YEAR 11 BIOLOGY NOTES

Biology n noun 1 the scientific study of living organisms. 2 the plants and animals of a particular area. 3 the features of a particular organism or class of organisms.

DERIVATIVES biologist noun ORIGIN C19: coined in German, via French from Greek bios 'life' + -logy.

"Evolution is the fundamental idea in all of life science - in all of biology." Bill Nye

Module 1: Cells as the Basis of Life

Outcomes

A student:

› conducts investigations to collect valid and reliable primary and secondary data and information BIO11/12-3
› selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media BIO11/12-4
› describes single cells as the basis for all life by analysing and explaining cells' ultrastructure and biochemical processes BIO11-8

Content Focus

Cells are the basis of life. They coordinate activities to form colonial and multicellular organisms. Students examine the structure and function of organisms at both the cellular and tissue levels in order to describe how they facilitate the efficient provision and removal of materials to and from all cells in organisms. They are introduced to and investigate biochemical processes through the application of the Working Scientifically skills processes.

Students are introduced to the study of microbiology and the tools that scientists use in this field. These tools will be used throughout the course to assist in making predictions and solving problems of a multidisciplinary nature.

Working Scientifically

In this module, students focus on conducting investigations to collect, process and analyse data and identify trends, patterns and relationships related to cell structure and function. Students should be provided with opportunities to engage with all Working Scientifically skills throughout the course.

Content

Cell Structure

Inquiry question: What distinguishes one cell from another?

Students:

- investigate different cellular structures, including but not limited to:
  - examining a variety of prokaryotic and eukaryotic cells (ACSBL032, ACSBL048)
  - describe a range of technologies that are used to determine a cell's structure and function

Students:

- investigate a variety of prokaryotic and eukaryotic cell structures, including but not limited to:
  - drawing scaled diagrams of a variety of cells (ACSBL035)
  - comparing and contrasting different cell organelles and arrangements
  - modelling the structure and function of the fluid mosaic model of the cell membrane (ACSBL045)

Cell Function

Inquiry question: How do cells coordinate activities within their internal environment and the external environment?

Students:

- investigate the way in which materials can move into and out of cells, including but not limited to:
  - conducting a practical investigation modelling diffusion and osmosis (ACSBL046)
  - examining the roles of active transport, endocytosis and exocytosis (ACSBL046)
  - relating the exchange of materials across membranes to the surface-area-to-volume ratio, concentration gradients and characteristics of the materials being exchanged (ACSBL047)

Students:

- investigate cell requirements, including but not limited to:
  - suitable forms of energy, including light energy and chemical energy in complex molecules (ACSBL044)
  - matter, including gases, simple nutrients and ions
  - removal of wastes (ACSBL044)

Students:

- investigate the biochemical processes of photosynthesis, cell respiration and the removal of cellular products and wastes in eukaryotic cells (ACSBL049, ACSBL050, ACSBL052, ACSBL053)

Students:

- conduct a practical investigation to model the action of enzymes in cells (ACSBL050)

Students:

- investigate the effects of the environment on enzyme activity through the collection of primary or secondary data (ACSBL050, ACSBL051)

Module 2: Organisation of Living Things

Outcomes

A student:

- selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media BIO11/12-4
- solves scientific problems using primary and secondary data, critical thinking skills and scientific processes BIO11/12-6
- communicates scientific understanding using suitable language and terminology for a specific audience or purpose BIO11/12-7
- explains the structure and function of multicellular organisms and describes how the coordinated activities of cells, tissues and organs contribute to macroscopic processes in organisms BIO11-9

Content Focus

Multicellular organisms typically consist of a number of interdependent transport systems that range in complexity and allow the organism to exchange nutrients, gases and wastes between the internal and external environments. Students examine the relationship between these transport systems and compare nutrient and gas requirements.

Models of transport systems and structures have been developed over time, based on evidence gathered from a variety of disciplines. The interrelatedness of these transport systems is critical in maintaining health and in solving problems related to sustainability in agriculture and ecology.

Working Scientifically

In this module, students focus on collecting, processing and analysing data and information to: identify trends, patterns and relationships; solve problems; and communicate ideas about the organisation of living things. Students should be provided opportunities to engage with all Working Scientifically skills throughout the course.

Content

Organisation of Cells

Inquiry question: How are cells arranged in a multicellular organism?

