Government of Western Australia
School Curriculum and Standards Authority

HUMAN BIOLOGY

ATAR COURSE

Year 12 syllabus

Acknowledgement of Country

Kaya. The School Curriculum and Standards Authority (the Authority) acknowledges that our offices are on Whadjuk Noongar boodjar and that we deliver our services on the country of many traditional custodians and language groups throughout Western Australia. The Authority acknowledges the traditional custodians throughout Western Australia and their continuing connection to land, waters and community. We offer our respect to Elders past and present.

Important information

This syllabus is effective from 1 January 2024.

Users of this syllabus are responsible for checking its currency.

Syllabuses are formally reviewed by the School Curriculum and Standards Authority (the Authority) on a cyclical basis, typically every five years.

Content

Rationale

Human biology covers a wide range of ideas relating to the functioning human. Students learn about themselves, relating structure to function and how integrated regulation allows individuals to survive in a changing environment. They research new discoveries that are increasing our understanding of the causes of dysfunction, which can lead to new treatments and preventative measures. Reproduction is studied to understand the sources of variation that make each of us unique individuals. Through a combination of classical genetics, and advances in molecular genetics, dynamic new biotechnological processes have resulted. Population genetics is studied to highlight the longer term changes leading to natural selection and evolution of our species.

As a science, the subject matter of this course is founded on knowledge and understanding that has been gained through systematic inquiry and scientific research. However, this knowledge is far from complete and is being modified and expanded as new discoveries and advancements are made. Students develop their understanding of the cumulative and evolving nature of scientific knowledge and the ways in which such knowledge is obtained through scientific investigations. They learn to think critically, to evaluate evidence, to solve problems and to communicate understandings in scientific ways.

An understanding of human biology is valuable for a variety of career paths. The course content deals directly and indirectly with many different occupations in fields, such as science education, medical and paramedical fields, food and hospitality, childcare, sport and social work. Appreciation of the range and scope of such professions broadens their horizons and enables them to make informed choices. This helps to prepare all students, regardless of their background or career aspirations, to take their place as responsible citizens in society.

Course outcomes

The Human Biology ATAR course is designed to facilitate achievement of the following outcomes.

Outcome 1 – Science Inquiry Skills

Students investigate questions in human biology, evaluate the impacts of advancements in human biology and communicate scientific understandings.

In achieving this outcome, students:

- plan and conduct investigations
- analyse data, draw conclusions, evaluate investigation design and findings
- evaluate the impact of advancements in human biology on individuals and society
- communicate understandings of human biology.

Outcome 2 – Science as a Human Endeavour

Students explore the application of the knowledge and understanding of human biological systems in a wide range of real world contexts.

In achieving this outcome, students:

- understand that knowledge of human biological systems has developed over time and continues to develop with improving technology
- understand how scientists use knowledge of human biological systems in a wide range of applications
- understand how knowledge of human biological systems influences society in local, regional and global contexts.

Outcome 3 – Science Understanding

Students understand how the structure and function of the human body maintain homoeostasis, and the importance of inheritance and its interrelationships with human variability and evolution.

In achieving this outcome, students:

- understand structure and function in the body
- understand inheritance in humans
- understand how the body maintains homeostasis
- understand human variability and evolution.

Organisation

This course is organised into a Year 11 syllabus and a Year 12 syllabus. The cognitive complexity of the syllabus content increases from Year 11 to Year 12.

Structure of the syllabus

The Year 12 syllabus is divided into two units which are delivered as a pair. The notional time for the pair of units is 110 class contact hours.

Unit 3 – Homeostasis and disease

This unit explores the nervous and endocrine systems and the mechanisms that help maintain the systems of the body to function within normal range, and the body's immune responses to invading pathogens.

Unit 4 – Human variation and evolution

This unit explores the variations in humans, their changing environment and evolutionary trends in hominids.

Each unit includes:

- a unit description – a short description of the focus of the unit
- unit content – the content to be taught and learned.

Organisation of content

Science strand descriptions

The Human Biology ATAR course has three interrelated strands: Science Inquiry Skills, Science as a Human Endeavour and Science Understanding, which build on students' learning in the Year 7–10 Science curriculum. The three strands of this course should be taught in an integrated way. The content descriptions for Science Inquiry Skills, Science as a Human Endeavour and Science Understanding have been written so that this integration is possible in each unit.

Science Inquiry Skills

Science inquiry involves identifying and posing questions; planning, conducting and reflecting on investigations; processing, analysing and interpreting data; and communicating findings. This strand is concerned with evaluating claims, investigating ideas, solving problems, reasoning, drawing valid conclusions, and developing evidence-based arguments.

Science investigations are activities in which ideas, predictions or hypotheses are tested and conclusions are drawn in response to a question or problem. Investigations can involve a range of activities, including experimental testing, field work, locating and using information sources, conducting surveys, and using modelling and simulations.

In science investigations, the collection and analysis of data to provide evidence play a major role. This can involve collecting or extracting information and reorganising data in the form of tables, graphs, flow charts, diagrams, text, keys, spread sheets and databases.

