles of lipids within the body to include energy store, heat and nerve insulation, fat pads on feet and hands, vitamin transport and hormones.</p> <p>d) <i>Cell transport</i></p> <p>1 Structure and function of membranes</p> <p>i Structure and function of membranes as described in the fluid mosaic model.</p> <p>ii Functions of lipids and proteins within the membrane.</p> <p>iii Rough and smooth endoplasmic reticulum and Golgi apparatus in the metabolism and transport of substances for export from the cell.</p>	<p>The detailed structure of carbohydrates is not required. The mention of the terms monosaccharide, disaccharide and polysaccharide is sufficient without any detail of the chemical linkages involved. The circumstances under which the body utilises glycogen, fats and proteins as sources of energy should be covered, for example in marathon running and starvation.</p> <p>In dealing with the fluid mosaic model of the cell membrane, its fluid and porous nature should be emphasised.</p>	<p>Carry out an investigation to identify unknown carbohydrates including reducing and non-reducing sugars, using a range of tests which might include Clinistix, iodine solution, Benedicts and Barfoed's reagents.</p> <p>Examine published micrographs of membranes.</p>

## National Course Specification: course details (cont)

### Unit 1: Cell Function and Inheritance (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>2 The absorption and secretion of materials</p> <p>i Diffusion and osmosis</p> <p>The need for a constant environment within the cell and the role of the cell membrane in maintaining this environment.</p> <p>ii Endocytosis and exocytosis</p> <p>iii Active transport</p> <p>The function of the cell membrane in relation to selective ion uptake and release of chemicals.</p>	<p>Diffusion and osmosis can be covered at an elementary level by considering the tendency for water to diffuse from a solution of high water concentration to one of lower water concentration. Cells such as red blood cells will then tend to burst in solutions of a water concentration higher than that of the plasma and shrink in solutions of a water concentration lower than that of the plasma.</p> <p>The terms crenation and haemolysis are not needed, but the importance of the maintenance of steady state of solute concentration in the body should be emphasised. The terms osmotic pressure, osmotic potential and water potential are unnecessary.</p> <p>Endocytosis and exocytosis are terms used to describe the movement of substances in and out of the cell by gross movements of the membrane. Phagocytosis and pinocytosis are examples of endocytosis. The secretion of hormones and enzymes from the cell are examples of exocytosis.</p> <p>The need for energy in active transport to move substances against gradients should be emphasised.</p>	<p>Carry out an investigation into the chemical nature of the cell membrane using, for example, beetroot tissue.</p> <p>Examine and interpret data on selective uptake and release of chemicals by cells.</p>

## National Course Specification: course details (cont)

### Unit 1: Cell Function and Inheritance (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>e) <i>Cellular response in defence</i></p> <p>i Recognition of self and non-self antigens as in ABO blood group system.</p> <p>ii Production of antibodies and the role of blood cells.</p> <p>Production of humoral antibodies by B-lymphocytes.</p> <p>Cell-mediated response by T-lymphocytes.</p> <p>iii The function of macrophages</p> <p>Phagocytosis and the function of lysosomes.</p>	<p>It should be emphasised that all body cells have antigenic molecules in their membranes and that an essential feature of the defence system is the ability to differentiate between self and foreign antigens. Moreover, every person, barring identical twins, has a unique signature recognised only by their own cells as being 'self' and therefore 'safe'. When this system breaks down, autoimmune disorders result.</p> <p>Antibodies are proteins synthesised in response to foreign antigens. Natural immunity should be treated as the ability of the body to recognise foreign material and mobilise cells (cellular response) and cell products (humoral response) to deal with that foreign material. The involvement of T-lymphocytes and B-lymphocytes in these responses should be taught, but no attempt made to distinguish between the structure of these cells. Mention should be made of the various ways in which T-lymphocytes and B-lymphocytes function, without naming the different sub-groups of these cells.</p> <p>The variety of antibody-antigen reactions need not be covered.</p>	<p>Examine data on ABO blood grouping and interpret this data to explain transfusion incompatibility.</p> <p>Obtain and present information on tissue transplantation. Discuss the problems of tissue rejection and use of suppressors in transplantation.</p>

## National Course Specification: course details (cont)

### Unit 1: Cell Function and Inheritance (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>iv Immunity</p> <p>Innate immunity.</p> <p>Acquired immunity: natural and artificial.</p> <p>Active and passive immunity.</p> <p>Autoimmunity and allergy.</p> <p>v The nature of viruses and their invasion of cells</p> <p>Alteration of cell instructions to produce more viruses.</p>	<p>The principles of vaccination should be understood in the context of artificially-acquired immunity as, for example, in vaccination against tetanus. Natural passive immunity is obtained via the placenta and breast milk. Artificial passive immunity can be given, for example, with the injection of the tetanus antitoxin to someone suffering from tetanus.</p> <p>Candidates should know that viruses are quite distinct from bacteria, protozoa and fungi. Viruses are classified as living only in so far as they can carry out reproduction and even that process requires the assistance of another cell which is damaged as a result. It is sufficient for candidates to know the approximate size of viruses and the fact that they contain DNA or RNA surrounded by a coat which is usually protein. Viruses can enter cells in a variety of ways.</p> <p>Viruses alter cell metabolism so that replication of the viral DNA/RNA can take place, resulting in the release of large numbers of viruses as the host cell bursts.</p>	<p>Examine published electron micrographs of viruses.</p> <p>Obtain and present information on the way the HIV 1 (Human Immunodeficiency Virus) disrupts the mechanisms of the immune system.</p> <p>Obtain and present data on the spread of a variety of viral diseases, their history and prevention.</p>

## National Course Specification: course details (cont)

### Unit 1: Cell Function and Inheritance (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>f) <i>Inheritance</i></p> <p>1 Chromosomes as vehicles of inheritance.</p> <p>i Genes as regions of chromosomal DNA.</p> <p>ii DNA replication, its importance, and its relationship to nuclear division.</p> <p>iii The normal chromosome complement, homologous pairs, autosomes and sex chromosomes.</p> <p>iv Outline of meiosis and its significance in the production of haploid gametes.</p> <p>v The contribution of independent assortment of chromosomes and crossing over to variation in gametes.</p> <p>vi Establishment of the diploid chromosome number at fertilisation and possible variety of genotype.</p>	<p>In meiosis, the following terms should be used: 1st and 2nd meiotic division, gamete mother cell, chromosome, chromatid, chiasmata, homologous. The names of the five meiotic stages are not required. Candidates should understand how the haploid number is established by separation of homologous chromosomes.</p> <p>Candidates should know how variation between gametes is achieved through independent assortment and exchange of chromosomal material.</p>	<p>Examine models and visual aids of chromosomes.</p> <p>Examine prepared slides and visual aids to show meiosis.</p> <p>Obtain and present information on genetic fingerprinting.</p>

## National Course Specification: course details (cont)

### Unit 1: Cell Function and Inheritance (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>2 Monohybrid inheritance</p> <p>i The pattern of inheritance of a pair of alleles where one is dominant and one is recessive.</p> <p>ii The effects of alleles exhibiting dominance, co-dominance and incomplete dominance.</p> <p>iii Possible combinations of multiple alleles.</p> <p>iv Sex-linked inheritance and the effects of the presence of genes on the X-chromosome and not on the Y-chromosome.</p> <p>v Polygenic inheritance leading to characteristics with a normal pattern of distribution.</p> <p>3 Mutations and chromosome abnormalities</p> <p>i Alteration of base type or sequence.</p> <p>ii Non-disjunction and its effects on human karyotypes.</p>	<p>The following terms should be known: haploid, diploid, gene, allele, homozygous, heterozygous, dominant, recessive, co-dominant, incompletely dominant, genotype, phenotype, F<sub>1</sub> and F<sub>2</sub> generations.</p> <p>Dominant and co-dominant alleles should be represented by upper case letters and recessive alleles by lower case letters.</p> <p>The sex chromosomes should be represented by the symbols X and Y and the alleles by the appropriate upper and lower case superscripts, for example X<sup>R</sup>X<sup>R</sup>, X<sup>r</sup>X<sup>r</sup>, X<sup>R</sup>X<sup>r</sup>, X<sup>R</sup>Y, X<sup>r</sup>Y.</p>	<p>Carry out an investigation to examine the phenotypes arising from monohybrid crosses.</p> <p>Calculate the answers to genetic problems using examples such as :</p> <ul style="list-style-type: none"> <li>- tongue rolling and Rhesus D-antigen</li> <li>- MN blood groups and sickle cell anaemia</li> <li>- ABO blood groups.</li> </ul> <p>Examine family trees illustrating autosomal and sex-linked characteristics such as colourblindness.</p> <p>Obtain and present information on a condition such as sickle cell anaemia or cystic fibrosis.</p> <p>Examine photographs of karyotypes of individuals with conditions such as Down's, Turner's and Klinefelter's syndromes.</p>

## National Course Specification: course details (cont)

### Unit 1: Cell Function and Inheritance (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>iii Genetic screening and counselling.</p> <p>The use of family histories in determining genotypes.</p> <p>The use of karyotypes of fetal material where there is a possibility of genetic disorder.</p> <p>Risk evaluation in cases of polygenic inheritance.</p> <p>Post-natal screening for conditions which have a genetic basis.</p>	<p>The relevance of the study of genetics should be reinforced by the investigation, where appropriate, of family histories exhibiting genetic conditions of medical importance. Examples might include albinism, Huntington's chorea, cystic fibrosis, phenylketonuria, haemophilia and muscular dystrophy.</p>	<p>Discuss case histories showing genetic conditions of medical importance.</p> <p>Obtain and present information on phenylketonuria (PKU).</p>

## National Course Specification: course details (cont)

### COURSE Human Biology (Higher)

#### UNIT 2: THE CONTINUATION OF LIFE (H)

##### Introduction

The introduction to the differing processes of gamete production in the male and the female, to fertilisation and to implantation provides a basis for consideration of the natural control mechanisms involved and then leads to ways in which these processes may be artificially bypassed or varied. The unit examines aspects of pre-natal and post-natal development of the individual and considers some of the factors involved in that development. An understanding of the placenta functioning as a two-way mechanism between maternal and fetal blood circulations is important, not only to understand fetal nutrition but also to appreciate the danger to the fetus of teratogenic factors and the changes which fetal material may bring about in the mother. The study of post-natal growth serves to underline development as a continuing process.

