E406 HUMAN BIOLOGY (YEAR 12) – 2008-2009

Rationale

Human Biology is the scientific study of humans as individuals and as populations and of their interactions with the environment. This academic discipline encompasses the study of the structure and function of the body, the human life cycle, the biological and cultural evolution of humans, human ecology and modern social issues.

This one-year course considers homeostatic processes, human origins and variations, and modern social issues related to the ecology and welfare of humans.

It is desirable but not essential for students to have studied the Year 11 course before the Year 12 course in Human Biology. The Year 11 and Year 12 courses consider different aspects of Human Biology. There is no Year 11 knowledge which is assumed prerequisite for study of the Year 12 course. However, students who have completed the Year 11 course or have a wide range of scientific and other relevant experiences are likely to be advantaged.

Only the process and intellectual skills which are developed in both Year 11 and Year 12 will be examined in the Year 12 TEE. The Tertiary Entrance Examination is based on Year 12 core material only.

General Aims

To develop an understanding of:

- the role played by the nervous and endocrine systems in maintaining a stable and optimal internal environment
- the mechanisms by which the liver, kidneys, pancreas and pituitary regulate the composition of body fluids
- the causes, spread, treatment and preventative measures for infectious diseases, specific and non-specific defences against infection
- the role played by genetic variation, adaptation and natural selection in primate evolution, the origin of humans and the development of human races
- the factors influencing human population growth and demography, and the impact of population growth, urbanisation and industrialisation on resource utilisation and the environment.

To develop competence in the:

- process skills of science associated with designing and performing controlled experiments, collecting, recording, presenting and interpreting data
- measurement of length, volume and mass, and in the calculation of magnifications, field diameters and estimations of dimension of structures in light microscopy
- literacy skills associated with information retrieval, report writing and effective oral and written communication.

To foster positive attitudes towards the:

- scientific study of human problems and a willingness to adopt rational scientific approaches to solving these problems
- differences in physical, intellectual and social capabilities among individuals
- maintenance of personal health and a commitment to the adoption of a health-sustaining lifestyle
- conservation of the environment.

Teaching – Learning Program

The content of the syllabus has been divided into two sections, each containing core and non-core material. The non-core content (in italics under 'Content') is considered to be enrichment material that will enhance students' understanding of the core content. **Teachers and students should select material from the non-core content to be studied concurrently with the core.**

Fifteen per cent of teaching time should be made available for this task, which will enable students to study half of the non-core content presented in the syllabus.

Some variation is possible in the sequence of material presented in the syllabus. Teachers should adopt whatever sequence they feel is most appropriate for their students.

When preparing programs of work teachers should plan to use a wide range of teaching strategies commensurate with the broad aims of the subject. Students should be involved in laboratory investigations, project work, assignments, and field work in the community.

Control of the body

General objectives

On completion of this section of the course students should be able to:

- explain that cells carry out the life sustaining processes of respiration, synthesis and growth
- discuss the variables which need to be maintained within narrow limits for continued efficient functioning of cells and tissues
- explain the characteristics of a steady-state control system
- describe the major structures and functions of the nervous system, and the features of nerve cells which adapt them to function as a communication system
- describe the relationships between the hypothalamus, pituitary and other endocrine glands
- describe the mode of action of hormones as illustrated by hormonal control of reproductive cycles and metabolic rate
- describe the roles played by the liver, kidneys, pancreas and pituitary in regulating the composition of body fluids

- relate the structure of the kidney and the nephron to the functions they perform
- describe how a set of inter-related homeostatic mechanisms maintains a constant internal environment in the face of internal or external changes
- describe the specific and non-specific mechanisms by which the body is protected from infection
- describe the causes of common infectious diseases, mechanisms of transmission and preventative measures
- discuss the ethical issues associated with the use of new medical technologies
- demonstrate competence in measurement of length, volume and mass, and in calculations of magnifications, field diameters and estimations of dimension of structures in light microscopy.
- retrieve information from a variety of sources, collate information into succinct reports, communicate accurately and clearly, both orally and in writing
- interpret data presented in graphical and tabular form
- display an awareness of behaviours consistent with the prevention of infectious diseases.

