Government of **Western Australia**
School Curriculum and Standards Authority

HUMAN BIOLOGY

ATAR COURSE

Year 11 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 2023.

Users of this syllabus are responsible for checking its currency.

Syllabuses are formally reviewed by the School Curriculum and Standards 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 11 syllabus is divided into two units, each of one semester duration, which are typically delivered as a pair. The notional time for each unit is 55 class contact hours.

Unit 1 – The functioning human body

In this unit, students analyse how the structure and function of body systems, and the interrelationships between systems, support metabolism and body functioning.

Unit 2 – Reproduction and inheritance

In this unit, students study the reproductive systems of males and females, the mechanisms of transmission of genetic material from generation to generation, and the effects of the environment on gene expression.

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 8th edition 2013* (www.nhmrc.gov.au/guidelines/publications/ea28).

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 8th edition 2013,* in addition to relevant state guidelines.

The Animal Welfare Act 2002 can be found at www.slp.wa.gov.au. The related animal welfare regulations, along with the licences required for the use and supply of animals, can be downloaded from www.dlg.wa.gov.au.

Information regarding the care and use of animals in Western Australian schools and agricultural colleges can be viewed at www.det.wa.edu.au/curriculumsupport/animalethics/detcms/portal/.

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.

Progression from the Year 7–10 curriculum

This syllabus continues to develop student understanding and skills from across the three strands of the Year 7–10 Science curriculum. In the Science Understanding strand, human biology draws on knowledge and understanding from the sub-strand of Biological sciences in Years 7, 8, 9 and 10 and Chemical sciences in Year 10.

In particular, this syllabus continues to develop the key concepts introduced in the Biological Sciences sub-strand, that is, that a diverse range of living things have evolved on Earth over hundreds of millions of years, that living things are interdependent and interact with each other and their environment, and that the form and features of living things are related to the functions their systems perform.

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 1 – The functioning human body

Unit description

This unit looks at how human structure and function supports cellular metabolism and how lifestyle choices affect body functioning.

Cells are the basic structural and functional unit of the human body. Cells contain structures that carry out a range of functions related to metabolism, including anabolic and catabolic reactions. Materials are exchanged in a variety of ways within and between the internal and external environment to supply inputs and remove outputs of metabolism. Metabolic activity requires the presence of enzymes to meet the needs of cells and the whole body. The respiratory, circulatory, digestive and excretory systems control the exchange and transport of materials in support of metabolism, particularly cellular respiration. The structure and function of the musculo-skeletal system provides for human movement and balance as the result of the co-ordinated interaction of the many components for obtaining the necessary requirements for life.

Students investigate questions about problems associated with factors affecting metabolism. They trial different methods of collecting data, use simple calculations to analyse data and become aware of the implications of bias and experimental error in the interpretation of results. They are encouraged to use ICT to interpret and communicate their findings in a variety of ways.

Unit content

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

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; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error and limitations in data; and select, synthesise and use evidence to make and justify conclusions
- interpret a range of scientific and media texts, and evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments
- select, construct and use appropriate representations, including labelled diagrams and images of various cells, tissues and organ systems, 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

- blood transfusions rely on determining blood groups (ABO and Rhesus), and can be used to treat many different diseases and conditions
- treatment of conditions due to system or organ dysfunction has changed through improvements in early diagnosis and appropriate use of drugs, physical therapy, and removal and/or replacement of affected parts
- osteoporosis and osteoarthritis are diseases, primarily of ageing, that cause disability. Increased understanding of the causes of these conditions leads to improved practices for management and prevention
- lifestyle choices, including being active or sedentary, the use of drugs and type of diet, can compromise body functioning in the short term and may have long-term consequences

Science Understanding

Cells and tissues

- the human body is comprised of cells, tissues and organs within complex systems that work together to maintain life
- cell organelles maintain life processes and require the input of materials and the removal of wastes to support efficient functioning of the cell
- the cell membrane separates the cell from its surroundings with a structure, described by the fluid mosaic model, which allows for the movement of materials into and out of the cell by osmosis, simple diffusion, facilitated diffusion, active transport and vesicular transport (endocytosis/exocytosis)
- factors affecting the exchange of materials across the cell membrane include surface area to volume ratio, concentration gradients, and the physical and chemical nature of the materials being exchanged
- the various tissues of the human body perform specific functions and can be categorised into four basic tissue types: epithelial, connective, muscular and nervous