The analysis of data to identify and select evidence, and the communication of findings, involve the selection, construction and use of specific representations, including mathematical relationships, symbols and diagrams.

Through the Human Biology ATAR course, students will continue to develop their science inquiry skills, building on the skills acquired in the Year 7–10 Science curriculum. Each unit provides specific skills to be taught. These specific skills align with the Science Understanding and Science as a Human Endeavour content of the unit.

Science as a Human Endeavour

Through science, we seek to improve our understanding and explanations of the natural world. The Science as a Human Endeavour strand highlights the development of science as a unique way of knowing and doing, and explores the use and influence of science in society.

As a science, human biology involves the construction of explanations based on evidence. The development of science concepts, models and theories is dynamic and involves critique and uncertainty. Science concepts, models and theories are reviewed as their predictions and explanations are continually re-assessed through new evidence, often through the application of new technologies. This review process involves a diverse range of scientists working within an increasingly global community of practice and can involve the use of international conventions and activities such as peer review.

The use and influence of science are shaped by interactions between science and a wide range of social, economic, ethical and cultural factors. The application of science may provide great benefits to individuals, the community and the environment, but may also pose risks and have unintended consequences. As a result, decision making about socio-scientific issues often involves consideration of multiple lines of evidence and a range of stakeholder needs and values. As an ever-evolving body of knowledge, science frequently informs public debate, but is not always able to provide definitive answers.

Science Understanding

Science understanding is evident when a person selects and integrates appropriate science concepts, models and theories to explain and predict phenomena, and applies those concepts, models and theories to new situations. Models in science can include diagrams, physical replicas, mathematical representations, word-based analogies (including laws and principles) and computer simulations. Development of models involves selection of the aspects of the system(s) to be included in the model, and thus models have inherent approximations, assumptions and limitations.

The Science Understanding content in each unit develops students' understanding of the key concepts, models and theories that underpin the subject, and of the strengths and limitations of different models and theories for explaining and predicting complex phenomena.

Safety

Science learning experiences may involve the use of potentially hazardous substances and/or hazardous equipment. It is the responsibility of the school to ensure that duty of care is exercised in relation to the health and safety of all students and that school practices meet the requirements of the *Work Health and Safety Act 2011*, in addition to relevant state or territory health and safety guidelines.

Animal ethics

Through a consideration of research ethics as part of Science Inquiry Skills, students will examine their own ethical position, draw on ethical perspectives when designing investigation methods, and ensure that any activities that impact on living organisms comply with the *Australian code of practice for the care and use of animals for scientific purposes* (www.nhmrc.gov.au).

Any teaching activities that involve the care and use of, or interaction with, animals must comply with the *Australian code of practice for the care and use of animals for scientific purposes*, in addition to relevant State guidelines.

Mathematical skills expected of students studying the Human Biology ATAR course

The Human Biology ATAR course requires students to use the mathematical skills they have developed through the Year 7–10 Mathematics curriculum, in addition to the numeracy skills they have developed through the Science Inquiry Skills strand of the Year 7–10 Science curriculum.

Within the Science Inquiry Skills strand, students are required to gather, represent and analyse numerical data to identify the evidence that forms the basis of scientific arguments, claims or conclusions. In gathering and recording numerical data, students are required to make measurements using appropriate units to an appropriate degree of accuracy.

Students may need to be taught when it is appropriate to join points on a graph and when it is appropriate to use a line of best fit. They may also need to be taught how to construct a straight line that will serve as the line of best fit for a set of data presented graphically.

It is assumed that students will be able to competently:

- perform calculations involving addition, subtraction, multiplication and division of quantities
- perform approximate evaluations of numerical expressions
- express fractions as percentages, and percentages as fractions
- calculate percentages
- recognise and use ratios
- transform decimal notation to power of ten notation
- comprehend and use the symbols/notations <, >, Δ, ≈
- translate information between graphical, numerical and algebraic forms
- distinguish between discrete and continuous data and then select appropriate forms, variables and scales for constructing graphs
- construct and interpret frequency tables and diagrams, pie charts and histograms
- describe and compare data sets using mean, median and inter-quartile range
- interpret the slope of a linear graph.

Representation of the general capabilities

The general capabilities encompass the knowledge, skills, behaviours and dispositions that will assist students to live and work successfully in the twenty-first century. Teachers may find opportunities to incorporate the capabilities into the teaching and learning program for the Human Biology ATAR course. The general capabilities are not assessed unless they are identified within the specified unit content.

Literacy

Literacy is important in students' development of Science Inquiry Skills and their understanding of content presented through the Science Understanding and Science as a Human Endeavour strands. Students gather, interpret, synthesise and critically analyse information presented in a wide range of genres, modes and representations (including text, flow diagrams, symbols, graphs and tables). They evaluate information sources and compare and contrast ideas, information and opinions presented within and between texts. They communicate processes and ideas logically and fluently and structure evidence-based arguments, selecting genres and employing appropriate structures and features to communicate for specific purposes and audiences.