Content

Introduction

Overview of the nature and scope of the subject of Human Biology. Cells carry out the life-sustaining processes of cellular respiration, synthesis and growth. Cells in complex multicellular organisms show specialisation and interdependence. Body systems operate together to supply the needs of cells.

Nervous and hormonal control

The concept of homeostasis. The need for steady-state control systems. Control mechanisms function at the level of cells, physiological systems and behaviour, and compensate for changes in the external or internal environment. The general components of steady-state control systems. The major divisions of the nervous system. The existence of receptors for external and internal stimuli, and the role of the senses such as hearing, balance and vision. Structure, function and defects of the eye and ear. The CNS, parts of the brain – cerebrum, cerebellum, hypothalamus, medulla, meninges – and their functions; the spinal cord and cerebrospinal fluid. The somatic and autonomic divisions of the peripheral nervous system, their roles and interrelationships, especially the relationship between the control centres of the medulla and the autonomic nervous system.

The neuron as the structural and functional unit of the nervous system – cell body, dendrites, axon, myelin sheath, nodes of Ranvier, motor end plate. Structure and function of receptor, connector and effector neurons. *Nerve impulse, electrical potential, ion imbalance, sodium pump, depolarisation, all-or-none law, transmission at the synapse, nerve 'poisons'.*

Parts of the brain and nerve pathways (names of nerves not required) in relation to the voluntary control of locomotion and object manipulation, and involuntary control of posture and balance.

Hormones – their secretion by endocrine glands, transport of, and target organ. Differences in the speed of transmission, specificity and persistence of action between hormones and nerves. Relationships between the hypothalamus, pituitary and other endocrine glands. Feedback loops as illustrated by regulation of basal metabolic rate (steady-state control) and the menstrual and ovarian cycles (cyclic control).

The general biological and social effects of chemicals as illustrated by alcohol, smoking, marijuana and heroin.

Cocaine, modern designer drugs, amphetamines, solvents.

Mental health – social, environmental and genetic contributing factors, stress and stress management.

Regulation

Regulation of cardiac output at rest and during exercise to supply the demands of muscle cells. Parasympathetic and sympathetic influences on the sino-atrial node under the control of the regulating centres of the medulla .

The role of the sinoatrial and atrioventricular nodes. Changes to, and regulation of, blood pressure during exercise. Artificial pacemakers.

The role of the medulla and concentrations of carbon dioxide and oxygen in the regulation of breathing. The dangers of hyperventilation.

The control of breathing during exercise. Sleep apnoea.

Regulation of blood sugar levels involving the liver, pancreas, insulin, glucagon, adrenalin and glycogen.

Heat generated by increased metabolic rate is dissipated under the control of sensors in the skin and hypothalamus, and the control centre of the brain stem. Conduction of excess heat to body surface by vasodilation of blood vessels, heat dissipation by radiation, convection, conduction, and evaporation of sweat. Vasoconstriction and shivering as responses to excessive heat loss.

Regulation of the composition of body fluids

The need for regulation of the composition of body fluids (pH, concentration of nutrients and wastes) to maintain the efficient functioning of cells. Nutrients, wastes and water move between cytoplasm and vascular fluids (plasma and lymph) via tissue fluids. These movements are due to pressure and concentration gradients. Excretion as removal of metabolic wastes, the role of the liver in deamination and the synthesis of urea. Gross structure of the kidney and relationships with the circulatory system, ureters, bladder, and urethra. Structure of the nephron-glomerulus, glomerular capsule, loop of Henle, convoluted tubules, collecting duct and blood supply. Filtration, active and passive reabsorption, active secretion. Differences in composition between plasma and urine. Regulation of water content by the thirst reflex and ADH.

Kidney malfunctions and treatment.

Prevention and control of infection

Pathogenic organisms and modes of transmission. Components of the protective system – skin and mucous membranes, lymph vessels and nodes, lymphocytes, B and T cells, phagocytes, tonsils, adenoids and thymus. The immune response, antigens, antibodies and their mode of action, phagocytosis. The effect of HIV on the immune system. The mechanism of immunisation. The action of antibiotics.