Students:

- compare the differences between unicellular, colonial and multicellular organisms by:
  - investigating structures at the level of the cell and organelle
  - relating structure of cells and cell specialisation to function

Students:

- investigate the structure and function of tissues, organs and systems and relate those functions to cell differentiation and specialisation (ACSBL055)

Students:

- justify the hierarchical structural organisation of organelles, cells, tissues, organs, systems and organisms (ACSBL054)

Nutrient and Gas Requirements

Inquiry question: What is the difference in nutrient and gas requirements between autotrophs and heterotrophs?

Students:

- investigate the structure of autotrophs through the examination of a variety of materials, for example: (ACSBL035)
  - dissected plant materials (ACSBL032)
  - microscopic structures
  - using a range of imaging technologies to determine plant structure

Students:

- investigate the function of structures in a plant, including but not limited to:
  - tracing the development and movement of the products of photosynthesis (ACSBL059, ACSBL060)

Students:

- investigate the gas exchange structures in animals and plants (ACSBL032, ACSBL056) through the collection of primary and secondary data and information, for example:
  - microscopic structures: alveoli in mammals and leaf structure in plants
  - macroscopic structures: respiratory systems in a range of animals

Students:

- interpret a range of secondary-sourced information to evaluate processes, claims and conclusions that have led scientists to develop hypotheses, theories and models about the structure and function of plants, including but not limited to: (ACSBL034)
  - photosynthesis
  - transpiration-cohesion-tension theory

Students:

- trace the digestion of foods in a mammalian digestive system, including:
  - physical digestion
  - chemical digestion
  - absorption of nutrients, minerals and water
  - elimination of solid waste

Students:

- compare the nutrient and gas requirements of autotrophs and heterotrophs

Transport

Inquiry question: How does the composition of the transport medium change as it moves around an organism?

Students:

- investigate transport systems in animals and plants by comparing structures and components using physical and digital models, including but not limited to: (ACSBL032, ACSBL058, ACSBL059, ACSBL060)
  - macroscopic structures in plants and animals
  - microscopic samples of blood, the cardiovascular system and plant vascular systems

Students:

- investigate the exchange of gases between the internal and external environments of plants and animals

Students:

- compare the structures and function of transport systems in animals and plants, including but not limited to: (ACSBL033)
  - vascular systems in plants and animals
  - open and closed transport systems in animals

Students:

- compare the changes in the composition of the transport medium as it moves around an organism

Module 3: Biological Diversity

Outcomes

A student:

- develops and evaluates questions and hypotheses for scientific investigation BIO11/12-1
- designs and evaluates investigations in order to obtain primary and secondary data and information BIO11/12-2
- communicates scientific understanding using suitable language and terminology for a specific audience or purpose BIO11/12-7
- describes biological diversity by explaining the relationships between a range of organisms in terms of specialisation for selected habitats and evolution of species BIO11-10

Content Focus

Biodiversity is important to balance the Earth's ecosystems. Biodiversity can be affected slowly or quickly over time by natural selective pressures. Human impact can also affect biodiversity over a shorter time period. In this module, students learn about the Theory of Evolution by Natural Selection and the effect of various selective pressures.

Monitoring biodiversity is key to being able to predict future change. Monitoring, including the monitoring of abiotic factors in the environment, enables ecologists to design strategies to reduce the effects of adverse biological change. Students investigate adaptations of organisms that increase the organism's ability to survive in their environment.

Working Scientifically

In this module, students focus on: designing appropriate investigations; collecting and processing data to develop questions to test hypotheses using appropriate media; communicating their understanding. Students should be provided with opportunities to engage with all Working Scientifically skills throughout the course.

Content

Effects of the Environment on Organisms

Inquiry question: How do environmental pressures promote a change in species diversity and abundance?

Students:

- predict the effects of selection pressures on organisms in ecosystems, including: (ACSBL026, ACSBL090)
  - biotic factors
  - abiotic factors

Students:

- investigate changes in a population of organisms due to selection pressures over time, for example: (ACSBL002, ACSBL094)
  - cane toads in Australia
  - prickly pear distribution in Australia

Adaptations

Inquiry question: How do adaptations increase the organism's ability to survive?

Students:

- conduct practical investigations, individually or in teams, or use secondary sources to examine the adaptations of organisms that increase their ability to survive in their environment, including:
  - structural adaptations
  - physiological adaptations
  - behavioural adaptations

Students:

- investigate, through secondary sources, the observations and collection of data that were obtained by Charles Darwin to support the Theory of Evolution by Natural Selection, for example:
  - finches of the Galapagos Islands
  - Australian flora and fauna

Theory of Evolution by Natural Selection

Inquiry question: What is the relationship between evolution and biodiversity?

