



SAMPLE COURSE OUTLINE

BIOLOGY
ATAR YEAR 12

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Sample course outline

Biology – ATAR Year 12

Unit 3 and Unit 4

Science Inquiry Skills align with the Science Understanding and Science as a Human Endeavour content of the unit and are integrated into the learning experiences.

- 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, including animal ethics
- conduct investigations, including the use of probabilities to predict inheritance patterns, real or virtual gel electrophoresis, and population simulations to predict population changes, 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 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; and use reasoning to construct scientific arguments
- select, construct and use appropriate representations, including models of DNA replication, transcription and translation, Punnett squares and allele frequencies in gene pools, 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

Semester 1 – Continuity of species

Week	Key teaching points
1	<p>Heredity</p> <ul style="list-style-type: none"> • DNA is a helical double-stranded molecule that occurs bound to proteins in chromosomes in the nucleus, and as unbound circular DNA in the cytosol of prokaryotes, and in mitochondria and chloroplasts of eukaryotic cells • the structural properties of the DNA molecule, including nucleotide composition and pairing and the hydrogen bonds between strands of DNA, allow for replication • select, construct and use appropriate representations, including models of DNA replication, to communicate conceptual understanding, solve problems and make predictions (SIS) • the genetic code is a base triplet code; genes include 'coding' and 'non-coding' DNA, and many genes contain information for protein production
2	<ul style="list-style-type: none"> • continuity of life requires the replication of genetic material and its transfer to the next generation through processes, including binary fission, mitosis, meiosis and fertilisation
3	<ul style="list-style-type: none"> • protein synthesis involves transcription of a gene into messenger RNA in the nucleus, and translation into an amino acid sequence at the ribosome • proteins including enzymes and structural proteins are essential to cell structure and

Week	Key teaching points
	<ul style="list-style-type: none"> functioning the phenotypic expression of genes depends on the interaction of genes and the environment
4–5	<ul style="list-style-type: none"> recombinant DNA technology and DNA identification technologies are applied in agriculture and environmental conservation transgenic organisms have been engineered for desirable traits – resistance, growth rate, product quality and yield, tolerance to adverse conditions DNA sequencing enables mapping species genomes; DNA profiling identifies the unique genetic makeup of individual conduct investigations, including real or virtual gel electrophoresis, safely, competently and methodically for the collection of valid and reliable data (SIS)
6	<ul style="list-style-type: none"> variations in the genotype of offspring arise as a result of the processes of meiosis, including crossing over and random assortment of chromosomes, fertilisation and mutations mutations in genes and chromosomes can result from errors in DNA replication or cell division, or from damage by physical or chemical factors in the environment
7–8	<ul style="list-style-type: none"> frequencies of genotypes and phenotypes of offspring are determined by patterns of inheritance, including dominance, autosomal and sex-linked alleles, multiple alleles and polygenes conduct investigations, including the use of probabilities to predict inheritance patterns, safely, competently and methodically for the collection of valid and reliable data (SIS) select, construct and use appropriate representations, including Punnett squares, to communicate conceptual understanding, solve problems and make predictions (SIS) <p>Task 1: Heredity – 40-minute test</p>
9–10	<p>Continuity of life on Earth</p> <ul style="list-style-type: none"> life has existed on Earth for approximately 3.5 billion years and has changed and diversified over time evidence for the theory of evolution includes <ul style="list-style-type: none"> comparative genomics (molecular evidence) the fossil record comparative anatomy and embryology technological developments in the fields of comparative genomics, comparative biochemistry and bioinformatics have enabled identification of further evidence for evolutionary relationships <p>Task 2: Fossils and evolution – In-class assessment based on research on fossils and evolution.</p>
11–12	<ul style="list-style-type: none"> evolutionary relationships between groups can be represented using phylogenetic trees mutation is the ultimate source of genetic variation as it introduces new alleles into a population natural selection occurs when selection pressures in the environment confer a selective advantage on a specific type of phenotype to enhance its survival and reproduction; this results in changes in allele frequency in the gene pool of a population select, construct and use appropriate representations, including allele frequencies in gene pools, to communicate conceptual understanding, solve problems and make predictions (SIS) in addition to environmental selection pressures, sexual selection, mutation, gene flow and genetic drift can contribute to changes in allele frequency in the gene pool of a population conduct investigations, including population simulations to predict population changes, safely, competently and methodically for the collection of valid and reliable data <p>Task 3: Practical – Changing a gene pool. A scientific report based on developing and conducting a simulation game with two sets of rules</p>
13	<ul style="list-style-type: none"> speciation and macro-evolutionary changes result from an accumulation of micro-evolutionary changes over time differing selection pressures between geographically isolated populations may lead to allopatric speciation