The existence of the body as a community of cells is explored with the recognition that this community requires stable environmental conditions, not only for its continuing function but also for its continuing survival. In addition, for cells to survive and function, raw materials must be made available and the waste products of cellular metabolism removed, thus passing from the cellular level to that of the whole organism.

The topic is studied in a holistic way rather than systematically. Having established the requirement for circulating body fluids and for exchange vessels, the role of the heart as a pump with variable output is considered, along with the mechanism for the coordination of its musculature. The roles of the red blood cells in the delivery of oxygen and of the alimentary system in the delivery of raw materials to cells are considered. The contributions of the kidneys and liver in relation to their function of removal of waste materials from the body are explored. Consideration is also given to regulating mechanisms in the body: control of heart rate, stabilisation of glucose levels in the blood, and the maintenance of constant body temperature. All of these are important examples of feedback control mechanisms which provide stable environmental conditions for the community of cells that form the whole organism.

It is important that candidates realise that the organism functions as an integrated unit, hence the holistic approach to the topic. Problems associated with being multicellular are analysed. The various organs involved are then introduced on a functional rather than on an anatomical basis.

Within the unit, there are areas impinging on religious or moral sensitivities and these or other areas may raise important ethical and legal questions. It is important to stress that the role of the biologist is to provide knowledge of these processes, on the basis of which individuals, families or societies may make informed and often crucial decisions.

Candidates studying this unit should have a clear understanding of the following content areas from Standard Grade Biology:

Topic 3 Animal Survival: male and female reproductive systems; gametes; fertilisation and implantation; structure and function of the placenta; digestion and absorption in the gut; structure and function of the kidney.

Topic 5 The Body in Action: gas exchange in the lungs and tissues; the heart and blood circulatory system.

Alternatively, candidates should have achieved the unit: *Animal Physiology (Int 2)*.

## National Course Specification: course details (cont)

### UNIT 2: The Continuation of Life (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>a) <b>Reproduction</b></p> <p>Fertility and its control:</p> <p>i Structure and function of reproductive organs.</p> <p>Structure of testes and ovaries and their function.</p> <p>The contribution to fertilisation of the secretions of the prostate gland and the seminal vesicles.</p> <p>ii Hormonal control.</p> <p>The influence of the pituitary hormones, follicle stimulating hormone (FSH) and luteinising hormone (LH) on the testes and the ovaries.</p> <p>The influence of testosterone on the testes.</p> <p>The influence of the ovarian hormones, oestrogen and progesterone, on the uterus and the pituitary.</p>	<p>The structure of the testes and ovaries need be known only in sufficient detail to allow understanding of hormonal influences on sperm production and the menstrual cycle. It is sufficient to know that sperm are produced in the seminiferous tubules and that the interstitial cells produce testosterone. In addition, it is adequate to know that the ovum is surrounded by a developing Graafian follicle and that, after ovulation, this develops into a corpus luteum.</p>	

## National Course Specification: course details (cont)

### UNIT 2: The Continuation of Life (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>Changes during the menstrual cycle and control of these changes through interaction of hormones.</p> <p>Continuous fertility in the male compared with cyclical fertility in the female.</p> <p>iii Intervention in fertility</p> <p>Causes of infertility to include failure to ovulate, blockage of uterine tubes, failure of implantation and low sperm counts.</p> <p>Treatment of infertility to include fertility drugs, <i>in vitro</i> fertilisation and artificial insemination.</p> <p>The biological basis of contraception by calculation of fertile period and by hormonal methods.</p>	<p>Changes during the menstrual cycle should include development of the follicle, ovulation, development of the corpus luteum, development of the endometrium, menstruation, the role of the cervix in fertility and changes in the body temperature.</p> <p>Calculation of fertile periods from data on timing of menstruation, body temperature and cervical mucus should be considered both from the point of view of increasing the chances of pregnancy and as a possible means of contraception. The treatment of contraception should not be reduced to a list of possible methods. The emphasis should be on the application of understanding of the biological basis.</p>	<p>Construct charts to illustrate the changes in the body during the menstrual cycle.</p> <p>Obtain and present information on causes of infertility and their treatment.</p> <p>Identify the fertile period from data on timing of menstruation, body temperature and cervical mucus.</p>

## National Course Specification: course details (cont)

### UNIT 2: The Continuation of Life (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>b) <i>Development</i></p> <p>Pre-natal and post-natal development of the individual:</p> <p>i Intra-uterine development</p> <p>Cleavage, implantation and differentiation.</p> <p>Monozygotic and dizygotic twins.</p> <p>Exchanges between maternal and fetal circulations, including transfer of harmful substances and pathogens.</p> <p>Influence of the placental hormones progesterone, oestrogen and of prolactin.</p> <p>Effects of the fetus on the maternal immune system, as illustrated by Rhesus problems and their solution.</p>	<p>Only brief details of these processes are required. For differentiation, it is sufficient to understand that many specialised cells originate from common embryonic tissue.</p> <p>Exchange with the maternal circulation should include movement of gases by diffusion, of glucose by active transport and of antibodies by pinocytosis.</p> <p>The relationship between the maternal immune system and the fetus should be considered from the point of view that the system does not normally reject the 'foreign' fetus.</p>	<p>Examine prepared slides and visual aids showing intra-uterine development.</p> <p>Obtain and present information on the effects on the embryo/fetus of harmful agents, eg rubella, thalidomide, alcohol and heroin.</p> <p>Analyse data on the effects of the Rhesus factor.</p>

## National Course Specification: course details (cont)

### UNIT 2: The Continuation of Life (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>ii Birth</p> <p>The role of oxytocin at birth and the use of artificial hormones in induction of birth.</p> <p>Nutrition of the new-born.</p> <p>iii The pattern of growth after birth</p> <p>The major stages of the growth curve, including changes in body proportions.</p> <p>The role of growth hormone.</p> <p>The major body changes in males and females at puberty.</p> <p>Hormonal changes and development in males and females at puberty.</p>	<p>Consideration of the nutrition of the new-born should include the presence of antibodies in colostrum and breast milk and some reference to the possibility of chemical contamination of colostrum and breast milk.</p> <p>The general effects of growth hormone on the growth process should be considered, but microscopic details of bone structure or bone growth are not required.</p>	<p>Analyse data to compare the composition of colostrum, breast milk and powdered cow's milk.</p> <p>Obtain and present information on organochlorines in breast milk.</p> <p>Examine case histories which illustrate treatment with growth hormone.</p> <p>Obtain and present information on illicit use of testosterone in sport.</p>

## National Course Specification: course details (cont)

### UNIT 2: The Continuation of Life (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>c) <i>Transport mechanisms</i></p> <p>Plasma, tissue fluid and lymph, and the need to circulate fluid in vessels:</p> <p>i The need for a transport system with vessels</p> <p>ii Tissue fluid and lymph</p> <p>The relationship of arterioles, capillaries, venules and lymphatic capillaries to the body cells and tissue fluid.</p> <p>The exchange of materials between arterioles, capillaries, venules, lymphatic capillaries, body cells and tissue fluid.</p> <p>iii The need to circulate fluid in vessels</p> <p>The heart; cardiac cycle; conducting system of the heart.</p>	<p>Candidates can calculate surface area to volume ratios and, through this, establish an understanding that if there is a small surface area for each unit of volume, diffusion alone will not suffice as a transport mechanism. In studying the transport system, reference should be made to exchange vessels.</p> <p>It will be necessary for candidates to know the names of the heart chambers, the valves, the vessels entering and leaving the heart and the vessels entering and leaving the main body organs and areas (coronary arteries, carotid artery, jugular vein, hepatic artery, hepatic vein, hepatic portal vein, renal artery and renal vein).</p> <p>Atrial systole, ventricular systole and diastole. The role of the sinoatrial node (SAN) and the atrioventricular node (AVN) in the cardiac cycle should be considered. No mention need be made of the bundle of His or the Purkinje fibres.</p>	<p>Calculate surface area to volume ratios.</p> <p>Use nomograms to estimate surface area of the body.</p> <p>Observe capillaries, eg nail bed. Examine prepared slides of arteries and veins.</p> <p>Demonstrate the presence of valves in veins.</p> <p>Obtain and present information on coronary heart disease. Use a stethoscope or listen to tape of heart sounds. Examine ECGs - normal, abnormal.</p>

## National Course Specification: course details (cont)

### UNIT 2: The Continuation of Life (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>Blood pressure in different parts of the circulation.</p> <p>Lymph circulation, lymph nodes.</p> <p>d) <b><i>Delivery of materials to cells</i></b></p> <p>Oxygen and nutrients:</p> <p>i Oxygen</p> <p>The affinity of haemoglobin for oxygen under different conditions.</p> <p>The structure of red blood cells related to their function. The production and breakdown of red blood cells.</p>	<p>The change of affinity of haemoglobin for oxygen, in relation to changes in blood oxygen tension and temperature only, should be considered.</p> <p>The structure of red blood cells should include reference to the biconcave shape, small size, the lack of a nucleus and the need for red blood cells to be flexible to pass through capillaries. These should be related to the cell's ability to absorb oxygen. The requirement for vitamin B<sub>12</sub> and iron in red blood cell production should be known. The life history of the red blood cell should be covered to the extent of sites of production, life span, sites of breakdown (spleen, liver and bone marrow) and subsequent fate of the products of breakdown.</p>	<p>Measure blood pressure using a digital sphygmomanometer. Digital sphygmomanometers are suitable for use in schools.</p> <p>Interpret graphs of pressure changes in heart and blood vessels.</p> <p>Analyse data from Hb/O<sub>2</sub> dissociation curves.</p>