Metabolism

- biochemical processes, including anabolic and catabolic reactions in the cell, are controlled in the presence of specific enzymes
- cellular respiration occurs, in different locations in the cytosol and mitochondria, to catabolise organic compounds, aerobically or anaerobically, to store energy in the form of adenosine triphosphate (ATP)
- for efficient metabolism, cells require oxygen and nutrients, including carbohydrates, proteins, lipids, vitamins and minerals
- enzyme function can be affected by factors including pH, temperature, presence of inhibitors, co-enzymes and co-factors, and the concentration of reactants and products

Respiratory system

- the exchange of gases between the internal and external environments of the body is facilitated by the structure and function of the respiratory system at the cell, tissue and organ levels
- the efficient exchange of gases in the lungs is maintained by the actions of breathing, blood flow and the structure of the alveoli

Circulatory system

- the transport of materials within the internal environment for exchange with cells is facilitated by the structure and function of the circulatory system at the cell, tissue and organ levels
- the components of blood facilitate the transport of different materials around the body (plasma and erythrocytes), play a role in the clotting of blood (platelets) and the protection of the body (leucocytes)
- the lymphatic system functions to return tissue fluid to the circulatory system and to assist in protecting the body from disease

Digestive system

- the supply of nutrients in a form that can be used in cells is facilitated by the structure and function of the digestive system at the cell, tissue and organ levels
- digestion involves the breakdown of large molecules to smaller ones by mechanical digestion (teeth, peristalsis, churning and bile) and chemical digestion (by enzymes with distinctive operating conditions and functions that are located in different sections of the digestive system)
- the salivary glands, pancreas, liver and gall bladder produce or store secretions which aid the processes of digestion
- absorption requires nutrients to be in a form that can cross cell membranes into the blood or lymph and occurs at different locations, including the small intestine and large intestine
- elimination removes undigested materials and some metabolic wastes from the body

Musculoskeletal system

- the muscular system is organised to maintain posture and produce movement; muscle fibre contraction can be explained using the sliding filament theory
- movement results from the actions of paired muscles, with others acting as stabilisers, to produce the required movement
- the skeletal framework of the body consists of bone and cartilage which function to provide body support, protection and movement, and is facilitated by the structure and function at cell and tissue levels
- articulations of joints of the skeleton are classified according to their structure or the range of movements permitted

Excretory system

- the excretory system regulates the chemical composition of body fluids by removing metabolic wastes and regulating water, salts, and nutrients (regulatory processes not required)
- deamination of amino acids in the liver produces urea, which then is transported to the kidneys for removal
- the nephrons in the kidney facilitate three basic processes: filtration, reabsorption and secretion during urine formation to maintain the composition of body fluids (hormone control is not required)

Unit 2 – Reproduction and inheritance

Unit description

This unit provides opportunities to explore, in more depth, the mechanisms of transmission of genetic materials to the next generation, the role of males and females in reproduction, and how interactions between genetics and the environment influence early development. The cellular mechanisms for gamete production and zygote formation contribute to human diversity. Meiosis and fertilisation are important in producing new genetic combinations.

The transfer of genetic information from parents to offspring involves the replication of deoxyribonucleic acid (DNA), meiosis and fertilisation. The reproductive systems of males and females are differentially specialised to support their roles in reproduction, including gamete production and facilitation of fertilisation. The female reproductive system also supports pregnancy and birth. Reproductive technologies can influence and control the reproductive ability in males and females. Cell division and cell differentiation play a role in the changes that occur between the time of union of male and female gametes and birth. Disruptions to the early development stages can be caused by genetic and environmental factors: inheritance can be predicted using established genetic principles. The testing of embryos, resulting from assisted reproductive technologies, is conducted for embryo selection, and the detection of genetic disease. The application of technological advances and medical knowledge has consequences for individuals and raises issues associated with human reproduction.

Students investigate an aspect of a given problem and trial techniques to collect a variety of quantitative and qualitative data. They apply simple mathematical manipulations to quantitative data, present it appropriately, and discuss sources and implications of experimental error. They also consider the limitations of their procedures and explore the ramifications of results that support or disprove their hypothesis. They are encouraged to use ICT in the analysis and interpretation of their data and presentation of their findings.

