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

SAMPLE COURSE OUTLINE

BIOLOGY
ATAR YEAR 11

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Sample course outline

Biology – ATAR Year 11

Unit 1 – Ecosystems and biodiversity

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 using ecosystem surveying techniques (quadrats, line transects and capture-recapture) 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 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 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 classification keys, food webs and biomass pyramids, 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

Week	Key teaching points
1	**Describing biodiversity** • biodiversity includes the diversity of genes, species and ecosystems; measures of biodiversity rely on classification and are used to make comparisons across spatial and temporal scales • *Australia's Biodiversity Conservation Strategy 2010–2030* presents a long-term view of the future and the actions that need to be implemented to conserve biodiversity
2–3	• biological classification is hierarchical and based on molecular sequences, different levels of similarity of physical features and methods of reproduction • classification systems are based on international conventions and are subject to change through debate and resolution; changes are based on all currently available evidence • biological classification systems reflect evolutionary relatedness between groups of organisms • most common definitions of species rely on morphological or genetic similarity or the ability to interbreed to produce fertile offspring in natural conditions – but in all cases, exceptions are found • select, construct and use appropriate representations, including classification keys, to communicate conceptual understanding, solve problems and make predictions (SIS) • conduct investigations, including using ecosystem surveying techniques (quadrats, line transects and capture-recapture) safely, competently and methodically for the collection of valid and reliable data **Start Task 1: Environmental investigation – The effect of fire on ecosystems**. Research and plan

Week	Key teaching points
	an investigation; collect data using biological field techniques; collate the data, analyse the results and write a scientific report in class under supervision.
4–5	• ecosystems are diverse, composed of varied habitats, consisting of a range of biotic and abiotic factors, and can be described in terms of their component species, species interactions and the abiotic factors that make up the environment • in addition to biotic factors, abiotic factors, including climate and substrate, can be used to describe and classify environments
6–8	• relationships and interactions within a species and between species in ecosystems include predation, competition, symbiosis (mutualism, commensalism and parasitism), collaboration and disease **Task 2: Test – Describing biodiversity**
9–10	**Ecosystem dynamics** • the biotic components of an ecosystem transfer and transform energy, originating primarily from the sun, and matter to produce biomass; and interact with abiotic components to facilitate biogeochemical cycling, including carbon and nitrogen cycling; these interactions can be represented using food webs and biomass pyramids
11–13	• species or populations, including those of microorganisms, fill specific ecological niches; the competitive exclusion principle postulates that no two species can occupy the same niche in the same environment for an extended period of time • the dynamic nature of populations influence population size, density, composition and distribution • ecosystems have carrying capacities that limit the number of organisms (within populations) they support, and can be impacted by changes to abiotic and biotic factors, including climatic events • contemporary technologies, including satellite sensing and remote monitoring enable improved monitoring of habitat and species population change over time • 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 (SIS) **Task 3: Extended response – Population dynamics**. In-class assessment task based on the interpretation of a scientific text.
14	• ecological succession involves changes in the populations of species present in a habitat; these changes impact the abiotic and biotic interactions in the community, which in turn influence further changes in the species present and their population size • fire is a dynamic factor in Australian ecosystems and has different effects on biodiversity • human activities that can affect biodiversity and can impact on the magnitude, duration and speed of ecosystem change include examples of ▪ habitat destruction, fragmentation or degradation ▪ the introduction of invasive species ▪ unsustainable use of natural resources ▪ the impact of pollutants, including biomagnification ▪ climate change • models of ecosystem interactions (food webs, successional models) can be used to predict the impact of change and are based on interpretation of, and extrapolation from, sample data (data derived from ecosystem surveying techniques); the reliability of the model is determined by the representativeness of the sampling **Submit Task 1: Environmental investigation – The effect of fire on ecosystems**
15	• identification and classification of an ecological area as a conservation reserve also requires consideration of the commercial and recreational uses of the area, as well as Indigenous Peoples' usage rights • conservation strategies used to maintain biodiversity are ▪ genetic strategies, including gene/seed banks and captive breeding programs

Week	Key teaching points
	▪ environmental strategies, including revegetation and control of introduced species ▪ management strategies, including protected areas and restricted commercial and recreational access • keystone species play a critical role in maintaining the structure of the community; the impact of a reduction in numbers, or the disappearance of keystone species on an ecosystem, is greater than would be expected, based on their relative abundance or total biomass • keystone species theory has informed many conservation strategies. However, there are differing views about the effectiveness of single-species conservation in maintaining complex ecosystem dynamics • contemporary technologies, including satellite sensing and remote monitoring enable improved monitoring of habitat and species population change over time • international agreements about biodiversity encourage international cooperation in the protection of unique locations, including ▪ World Heritage sites, for example, Shark Bay, Great Barrier Reef ▪ biodiversity hotspots, for example, south west WA ▪ international migration routes and areas used for breeding, for example, by birds, whales, turtles, whale sharks **Task 4: Test – Ecosystem dynamics**
16	**Task 5: Semester 1 examination**

Unit 2 – From single cells to multicellular organisms

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 microscopy techniques, real or virtual dissections and chemical analysis, safely, competently, ethically 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 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 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 diagrams of structures and processes, and images from different imaging techniques, 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 2