Numeracy

Numeracy is key to students' ability to apply a wide range of Science Inquiry Skills, including making and recording observations; ordering, representing and analysing data; and interpreting trends and relationships. They employ numeracy skills to interpret complex spatial and graphic representations, and to appreciate the ways in which human biological systems are structured, interact and change across spatial and temporal scales. They engage in analysis of data, including issues relating to reliability and probability, and they interpret and manipulate mathematical relationships to calculate and predict values.

Information and communication technology capability

Information and communication technology (ICT) capability is a key part of Science Inquiry Skills. Students use a range of strategies to locate, access and evaluate information from multiple digital sources; to collect, analyse and represent data; to model and interpret concepts and relationships; and to communicate and share science ideas, processes and information. Through exploration of Science as a Human Endeavour concepts, students assess the impact of ICT on the development of science and the application of science in society, particularly with regard to collating, storing, managing and analysing large data sets.

Critical and creative thinking

Critical and creative thinking is particularly important in the science inquiry process. Science inquiry requires the ability to construct, review and revise questions and hypotheses about increasingly complex and abstract scenarios and to design related investigation methods. Students interpret and evaluate data; interrogate, select and cross-reference evidence; and analyse processes, interpretations, conclusions and claims for validity and reliability, including reflecting on their own processes and conclusions. Science is a creative endeavour and students devise innovative solutions to problems, predict possibilities, envisage consequences and speculate on possible outcomes as they develop Science Understanding and Science Inquiry Skills. They also appreciate the role of critical and creative individuals and the central importance of critique and review in the development and innovative application of science.

Personal and social capability

Personal and social capability is integral to a wide range of activities in human biology. Students develop and practise skills of communication, teamwork, decision-making, initiative-taking and self-discipline with increasing confidence and sophistication. In particular, students develop skills in both independent and collaborative investigation; they employ self-management skills to plan effectively, follow procedures efficiently and work safely; and they use collaboration skills to conduct investigations, share research and discuss ideas. In considering aspects of Science as a Human Endeavour, students also recognise the role of their own beliefs and attitudes in their response to science issues and applications, consider the perspectives of others, and gauge how science can affect people’s lives.

Ethical understanding

Ethical understanding is a vital part of science inquiry. Students evaluate the ethics of experimental science, codes of practice, and the use of scientific information and science applications. They explore what integrity means in science, and they understand, critically analyse and apply ethical guidelines in their investigations. They consider the implications of their investigations on others, the environment and living organisms. They use scientific information to evaluate the claims and actions of others and to inform ethical decisions about a range of social, environmental and personal issues and applications of science.

Intercultural understanding

Intercultural understanding is fundamental to understanding aspects of Science as a Human Endeavour, as students appreciate the contributions of diverse cultures to developing science understanding, and the challenges of working in culturally diverse collaborations. They develop awareness that raising some debates within culturally diverse groups requires cultural sensitivity, and they demonstrate open-mindedness to the positions of others. Students also develop an understanding that cultural factors affect the ways in which science influences and is influenced by society.

Representation of the cross-curriculum priorities

The cross-curriculum priorities address contemporary issues which students face in a globalised world. Teachers may find opportunities to incorporate the priorities into the teaching and learning program for the Human Biology ATAR course. The cross-curriculum priorities are not assessed unless they are identified within the specified unit content.

Aboriginal and Torres Strait Islander histories and cultures

Contexts that draw on Aboriginal and Torres Strait Islander histories and cultures provide opportunities for students to recognise the importance of Aboriginal and Torres Strait Islander Peoples’ knowledge in developing a richer understanding of ancient inhabitants of Australia. Students could develop an appreciation of the traditional hunter gatherer lifestyle of Aboriginal and Torres Strait Islander Peoples and their impact on the environment. They could examine the ways in which the environment and cultural practices, such as standards stipulating marriage between people of different skin groups have, in turn influenced the genetic integrity of groups, especially in isolated communities, and led to changes in physical, behavioural and physiological features of the Aboriginal and Torres Strait Islander Peoples over tens of thousands of years. The ways in which these features have changed over time to help them successfully survive in the varying environment will be considered in this course.

Asia and Australia's engagement with Asia

Contexts that draw on Asian scientific research and development, and collaborative endeavours in the Asia Pacific region, provide an opportunity for students to investigate Asia and Australia’s engagement with Asia. Students could examine the important role played by people of the Asia region in such areas as medicine, biomechanics and biotechnology. They could consider collaborative projects between Australian and Asian scientists and the contribution these make to scientific knowledge.

Sustainability

The Sustainability cross-curriculum priority is not explicitly addressed in the Human Biology ATAR course. Human biology provides authentic contexts for exploring, investigating and understanding the function and interactions of human body systems across a range of spatial and temporal scales. By investigating the relationships between the systems and system components of the human body, and how systems respond to change, students develop an appreciation for the interconnectedness of the human body to the biosphere, hydrosphere and atmosphere.

