COURSE OUTLINE
BIOLOGY – ATAR YEAR 11: 2022
UNIT 1 AND UNIT 2

Unit 1: Semester 1- Ecosystems and biodiversity

Term	Week	Topic and Key teaching points	Syllabus Content	Assessment
1	1–2	**Science Inquiry Skills** **Ch 1.1 Investigations** **Ch 1.2 The scientific method** **Ch 1.3 Communicating your results** **Ch 1.4 Ecosystem survey techniques** **Ch 1.5 Microscopy techniques** **Ch 1.6 Dissections** Chapter 1 Review Questions Chapter 1 Practice Exam Questions	**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, 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 • 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, 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 • Communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports	Task 1: Science Inquiry Skills

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			Science as a Human Endeavour • Ethical treatment of animals, including the three strategies of replacement, reduction and refinement, forms the basis of many international guidelines in animal research	
1	3-5	**Biodiversity and Classification** **Ch 2.1 Biology and biodiversity** Question set 2.1 Ningaloo Reef and the Great Barrier Reef **Ch 2.2 Measuring biodiversity** Question set 2.2 **Ch 2.3 Biological classification** Question set 2.3 **Ch 2.4 Levels of classification** Question set 2.4 **Ch 2.5 Classification and the characteristics of organisms** Question set 2.5 Case study: 21st century classification and DNA barcoding	**Science inquiry skills** • Select, construct and use appropriate representations, including classification keys, food webs and biomass pyramids, to communicate conceptual understanding, solve problems and make predictions **Science understanding** *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 • Biological classification is hierarchical and based on molecular sequences, different levels of similarity of physical features and methods of reproduction • 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 **Science as a Human Endeavour** • Classification systems are based on international conventions and are subject to change through debate and resolution; changes are based on all currently available evidence	

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1	3-5	**Ch 2.6 Classification in Kingdom Animalia** Question set 2.6 **Ch 2.7 Classification in Kingdom Plantae** Question set 2.7 **Ch 2.8 Classification keys** Question set 2.8 **Ch 2.9 Classification reflects evolution** Question set 2.9 Scientific literacy: Wattle lot of fuss over a name Investigation: 2.1 Identifying insects Chapter 2 Review questions Chapter 2 Practice exam questions	**Science inquiry skills** • Select, construct and use appropriate representations, including classification keys, food webs and biomass pyramids, to communicate conceptual understanding, solve problems and make predictions **Science understanding** *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 • Biological classification is hierarchical and based on molecular sequences, different levels of similarity of physical features and methods of reproduction • 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 **Science as a Human Endeavour** • Classification systems are based on international conventions and are subject to change through debate and resolution; changes are based on all currently available evidence	

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1	6-7	**Ecosystem Classification and Relationships** **3.1 Ecosystems and their classification** Question set 3.1 **3.2 Classification of ecosystems using abiotic and biotic factors** Case study: Ecological research in an Australian tropical savanna ecosystem Question set 3.2 **3.3 Relationships and interactions between living things** Question set 3.3a Question 3.3b Scientific literacy: Threatened ecological communities in WA Investigation: 3.1 Evidence for predator-prey relationships and ecosystems from owl pellets Chapter 3 Review questions Chapter 3 Practice exam questions	**Science understanding** *Describing biodiversity* • 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 • Relationships and interactions within a species and between species in ecosystems include predation, competition, symbiosis (mutualism, commensalism and parasitism), collaboration and disease • In addition to biotic factors, abiotic factors, including climate and substrate, can be used to describe and classify environments	Task 2: TEST Describing Biodiversity

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1	8-9	**Energy and Matter in Ecosystems** **4.1 Energy and matter** Question set 4.1 **4.2 Biotic components of ecosystems transfer and transform energy and matter** Question set 4.2 **4.3 Analysing energy and matter transfer** Question set 4.3 **4.4 Ecological pyramids: energy flow and change** Question set 4.4 **4.5 Biogeochemical cycling of matter** Question set 4.5a Question set 4.5b **4.6 Ecological niches** Question set 4.6 **4.7 Coexistence and keystone species** Scientific literacy: Rainforest rescue campaign Question set 4.7 Food web case study	Science understanding *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 • 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 • 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 Science as a Human Endeavour • 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	Task 3: Extended Response Ecosystem Dynamics