Unit content

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

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; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error and limitations in data; and select, synthesise and use evidence to make and justify conclusions
- interpret a range of scientific and media texts, and evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments

- select, construct and use appropriate representations, including models of DNA replication, transcription and translation, Punnett squares, pedigrees and karyotypes, 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

- the use of genetic screening to assess the risk of inherited disorders has implicit ethical considerations
- discoveries made through the use of modern biotechnological techniques have increased understanding of DNA and gene expression
- greater understanding of the menstrual cycle, conception and implantation has produced improved methods of the establishment of a pregnancy, along with advancements in contraceptive methods; both have ethical considerations
- new technologies, including the cervical screening test, breast screening and blood tests for prostate cancer, have made early detection of cancers possible
- lifestyle choices, including diet, illicit drugs, alcohol and nicotine, may affect foetal development

Science Understanding

DNA

- DNA occurs bound to proteins in chromosomes in the nucleus and as unbound DNA in the mitochondria
- DNA stores the information for the production of proteins that determines the structure and function of cells
- the structural properties of the helical DNA molecule, including double-stranded, nucleotide composition and weak bonds involved in base pairing between the complementary strands, allow for its replication
- protein synthesis involves the transcription of a gene on DNA into messenger RNA in the nucleus, and translation into an amino acid sequence at the ribosome with the aid of transfer RNA
- epigenetics is the study of phenotypic expression of genes, which depends on the factors controlling transcription and translation during protein synthesis, the products of other genes, and the environment

Cell reproduction

- mitosis forms part of the cell cycle producing new cells with the same genetic content
- the sequence of DNA replication, chromosome duplication and chromosome separation are important processes in the production of identical daughter cells by mitosis for growth, repair and replacement of tissues within the body
- stem cells have the ability to divide by mitosis and differentiate into many different tissues, depending on the level of cell potency
- uncontrolled division of cells can result in the development of tumours/cancers
- meiosis produces gametes for reproduction and involves DNA replication, chromosome pairing, and two successive nuclear divisions distributing haploid sets of chromosomes to each gamete
- crossing over, non-disjunction and random assortment of chromosomes during meiosis will produce gametes with different genetic content

- differences between mitosis and meiosis reflect their roles in the body
- variations in the genotypes of offspring, including gender, arise as a result of the processes of meiosis and fertilisation

Human reproduction

- the production of offspring is facilitated by the structure and function of the male and female reproductive systems in producing and delivering gametes for fertilisation and providing for the developing embryo and foetus
- both male and female reproductive systems are regulated by hormones, including the regulation of the menstrual and ovarian cycles
- human gametes are produced through spermatogenesis and oogenesis, which are specific forms of meiosis, but varying significantly in process and products
- for the establishment of a pregnancy, conception requires the union of viable sperm and ovum at the optimal time in the ovarian cycle
- the development of the embryo after implantation involves the differentiation of cells into three different germ layers that will eventually produce specific systems in the body and the placenta
- the stages of labour include birth, during which there are circulatory system changes in the child
- contraception methods that reduce the probability of the union of gametes or implantation all have limitations, risks and benefits, and include methods that:
  - use fertility awareness
  - use steroid hormones
  - use physical barriers between gametes
  - use chemical spermicides
  - use sterilisation (tubal ligation, vasectomy)
  - function after coitus (emergency contraceptive pill and intrauterine devices [IUDs]).
- Sexually transmitted infections (STIs), diseases transmitted through unprotected sex or genital contact, can be prevented through safe sex methods; early detection and treatment of infection are important and, if left untreated, STIs can lead to serious health consequences
- there are a variety of assisted reproductive technologies to help overcome infertility problems, but each has its limitations, risks and benefits
- there are a range of techniques available to screen embryos before implantation or during early development, including blood tests, ultrasound, amniocentesis and chorionic villi sampling

Types of inheritance

- probable frequencies of genotype and phenotype of offspring can be predicted using Punnett squares and by taking into consideration patterns of inheritance, including the effects of dominance, co-dominance, autosomal or sex-linked alleles, and multiple alleles: Huntington's disease, phenylketonuria (PKU), ABO blood groups, red–green colour blindness/haemophilia show different inheritance patterns
- pedigree charts can be constructed for families with a particular genetic disorder and can be used to reveal patterns of inheritance and assist in determining the probability of inheriting the condition in future generations

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 11 syllabus and the weighting for each assessment type.