## National Course Specification: course details (cont)

### UNIT 2: The Continuation of Life (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>ii Nutrients</p> <p>The absorption of nutrients.</p> <p>The dual blood supply of the liver.</p> <p>The role of the liver in carbohydrate, lipid and protein metabolism.</p> <p>The fate of absorbed materials.</p> <p>e) <b><i>Removal of materials from the blood</i></b></p> <p>The role of the liver, lungs and kidneys:</p> <p>i The role of the liver</p> <p>Conservation of useful substances.</p> <p>Detoxification of toxic materials.</p>	<p>The absorption of glucose, fats and amino acids should be reviewed briefly. The role of bile salts as emulsifiers, and lacteals in the absorption of lipids, should be studied. The need for the intrinsic factor for vitamin B<sub>12</sub> absorption should be known.</p> <p>There is no need to study the structure of the liver.</p> <p>Study of the functions of the liver should be restricted to those which relate to the content of this section.</p> <p>The fate of absorbed materials should include reference to the role of carbohydrates, lipids and proteins in cell function. Brief reference should also be made to the need for vitamins and minerals in enzymic reactions.</p>	<p>Carry out investigations to examine the effect of bile salts (a) as an emulsifier and (b) on the action of lipase.</p> <p>Examine electron micrographs to show microvilli.</p> <p>Analyse data on composition of plasma of hepatic artery, hepatic vein and hepatic portal vein.</p>

## National Course Specification: course details (cont)

### UNIT 2: The Continuation of Life (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>Removal of bilirubin and its excretion into bile.</p> <p>Production of urea.</p> <p>ii The role of the lungs in the removal of carbon dioxide</p> <p>iii The role of the kidneys</p> <p>The mechanisms of kidney function to include ultrafiltration and reabsorption.</p> <p>f) <b>Regulating mechanisms</b></p> <p>The principle of negative feedback control as illustrated by the following physiological mechanisms:</p> <p>i The control of heart rate: the effects of exercise on the cardiovascular and respiratory systems</p>	<p>Candidates should know the names and functions of the following: Bowman’s capsule, glomerulus, proximal convoluted tubule, loop of Henle, distal convoluted tubule and collecting duct. The role of the loop of Henle and ADH in the control of water content of the blood should be covered. Details of counter-current mechanisms need not be studied.</p> <p>The control of heart rate should include hormonal and nervous control linked to the effects of exercise.</p>	<p>Carry out an investigation to determine the quantity of urea in an ‘artificial urine’ sample.</p> <p>Analyse data on glomerular filtrate, tubule fluid and urine composition and rates of production.</p> <p>Analyse graphs showing distribution of blood to tissues at rest and during exercise.</p> <p>Calculate cardiac output under different conditions.</p>

## National Course Specification: course details (cont)

### UNIT 2: The Continuation of Life (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>ii Blood sugar: the roles of insulin, glucagon and adrenaline.</p> <p>iii Temperature: the role of the hypothalamus as a temperature monitoring centre; nerve communication between the hypothalamus and effectors; involuntary and voluntary responses in temperature regulation and changes in the ability to control body temperature as age increases.</p>	<p>Endocrine glands need not be discussed in detail but the central role of hormones (originating in named, specific glands) should be mentioned, namely insulin, glucagon, adrenaline.</p> <p>Temperature control should be related to surface area and volume. The lack of maturity of the temperature control mechanism in infants and the multifactorial nature of hypothermia in the elderly should be covered.</p>	<p>Analyse glucose tolerance curves of normal and diabetic subjects.</p> <p>Carry out investigations into human body responses to sudden heat loss where changes can be detected visibly on the skin of the hand using a thermistor.</p> <p>Analyse data on hypothermia in infancy and old age.</p>

## **National Course Specification: course details (cont)**

### **COURSE Human Biology (Higher)**

#### **UNIT 3: BEHAVIOUR, POPULATIONS AND THE ENVIRONMENT (H)**

##### **Introduction**

It is in the area of behaviour that the human species differs most markedly from other mammals. These differences result from the development of the nervous system together with the development of sophisticated communication skills, improving communication not only between individuals of the species, but also between societies and between generations. The area of behaviour encompasses the whole of human activity and cannot be ignored in any study of human biology.

The unit examines some of the internal and external mechanisms that bring about behaviour. The organisation of the nervous system forms a basis for consideration of the cerebral hemispheres and some of the characteristics associated with the functioning of the human cerebral cortex in relation to sensory skills, motor skills, language skills and memory. Genetic influences on behaviour are analysed by reference to genetic disorders. Environmental factors are examined in relation to the development of the individual, to intelligence and to the effects of maturation of the individual on learning processes. The influence of the environment on learning is explored by considering the effects of experience on behaviour and the role of memory in these processes. The ability to communicate verbally is explored to show its potential to modify behaviour. Interactions between individuals or between groups of individuals modify behaviour patterns and these interactions are explored by reference to infant attachment, social facilitation, deindividuation and social influences.

Although the unit considers only a few of the many influences on human behaviour at the individual and group level, it is hoped that this will stimulate in candidates a critical awareness of their own behaviour. Candidates should understand that this individual behaviour, which is dependent on the genome, has been modified by social interactions and environmental factors and that both of these, although constantly changing, will continue to affect their behaviour patterns in the future. It is important for candidates to be aware of the effects of technology on this process. Social interactions have been increased by travel, the written word and the introduction of advanced communication technologies.

All living species are subject to processes which can limit their abundance. These processes include predation and other causes of mortality, such as shortage of food and, to a lesser extent, disease. Relatively recently, in a geological timescale, the human species effectively overcame predation and acquired the ability to increase food supply, with the consequence that population numbers are now rising exponentially. One interpretation of these events could be that mechanisms limiting abundance no longer apply to the human species as a whole. The other is that human populations are still subject to population regulatory processes and that the time may be approaching when these processes will begin to exert their effects globally. It is clear that, whereas the biological mechanisms determining abundance are exerted on all species, the responses to them by the human species involve technological mechanisms which result in ever greater manipulation of the natural environment.

The unit examines the growth of human populations and explores some of its causes, potential limitations, consequences and possible solutions. It also examines some of the limiting factors, such as food and water availability, and disease. The effects of changes in these limiting factors, particularly as they affect child mortality in different populations, are analysed. Finally, the unit deals with the environmental effects of maintaining a high population but avoids, as far as possible, those environmental perturbations that are due to non-biological influences.

## National Course Specification: course details (cont)

### COURSE Human Biology (Higher)

Major issues are raised, particularly with regard to human population growth, to the consequences of continued and unrestrained growth and to possible ways of controlling this growth. The approach taken is scientific, with emphasis on the biology of the human species in relation to population growth. Industrial pollution, although a major issue, is omitted. Nevertheless, an examination of the environmental consequences of increasing food supplies for an ever-expanding population highlights many problems about which candidates should be aware. Thus, the effects of chemical pollution (fertilisers and pesticides), atmospheric pollution through excess carbon dioxide and methane production (burning of fossil fuels and animal husbandry) and desertification (deforestation and water cycles) are all embraced by this unit.

Candidates should have a clear understanding of the following content areas from Standard Grade Biology:

- Topic 1 The Biosphere: population regulation; nutrient cycles; pollution.
- Topic 2 The World of Plants: ecosystems.
- Topic 3 Animal Survival: behavioural responses of animals to their environment.
- Topic 5 The Body in Action: structure and function of the central nervous system and its sensory receptors.
- Topic 7 Biotechnology: genetic engineering.

Alternatively, candidates should have achieved the units: *Living Cells (Int 2)*, *Environmental Biology and Genetics (Int 2)* and *Animal Physiology (Int 2)*.