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		Chapter 4 Review questions Chapter 4 Practice exam questions		
1	10	**Population Dynamics** **5.1 What is a population?** Question set 5.1 **5.2 Measuring populations** Scientific literacy: The slaughtering of whales Question set 5.2	**Science inquiry skills** • 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 **Science understanding** *Ecosystem dynamics* • The dynamic nature of populations influences 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 **Science as a Human Endeavour** • Contemporary technologies, including satellite sensing and remote monitoring enable improved monitoring of habitat and species population change over time	
2	1	**5.3 Carrying capacity and population grown curves** Question set 5.3 Case study: Improved monitoring of quokkas	**Science inquiry skills** • 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 **Science understanding**	

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		Activity 5.1 Estimation of population size Investigation 5.1: Distribution and abundance: how many plants? Chapter 5 Review questions Chapter 5 Practice exam questions	*Ecosystem dynamics* • The dynamic nature of populations influences 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 **Science as a Human Endeavour** • Contemporary technologies, including satellite sensing and remote monitoring enable improved monitoring of habitat and species population change over time	
2	2-3	**Changes in Ecosystems** **6.1 Evidence of change in ecosystems** Question set 6.1 **6.2 Ecological succession** Question set 6.2 **6.3 Natural disturbances and succession events** Scientific literacy: Understanding the long-term impact of prescribed burning Question set 6.3 Case study: Indigenous ecological knowledge **6.4 Ecosystem models and predicting the impact of change** Chapter 6 Review questions Chapter 6 Practice exam questions	**Science understanding** *Ecosystem dynamics* • Fire is a dynamic factor in Australian ecosystems and has different effects on biodiversity • 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 • 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	Task 4: Wattles-The Fire Weed

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2	4-5	**Ecosystem Changes and Conservation Strategies for Biodiversity** **7.1 Human impact on biodiversity and ecosystems** Question set 7.1 **7.2 Habitat destruction and conservation strategies** Case study: Carnaby's black cockatoo Scientific literacy: Environmental conservation strategy: Gondwana Link Question set 7.2 **7.3 Introduced and invasive species** Question set 7.3 **7.4 Unsustainable use of natural resources** Question set 7.4 **7.5 The impact of pollutants: eutrophication, biomagnification, and plastics** Question set 7.5 **7.6 Climate change** Question set 7.6 **7.7 International collaboration on biodiversity** Case study: Numbat captive breeding program at Perth Zoo Chapter 7 Review questions Chapter 7 Practice exam questions	**Science understanding** *Ecosystem dynamics* • 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 • Conservation strategies used to maintain biodiversity are: ‣ genetic strategies, including gene/seed banks and captive-breeding programs ‣ environmental strategies, including revegetation and control of introduced species ‣ management strategies, including protected areas and restricted commercial and recreational access **Science as a Human Endeavour** • 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 • *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	Task 5: TEST Ecosystem Dynamics

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			• 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	
2	6		Revision Past Exam Paper Practice	
2	7-8		Semester 1 examination	Task 6: Semester 1 Exam

Unit 2: Semester 2 From single cells to multicellular organisms

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2	9-10	**Cell Requirements, Microscopy, Structures and Functions** **8.1 Cells and their requirements** Question set 8.1 **8.2 Types of cells** Case study: Virtual plant cell: immersing in biology using virtual reality Question set 8.2 **8.3 Cells require energy** Question set 8.3 **8.4 Specialised organelles synthesise complex molecules** Question set 8.4 **8.5 Specialised organelles remove cellular products** Question set 8.5 Activity 8.1 Microscopes and field of view Activity: How big? Investigation 8.1 Microscopes and cells Investigation 8.2 Investigating cells	**Science inquiry skills** • 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 • 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 **Science understanding** *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 • Eukaryotic cells carry out specific cellular functions in specialised structures and organelles, including ‣ cell membrane ‣ cell wall	

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		Chapter 8 Review questions Chapter 8 Practice exam questions	‣ chloroplasts ‣ endoplasmic reticulum (rough and smooth) ‣ Golgi apparatus ‣ lysosomes ‣ mitochondria ‣ nucleus ‣ ribosomes ‣ vacuoles • Biological molecules are synthesised from monomers to produce complex structures, including carbohydrates, proteins and lipids **Science as a Human Endeavour** • Developments in microscopy and associated preparation techniques have contributed to more sophisticated models of cell structure and function	
3	1-3	**Cell Membrane and Transport Processes** **9.1 The cell membrane: selectively permeable** Question set 9.1 Scientific literacy: Development of the cell membrane model **9.2 Membrane structure and the fluid mosaic model** Question set 9.2	**Science understanding** *Cells as the basis of life* • 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	Task 7: Practical Lab report: Osmosis