Students appreciate that the study of human biology provides the basis for decision making in many areas of society and that these decisions can impact the Earth system. They understand the importance of using science to predict possible effects of an altered environment on the human body, and to develop management plans or alternative technologies that minimise these effects and provide for a more sustainable future.

Unit 3 – Homeostasis and disease

Unit description

This unit explores the nervous and endocrine systems and the mechanisms that help maintain the systems of the body to function within normal range, and the body's immune responses to invading pathogens.

The complex interactions between body systems in response to changes in the internal and external environments facilitate the maintenance of optimal conditions for the functioning of cells. Feedback systems involving the autonomic nervous system, the endocrine system and behavioural mechanisms maintain the internal environment for body temperature, body fluid composition, blood sugar and gas concentrations within tolerance limits. The structure and function of the endocrine system, including the glands, hormones, target organs and modes of action, can demonstrate the many interactions that enable the maintenance of optimal cellular conditions. The structure and function of the autonomic nervous system, and its relationship with other parts of the nervous system, can be linked to the roles each play in maintaining homeostasis of internal environmental conditions. Comparing and contrasting the endocrine and nervous systems can highlight the roles of each in homeostasis. Humans can intervene to treat homeostatic dysfunction and influence the quality of life for individuals and families.

Different body systems have mechanisms, including physical and chemical barriers that protect the body against invasion by pathogens. The non-specific actions of the body can be aided by the use of antibiotics and antiviral drugs to counter the invasion or reduce the effect of the pathogen. Specific resistance mechanisms involve the recognition of invading pathogens and produce long-lasting immunity. Vaccinations can result in immunity to infection by exposure to attenuated versions of the pathogens.

Unit content

An understanding of the Year 11 content is assumed knowledge for students in Year 12. It is recommended that students studying Unit 3 and Unit 4 have completed Unit 1 and Unit 2.

This unit includes the knowledge, understandings and skills described below. This is the examinable content.

Science Inquiry Skills

- identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes
- design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics
- conduct investigations safely, competently and methodically for the collection of valid and reliable data
- represent data in meaningful and useful ways, including the use of mean, median, range and probability; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental accuracy, the nature of the procedure and the sample size may influence limitations in data; and select, synthesise and use evidence to make and justify conclusions
- interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence, and use reasoning to construct scientific arguments

- select, use and/or construct appropriate representations, including diagrams, models and flow charts, to communicate conceptual understanding, solve problems and make predictions.
- communicate to specific audiences, and for specific purposes, using appropriate language, nomenclature, genres and modes, including scientific reports

Science as a Human Endeavour

- synthetic hormones may be developed to control or treat endocrine dysfunction, including diabetes mellitus, hypothyroidism and hyperthyroidism, to improve the quality of life for individuals
- gene therapy can be used to treat a range of diseases, including diabetes mellitus
- hormones and vaccines can be developed using recombinant DNA technology
- the decision to participate in immunisation programs can be influenced by the social, economic and cultural context in which it is considered
- cell replacement therapy has the potential to treat nervous system disorders including Alzheimer's and Parkinson's diseases

Science Understanding

Endocrine system

- the hypothalamus, pituitary, thyroid, parathyroid, pancreas, thymus, gonads, pineal and adrenal glands, are endocrine glands found in the human body
- hormones secreted from the hypothalamus, pituitary, thyroid, parathyroid, pancreas and adrenal glands are involved in homeostasis by affecting specific target organs
- the secretions of the pituitary gland are controlled by the hypothalamus through transport of hormones, either via nerve cells or the vascular link between them
- hormones can be lipid-soluble and able to cross cell membranes to bind with and activate intracellular receptors or, water-soluble and able to bind with and activate receptors on cell membranes, and require secondary messengers to affect cell functioning

Central and peripheral nervous system

- structure and function of the divisions of the nervous system can be observed and compared at different levels in detecting and responding to the changes in the internal and external environments including:
  - central-peripheral
  - afferent-efferent
  - autonomic-somatic
  - sympathetic-parasympathetic
- the parts of the central nervous system, including the brain (cerebrum, cerebellum, medulla oblongata, hypothalamus, corpus callosum) and spinal cord, have specific roles in the co-ordination of body functions and are protected by the bones of the skull, the meninges and cerebro-spinal fluid
- different receptors detect changes in the internal and external environments, including thermoreceptors, osmoreceptors, chemoreceptors and receptors for touch and pain

- the reflex arc comprises of specially structured neurons, including sensory, interneuron and motor neurons, to transmit information from the receptor to the effector to respond rapidly to stimuli
- transmission of nerve impulses is via electro-chemical changes that occur at the generation of the impulse, the propagation of the impulse along the nerve fibre, and the transfer of the impulse across the synapse
- the nervous and endocrine systems work together to co-ordinate functions of all body systems, but differ in terms of:
  - speed of action
  - duration of action
  - nature and transmission of the message
  - specificity of message