The immune response in relation to cancer, transplantation, and tissue matching, ethical issues.

Interferon. Histamine and the inflammatory response, allergies, hayfever, asthma.

Human populations

General objectives

On completion of this section of the course students should be able to:

- describe the interaction between genetic and environmental factors that determine the phenotype of an individual
- discuss the ways in which genotype affects phenotype for both monogenic and polygenic traits
- use pedigrees to predict the inheritance of human characteristics
- discuss the role of variation, isolation, migration, natural selection and random genetic drift in human evolution
- describe the temporal and geographic distribution, evolutionary trends in physical characteristics, cultures and lifestyles inferred for: the australopithecines, **Homo habilis, Homo erectus,** the neanderthals and **Homo sapiens**
- analyse evidence from fossils and comparative studies of living primates to evaluate several possible lines of human evolution
- flexibly revise explanations of human evolution as knowledge of evolutionary mechanisms and human pre-history increases
- discuss the possible adaptive significance of human physical and cultural variations
- display tolerance and understanding of physical and cultural differences between human populations
- describe the interacting factors that influence the growth of human populations
- discuss the effects of rapid human population growth on the availability of food, water, energy and other resources
- describe the factors that threaten the quality of the environment and the quality of life
- display positive attitudes towards conservation and protection of the environment
- analyse and interpret data presented in tabular and graphical form
- retrieve information from a variety of sources, collate information into succinct reports, communicate accurately and clearly, both orally and in writing.

Content

Genetics and mechanisms of evolution

Genetic and environmental influences on individuals. Sex determination. Pedigree construction and symbols used. Autosomal, X-linked, dominant, recessive, multiple alleles, co-dominance and polygenic modes of inheritance. Examples including Huntington disease, PKU, Duchenne muscular dystrophy, and skin colour (dihybrid crosses not required). Also ABO blood groups and the existence of other blood grouping systems.

Rhesus blood groups.

Bioethical issues related to eugenics. The historical development of evolutionary theory – Darwin, Wallace, Lamarck and Lyell.

The contributions of mutation, natural selection, isolation, random genetic drift and migration to changes in allele frequency and hence evolution.

The Hardy-Weinberg equilibrium.

Evidence for evolution – fossils, comparative studies of anatomy, DNA and proteins.

Human evolution

Fossils and fossilisation.

Age of the Earth, the timing and appearance of life, vertebrates, mammals, primates and hominids in the fossil record.

Geological time scales with an emphasis on the Cainozoic.

Principles of relative and absolute dating, stratigraphy, index fossils, radiocarbon dating.

Awareness of other dating techniques and the type of information they provide (detailed knowledge not required).

Comparative studies of pongids and hominids and their evolution.

Temporal and geographic distribution, physical characteristics, cultures and lifestyles inferred for: the australopithecines, **Homo habilis, Homo erectus,** the neanderthals and **Homo sapiens.**

Key physical and cultural trends in human evolution (bipedalism, reduction of teeth, enlargement of brain, development of tools, fire, shelter, art, religion and food acquisition up to and including the agricultural revolution).

Alternative lineages proposed for Homo sapiens *based on fossil evidence and on comparative studies of proteins in living primates.*

Cultural evolution from the agricultural revolution to the present.

Techniques of tool making.

Human variations and lifestyle

The concept of race in terms of the human need to sort and classify and the failure to recognise continuous variation. The misuse of the term race. Physical variation in terms of clines and possible adaptive significance of characteristics such as body form and skin colour.

Possible adaptive significance of different lifestyles such as agriculturalist, nomad, industrialist, hunter-gatherer.

The origin of human variation and modern populations.

Theories concerning Aboriginal settlement of Australia (memorisation of fossil sites not required).

The range of physical and cultural diversity amongst Aborigines. The impact of European settlement upon Aboriginal wellbeing and culture.