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>a) <i>Nervous system and memory</i></p> <p>Structure and function of the nervous system and its role in memory:</p> <p>i The brain</p> <p>Large size of the human brain.</p> <p>The cerebrum and its convoluted surface.</p> <p>Localisation of function in discrete areas and the function carried out.</p> <p>The relationship between the size of a discrete area and the function carried out.</p>	<p>In relatively recent evolutionary times there has been an exponential increase in human brain capacity. It is the large size of the human brain which gives humans a unique place in the animal world.</p> <p>The convoluted surface of the cerebrum allows an increased number of cell bodies to be located on the surface of the cerebrum, maximising the potential for interconnections between neurones. Candidates are not required to know the names or exact locations of the various areas of the cerebrum; it is sufficient to know that they exist as discrete areas.</p> <p>Mention should be made of the existence of somatosensory, motor, visual, auditory, language and association areas in the cerebrum, but only to stress the significance of their localisation and of interconnections between them. Attention should be drawn to the relationship between the large size of the part of the motor area devoted to the hands and lips and the degree of fine motor control.</p>	<p>Examine data on clinical observations of brain injuries and lesions, EEGs, brain scans and split brain studies as evidence of the localisation of brain functions.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>The importance of the corpus callosum in transferring information between the two hemispheres.</p> <p>ii Organisation of the nervous system</p> <p>Division into central and peripheral nervous systems. Division into somatic and autonomic nervous systems (sympathetic and parasympathetic).</p> <p>Functions of dendrites, cell body, axons and myelin sheath. The continuing post-natal development of myelination.</p>	<p>In examining the nervous system, emphasis has been placed on those aspects which are of particular relevance to the human species. A brief introduction outlining the structural division of the central and peripheral systems and the functional division of somatic and autonomic systems is all that is required. Candidates should be aware that the sympathetic and parasympathetic systems are often antagonistic. Suitable examples to illustrate the arousal influence of the sympathetic system are its effects on heartbeat, blood distribution and perspiration. The effect of the parasympathetic system on these functions demonstrates its role in conserving and protecting bodily resources.</p> <p>Details of the nature of the nerve impulse or the nodes of Ranvier are not required. The mechanism of myelination by Schwann cells should not be covered but consequences of myelination on the speed of transmission of impulses should be stressed, with particular reference to post-natal development.</p>	<p>Examine suitable slides and photomicrographs of dendrites, cell body, axon and myelin sheath.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>Chemical transmission at the synapse by neurotransmitters. The need for removal of neurotransmitters. Excitatory and inhibitory signals.</p> <p>Converging and diverging neural pathways. Plasticity of response of the nervous system.</p> <p>iii Memory</p> <p>Localisation of memory in the brain.</p> <p>The processes of encoding, storage and retrieval.</p>	<p>Candidates should be aware that as well as transmitting impulses, synapses can filter out weak stimuli arising from insufficient secretion of transmitter. Acetylcholine is a suitable example of a neurotransmitter which is removed by enzymic degradation. Noradrenaline is an example of a neurotransmitter removed by reabsorption. Candidates should be aware that it is the receptors (not the transmitter) that determine whether a signal is excitatory or inhibitory.</p> <p>Converging and diverging neural pathways should be studied to demonstrate the complex interactions of the nervous system. The role of diverging neural pathways in bringing about fine motor control should be studied. The role of converging neural pathways from rod cells in the retina in bringing about light sensitivity should be studied. The plasticity of response of the neural system can be investigated to show the suppression of reflexes or sensory impulses by converging neural pathways.</p> <p>The limbic system is thought to be the part of the brain involved in memory.</p>	<p>Carry out an investigation into the ability of the brain to suppress reflexes or sensory impulses.</p> <p>Examine audio-visual material or data on amnesiac studies which demonstrate different types of memory.</p> <p>Design and carry out an investigation to determine the memory span for letters or numbers.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>Short-term memory.</p> <p>Transfer of information between short and long-term memory.</p> <p>The evidence for a molecular basis for memory.</p>	<p>The increase in memory span by ‘chunking’.</p> <p>Information is encoded into memory from images such as visual images and sounds. Short-term memory has a limited capacity to store items of information (known as memory span). Information is transferred from short-term memory to long-term memory as a result of rehearsal, organisation and by the elaboration of meaning. The serial position effect. Retrieval from long-term memory is aided by the use of contextual cues which relate to the method of coding.</p> <p>The loss of acetylcholine-producing cells of the limbic system in Alzheimer’s disease, which is characterised by memory loss, provides evidence that acetylcholine is involved in linking neurones to form memories. That the neurones in the limbic system are rich in one particular receptor known as NMDA suggests that this substance also has a role in memory storage.</p>	<p>Carry out an investigation on increasing the memory span of short-term memory by ‘chunking’.</p> <p>Carry out an investigation on the serial position effect.</p> <p>Carry out an investigation on the factors which improve retrieval from long-term memory.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>b) <i>Behaviour</i></p> <p>1 Factors influencing the development of behaviour</p> <p>i Maturation</p> <p>Constancy of sequencing in maturation. The sequence of development leading to walking in infants.</p> <p>ii Inheritance</p> <p>Inherited conditions that affect the development of the nervous system.</p>	<p>All aspects of development, including behaviour, are influenced by maturation, inheritance and environment. It is impossible to identify behaviours which are influenced by only one of these factors, although the development of some behaviours may be more strongly influenced by one factor than by others.</p> <p>Maturation should be viewed as an inherited sequence of developmental stages, the rate of which may be limited or enhanced by genetic or environmental factors. The stages of motor development in walking are a clear example of development in which maturation is a major influence. They also demonstrate the relationship between the development of the nervous system (particularly nerve myelination) and behaviour.</p> <p>Inherited factors can determine the potential for behavioural development.</p> <p>PKU and Huntington's chorea are examples of inherited disorders which can affect the nervous system and thus affect behaviour.</p>	<p>Examine data or audio-visual material on the sequence of development in walking, speech and cognitive abilities.</p> <p>Examine data on the effects of PKU and Huntington's chorea on the nervous system and behaviour.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>iii Environment</p> <p>The value of twin studies in investigating the influence of the environment on behaviour.</p> <p>iv The inter-relationship between maturation, inheritance and the environment</p> <p>Influences on the development of intelligence.</p>	<p>The influence of the environment (including experience) is considered further in Communication and Social Behaviour. Programmes to accelerate the age at which infants walk illustrate the effect of the environment on development and how it is limited by the process of maturation. Twin studies are useful in demonstrating the influence of the environment as it is assumed that the genetic and maturation factors will be the same for identical twins.</p> <p>All behaviours are influenced by a combination of maturational, inherited and environmental factors. The development of intelligence demonstrates the influence of the combined effects of maturation, polygenic inheritance and environmental factors.</p> <p>Intelligence should be regarded as a wide range of intellectual skills which cannot be measured merely by IQ tests. Evidence of genetic and environmental influences on intelligence should emphasise the difficulty of separating these influences due to the uncontrolled nature of environmental factors and to natural genetic variation.</p>	<p>Examine data on twin studies which demonstrate the influence of genetic and environmental factors.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>2 Communication and social behaviour</p> <p>i The effect of infant attachment</p> <p>The long period of dependency providing opportunities for learning.</p> <p>The importance of infant attachment in the development of later social development and competence.</p> <p>ii The effect of communication</p> <p>The importance of non-verbal communication in parent-infant bonding and in adult communication.</p> <p>The use of language (both written and spoken) to convey information.</p>	<p>The modification of behaviour should be introduced by relating it to the nervous system. The nervous system detects information; a decision is then based on this information modified if necessary by previous experience. This results in the behaviour shown.</p> <p>The human has a long period of dependency upon adult members of the species. During the early part of this period, critical stages of development must take place to allow later development of communication and other social skills. This long period of dependency also provides considerable time for learning to occur.</p> <p>Much of human behaviour is unique because of the ability to communicate through language.</p> <p>Non-verbal communication is important in the formation of relationships between parents and their children. Non-verbal communication can signal attitudes and emotions between individuals as well as acting as an aid to verbal communication. Specific examples such as smiling, winking and folding arms should be discussed.</p> <p>Language uses symbols to represent information and enables it to be organised into categories and hierarchies. This allows the transfer of information, thus accelerating learning and intellectual development.</p>	<p>Examine data/audio-visual material on the effect of deprivation/social isolation in infancy.</p> <p>Observe and discuss non-verbal communication.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>iii The effect of experience</p> <p>The effect of practice on motor skills.</p> <p>Imitation.</p> <p>Reinforcement, shaping and extinction of behaviour as seen in trial and error learning.</p> <p>Generalisation and discrimination.</p>	<p>The repeated use of a motor skill results in a motor pathway being established. This ‘motor memory’ is seen, for example, in the skills of riding a bike or driving a car.</p> <p>A great deal of human behaviour is learned by observing and imitating the behaviour of others. This is often a preferred means of learning and is used in training situations.</p> <p>The effect of cultural transmission is highly significant. Behaviour patterns which have positive consequences for the individual are likely to be repeated and so become reinforced. Shaping is the rewarding of behaviour that approximates to the desired behaviour. If behaviour patterns are not rewarded, they are likely to disappear (extinction). Rewarded behaviour, unrewarded behaviour and shaping should be studied using examples from learning in children.</p> <p>Generalisation and discrimination may result in, for example, a child who has been bitten by a dog to fear all dogs (generalisation) or only responding with fear of large dogs (discrimination).</p>	<p>Design and carry out an investigation on learning using a finger maze.</p> <p>Design and carry out an investigation on the speed of performance of a task by following instructions and by imitation.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>iv The effect of group behaviour and social influence</p> <p>Social facilitation: increased performance in competitive situations.</p> <p>Deindividuation: loss of personal identity in a group leading to diminished restraints on behaviour.</p> <p>Influences that change beliefs: internalisation - changing beliefs as a result of persuasion; identification - changing beliefs to be like an admired influencing source.</p>	<p>Deindividuation is often used to explain the anti-social behaviour of some groups which would not be shown by individuals from these groups on their own.</p> <p>Much of drug education and advertising is designed to change behaviour by influencing through persuasion or by identifying with individuals who are respected or admired.</p>	<p>Examine and discuss strategies used in drug education and advertising.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>c) <i>Population growth and the environment</i></p> <p>1 Population change</p> <p>i Human population growth</p> <p>Pre-history of modern man.</p> <p>Growth of world population to the end of the twentieth century demonstrating the change from a period of stability to exponential growth.</p> <p>Demographic trends in developed and developing countries.</p> <p>Factors which may explain exponential growth of populations:</p> <ul style="list-style-type: none"> <li>• overpredation</li> <li>• increasing food availability</li> <li>• reduction in child mortality</li> <li>• increase of life expectancy and the consequences of female fecundity.</li> </ul> <p>ii Population control through birth rate reduction and the effect on population increase</p>	<p>Candidates should understand the concepts of population abundance and regulation as they apply to a non-human vertebrate. They should understand that human populations are also regulated but that carrying capacity has increased and has yet to reach a new level. Candidates should be aware of the main events in the cultural evolution of modern man and be able to compare this with extant examples of pre-industrial cultures. Special mention should be made of the importance for population growth of survival to reproductive age through improvements in child care and vaccination programmes to control childhood diseases. When examining other ways in which the normal constraints on population abundance could be circumvented, reference should be made to the effects that changes in cultural habits, such as curtailment of prolonged suckling of infants (which can postpone conception), and extended fertility, with increasing lifespan and early puberty, can have on population growth.</p>	<p>Obtain and present information on human population density in various undeveloped societies.</p> <p>View and discuss audio-visual material on contemporary non-industrial cultures.</p> <p>Obtain and present information on population growth.</p> <p>Interpret population pyramids, comparing potential for population growth in a developed and a developing country.</p> <p>Use a computer simulation to investigate the effect of adjusting variables on population growth.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>2 Population limiting factors</p> <p>i Food supply</p> <p>Consequences of increasing demand for agricultural land especially in developing countries.</p> <p>Purpose and impact of fertiliser, herbicide, fungicide and pesticide use.</p> <p>Increasing food production by selective plant breeding and genetic manipulation.</p> <p>Effects of food shortage: malnutrition and starvation.</p> <p>ii Water supply</p> <p>Meeting increased demand worldwide.</p> <p>Unpredictability of supply due to climatic changes and erosion.</p>	<p>Candidates should understand the potential population-limiting effects of food, water and disease on human populations, by reference to examples of other vertebrate populations.</p> <p>The effect of land-use changes on natural succession in developed countries should be explained and candidates should be able to relate this to similar changes taking place now in developing countries. The extent of losses of forest to agriculture and for fuel should be highlighted and the consequences of non-renewal made clear.</p> <p>The ways in which the human species has so far been able largely to circumvent the effects of food shortages by increasing food supply through the use of fertilisers and other chemicals should be set in the context of increasing aquatic pollution.</p>	<p>Analyse data on the effect of pesticides or fertilisers.</p> <p>View and discuss suitable audio-visual data.</p> <p>Discuss the biological implications of the increased demand for water.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>Consequences of deforestation and marginal-land farming practices for water supply cycle.</p> <p>iii Disease</p> <p>Regulatory effects of disease on populations.</p> <p>Use of vaccines to control major childhood diseases, eg measles, whooping cough.</p> <p>Effects of improved hygiene and sanitation.</p>	<p>Problems of providing secure drinking-water supplies in the face of possible climatic change, landscape changes and desertification should be considered. In presenting water resource problems, reference should be made not only to the failure of water supply through seasonal rain failure, but also to the large and increasing demand for water worldwide. Candidates should also be aware of the threat to food supplies through marine pollution.</p> <p>Disease control through improved living conditions and health care programmes should be highlighted. In dealing with disease, a comparison should be made between the major epidemics of fatal diseases occurring in historical times and the current situation where it may be argued that such epidemics only occur on a smaller scale, due to medical advances and the availability of organised assistance through the WHO where serious life-threatening outbreaks occur. It is nevertheless important to stress that the common childhood diseases, as well as diseases such as malaria, account for millions of childhood fatalities each year.</p>	<p>Analyse data on the eradication of smallpox.</p> <p>Obtain and present information on the use of vaccines.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>3 Population effects on the environment</p> <p>i Disruption of food webs</p> <p>Effects of chemicals (agricultural and other) on wildlife.</p> <p>Loss of complexity leading to instability.</p> <p>ii Disruption of nitrogen cycle</p> <p>Algal blooms in marine and freshwater environments.</p> <p>Inadequate sewage treatment.</p> <p>Contamination of drinking water supplies by nitrates and nitrites.</p>	<p>Candidates should be made aware of the benefits and disadvantages of using chemicals to enhance food production, particularly in the context of induced instability of ecosystems by loss of species. This consideration can be linked to the other aspect of chemical use, which is the polluting effects of excess nitrogen and phosphorus.</p> <p>The serious problem of sewage disposal in expanding populations should be emphasised and solutions to this problem discussed.</p>	<p>Carry out a case study of one of the population effects (disruption of food web, nitrogen cycle, carbon cycle).</p> <p>Carry out an investigation into the effect of specific chemicals on plant populations.</p>