Homeostasis

- homeostatic processes involve nerves and hormones in maintaining the body's internal environment within tolerance limits through the control of metabolism and physiological and behavioural activities
- thermoregulation occurs by the control of heat exchange and metabolic activity through physiological and behavioural mechanisms
- blood sugar levels are maintained by controlling of sugar uptake, its storage and release by cells and use in metabolism; these processes involve the hormones of the pancreas and adrenal glands
- body fluid concentrations are maintained by balancing water and salts via the skin, digestive system and the kidneys, which involve the actions of antidiuretic hormone (ADH) and aldosterone on the nephron, and the thirst reflex
- gas concentrations are controlled by balancing the intake of oxygen and the removal of carbon dioxide via the lungs, through the actions of the medulla oblongata and the autonomic nervous system

Response to infection

- infectious diseases caused by invasion of pathogens in the form of viruses and bacteria can be transmitted from one host to another
- transmission of pathogens occurs by various mechanisms, including through:
  - direct and indirect contact
  - transfer of body fluids
  - disease-specific vectors
  - contaminated food and water

- the body's external defence mechanisms against pathogens include features of the:
  - skin
  - digestive tract
  - urogenital tract
  - respiratory system
  - the ear
  - the eye
- pathogens that enter the body are targeted by non-specific immune responses of inflammation and fever
- antiviral and antibiotic drugs are used for treating infections and differ in their specificity to pathogens
- passive immunity can be acquired as antibodies gained through the placenta, or antibody serum injections; active immunity can be acquired through natural exposure to the pathogen, or the use of vaccines
- immunity is gained through the exposure to specific antigens by the production of antibodies by B lymphocytes and the provision of cell-mediated immunity by T lymphocytes; in both cases memory cells are produced

Unit 4 – Human variation and evolution

Unit description

This unit explores the variations in humans in their changing environment and evolutionary trends in hominids.

Humans can show multiple variations in characteristics due to the effect of polygenes or gene expression. The changing environment can influence the survival of genetic variation through the survival of individuals with favourable traits. Gene pools are affected by evolutionary mechanisms, including natural selection, migration and chance occurrences. Population gene pools vary due to interaction of reproductive and genetic processes and the environment. Over time, this leads to evolutionary changes. Gene flow between populations can be stopped or reduced by barriers. Separated gene pools can undergo changes in allele frequency, due to natural selection and chance occurrences, resulting in speciation and evolution. Evidence for these changes comes from fossils and comparative anatomy and biochemical studies.

A number of trends appear in the evolution of hominids and these may be traced using phylogenetic trees. The selection pressures on humans have changed due to the control humans have over the environment and survival.

Unit content

This unit includes the knowledge, understandings and skills described below. This is the examinable content.

Science Inquiry Skills

- identify, research and construct questions for investigation; propose hypotheses; and predict possible outcomes
- design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics
- conduct investigations safely, competently and methodically for valid and reliable collection of data
- represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; discuss the ways in which measurement error, instrumental accuracy, the nature of the procedure and sample size may influence limitations in data; and select, synthesise and use evidence to make and justify conclusions
- interpret a range of scientific and media texts, and evaluate models, processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments
- select, use and/or construct appropriate representations, including diagrams, models and flow charts, to communicate conceptual understanding, solve problems and make predictions
- communicate to specific audiences, and for specific purposes, using appropriate language, nomenclature, genres and modes, including scientific reports

Science as a Human Endeavour

- developments in biotechnology, for example polymerase chain reaction (PCR), gel electrophoresis and DNA sequencing, have increased access to genetic information of species and provide evidence for evolution (the process of obtaining a DNA sequence is not required)
- developments in the fields of comparative biochemistry (including DNA and protein sequences) and bioinformatics have enabled identification of further evidence for evolutionary relationships, which help refine existing models and theories

Science Understanding

Mutations

- mutations in genes and chromosomes can result from errors in DNA replication, cell division or from damage caused by mutagens
- different genotypes produce a variety of phenotypes, which are acted on differently by factors in the environment, producing different rates of survival
- mutations are the ultimate source of variation introducing new alleles into a population: new alleles may be favourable or unfavourable to survival

Gene pools

- populations can be represented as gene pools that reflect the frequency of alleles of a particular gene; gene pools can be used to compare populations at different times or locations
- gene pools are dynamic, with changes in allele frequency caused by:
  - mutations
  - differing selection pressures
  - random genetic drift, including the founder effect
  - changes in gene flow between adjoining groups
- the incidence of genetic diseases in particular populations illustrates the effects of different factors on the dynamics of gene pools; for example, sickle-cell anaemia
- natural selection occurs when factors in the environment confer a selective advantage on specific phenotypes to enhance survival and reproduction
- the mechanisms underpinning the theory of evolution by natural selection include inherited variation, struggle for existence, isolation and differential selection, producing changes to gene pools to such an extent that speciation occurs

Evidence for evolution

- evolutionary relationships between groups can be represented using phylogenetic trees (construction of phylogenetic trees not required)
- the fossil record is incomplete and cannot represent the entire biodiversity of a time or a location due to many factors that affect fossil formation, the persistence of fossils and accessibility to fossilised remains
- sequencing a fossil record requires a combination of relative and absolute dating techniques to locate fossils onto the geological timeline