Human ecology

Birth, death and fertility rates as factors influencing population growth rate and size. The need and means of controlling population growth rate and size. Population trends in a variety of countries, demographic transition and impact on global population. The effects of increased population density, urbanisation and industrialisation on the global availability of food, water and energy and on environmental problems such as global warming, ozone depletion and water pollution.

Ways of acting locally to reduce environmental impact e.g. recycling, reducing pollution, controlling birth rate.

Environmental impact studies. The role of government and other organisations in limiting damage to ecosystems and promoting rehabilitation of damaged areas.

Natural disasters – earthquakes, floods, cyclones, fires and their effects on sanitation, food, communication, shelter and resources.

Time Allocation

The course has been designed to be completed through a structured education program of approximately 110 hours in any suitable contexts and series of learning experiences. Typically the course will be studied over the period of one school year. For administrative reasons schools wishing to vary this delivery pattern (e.g. over a shorter period or over a longer period up to two school years) are required to notify the Chief Executive Officer, Curriculum Council.

Subject Completion

Students must complete the school's structured educational and assessment program for a subject in order to be eligible to receive a grade unless there are exceptional and justifiable circumstances. In situations where the school considers that insufficient information has been gathered to justify the award of a grade for the subject, a result of U (for unfinished) should be allocated. The Curriculum Council offers the flexibility for the U to be converted to a grade after the final grades have been submitted. Further details on assessment and grading are provided in Volume I of the Syllabus Manuals.

Resources

Note 1: In view of the rapidly changing information in the field of Human Evolution, the Examining Panel and the Syllabus Committee most strongly recommend that teachers consult text or website materials published since 2000 for the Human Evolution section of the course.

Note 2: The resources in this list were available at the time of printing, but please be aware that their subsequent availability cannot be guaranteed.

Note 3: '(OP)' identifies resources that are out of print but still valuable if teachers can locate them in their department or library.

Textbooks

No one text covers the syllabus comprehensively or with the desired emphasis in all sections. The books listed below may be regarded as basic general texts suitable for significant parts of the course.

Criddle, R.A., *Human Biology for the 1990s, Book 2*, Bookland, Perth, 1990.**(OP)**

Harrison, J., *Our Human Species*, Ecopress, 1996.

Harrison, J., *Science Skills for Senior Students*, Ecopress, 1993.

Newton, T.J., and Joyce, A.P., *Human Perspectives, Book 2*, (3rd ed.), McGraw-Hill, Sydney, 1995.

Newton, T.J., and Joyce, A.P., *The Essential Dictionary of Human Biology*, McGraw-Hill, Sydney, 1996.

Laboratory Manuals

Anderson, K.C., and Mars, R., *Designing Science Experiments*, (2nd ed.), Bio Publishers, 1994.

Deleuil, L.S., (ed.), *Human Biology Laboratory Manual*, (Year 12) (3rd ed.), Science Teachers' Association of WA, Perth, 1992.

Teacher References

Marieb, E.N., *Human Anatomy and Physiology*, (4th ed.), Benjamin Cummings, Redwood City, California. 1997.

Martini, F.H., *Fundamentals of Anatomy and Physiology*, (4th ed.), Prentice Hall, New Jersey, 1997.

Relethford, *Human Species*,

Tanner, N., *On Becoming Human*,

Weiss, M.L., and Mann, A.E., *Human Biology and Behaviour* (5th ed.), Addison Wesley Longman, New York, 1990.

http://www.indiana.edu/~origins/

http://www.leeds.ac.uk/chb/h1060.html

http://www.mnsu.edu/emuseum/biology/humanevolution/index.shtml

Supplementary

Note: References suitable for students are marked with an asterisk to distinguish them from teacher references. Many of the titles designated as teacher references contain sections which are suitable as student library reference material. Pamphlets produced by government departments and other community agencies are an additional source of student references.

Control of the Body

Ornstein, R., Thompson, R.F., Macaulay, D., Ornstein, R.E., *The Amazing Brain*, Houghton Mifflin Co., 1991.

*Public Health Department of Western Australia, *The Moderate Drinkers Guide*, Government Printer, Perth.**(OP)**

*Vander, A., Sherman, J., Luciano, D., *Human Physiology: The Mechanisms of Body Function*, WCB/McGraw-Hill, 1997.