## National Course Specification: course details (cont)

### Unit 3: Behaviour, Populations and Environment (H)

CONTENT	NOTES	LEARNING ACTIVITIES
<p>iii Disruption of carbon cycle</p> <p>Reasons for global increase in carbon dioxide and methane levels.</p> <p>Rise in sea level.</p>	<p>The vast increase in carbon dioxide leading to the 'greenhouse effect' or global warming is an important and complex issue which requires careful presentation. The various sources of this carbon dioxide and the predictions for the further increase in levels due to increasing world population should be explained. Increases in methane production, which is also a contributory factor in global warming, should be highlighted.</p> <p>The consequences of increasing temperatures, ie, climatic change and rising sea levels, may be discussed in terms of the implications of loss of land and potentially catastrophic changes in habitat for food production and wildlife.</p>	

## National Unit Specification: course details (cont)

**COURSE** Human Biology (Higher)

### ASSESSMENT

To gain the award of the course, the candidate must achieve all the component units of the course 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 demonstrate achievement 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. 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 external course examination will sample across all of the unit outcomes and achievement will be graded on the basis of cut-off scores.

The assessment of knowledge and understanding, problem solving and practical abilities will be based upon the course content described for the three units:

- *Cell Function and Inheritance (H)*
- *The Continuation of Life (H)*
- *Behaviour, Populations and the Environment (H)*.

The content contexts of these units will be sampled equally in the course examination which will include familiar contexts as well as contexts which are less familiar and more complex 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.

The examination will consist of one paper of 2 hours 30 minutes with a total of 130 marks. The paper will consist of three sections:

#### Section A

This section will contain 30 multiple choice questions. Between 9 and 11 of these will test problem solving and practical abilities, the remainder will test knowledge and understanding. Section A will have an allocation of 30 marks. Candidates will be expected to answer all the questions.

#### Section B

This section will contain structured questions and data handling questions with an allocation of 80 marks. Between 25 and 30 marks will test problem solving and practical abilities, the remainder will test knowledge and understanding. Candidates will be expected to answer all the questions.

## **National Unit Specification: course details (cont)**

**COURSE**                    Human Biology (Higher)

### **Section C**

This section will consist of four extended response questions to test the candidates ability to select, organise and present relevant knowledge. Section C will have an allocation of 20 marks and will include:

- two structured extended response questions each with an allocation of 10 marks. Candidates will be expected to answer one of these questions. Marking schemes for these questions will be similar to current practice for essay questions
- two open extended response questions for 10 marks (1 mark for relevance, 1 mark for coherence and 8 marks for knowledge and understanding). Candidates will be expected to answer one of these questions.

### **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.

#### **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.

#### **Testing for the course outcomes**

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

#### **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 Unit Specification: course details (cont)

### COURSE Human Biology (Higher)

#### Problem solving and practical abilities

Questions relating to each of the following points will be included in the course examination in order to test the candidate's 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, tables and/or graphs.
3. Process information accurately using calculations where appropriate. Calculations to include percentages, averages and/or ratios. Significant figures and units should be used appropriately.
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 of 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. 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 Higher, typically two 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 than extracting data from two sources for example, depending upon the nature of the data.

Where there are not two separate sources of data, the provided data should normally have two to three 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.

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

## National Unit Specification: course details (cont)

**COURSE** Human Biology (Higher)

### DETAILS OF THE INSTRUMENTS FOR INTERNAL ASSESSMENT

#### 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.

#### Evidence requirements for 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 Higher Human Biology. This report can then be used as evidence for Outcome 3 for all of the units of the course.

### APPROACHES TO LEARNING AND TEACHING

Suggestions for appropriate learning activities are contained in 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 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 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.

#### Use of the additional 40 hours

This time may be used:

- to provide an introduction to the course and assessment methods
- to allow more practical work to be undertaken by the candidates
- for remediation of particular aspects of work in which candidates require to be re-assessed
- for consolidation and integration of learning
- to practice techniques in answering multiple choice questions
- to develop extended response writing skills

## **National Unit Specification: course details (cont)**

### **COURSE**            Human Biology (Higher)

- to practice applying knowledge and understanding, problem solving and practical abilities in contexts more complex than in the units
- 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, 2001).

## National Unit Specification: general information

**UNIT** Cell Function and Inheritance (Higher)

**NUMBER** D043 12

**COURSE** Human Biology (Higher)

### SUMMARY

The unit seeks to develop knowledge and understanding, problem solving and practical abilities related to the role of enzymes in cell metabolism, protein synthesis, energy transfer, cell transport, cellular response in defence and inheritance. This is a component unit of Higher Human Biology.

### OUTCOMES

- 1 Demonstrate knowledge and understanding related to cell function and inheritance.
- 2 Solve problems related to cell function and inheritance.
- 3 Collect and analyse information related to Higher Human Biology obtained by experiment.

### RECOMMENDED ENTRY

Entry to this unit is at the discretion of the centre. However, it would be an advantage if the candidate had attained one of the following:

- Standard Grade Biology with Knowledge and Understanding and Problem Solving at grades 1 or 2
- Intermediate 2 Biology.

In particular, candidates should have a clear understanding of the Standard Grade Biology topics of carbohydrates, proteins, fats, cell structure, cell respiration, osmosis, enzymes, the nature of microbes and the action of antibiotics. Alternatively, candidates should have achieved the units: *Living Cells (Int 2)* and *Environmental Biology and Genetics (Int 2)*.

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### Administrative Information

**Superclass:** RH

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## **National Unit Specification: general information (cont)**

**UNIT** Cell Function and Inheritance (Higher)

### **CREDIT VALUE**

1 credit at 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 Function and Inheritance (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 function and inheritance.