- both relative dating techniques, including stratigraphy and index fossils, and absolute dating techniques, including radiocarbon dating and potassium-argon dating, have limitations of application

Hominid evolutionary trends

- humans as primates are classified as great apes. The species within the great ape family are differentiated by DNA nucleotide sequences, which brings about differences in:
  - relative size of cerebral cortex
  - mobility of the digits
  - stance and locomotion – adaptations to bipedalism, brachiation and quadrupedalism
  - prognathism and dentition
- determining relatedness and possible evolutionary pathways for hominins uses evidence from comparisons of modern humans and the other great apes with fossils of:
  - *Australopithecus afarensis*
  - *Australopithecus africanus*
  - *Paranthropus robustus*
  - *Homo habilis*
  - *Homo erectus*
  - *Homo neanderthalensis*
  - *Homo sapiens*
- tool use is seen in a number of hominin species and the study of these tools provides important insight into the evolution of the human cognitive abilities and lifestyles. Trends are seen in the changes in manufacturing techniques and the materials used in the tool cultures of:
  - *Homo habilis*
  - *Homo erectus*
  - *Homo neanderthalensis*
  - *Homo sapiens*

School-based assessment

The *Western Australian Certificate of Education (WACE) Manual* contains essential information on principles, policies and procedures for school-based assessment that needs to be read in conjunction with this syllabus.

Teachers design school-based assessment tasks to meet the needs of students. The table below provides details of the assessment types for the Human Biology ATAR Year 12 syllabus and the weighting for each assessment type.

Assessment table – Year 12

Type of assessment	Weighting
Science inquiry Science inquiry involves identifying and posing questions; planning, conducting and reflecting on investigations; processing, analysing and interpreting data; and communicating findings. It is concerned with evaluating claims, investigating ideas, solving problems, reasoning, drawing valid conclusions, and/or developing evidence-based arguments. Students must complete at least one investigation over the year/pair of units. **Practical** Practical work can involve a range of activities, such as practical tests; modelling and simulations; qualitative and/or quantitative analysis of second-hand data; and brief summaries of practical activities. **Investigation** Investigations are more extensive activities, which can include experimental testing; conducting surveys; and/or comprehensive scientific reports.	10%
Extended response Tasks requiring an extended response can involve selecting and integrating appropriate science concepts, models and theories to explain and predict phenomena, and applying those concepts, models and theories to new situations; interpreting scientific and/or media texts and evaluating processes, claims and conclusions by considering the quality of available evidence; and/or using reasoning to construct scientific arguments. Assessment can take the form of answers to specific questions based on individual research; exercises requiring analysis; and interpretation and evaluation of information in scientific journals, media texts and/or advertising.	15%
Test Tests typically consist of multiple choice questions and questions requiring short and extended answers. They should be designed so that students can apply their understanding and skills in human biology to analyse, interpret, solve problems and construct scientific arguments.	25%
Examination Typically conducted at the end of each semester and/or unit, and reflecting the examination design brief for this syllabus.	50%

Teachers are required to use the assessment table to develop an assessment outline for the pair of units.

The assessment outline must:

- include a set of assessment tasks
- include a general description of each task
- indicate the unit content to be assessed
- indicate a weighting for each task and each assessment type
- include the approximate timing of each task (for example, the week the task is conducted, or the issue and submission dates for an extended task).

In the assessment outline for the pair of units, each assessment type must be included at least once over the year/pair of units.

The set of assessment tasks must provide a representative sampling of the content for Unit 3 and Unit 4.

Appropriate strategies should be used to authenticate student achievement for tasks that have been completed out of class or as part of a group.

Grading

Schools report student achievement in terms of the following grades:

Grade	Interpretation
A	Excellent achievement
B	High achievement
C	Satisfactory achievement
D	Limited achievement
E	Very low achievement

The teacher prepares a ranked list and assigns the student a grade for the pair of units. The grade is based on the student's overall performance as judged by reference to a set of pre-determined standards. These standards are defined by grade descriptions and annotated work samples. The grade descriptions for the Human Biology ATAR Year 12 syllabus are provided in Appendix 1. They can also be accessed, together with annotated work samples, through the Guide to Grades link on the course page of the Authority website at www.scsa.wa.edu.au.

To be assigned a grade, a student must have had the opportunity to complete the education program, including the assessment program (unless the school accepts that there are exceptional and justifiable circumstances).

Refer to the *WACE Manual* for further information about the use of a ranked list in the process of assigning grades.

ATAR course examination

All students enrolled in the Human Biology ATAR Year 12 course are required to sit the ATAR course examination. The examination is based on a representative sampling of the content for Unit 3 and Unit 4. Details of the ATAR course examination are prescribed in the examination design brief on the following page.

Refer to the *WACE Manual* for further information.