Students:

- explain biological diversity in terms of the Theory of Evolution by Natural Selection by examining the changes in and diversification of life since it first appeared on the Earth (ACSBL088)

Students:

- analyse how an accumulation of microevolutionary changes can drive evolutionary changes and speciation over time, for example: (ACSBL034, ACSBL093)
  - evolution of the horse
  - evolution of the platypus

Students:

- explain, using examples, how Darwin and Wallace's Theory of Evolution by Natural Selection accounts for:
  - convergent evolution
  - divergent evolution

Students:

- explain how punctuated equilibrium is different from the gradual process of natural selection

Evolution – the Evidence

Inquiry question: What is the evidence that supports the Theory of Evolution by Natural Selection?

Students:

- investigate, using secondary sources, evidence in support of Darwin and Wallace's Theory of Evolution by Natural Selection, including but not limited to:
  - biochemical evidence, comparative anatomy, comparative embryology and biogeography (ACSBL089)
  - techniques used to date fossils and the evidence produced

Students:

- explain modern-day examples that demonstrate evolutionary change, for example:
  - the cane toad
  - antibiotic-resistant strains of bacteria

Module 4: Ecosystem Dynamics

Outcomes

A student:

- develops and evaluates questions and hypotheses for scientific investigation BIO11/12-1
- designs and evaluates investigations in order to obtain primary and secondary data and information BIO11/12-2
- conducts investigations to collect valid and reliable primary and secondary data and information BIO11/12-3
- selects and processes appropriate qualitative and quantitative data and information using a range of appropriate media BIO11/12-4
- analyses and evaluates primary and secondary data and information BIO11/12-5
- analyses ecosystem dynamics and the interrelationships of organisms within the ecosystem BIO11-11

Content Focus

The Earth's biodiversity has increased since life first appeared on the planet. The Theory of Evolution by Natural Selection can be used to explain periodic increases and decreases in populations and biodiversity. Scientific knowledge derived from the fossil record, and geological evidence has enabled scientists to offer valid explanations for this progression in terms of biotic and abiotic relationships. Students engage in the study of past ecosystems and create models of possible future ecosystems so that human impact on biodiversity can be minimised. The study of ecosystem dynamics integrates a range of data that can be used to predict environmental change into the future.

Working Scientifically

In this module, students focus on developing questions and hypotheses when planning and conducting investigations. Students study trends, patterns and relationships in data to analyse the interrelationships within and dynamics of an ecosystem. Students should be provided with opportunities to engage with all Working Scientifically skills throughout the course.

Content

Population Dynamics

Inquiry question: What effect can one species have on the other species in a community?

Students:

- investigate and determine relationships between biotic and abiotic factors in an ecosystem, including: (ACSBL019)
  - the impact of abiotic factors (ACSBL021, ACSBL022, ACSBL025)
  - the impact of biotic factors, including predation, competition and symbiotic relationships (ACSBL024)
  - the ecological niches occupied by species (ACSBL023)
  - predicting consequences for populations in ecosystems due to predation, competition, symbiosis and disease (ACSBL019, ACSBL020)
  - measuring populations of organisms using sampling techniques (ACSBL003, ACSBL015)

Students:

- explain a recent extinction event (ACSBL024)

Past Ecosystems

Inquiry question: How do selection pressures within an ecosystem influence evolutionary change?

Students:

- analyse palaeontological and geological evidence that can be used to provide evidence for past changes in ecosystems, including but not limited to:
  - Aboriginal rock paintings
  - rock structure and formation
  - ice core drilling

Students:

- analyse evidence that present-day organisms have evolved from organisms in the past by examining and interpreting a range of secondary sources to evaluate processes, claims and conclusions relating to the evolution of organisms in Australia, for example: (ACSBL005, ACSBL027)
  - small mammals
  - sclerophyll plants

Students:

- investigate the reasons for changes in past ecosystems, by:
  - interpreting a range of secondary sources to develop an understanding of the changes in biotic and abiotic factors over short and long periods of time (ACSBL025, ACSBL026)
  - evaluating hypotheses that account for identified trends (ACSBL001)

Future Ecosystems

Inquiry question: How can human activity impact on an ecosystem?

Students:

- investigate changes in past ecosystems that may inform our approach to the management of future ecosystems, including:
  - the role of human-induced selection pressures on the extinction of species (ACSBL005, ACSBL028, ACSBL095)
  - models that humans can use to predict future impacts on biodiversity (ACSBL029, ACSBL071)
  - the role of changing climate on ecosystems

Students:

- investigate practices used to restore damaged ecosystems, Country or Place, for example:
  - mining sites
  - land degradation from agricultural practices