Week	Key teaching points
1	**Cells as the basis of life** • cells require energy inputs, including light energy or chemical energy in complex molecules, and matter, including gases, simple nutrients and ions, and removal of wastes, to survive • prokaryotic and eukaryotic cells have many features in common, which is a reflection of their common evolutionary past, but prokaryotes lack internal membrane-bound organelles, do not have a nucleus, are significantly smaller than eukaryotes, usually have a single circular chromosome, and exist as single cells • metabolism describes the sum total of the physical and chemical processes by which cell components transform matter and energy needed to sustain life • biological molecules are synthesised from monomers to produce complex structures, including carbohydrates, proteins and lipids
2–3	• eukaryotic cells carry out specific cellular functions in specialised structures and organelles, including ▪ cell membrane ▪ cell wall ▪ chloroplasts ▪ endoplasmic reticulum (rough and smooth) ▪ Golgi apparatus ▪ lysosomes ▪ mitochondria ▪ nucleus ▪ ribosomes

Week	Key teaching points
	▪ vacuoles • developments in microscopy and associated preparation techniques have contributed to more sophisticated models of cell structure and function • conduct investigations, including microscopy techniques, safely, competently, ethically and methodically for the collection of valid and reliable data (SIS) **Task 6: Practical – Microscopy techniques**. Prepare slides, set up and focus a microscope, state magnification, measure and calculate cell size, interpret images and draw diagrams.
4	• the cell membrane model has been continually reconceptualised and revised since the mid-nineteenth century and the currently accepted model, based on the evidence from improved technologies, is the fluid mosaic model • the currently accepted model of the cell membrane is the fluid mosaic model • the cell membrane separates the cell from its surroundings and controls the exchange of materials, including gases, nutrients and wastes, between the cell and its environment • movement of materials across membranes occurs via ▪ passive processes, including diffusion, facilitated diffusion, osmosis ▪ active processes, including active transport, endocytosis and exocytosis • factors that affect exchange of materials across membranes include ▪ the surface area to volume ratio of the cell ▪ concentration gradients ▪ the physical and chemical nature of the materials being exchanged • conduct investigations, including chemical analysis, safely, competently, ethically and methodically for the collection of valid and reliable data (SIS) **Task 7: Practical – The cell membrane**. Infer the structure of the cell membrane from observations of beetroot in different solutions.
5–6	• biochemical processes in the cell are controlled by factors, including the nature and arrangement of internal membranes, and the presence of specific enzymes • enzymes have specific functions which can be affected by factors, including ▪ temperature ▪ pH ▪ presence of inhibitors ▪ concentrations of reactants and products • the use of probes technologies and computer analysis has further advanced the understandings of vital chemical processes in cells • two models that are used to explain enzyme action are the lock and key model and the induced fit model • conduct investigations, including chemical analysis, safely, competently, ethically and methodically for the collection of valid and reliable data **Task 8: Investigation – Enzyme action**. Plan and conduct an investigation to investigate factors affecting catalase enzyme activity.
7	• photosynthesis is a biochemical process that uses light energy to synthesise organic compounds; light dependent and light independent reactions occur at different sites in the chloroplast; and make up separate parts of the overall process that can be represented as a balanced chemical equation • the rate of photosynthesis can be affected by the availability of light and carbon dioxide, and temperature **Task 9: Test – Cells as the basis of life**
8–9	• cellular respiration is a biochemical process that occurs in different locations in the cytosol and mitochondria, and metabolises organic compounds, aerobically or anaerobically, to release useable energy in the form of ATP; products of anaerobic respiration vary between organisms (plants, yeast, bacteria, animals); the overall process of aerobic respiration can be represented as a balanced chemical equation • the rate of respiration can be affected by the availability of oxygen and glucose, and

Week	Key teaching points
	temperature • current research for the production of food, beverages and biofuels, and breakdown of rubbish, involving the control of cellular respiration and photosynthesis **Task 10: Extended response – Current research involving the control of photosynthesis and respiration**. In-class assessment based on research topics related to the control of photosynthesis and respiration. (Topics could include: Improving photosynthesis to increase crop yield; Use of yeast in the production of wine or beer; Production of biofuels from the breakdown of rubbish).
10	**Multicellular organisms** • multicellular organisms have a hierarchical structural organisation of cells, tissues, organs and systems • ethical treatment of animals, including the three strategies of replacement, reduction and refinement, forms the basis of many international guidelines in animal research • in animals, the exchange of gases between the internal and external environments of the organism is facilitated by the structure of the exchange surface(s), including spiracles, gills, alveoli and skin • in vascular plants, gases are exchanged via stomata and does not involve the plant transport system
11–12	• in animals, the acquisition and processing of nutrients is facilitated by the structure of the digestive system; animals may have a gastrovascular cavity with one opening or a specialised alimentary canal with two openings; specialisation of alimentary canals is related to diet, for example, herbivores and carnivores
13–14	• in animals, the transport of materials within the internal environment for exchange with cells is facilitated by the structure of open and closed circulatory systems according to the different metabolic requirements of organisms and differing environments • in vascular plants, transport of water and mineral nutrients from the roots occurs via xylem through root pressure, capillary action (adhesion and cohesion of water molecules), transpiration; transport of the products of photosynthesis and some mineral nutrients occurs by translocation in the phloem
15	• terrestrial Australian plants are adapted to minimise water loss in an arid environment **Task 11: Test – Multicellular organisms**
16	**Task 12: Semester 2 examination**