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		9.3 Passive movement across membranes Application 9.1 Osmosis in the laundry Question set 9.3 **9.4 Active transport across membranes** Question set 9.4 **9.5 Active movement of large substances across membranes** Case study: Aquaporins Question set 9.5 **9.6 Factors that affect exchange of materials** Question set 9.6 Investigation 9.1 Investigating the rate of osmosis Investigation 9.2 Investigating cell size using agar cubes Deshelled eggs Moving molecules Chapter 9 Review Questions Chapter 9 Practice exam questions	‣ 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 **<u>Science as a Human Endeavour</u>** • 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	

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3	4-6	**Enzymes, Photosynthesis and Respiration** **10.1 Biochemical processes in cells** Question set 10.1 **10.2 Enzymes** Question set 10.2 Application: Special enzymes **10.3 Modelling enzyme specificity** Question set 10.3 **10.4 Factors that affect enzyme activity** Question set 10.4 **10.5 ATP** Question set 10.5 **10.6 Photosynthesis** Scientific literacy: Innovative research Case study: Combining algal and plant photosynthesis Question set 10.6 **10.7 Cellular respiration** Question set 10.7	**Science understanding** *Cells as the basis of life* • 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 • Two models that are used to explain enzyme action are the lock and key model and the induced-fit model • 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 • 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 usable 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	Task 8: Validation: Photosynthesis and Respiration

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		Investigation 10.1 The effect of light of photosynthesis Chapter 10 Review questions Chapter 10 Practice exam questions	• The rate of respiration can be affected by the availability of oxygen and glucose, and temperature **Science as a Human Endeavour** • The use of probes technologies and computer analysis has further advanced the understandings of vital chemical processes in cells • Current research for the production of food, beverages and biofuels, and the breakdown of rubbish, involves the control of cellular respiration and photosynthesis	
3	7	**Cells in Multicellular Organisms** **11.1 A hierarchy in structure: from atoms to organisms** Application 11.1 Little animals in water Question set 11.1 **11.2 Cell specialisation and differentiation** Question set 11.2 **11.3 Another hierarchy in structure: cells, tissues organs, systems** Scientific literacy: Harry Perkins Institute: cell research Question set 11.3 Case study: Specialist cells could combat devil facial tumour disease Investigation 11.1 Exploring tissues Chapter 11 Review questions Chapter 11 Practice exam questions	**Science understanding** *Multicellular organisms* • Multicellular organisms have a hierarchical structural organisation of cells, tissues, organs and systems	Task 9: TEST Cells and Cell Processes

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3	8-10	**Animal Systems** **12.1 Open and closed circulatory systems** Question set 12.1 **12.2 The mammalian circulatory system** Application: The colour of blood Question set 12.2 **12.3 Respiratory systems** Question set 12.3 **12.4 Digestive system** Question set 12.4 **12.5 Excretory systems (extension topic)** Question set 12.5 Chapter 12 Review questions Chapter 12 Practice exam questions	**Science understanding** *Multicellular organisms* • 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 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 • 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	
4	1	**Animal Systems** **12.1 Open and closed circulatory systems** Question set 12.1 **12.2 The mammalian circulatory system** Application: The colour of blood Question set 12.2 **12.3 Respiratory systems** Question set 12.3 **12.4 Digestive system** Question set 12.4 **12.5 Excretory systems (extension topic)** Question set 12.5	**Science understanding** *Multicellular organisms* • 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 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	Task 10: Extended Response Comparative Structure and Function of Animal systems

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		Activity: Fish dissection Chapter 12 Review questions Chapter 12 Practice exam questions	• 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	
4	2-4	**Plant Systems** **13.1 Vascular plant structure and function** Question set 13.1 **13.2 Plant gas exchange** Question set 13.2 **13.3 Plant transport** Question set 13.3 Case study: Algae architecture **13.4 Australian terrestrial plant adaptations** Question set 13.4 Scientific literacy: Improving plant growth under drought conditions Investigation 13.1 Plant transport systems Investigation 13.2 Leaf structure Chapter 13 Review questions Chapter 13 Practice exam questions	**Science understanding** *Multicellular organisms* • In vascular plants, gases are exchanged via stomata and the plant surface and does not involve the plant transport system • 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 • Terrestrial Australian plants are adapted to minimise water loss in an arid environment	Task 11: TEST Multicellular Organisms
4	5		Revision	
4	6-7		Semester 2 examination	Task 12: Semester 2 Exam
4	8		Examination feedback	