##### Performance criteria

- (a) The role of enzymes is described correctly in relation to cell metabolism.
- (b) Protein synthesis is described correctly in terms of protein structure and function, and the role of DNA, RNA and cellular organelles.
- (c) Energy transfer is described correctly in relation to the role and production of ATP.
- (d) Cell transport is described correctly in terms of the structure and function of membranes, and the absorption and secretion of materials.
- (e) Cellular response in defence is described correctly in relation to humans.
- (f) Inheritance is described correctly in terms of chromosomes as vehicles of inheritance, monohybrid inheritance, and mutations and chromosome abnormalities.

##### Evidence requirements

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

#### OUTCOME 2

Solve problems related to cell function and inheritance.

##### 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 and with problems in the context of the role of enzymes in cell metabolism, protein synthesis, energy transfer, cell transport, cellular response in defence or inheritance.

## **National Unit Specification: statement of standards (cont)**

### **UNIT**                      Cell Function and Inheritance (Higher)

#### **OUTCOME 3**

Collect and analyse information related to Higher Human 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 in relation to the contents and notes specified for Higher Human 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 Function and Inheritance (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 THE CONTENT AND CONTEXT OF THIS UNIT

##### *Outcome 1*

##### a) **The role of enzymes in cell metabolism**

- i Catalytic activity.  
Enzymes as catalysts within and outwith the cell in biochemical pathways.  
Inborn errors of metabolism involving absence of enzymes.
- ii Factors affecting enzyme activity.  
The effects of various factors on enzyme activity to include inhibition, substrate concentration and enzyme concentration.  
Activation of enzymes by mineral ions, vitamins and other enzymes.

##### b) **Protein synthesis**

- 1 Protein structure and function
  - i The structure of protein.
  - ii A brief mention of the many functions of proteins to include: enzymes, some hormones, muscular contraction, transport of substances, antibodies and structural proteins.
- 2 Role of DNA, RNA and cellular organelles
  - i Deoxyribonucleic acid (DNA): structure, in particular the double helix; nucleotides and bases; pairing of named bases.
  - ii Ribonucleic acid (RNA): single strand structure; the replacement of thymine with uracil and of deoxyribose with ribose; the functions of mRNA and tRNA in the synthesis of proteins; triplet code; codons and anti-codons.
  - iii The structure and role of the nucleus and nucleolus in RNA synthesis and transport.
  - iv Ribosomes: their distribution within the cell and function in protein synthesis.

##### c) **Energy transfer**

The role and production of adenosine triphosphate (ATP)

- i ATP as a means of transferring chemical energy  
Regeneration of ATP from ADP and inorganic phosphate (Pi).
- ii Glycolysis: the breakdown of glucose to pyruvic acid with a net production of ATP in the cytoplasm.
- iii Krebs (citric acid, tricarboxylic acid) cycle and cytochrome system. The location of these reactions within the cristae and matrix of the mitochondrion.  
Relationship of folding of inner membrane to activity of mitochondrion.  
The production of ATP, carbon dioxide, hydrogen and reduced co-enzyme.
- iv The distinction between anaerobic and aerobic phases of respiration with reference to location, level of ATP produced and final metabolic products.
- v Carbohydrates, lipids and proteins as sources of energy within the cell.  
A brief mention of the many roles of lipids within the body to include energy store, heat and nerve insulation, fat pads on feet and hands, vitamin transport and hormones.

## National Unit Specification: support notes (cont)

### UNIT Cell Function and Inheritance (Higher)

#### d) Cell transport

- 1 Structure and function of membranes
  - i Structure and function of membranes as described in the fluid mosaic model.
  - ii Functions of lipids and proteins within the membrane.
  - iii Rough and smooth endoplasmic reticulum and Golgi apparatus in the metabolism and transport of substances for export from the cell.
- 2 The absorption and secretion of materials
  - i Diffusion and osmosis.

The need for a constant environment within the cell and the role of the cell membrane in maintaining this environment.
  - ii Endocytosis and exocytosis.
  - iii Active transport.

The function of the cell membrane in relation to selective ion uptake and release of chemicals.

#### e) Cellular response in defence

- i Recognition of self and non-self antigens as in ABO blood group system.
- ii Production of antibodies and the role of blood cells.

Production of humoral antibodies by B-lymphocytes.  
Cell-mediated response by T-lymphocytes.
- iii The function of macrophages.

Phagocytosis and the function of lysosomes.
- iv Immunity.

Innate immunity.  
Acquired immunity: natural and artificial.  
Active and passive immunity.  
Autoimmunity and allergy.
- v The nature of viruses and their invasion of cells.

Alteration of cell instructions to produce more viruses.

#### f) Inheritance

- 1 Chromosomes as vehicles of inheritance.
  - i Genes as regions of chromosomal DNA.
  - ii DNA replication, its importance and its relationship to nuclear division.
  - ii The normal chromosome complement, homologous pairs, autosomes and sex chromosomes.
  - iv Outline of meiosis and its significance in the production of haploid gametes.
  - v The contribution of independent assortment of chromosomes and crossing over to variation in gametes.
  - vi Establishment of the diploid chromosome number at fertilisation and possible variety of genotype.
- 2 Monohybrid inheritance
  - i The pattern of inheritance of a pair of alleles where one is dominant and one is recessive.
  - ii The effects of alleles exhibiting dominance, co-dominance and incomplete dominance.
  - iii Possible combinations of multiple alleles.
  - iv Sex-linked inheritance and the effects of the presence of genes on the X-chromosome and not on the Y-chromosome.
  - v Polygenic inheritance leading to characteristics with a normal pattern of distribution.

## National Unit Specification: support notes (cont)

### UNIT Cell Function and Inheritance (Higher)

- 3 Mutations and chromosome abnormalities
  - i Alteration of base type or sequence.
  - ii Non-disjunction and its effects on human karyotypes.
  - iii Genetic screening and counselling
    - The use of family histories in determining genotypes.
    - The use of karyotypes of fetal material where there is a possibility of genetic disorder.
    - Risk evaluation in cases of polygenic inheritance.
    - Post-natal screening for conditions which have a genetic basis.

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:

- design and carry out an investigation to measure the effect of an inhibitor on enzyme activity
- obtain information from a variety of sources on the nature of DNA and RNA and their roles in protein synthesis
- examine and interpret data on the selective uptake and release of chemicals by cells
- examine data on ABO blood grouping and interpret this data to explain transfusion incompatibility
- obtain and present information on tissue transplantation
- obtain and present information on the way the HIV 1 (Human Immunodeficiency Virus) disrupts the mechanisms of the immune system
- obtain and present data on the spread of a variety of viral diseases, their history and prevention
- obtain and present information on genetic fingerprinting
- calculate the answers to genetic problems using examples such as: tongue rolling and Rhesus D-antigen; MN blood groups and sickle cell anaemia; ABO blood groups
- obtain and present information on a condition such as sickle cell anaemia or cystic fibrosis
- obtain and present information on phenylketonuria (PKU).

#### *Outcome 3*

Suitable experiments in the context of this unit include:

- the effect of enzyme concentration on enzyme action
- dehydrogenase activity in yeast
- tests for carbohydrates
- the chemical nature of the plasma membrane
- inhibition of catechol oxidase by lead.

Candidates or centres could devise other appropriate experiments in the context of the role of enzymes in cell metabolism, protein synthesis, energy transfer, cell transport, cellular response in defence or inheritance.

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**                      Cell Function and Inheritance (Higher)

#### **GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT**

Details of suitable approaches are detailed 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.

##### ***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.

## **National Unit Specification: support notes (cont)**

### **UNIT                      Cell Function and Inheritance (Higher)**

#### **Assessment of Outcome 3**

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

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), and carrying out the experiment.

## National Unit Specification: support notes (cont)

### UNIT Cell Function and Inheritance (Higher)

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

<p>(b) The experimental procedures are described accurately.</p>	<p>A clear statement of the aim of the experiment.</p> <p>A few brief concise sentences including as appropriate:</p> <ul style="list-style-type: none"> <li>• a labelled diagram or brief description of apparatus or instruments used</li> <li>• how the independent variable was altered</li> <li>• control measure used</li> <li>• how measurements were taken or observations made.</li> </ul> <p>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.</p>
<p>(c) Relevant measurements and observations are recorded in an appropriate format.</p>	<p>Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/ readings entered correctly.</p>
<p>(d) Recorded information is analysed and presented in an appropriate format.</p>	<p>Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent, as appropriate:</p> <ul style="list-style-type: none"> <li>• 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</li> <li>• 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.</li> </ul>
<p>(e) Conclusions drawn are valid.</p>	<p>Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least <b>one</b> of the following should be included:</p> <ul style="list-style-type: none"> <li>• overall pattern to readings or observations (raw data)</li> <li>• trends in analysed information or results</li> <li>• connection between variables and controls.</li> </ul>
<p>(f) The experimental procedures are evaluated with supporting argument.</p>	<p>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 supporting argument in at least <b>one</b> of the following:</p> <ul style="list-style-type: none"> <li>• effectiveness of procedures</li> <li>• control of variables</li> <li>• limitations of equipment</li> <li>• possible sources of error</li> <li>• possible improvements.</li> </ul>

## **National Unit Specification: support notes (cont)**

### **UNIT Cell Function and Inheritance (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 the report 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. 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 may transfer evidence for Outcome 3 from one level to the one below provided the experiments are in the context of the course concerned.

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, 2001).

## **National Unit Specification: general information**

<b>UNIT</b>	The Continuation of Life (Higher)
<b>NUMBER</b>	D044 12
<b>COURSE</b>	Human Biology (Higher)

### **SUMMARY**

This unit seeks to develop knowledge and understanding, problem solving and practical abilities related to reproduction, development, transport mechanisms, delivery of materials to cells, removal of materials from the blood and regulating mechanisms. This unit is a component unit of Higher Human Biology.

