Human Biology Exam Topics

**UNIT 3:**

**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](http://www.australiancurriculum.edu.au/Glossary?a=SSCSBI&t=Secondary%20data) to be collected; conduct risk assessments; and consider research ethics, including animal ethics
* conduct investigations, including the collection of data related to homeostasis and the use of models of disease transmission, 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 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 uncertainty 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 models, processes, claims and conclusions by considering the quality of available evidence, including interpreting confidence intervals in secondary data; 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 are developed using recombinant DNA and associated biotechnological techniques
* 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**

1. **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

1. **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 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

1. **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

1. **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](http://www.wikipedia.org/wiki/Antibiotic) drugs are used for treating [infections](http://www.wikipedia.org/wiki/Infection) 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:**

**Science Inquiry Skills (Identical to UNIT 3 except for the following dot point)**

* conduct investigations, including the use of virtual or real biotechnological techniques of polymerase chain reaction (PCR), gel electrophoresis for deoxyribonucleic acid (DNA)sequencing, and techniques for relative and absolute dating, safely, competently and methodically for valid and reliable collection of data

**Science as a Human Endeavour**

* developments in biotechnology have increased access to genetic information of species, populations and individuals, existing now or in the past, the interpretation and use of which may be open to ethical considerations
* developments in the fields of comparative genomics, comparative biochemistry 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, including the incidence of Tay-Sachs disease, thalassemia and 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**

* biotechnological techniques provide evidence for evolution by using PCR (to amplify minute samples of DNA to testable amounts), bacterial enzymes and gel electrophoresis to facilitate DNA sequencing of genomes
* comparative studies of DNA (genomic and mitochondrial), proteins and anatomy, provide additional evidence for evolution; genomic information enables the construction of phylogenetic trees showing evolutionary relationships between groups
* 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 in the same taxonomic family as the great apes. The species within the family are differentiated by DNA nucleotide sequences, which brings about differences in:
  + - relative size of cerebral cortex
    - mobility of the digits
    - locomotion – adaptations to bipedalism and quadrupedalism
    - prognathism and dentition
* determining relatedness and possible evolutionary pathways for hominids uses evidence from comparisons of modern humans and the 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 hominid 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*
    - *Home sapien*