Assessment table – Year 11

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 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/or brief summaries of practical activities. **Investigation** Investigations are more extensive activities, which can include experimental testing; conducting surveys; and/or comprehensive scientific reports.	20%
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 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. In preparation for Unit 3 and Unit 4, the examination should reflect the examination design brief included in the ATAR Year 12 syllabus for this course.	40%

Teachers are required to use the assessment table to develop an assessment outline for the pair of units (or for a single unit where only one is being studied).

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 twice. In the assessment outline where a single unit is being studied, each assessment type must be included at least once.

The set of assessment tasks must provide a representative sampling of the content for Unit 1 and Unit 2.

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 (or for a unit where only one unit is being studied). 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 11 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.

Appendix 1 – Grade descriptions Year 11

A	**Understanding and applying concepts** Applies scientific concepts to accurately explain and link complex processes in detail. Applies models to explain processes in detail, using supporting examples and diagrams where appropriate. Accurately applies scientific knowledge to unfamiliar contexts or examples. Analyses issues and presents well-developed arguments which are supported by evidence. Accurately interprets data and diagrams. Describes complex relationships between data and concepts using appropriate terminology and conventions. Performs calculations accurately using correct units.
	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 in detail and accurately collects data. Processes data accurately and provides relevant suggestions to improve the validity and reliability of the investigation. Organises data logically, and correctly presents it in a range of forms, including graphs, tables and charts to reveal patterns and relationships. Comprehensively explains trends using numerical data and uses evidence to draw conclusions that relate to the hypothesis. Communicates detailed information and concepts logically and coherently, using correct terminology and appropriate conventions.

B	**Understanding and applying concepts** Applies scientific concepts to accurately explain and link simple, and some complex, processes. Applies models to explain processes using supporting examples and diagrams where appropriate. Applies scientific knowledge to unfamiliar contexts or examples, sometimes lacking detail. Presents well-developed arguments which are supported by evidence. Interprets most data and diagrams correctly. Describes relationships between data and concepts using appropriate terminology and conventions. Solves calculations with only minor inaccuracies.
	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. Processes data and suggests ways to improve the validity and reliability of the investigation. Presents data in a range of forms, including graphs, tables and charts to reveal patterns and relationships. Explains trends and uses evidence to draw conclusions that relate to the hypothesis. Communicates information and concepts logically, using correct terminology and appropriate conventions.

C	**Understanding and applying concepts** Applies scientific concepts to describe some systems and processes. Applies models to explain some processes using supporting examples and diagrams where appropriate. Applies scientific knowledge to some unfamiliar contexts or examples. Presents arguments or statements supported by some evidence. Develops responses which lack detail and may include irrelevant information. Interprets some data and diagrams correctly. Describes simple relationships between data and concepts using appropriate terminology and conventions. Solves calculations with only minor inaccuracies.
	Science inquiry skills Formulates a testable hypothesis that links dependent and independent variables. Designs investigations to identify and control some variables, briefly outlines the experimental method and collects data. Processes data and makes general suggestions for improving the investigation. Presents data using basic tables and graphs. Describes trends in the data and draws simple conclusions that may not be linked back to the hypothesis. Communicates information and concepts, without detail, using some correct terminology and appropriate conventions.

D	**Understanding and applying concepts** Incorrectly applies scientific concepts to describe systems and processes. Inconsistently applies models and includes some irrelevant or incorrect information. Inconsistently applies scientific knowledge to unfamiliar contexts. Presents statements of ideas with limited development of an argument. Makes little use of evidence. Includes several inaccuracies in the interpretation of data and diagrams. Incorrectly describes the relationships between data and concepts, using inappropriate terminology. Performs calculations with errors and omissions. Presents working out which does not use appropriate conventions.
	Science inquiry skills Identifies one or more relevant variables without making links between them. Identifies a limited number of controlled variables. Does not distinguish between the dependent, independent and controlled variables. Method lacks detail. Presents data that is unclear, insufficient and lacks appropriate processing. Identifies trends in the data incorrectly or overlooks trends. Offers simple conclusions that are not supported by the data or are not related to the hypothesis. Communicates information using everyday language with frequent 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.