### **OUTCOMES**

- 1 Demonstrate knowledge and understanding related to the continuation of life.
- 2 Solve problems related to the continuation of life.
- 3 Collect and analyse information related to the Higher Human Biology obtained by experiment.

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### **Administrative Information**

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<b>Publication date:</b>	June 2002
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## **National Unit Specification: general information (cont)**

**UNIT**                      The Continuation of Life (Higher)

### **RECOMMENDED ENTRY**

Entry to this unit is at the discretion of the centre. However, it would be an advantage if the candidate had attained one of the following:

- Standard Grade Biology with Knowledge and Understanding and Problem Solving at Credit level
- Intermediate 2 Biology

In particular, candidates should have a clear understanding of the Standard Grade Biology topics of male and female reproductive systems, gametes, fertilisation and implantation, structure and function of placenta, digestion and absorption in the gut, structure and function of the kidney, gas exchange in the lungs and tissues, and the heart and blood circulatory systems. Alternatively, candidates should have achieved the unit: Animal Physiology (Int 2).

### **CREDIT VALUE**

1 credit at 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                      The Continuation of Life (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 the continuation of life.

##### **Performance criteria**

- (a) Reproduction is described correctly in relation to fertility and its control.
- (b) Development is described correctly in relation to pre-natal and post-natal development of the individual.
- (c) Transport mechanisms are described correctly in relation to tissue fluid and lymph and the need to circulate fluid in vessels.
- (d) The delivery of materials to cells is described correctly in relation to oxygen and nutrients.
- (e) The removal of materials from the blood is described correctly in relation to the role of the liver, lungs and kidneys.
- (f) Regulating mechanisms are described correctly in relation to the principle of negative feedback.

##### **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 the continuation of life.

##### **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 and with problems in the context of reproduction, development, transport mechanisms, delivery of materials to cells, removal of materials from the blood or regulating mechanisms.

## **National Unit Specification: statement of standards (cont)**

### **UNIT**                      The Continuation of Life (Higher)

#### **OUTCOME 3**

Collect and analyse information related to Higher Human 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 in relation to the contents and notes specified for Higher Human 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 The Continuation of Life (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 THE CONTENT AND CONTEXT FOR THIS UNIT

##### Outcome 1

##### a) Reproduction

###### 1 Fertility and its control

###### i Structure and function of reproductive organs.

Structure of testes and ovaries and their function.

The contribution to fertilisation of the secretions of the prostate gland and the seminal vesicles.

###### ii Hormonal control.

The influence of the pituitary hormones, follicle stimulating hormone (FSH) and luteinising hormone (LH), on the testes and the ovaries.

The influence of testosterone on the testes.

The influence of the ovarian hormones, oestrogen and progesterone, on the uterus and the pituitary.

Changes during the menstrual cycle and control of these changes through interaction of hormones.

Continuous fertility in the male compared with cyclical fertility in the female.

###### iii Intervention in fertility.

Causes of infertility to include failure to ovulate, blockage of uterine tubes, failure of implantation and low sperm counts.

Treatment of infertility to include fertility drugs, *in vitro* fertilisation and artificial insemination.

The biological basis of contraception by calculation of fertile period and by hormonal methods.

##### b) Development

###### 1 Pre-natal and post-natal development of the individual

###### i Intra-uterine development.

Cleavage, implantation and differentiation.

Monozygotic and dizygotic twins.

Exchanges between maternal and fetal circulations, including transfer of harmful substances and pathogens.

Influence of the placental hormones progesterone and oestrogen, and of prolactin.

Effects of the fetus on the maternal immune system, as illustrated by Rhesus problems and their solution.

###### ii Birth.

The role of oxytocin at birth and the use of artificial hormones in induction of birth.

Nutrition of the new-born.

###### iii The pattern of growth after birth.

The major stages of the growth curve, including changes in body proportions.

The role of growth hormone.

The major body changes in males and females at puberty.

Hormonal changes and development in males and females at puberty.

## National Unit Specification: support notes (cont)

### UNIT The Continuation of Life (Higher)

#### c) **Transport mechanisms**

##### 1 Plasma tissue fluid and lymph and the need to circulate fluid in vessels

i The need for a transport system with vessels.

ii Tissue fluid and lymph.

The relationship of arterioles, capillaries, venules and lymphatic capillaries to the body cells and tissue fluid.

The exchange of materials between arterioles, capillaries, venules and lymphatic capillaries, body cells and tissue fluid.

iii The need to circulate fluid in vessels.

The heart; cardiac cycle; conducting system of the heart.

Blood pressure in different parts of the circulation.

Lymph circulation, lymph nodes.

#### d) **Delivery of materials to cells**

##### Oxygen and nutrients

i Oxygen.

The affinity of haemoglobin for oxygen under different conditions.

The structure of red blood cells related to their function. The production and breakdown of red blood cells.

ii Nutrients.

The absorption of nutrients.

The dual blood supply of the liver.

The role of the liver in carbohydrate, lipid and protein metabolism.

The fate of absorbed materials.

#### e) **Removal of materials from the blood**

##### The role of the liver, lungs and kidneys

i The role of the liver.

Conservation of useful substances.

Detoxification of toxic materials.

Removal of bilirubin and its excretion into bile.

Production of urea.

ii The role of the lungs in the removal of carbon dioxide.

iii The role of the kidneys.

The mechanisms of kidney function, including ultrafiltration and reabsorption.

## National Unit Specification: support notes (cont)

### UNIT The Continuation of Life (Higher)

#### f) **Regulating mechanisms**

The principle of negative feedback control as illustrated by the following physiological mechanisms:

- i The control of heart rate: the effects of exercise on the cardiovascular and respiratory systems.
- ii Blood sugar: the roles of insulin, glucagon and adrenaline.
- iii Temperature: the role of the hypothalamus as a temperature monitoring centre; nerve communication between the hypothalamus and effectors; involuntary and voluntary responses in temperature regulation and changes in the ability to control body temperature as age increases.

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:

- construct charts to illustrate the changes in the body during the menstrual cycle
- obtain and present information on causes of infertility and their treatment
- identify the fertile period from data on timing of menstruation, body temperature and cervical mucus
- obtain and present information on the effects on the embryo/fetus of harmful agents, eg rubella, thalidomide, alcohol and heroin
- analyse data on the effects of the Rhesus factor
- analyse data to compare the composition of colostrum, breast milk and powdered cow's milk
- obtain and present information on organochlorines in breast milk
- obtain and present information on the illicit use of testosterone in sport
- calculate surface area to volume ratios
- use nomograms to estimate surface area of the body
- obtain and present information on coronary heart disease
- interpret graphs of pressure changes in heart and blood vessels
- analyse data from Hb/ O<sub>2</sub> dissociation curves
- analyse data on composition of plasma of hepatic artery, hepatic vein and hepatic portal vein
- analyse data on glomerular filtrate, tubule fluid and urine composition and rates of production
- analyse graphs showing distribution of blood to tissues at rest and during exercise
- calculate cardiac output under different conditions
- analyse glucose tolerance curves of normal and diabetic subjects.

#### **Outcome 3**

Suitable experiments in the context of this unit include:

- bile salts and lipase activity
- testing 'artificial urine' samples
- body response to sudden heat loss.

## **National Unit Specification: support notes (cont)**

### **UNIT                      The Continuation of Life (Higher)**

Candidates or centres could devise other appropriate experiments in the context of reproduction, development, transport mechanisms, delivery of materials to cells, removal of materials from the blood or regulating mechanisms.

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 detailed 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.

##### ***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.

## **National Unit Specification: support notes (cont)**

### **UNIT                      The Continuation of Life (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 Higher Biology. This report can then be used as evidence for Outcome 3 for the other units of the course.

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), and carrying out the experiment.

## National Unit Specification: support notes (cont)

### UNIT The Continuation of Life (Higher)

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

<p>(b) The experimental procedures are described accurately.</p>	<p>A clear statement of the aim of the experiment.</p> <p>A few brief concise sentences including as appropriate:</p> <ul style="list-style-type: none"> <li>• a labelled diagram or brief description of apparatus or instruments used</li> <li>• how the independent variable was altered</li> <li>• control measure used</li> <li>• how measurements were taken or observations made.</li> </ul> <p>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.</p>
<p>(c) Relevant measurements and observations are recorded in an appropriate format.</p>	<p>Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/ readings entered correctly.</p>
<p>(d) Recorded information is analysed and presented in an appropriate format.</p>	<p>Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent, as appropriate:</p> <ul style="list-style-type: none"> <li>• 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</li> <li>• 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.</li> </ul>
<p>(e) Conclusions drawn are valid.</p>	<p>Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least <b>one</b> of the following should be included:</p> <ul style="list-style-type: none"> <li>• overall pattern to readings or observations (raw data)</li> <li>• trends in analysed information or results</li> <li>• connection between variables and controls.</li> </ul>
<p>(f) The experimental procedures are evaluated with supporting argument.</p>	<p>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 supporting argument in at least <b>one</b> of the following:</p> <ul style="list-style-type: none"> <li>• effectiveness of procedures</li> <li>• control of variables</li> <li>• limitations of equipment</li> <li>• possible sources of error</li> <li>• possible improvements.</li> </ul>

## **National Unit Specification: support notes (cont)**

### **UNIT                      The Continuation of Life (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/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. 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 may transfer evidence for Outcome 3 from one level to the one below provided the experiments are in the context of the course concerned.

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, 2001).

## **National Unit Specification: general information**

<b>UNIT</b>	Behaviour, Populations and the Environment (Higher)
<b>NUMBER</b>	D045 12
<b>COURSE</b>	Human Biology (Higher)

### **SUMMARY**

The unit seeks to develop knowledge and understanding, problem solving and practical abilities in the context of the nervous system and memory, behaviour and population growth and the environment. This is a component unit of Higher Human Biology.