Week	Key teaching points
	<ul style="list-style-type: none"> selective breeding (artificial selection) through the intentional reproduction of individuals with desirable characteristics results in changes in allele frequencies in the gene pools over time
14	<ul style="list-style-type: none"> populations with reduced genetic diversity face increased risk of extinction using transgenic organisms may have adverse effects on genetic diversity and the environment <ul style="list-style-type: none"> the effects on non-target organisms more rapid evolution of pesticide-resistant species the possibility of gene flow from crop species to weed species resulting in the emergence of 'super weeds' biotechnology can be used in environmental conservation for <ul style="list-style-type: none"> monitoring endangered species assessing gene pools for breeding programs quarantine conservation planning to maintain viable gene pools includes consideration of <ul style="list-style-type: none"> biogeography reproductive behaviour population dynamics <p>Task 4: Continuity of life on Earth – 40-minute test</p>
15	Task 5: Semester 1 Examination

Semester 2 – Surviving in a changing environment

Week	Key teaching points
1–3	<p>Homeostasis</p> <ul style="list-style-type: none"> homeostasis is the process by which the body maintains a relatively constant internal environment; it involves a stimulus-response model in which change in external or internal environmental conditions is detected and appropriate responses occur via negative feedback changes in an organism's metabolic activity, in addition to structural features and changes in physiological processes and behaviour, enable the organism to maintain its internal environment within tolerance limits (temperature, nitrogenous waste, water, salts, and gases) thermoregulatory mechanisms include structural features, behavioural responses and physiological mechanisms to control heat exchange and metabolic activity; animals can be endothermic or ectothermic <p>Task 6: Investigation – Temperature regulation in animals – an investigation into thermoregulatory mechanisms</p>
4–5	<ul style="list-style-type: none"> the type of nitrogenous waste produced by different vertebrate groups can be related to the availability of water in the environment animals have a variety of behavioural, physiological and structural adaptations to maintain water and salt balance in terrestrial and aquatic environments
6–7	<ul style="list-style-type: none"> to maintain water balance and allow for gas exchange, xerophytes and halophytes have a variety of structural and physiological adaptations <p>Task 7: Homeostasis – 40-minute test</p>
8	<p>Infectious disease</p> <ul style="list-style-type: none"> infectious disease differs from other disease in that it is caused by invasion by a pathogen and can be transmitted from one host to another zoonoses, such as influenza, can be transmitted between vertebrate species the major groups of organisms that cause disease are bacteria, fungi, protists and viruses; each group can be distinguished by its structural characteristics the spread of a specific disease involves a range of interrelated factors, including <ul style="list-style-type: none"> growth of the pathogen population density of the host population mode of transmission

Week	Key teaching points
	<ul style="list-style-type: none"> susceptibility of urban areas to epidemics and pandemics of infectious disease can be due to population density, variation in living conditions and healthcare provisions Activity: http://www.csiro.au/helix/science/activities/infection.html
9	<ul style="list-style-type: none"> diseases caused by these major pathogen groups include <ul style="list-style-type: none"> tuberculosis, tetanus, crown gall of plants contemporary models can project the spread of disease and simulate the effects of possible interventions. Supercomputing has enabled models to predict the relationships between epidemic frequency and location, and factors such as population size, environmental change, persistence and antibiotic resistance conduct investigations, including population simulations to predict population changes, safely, competently and methodically for the collection of valid and reliable data Task 8: Practical – Modelling an outbreak of a disease. The Nuffield Foundation, Spread of infectious diseases http://www.nuffieldfoundation.org/science-society/activities-infectious-diseases-now
10	<ul style="list-style-type: none"> diseases caused by these major pathogen groups include <ul style="list-style-type: none"> amphibian chytrid fungus Task 9: Amphibian chytrid fungus disease – an extended response consisting of one week of research, followed by an in-class validation based on the research
11	<ul style="list-style-type: none"> diseases caused by these major pathogen groups include <ul style="list-style-type: none"> malaria, <i>Phytophthora</i> dieback disease
12	<ul style="list-style-type: none"> diseases caused by these major pathogen groups include <ul style="list-style-type: none"> influenza, Ross River virus, viral disease of honeybees, Australian bat lyssavirus
13	<ul style="list-style-type: none"> the distribution of mosquito-borne diseases may be affected by global climatic changes many pathogens evolve rapidly in a changing environment international cooperation and communication are needed to evaluate the risk of a spread of disease, including the emergence of new viral diseases
14	<ul style="list-style-type: none"> management strategies are used to control the spread of infectious diseases, including <ul style="list-style-type: none"> quarantine immunisation – herd immunity disruption of pathogen life cycle medications – antibiotics and antivirals physical preventative measures quarantine measures protect Australia’s agriculture industry and environment against the influx of disease-carrying materials and organisms in the face of increasing global trade and travel Task 10: Infectious disease – 40-minute test
15	Task 11: Semester 2 Examination