Examination design brief – Year 12

Time allowed

Reading time before commencing work: ten minutes
Working time for paper: three hours

Permissible items

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: up to three calculators, which do not have the capacity to create or store programmes or text, are permitted in this ATAR course examination

Section	Supporting information
Section One **Multiple-choice** 30% of the total examination 30 questions Suggested working time: 40 minutes	Questions can require the candidate to refer to the stimulus material that can include: text, diagrams, second-hand data and/or graphs.
Section Two **Short answer** 50% of the total examination 6–10 questions Suggested working time: 90 minutes	Each question is divided into parts. Typically, the parts within a question are of increasing difficulty. Questions can require the candidate to refer to the stimulus material that can include: text, diagrams, second-hand data and/or recent research material.
Section Three **Extended answer** 20% of the total examination **Unit 3** One question from a choice of two **Unit 4** One question from a choice of two Suggested working time: 50 minutes	Questions can require the candidate to refer to the stimulus material that can include: text, diagrams, second-hand data and/or recent research findings. The candidate's responses can include clearly labelled diagrams with explanatory notes; lists of points with linking sentences; clearly labelled tables and graphs; and/or annotated flow diagrams with supporting notes.

Appendix 1 – Grade descriptions Year 12

A	**Understanding and applying concepts** Applies models and scientific principles to comprehensively explain and link complex systems and processes. Supports responses with a range of appropriate examples and accurate diagrams. Accurately applies scientific knowledge to explain, in detail, unfamiliar contexts or examples. Selects and accurately evaluates scientific information from a variety of sources to present logical, well-developed reasons or arguments which are supported by relevant, detailed evidence. Interprets information to describe trends or relationships in detail. Makes accurate predictions. Interprets data and diagrams accurately. Describes complex relationships between data and concepts using appropriate terminology and conventions. Solves calculations accurately using appropriate conventions and presents working in a clear logical manner.
	Science inquiry skills Formulates a testable hypothesis that clearly states the relationship between dependent and independent variables. Designs investigations to identify and control appropriate variables, describes the experimental method in detail and accurately collects data. Organises data logically and accurately processes data. Presents data in a range of forms, including graphs, tables and charts to show patterns and relationships. Comprehensively explains trends using numerical data, where appropriate, and uses evidence to draw conclusions that support or refute the hypothesis. Evaluates the experimental method and provides specific relevant suggestions to improve the validity and reliability of the data collected. Communicates detailed information and concepts logically and clearly, using appropriate scientific language and conventions.

B	**Understanding and applying concepts** Applies models and scientific principles to accurately explain and link simple, and some complex, systems and processes. Supports responses with appropriate examples and accurate diagrams. Applies scientific knowledge to explain unfamiliar contexts or examples, sometimes omitting detail. Selects and evaluates scientific information from a variety of sources to present logical reasons or arguments which are supported by relevant evidence. Interprets information to describe trends or relationships and makes predictions. Interprets most data and diagrams accurately. Describes relationships between data and concepts using appropriate terminology and conventions. Solves calculations with minor errors and presents working in a logical manner, using appropriate conventions.
	Science inquiry skills Formulates a testable hypothesis that states the relationship between dependent and independent variables. Designs investigations to identify and control appropriate variables, describes the experimental method and accurately collects data. Organises data logically and usually processes data accurately. Presents data in a range of forms, including graphs, tables and charts to show patterns and relationships. Explains trends using some numerical data, where appropriate, and uses evidence to draw conclusions that support or refute the hypothesis. Evaluates the experimental method and provides relevant suggestions to improve the validity and reliability of the data collected. Communicates information and concepts clearly, using appropriate scientific language and conventions.

C	**Understanding and applying concepts** Applies models and scientific principles to describe simple systems and processes. Provides examples in some responses and draws diagrams that may contain minor inaccuracies or omissions. Provides responses to unfamiliar contexts which are generic and may lack specific application of scientific knowledge. Selects some scientific information to provide generalised arguments or statements supported by some evidence. Responses may lack detail and include irrelevant information. Interprets information to describe simple trends or relationships. Interprets some data and diagrams accurately. Describes simple relationships between data and concepts using appropriate terminology and conventions. Calculations may contain errors. Presents working which may be unclear. Appropriate conventions may be omitted.
	Science inquiry skills Formulates a testable hypothesis that links the dependent and independent variables. Designs investigations to identify and control some variables, briefly outlines the experimental method and collects data. Organises and processes data with some errors or omissions. Presents data using basic tables and appropriate graphs. Describes trends in the data and draws simple conclusions that may not be linked back to the hypothesis. Provides general suggestions to improve the investigation. Communicates information and concepts, without detail, using some appropriate terminology and conventions.