Human Populations

Boyd, R., and Silk, J., *How Humans Evolved*, Norton Press, 2003.

*Larsen, C.S., *Human Origins : The Fossil Record*, Waveland Press, 1998.

Leakey, R.E. and Lewin, R., *Origins Reconsidered : In Search of What Makes Us Human*, Little Brown and Company, London, 1992.

Stringer, C. and McKie, R., *African Exodus: The Origins of Modern Humanity*, Henry Holt & Co. Inc., 1998.

*http://www.animalomnibus.com/primates.htm

http://www.anth.ucsb.edu/projects/human/

*http://www.anthro.palomar.edu/vary/vary_3.htm

hhtp://www.archeologyinfo.com/

*http://www.austmus.gov.au/human_evolution

*http://www.austmus.gov.au/human_evolution/skulls/a_affarensis.htm

http://www.becominghuman.org/

http://www.mnh.si.edu/anthro/humanorigins/ha/ances_start.html

http://www.nhm.ac.uk/paleontology/v&a/cbs/evolution.html

*http://www.onelife.com/evolve.manev.html

*http://www.talkorigins.org/faqs/homs/

http://science.uniserve.edu.au/school/curric/stage6/biol/humnstor_evolution

Examination Details

The examination will consist of one written paper of three hours duration.

Part One: multiple choice questions (40%).

Part Two: short answer questions (40%).

Part Three: extended answer questions (20%).
Candidates will have to answer one question from the *Control of the Body* section of the syllabus (Section A) and one question from the *Human Populations* section of the syllabus (Section B).

Resources:

- Candidates will need a 2B, B or HB pencil for answering multiple choice questions.
- Calculators satisfying the conditions set by the Curriculum Council for this subject, which are listed on the Curriculum Council website: www.curriculum.wa.edu.au/pages/student/calculators.htm

Note: This examination will aim to test achievement in core objectives of the subject. Non-core content and other material that is not included in the syllabus will not be assessed but may form the context of questions that assess core objectives.

Assessment Structure

Assessment structures are an integral part of all Accredited Courses.

The structure specifies:

1. the components and learning outcomes to be included in assessment
2. weightings to be applied to these components
3. the types of assessment considered appropriate for the course.

Table 1

Syllabus Content	Weighting percentage
Control of the body	45-55
Human populations	45-55
Core content	80-90
Non-core content	10-20

Table 2

Learning Outcomes	Weighting percentage
Content knowledge	60-70
Science process skills	20-30
Sensorimotor skills	5-10

Table 3

Types of Assessment	Weighting percentage
Examinations	30-50
Topic/section tests	20-40
Practical tests	5-10
Other assessment techniques e.g. laboratory reports, assignments, oral presentations etc.	20-30

The assessment program must provide students with the opportunity to demonstrate achievement of the requirements of the course.
and
students must complete the requirements of the course.

Notes on Table 1

Both core and non-core content are to be assessed in the school assessments. Only core content is assessed in the TEE external examination.

Notes on Table 2

Content Knowledge

This includes students' ability to recall, explain, analyse, apply, evaluate and synthesise knowledge of the facts, concepts, propositions and theories outlined in the syllabus.

Science process skills

Science process skills are the intellectual skills associated with observing, recording, presenting and interpreting data, designing controlled experiments, information retrieval, report writing and communicating ideas orally and in writing as outlined in the syllabus.

Sensori-motor skills

Sensori-motor skills are the manipulative skills associated with measurement, and microscopy as outlined in the syllabus.

Notes on Table 3

Examinations and topic tests

Examinations and tests should include items from the full range of levels in Bloom's taxonomy. An appropriate balance of test items would be:

Knowledge and comprehension	60-70
Application, analysis, synthesis and evaluation	30-40

Grade-Related Descriptors

Grade-Related Descriptors describe the student performance standards that are used to award grades in this subject. Schools delivering this subject have been provided with a copy of the document. Additional copies may be purchased from the Curriculum Council.