### **OUTCOMES**

- 1 Demonstrate knowledge and understanding related to behaviour, populations and the environment.
- 2 Solve problems related to behaviour, populations and the environment.
- 3 Collect and analyse information related to Higher Human Biology obtained by experiment.

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### **Administrative Information**

<b>Superclass:</b>	RH
<b>Publication date:</b>	June 2002
<b>Source:</b>	Scottish Qualifications Authority
<b>Version:</b>	05

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## **National Unit Specification: general information (cont)**

**UNIT** Behaviour, Populations and the Environment (Higher)

### **RECOMMENDED ENTRY**

Entry to this unit is at the discretion of the centre. However, it would be an advantage if the candidate had attained one of the following:

- Standard Grade Biology with Knowledge and Understanding and Problem Solving at Credit level
- Intermediate 2 Biology.

In particular, candidates should have a clear understanding of the Standard Grade Biology topics of behavioural responses of animals to their environment, structure and function of the central nervous system and its sensory receptors, population regulation, nutrient cycles, pollution, ecosystems, and genetic engineering. Alternatively, candidates should have achieved the units: *Environmental Biology and Genetics (Int 2)* and *Animal Physiology (Int 2)*.

### **CREDIT VALUE**

1 credit at 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 Behaviour, Populations and the Environment (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 behaviour, populations and the environment.

##### **Performance criteria**

- (a) The nervous system is described correctly in relation to its structure and function and its role in memory.
- (b) Behaviour is explained correctly in terms of the factors influencing the development of behaviour, and communication.
- (c) Population growth and the environment is described correctly in terms of population change, population limiting factors and population effects on the environment.

##### **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 behaviour, populations and the environment.

##### **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 attainment must be generated from a closed-book test with items covering all the above performance criteria and with problems in the context of the nervous system and memory, behaviour and population growth and the environment.

## **National Unit Specification: statement of standards (cont)**

### **UNIT Behaviour, Populations and the Environment (Higher)**

#### **OUTCOME 3**

Collect and analyse information related to Higher Human 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 in relation to the contents and notes specified for Higher Human 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 Behaviour, Populations and the Environment (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 THE CONTENT AND CONTEXT FOR THIS UNIT

##### *Outcome 1*

##### a) **Nervous system and memory**

Structure and function of the nervous system and its role in memory

##### i The brain.

Large size of the human brain.

The cerebrum and its convoluted surface.

Localisation of function in discrete areas and the function carried out.

The relationship between the size of a discrete area and the function carried out.

The importance of the corpus callosum in transferring information between the two hemispheres.

##### ii Organisation of the nervous system.

Division into central and peripheral nervous systems. Division into somatic and autonomic nervous systems (sympathetic and parasympathetic).

Functions of dendrites, cell body, axons and myelin sheath. The continuing post-natal development of myelination.

Chemical transmission at the synapse by neurotransmitters. The need for removal of neurotransmitters. Excitatory and inhibitory signals.

Converging and diverging neural pathways. Plasticity of response of the nervous system.

##### iii Memory.

Localisation of memory in the brain.

The processes of encoding, storage and retrieval.

Short-term memory.

Transfer of information between short and long-term memory.

The evidence for a molecular basis for memory.

##### b) **Behaviour**

1 Factors influencing the development of behaviour

##### i Maturation.

Constancy of sequencing in maturation. The sequence of development leading to walking in infants.

##### ii Inheritance.

Inherited conditions that affect the development of the nervous system.

##### iii Environment.

The value of twin studies in investigating the influence of the environment on behaviour.

iv The inter-relationship between maturation, inheritance and the environment. Influences on the development of intelligence.

## National Unit Specification: support notes (cont)

### UNIT Behaviour, Populations and the Environment (Higher)

- 2 Communication and social behaviour
    - i The effect of infant attachment.  
The long period of dependency providing opportunities for learning.  
The importance of infant attachment in the development of later social development and competence.
    - ii The effect of communication.  
The importance of non-verbal communication in parent-infant bonding and in adult communication.  
The use of language (both written and spoken) to convey information.
    - iii The effect of experience.  
The effect of practice on motor skills.  
Imitation.  
Reinforcement, shaping and extinction of behaviour as seen in trial and error learning.  
Generalisation and discrimination.
    - iv The effect of group behaviour and social influence.  
Social facilitation: increased performance in competitive situations.  
Deindividuation: loss of personal identity in a group leading to diminished restraints on behaviour.  
Influences that change beliefs: internalisation - changing beliefs as a result of persuasion; identification - changing beliefs to be like an admired influencing source.
- c) **Population growth and the environment**
- 1 Population change
    - i Human population growth.  
Pre-history of modern man.  
Growth of world population to the end of the twentieth century demonstrating the change from a period of stability to exponential growth.  
Demographic trends in developed and developing countries.  
Factors which may explain exponential growth of populations:
      - overpredation
      - increasing food availability
      - reduction in child mortality
      - increase of life expectancy and the consequences of female fecundity.
    - ii Population control through birth rate reduction and the effect on population increase.

## National Unit Specification: support notes (cont)

### UNIT Behaviour, Populations and the Environment (Higher)

- 2 Population limiting factors
  - i Food supply.  
Consequences of increasing demand for agricultural land especially in developing countries.  
Purpose and impact of fertiliser, herbicide, fungicide and pesticide use.  
Increasing food production by selective plant breeding and genetic manipulation.  
Effects of food shortage: malnutrition and starvation.
  - ii Water supply.  
Meeting long increased demand worldwide.  
Unpredictability of supply due to climatic changes and erosion.  
Consequences of deforestation and marginal-land farming practices for water supply cycle.
  - iii Disease.  
Regulatory effects of disease on populations.  
Use of vaccines to control major childhood diseases, eg measles, whooping cough.  
Effects of improved hygiene and sanitation.
  
- 3 Population effects on the environment
  - i Disruption of food webs.  
Effects of chemicals (agricultural and other) on wildlife.  
Loss of complexity leading to instability.
  - ii Disruption of nitrogen cycle  
Algal blooms in marine and freshwater environments.  
Inadequate sewage treatment.  
Contamination of drinking-water supplies by nitrates and nitrites.
  - iii Disruption of carbon cycle  
Reasons for global increase in carbon dioxide and methane levels.  
Rise in sea level.

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:

- design and carry out an investigation to determine the memory span for letters or numbers
- design and carry out an investigation on learning using a finger maze
- design and carry out an investigation on the speed of performance of a task by following instructions and by imitation
- obtain and present information on human population density in various undeveloped societies
- obtain and present information on population growth
- interpret population pyramids, comparing potential for population growth in a developed and a developing country
- analyse data on the effect of pesticides or fertilisers
- analyse data on the eradication of smallpox
- obtain and present information on the use of vaccines.

## National Unit Specification: support notes (cont)

### UNIT Behaviour, Populations and the Environment (Higher)

#### *Outcome 3*

Suitable experiments in the context of this unit include:

- short-term memory span
- the serial position effect
- learning using a finger maze
- the ability of the brain to suppress impulses
- factors which improve retrieval from long-term memory
- the speed of performance of a task by following instructions and by imitation
- the effect of specific chemicals on plant populations.

Candidates or centres could devise other appropriate experiments in the context of the nervous system and memory, behaviour and population growth and the environment.

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 detailed 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.

#### *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:
- b) Sources of information to include: texts, tables, charts, graphs and diagrams
- c) Formats of presentation to include: written summaries, extended writing, tables and graphs.
- d) Calculations to include: percentages, averages, ratios. Significant figures and units should be used appropriately.
- e) Conclusions drawn should include some justification.
- f) 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.

## **National Unit Specification: support notes (cont)**

### **UNIT Behaviour, Populations and the Environment (Higher)**

- g) 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 Higher Human Biology. This report can then be used as evidence for Outcome 3 for the other units of the course.

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), and carrying out the experiment.

## National Unit Specification: support notes (cont)

### UNIT Behaviour, Populations and the Environment (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.	<p>A clear statement of the aim of the experiment.</p> <p>A few brief concise sentences including as appropriate:</p> <ul style="list-style-type: none"> <li>• a labelled diagram or brief description of apparatus or instruments used</li> <li>• how the independent variable was altered</li> <li>• control measure used</li> <li>• how measurements were taken or observations made.</li> </ul> <p>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.</p>
(c) Relevant measurements and observations are recorded in an appropriate format.	<p>Readings or observations (raw data) must be recorded in a clear table with correct headings, appropriate units and results/ readings entered correctly.</p>
(d) Recorded information is analysed and presented in an appropriate format.	<p>Data should be analysed and presented in tabular, graphical format or as a scatter diagram or equivalent as appropriate:</p> <ul style="list-style-type: none"> <li>• 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</li> <li>• 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 quantity and units and with variable correctly plotted.</li> </ul>
(e) Conclusions drawn are valid.	<p>Conclusions should use evidence from the experiment and relate back to the aim of the experiment. At least <b>one</b> of the following should be included:</p> <ul style="list-style-type: none"> <li>• overall pattern to readings or observations (raw data)</li> <li>• trends in analysed information or results</li> <li>• connection between variables and controls.</li> </ul>
(f) The experimental procedures are evaluated with supporting argument.	<p>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 supporting argument in at least <b>one</b> of the following:</p> <ul style="list-style-type: none"> <li>• effectiveness of procedures</li> <li>• control of variables</li> <li>• limitations of equipment</li> <li>• possible sources of error</li> <li>• possible improvements.</li> </ul>

## **National Unit Specification: support notes (cont)**

### **UNIT Behaviour, Populations and the Environment (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 one individual work of the candidate.

Teachers/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. 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 may transfer evidence for Outcome 3 from one level to the one below provided the experiments are in the context of the units concerned.

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, 2001).