Scope and Sequence

Human biology covers a wide range of ideas relating to the functioning human and how integrated regulation allows individuals to survive in a changing environment. New discoveries are increasing our understanding of the causes of dysfunction, leading to new treatments and preventative measures. Genetics, advances in molecular genetics and new biotechnological techniques contribute to a more informed view of the evolution of human beings.

Systematic inquiry and scientific research are the foundations for knowledge and understanding of human biology which is continually evolving. The ability to think critically, evaluate evidence and accurately communicate complex concepts to a variety of audiences is especially important.

The book is structured on the contents of Units 3 and 4 of the Australian Tertiary Admission Rank Human Biology syllabus as published by the School Curriculum and Standards Authority, Western Australia.

Science Inquiry Skills														
These skills are tested in part in the one or more activities at the end of each chapter	***Unit 3*** ***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*** ***This unit explores the variations in humans in their changing environment and evolutionary trends in hominids***						
Chapter	1	2	3	4	5	6	7	8	9	10	11	12	13	14
• identify, research and construct questions for investigation														
• propose hypotheses and predict possible outcomes														
• the type and amount of primary and/or secondary data to be collected														
• 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 the sample size may influence limitations in data
•	select, synthesise and use evidence to make and justify conclusions
•	interpret a range of scientific and media texts
•	evaluate models, processes claims and conclusion by considering the quality of available evidence
•	use reasoning to construct scientific arguments
•	select and use/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 models, including scientific reports.

Science as a Human Endeavour														
Chapter	1	2	3	4	5	6	7	8	9	10	11	12	13	14
• 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 and Parkinson diseases														
• 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														
• 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														
Chapter	1	2	3	4	5	6	7	8	9	10	11	12	13	14
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, 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

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														
• 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 time line														
• 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*														