D	**Understanding and applying concepts** Applies some scientific concepts correctly to describe systems and processes. Inconsistently applies scientific knowledge to unfamiliar contexts. Presents statements of ideas with limited development of an argument. Provides limited supporting evidence. Responses may contain multiple errors, inconsistencies or misconceptions. Attempts to interpret information and identify relationships. Interpretation of data and diagrams is limited. Describes some simple relationships between data and concepts, using inappropriate terminology or every-day language. Calculations may be incomplete and contain multiple errors. Working is often omitted.
	Science inquiry skills Identifies one or more relevant variables without making links between them. Identifies a limited number of controlled variables. May not distinguish between the dependent, independent and controlled variables. Describes an experimental method which may lack detail. May present data that is unclear, insufficient and lacks appropriate processing. Identifies some trends in the data correctly. Offers simple conclusions that are not always supported by the data or may not be linked to the hypothesis. Provides suggestions that may not improve the investigation. Communicates information using everyday language with some errors in the use of conventions.

E	Does not meet the requirements of a D grade and/or has completed insufficient assessment tasks to be assigned a higher grade.

Appendix 2 – Glossary

This glossary is provided to enable a common understanding of the key terms in this syllabus.

Accuracy
The extent to which a measurement result represents the quantity it purports to measure; an accurate measurement result includes an estimate of the true value and an estimate of the uncertainty.

Animal ethics
Consideration of respectful, fair and just treatment of animals. The use of animals in science involves consideration of replacement (substitution of insentient materials for conscious living animals), reduction (using only the minimum number of animals to satisfy research statistical requirements) and refinement (decrease in the incidence or severity of 'inhumane' procedures applied to those animals that still have to be used).

Biotechnology
The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for human purposes.

Comparative genomics
The study and comparison of the genome sequences of different species; comparative genomics enables identification of genes that are conserved or common among species, as well as genes that give each organism its unique characteristics.

Data
The plural of datum; the measurement of an attribute, for example, the volume of gas or the type of rubber. This does not necessarily mean a single measurement: it may be the result of averaging several repeated measurements. Data may be quantitative or qualitative and be from primary or secondary sources.

Evidence
In science, evidence is data that is considered reliable and valid and which can be used to support a particular idea, conclusion or decision. Evidence gives weight or value to data by considering its credibility, acceptance, bias, status, appropriateness and reasonableness.

Field work
Observational research undertaken in the normal environment of the subject of the study.

Genre
The categories into which texts are grouped; genre distinguishes texts on the basis of their subject matter, form and structure (for example, scientific reports, field guides, explanations, procedures, biographies, media articles, persuasive texts, narratives).

Hypothesis
A scientific statement based on the available information that can be tested by experimentation. When appropriate, the statement expresses an expected relationship between the independent and dependent variables for observed phenomena.

Investigation
A scientific process of answering a question, exploring an idea or solving a problem, that requires activities, such as planning a course of action, collecting data, interpreting data, reaching a conclusion and communicating these activities. Investigations can include observation, research, field work, laboratory experimentation and manipulation of simulations.

Law
A statement describing invariable relationships between phenomena in specified conditions, frequently expressed mathematically.

Measurement error
The difference between the measurement result and a currently accepted or standard value of a quantity.

Media texts
Spoken, print, graphic or electronic communications with a public audience. Media texts can be found in newspapers, magazines and on television, film, radio, computer software and the internet.

Mode
The various processes of communication – listening, speaking, reading/viewing and writing/creating.

Model
A representation that describes, simplifies, clarifies or provides an explanation of the workings, structure or relationships within an object, system or idea.

Primary data
Data collected directly by a person or group.

Primary source
Report of data created by the person or persons directly involved in observations of one or more events, experiments, investigations or projects.

Reliable data
Data that has been judged to have a high level of reliability; reliability is the degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute, achieving similar results for the same population.

Reliability
The degree to which an assessment instrument or protocol consistently and repeatedly measures an attribute, achieving similar results for the same population.

Representation
A verbal, visual, physical or mathematical demonstration of understanding of a science concept or concepts. A concept can be represented in a range of ways and using multiple modes.

Research
To locate, gather, record, attribute and analyse information in order to develop understanding.

Research ethics
Norms of conduct that determine ethical research behaviour; research ethics are governed by principles, such as honesty, objectivity, integrity, openness and respect for intellectual property and include consideration of animal ethics.

Risk assessment (in the school/agricultural college context)
Evaluations performed to identify, assess and control hazards in a systematic way that is consistent, relevant and applicable to all school activities. Requirements for risk assessments related to particular activities will be determined by jurisdictions, schools or teachers as appropriate.

Secondary data
Data collected by a person or group other than the person or group using the data.

Secondary source
Information that has been compiled from records of primary sources by a person or persons not directly involved in the primary event.

Simulation
A representation of a process, event or system which imitates a real or idealised situation.

System
A group of interacting objects, materials or processes that form an integrated whole. Systems can be open or closed.

Theory
A set of concepts, claims and/or laws that can be used to explain and predict a wide range of related observed or observable phenomena. Theories are typically founded on clearly identified assumptions, are testable, produce reproducible results and have explanatory power.

Uncertainty
Range of values for a measurement result, taking account of the likely values that could be attributed to the measurement result, given the measurement equipment, procedure and environment.

Validity
The extent to which tests measure what was intended; the extent to which data, inferences and actions produced from tests and other processes are accurate.