**Stage 1 Biology – Semester 1 Program 1**

This program articulates with LAP 1

This is a 10-credit program for students intending to study Stage 1 Biology

Number of lessons equivalent to 60 hrs per semester, including 8–10 hrs of practical activities

| **Science Understandings** | **Activities/teaching strategies** | **SIS** | **SHE** |
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| **Week 1** | | | |
| Introduction to biology.  Living things are distinguishable from non-living things.  The characteristics of living things.  The cell theory unifies all living things.  Living things are made up of one or more cells. | Class discussion on what defines “Biology”?  Review the concept of living compared to non-living.  List the characteristics of living things, e.g. REMRING or MRS GREN.  Use microscopes and diagrams to show that cells are the structural and functional units of life, come from pre-existing cells, and contain hereditary material.  Introduce the concepts of unicellular and multicellular. |  | The development of the microscope – a brief history: Robert Hooke’s development of the compound microscope and examination of cork tissue.  Watch YouTube Video: Cell Theory (3.30 min)  (<https://youtu.be/dscY_2QQbKU>) |
| **Week 2** | | | |
| The major cell types are: Prokaryotic cells and Eukaryotic cells.  The cell membrane separates cellular activity from the external environment.  The structure of the cell membrane. | Review the 5 kingdoms of living things: Prokaryotic cells are found in the Monera Kingdom.  Draw diagrams to compare the structure and show that Prokaryotic cells lack internal membrane-bound organelles, do not have a nucleus, are significantly smaller than eukaryotic cells, and usually have a single circular chromosome.  Identify the organelles in cells. Know that each organelle has a specific function: nucleus, ribosome, vacuole, mitochondrion, chloroplast, endoplasmic reticulum, Golgi body.  Draw labelled diagrams of the semi-permeable cell membrane. Consider the phospholipid bilayer and the role of the embedded proteins.  Describe the structure of the membrane in terms of the Fluid Mosaic Model – students to write an extended response on the structural arrangement of the cell membrane.  Activity: Watch a simulation of the cell membrane (and transport.  <http://phet.colorado.edu/en/simulation/membrane-channels>)  and/or YouTube video on Cell membrane structure.<https://youtube/QQgXfuFyKM4> | Practical: Review the Use of a light Microscope.  Microscope skills: view cells from various organisms.  Activity: Look at photomicrographs of various organelles and draw schematic diagrams. | Students provided with the following URL (<http://www.timetoast.com/timelines/history-of-the-theoretical-models-of-the-cell-membrane>) to investigate the changes in understanding of the structure of the cell membrane over time. |
| **Week 3-5** | | | |
| The importance of the cell membrane.  Material requirements move in and wastes and cell products move out of cells.  The selectively permeable nature of the cell membrane maintains relatively constant internal conditions.  The surface area-to-volume ratio of cells is critical to their survival. | Use diagrams of the cell membrane to explain how the exchange of materials between the cell and its environment is controlled: size, charge, and composition of the material being transported.  Consider also the processes of endocytosis and exocytosis and how the membrane is arranged to enable transport of materials.  Activity: Watch a short video showing the process of endocytosis and exocytosis. <https://youtu.be/qpw2p1x9Cic>  Students draw schematic diagrams to show endocytosis and exocytosis.  Describe how some substances move passively by diffusion and osmosis across the cell membrane with the concentration gradient.  Draw a table to compare active and passive transport with regard to:   * concentration gradient * energy requirement * type of materials transported. | Practical: Investigate the effect of diffusion using cellulose tubing, starch, and iodine solutions. Discuss the idea of design, altering the independent variable.  **Summative Practical Investigation:**  Observe the effect of salt concentration on osmosis in rhubarb epidermal cells or potato cubes (can combine the later with SA:Vol ratio.)  Practical: The effect of size on diffusion using agar cubes. |  |
| **Week 6-7** | | | |
| Cell survival:  Cells use metabolic pathways.  Enzymes are organic catalysts. | Discuss the need for cells to metabolise the materials in a cell.  Define the concept of a metabolic pathway: use common examples – cellular respiration as an example (no details).  Describe the role of enzymes in metabolism – introduce the induced fit model. | Practical: Investigate factors that may affect enzyme activity. (Hydrogen peroxide and catalase). |  |
| **Week** **8** | | | |
| Introduction to the Microscopic World.  Microorganisms are important living things.  Microorganisms include bacteria, fungi and protists.  In ideal conditions bacteria grow exponentially.  Different bacteria require specific conditions for growth.  Microorganisms act as decomposers, which enables recycling of essential nutrients.  Bacteria reproduce by binary fission (asexual). | Discussion on what bacteria require to grow, look at different types of bacteria and their requirements for survival, e.g. not all bacteria require oxygen.  Look at graphs that show the growth cycle of bacteria.  Describe the way bacteria reproduce using binary fission.   * Binary fission is an asexual process- produces genetically identical offspring. * The concept of the bacterial colony. | Practical: Grow bacteria on agar plates – investigate factors that affect bacterial growth. Consider the effects of factors such as:   * temperature * nutrient availability * moisture * pH * removal of wastes * oxygen * antibiotics/ * antiseptics   Research Task: Investigate the claim on antibacterial products that they kill 99.9% of bacteria. |  |
| **Week 9-10** | | | |
| Microorganisms are important to humans. | Introduce the concept of recombinant DNA technology.  Discuss the benefits to humans, e.g. production of growth hormones or insulin in the treatment of disease.  Discuss the ethics.  Explore the techniques used in recombinant DNA technology, including the use of specific enzymes.  Explore the other applications where microbes are beneficial to humans, e.g. in the food industry.  Discuss the role of microbes in the environment, e.g. oxygen production by phytoplankton or in the decomposition of dead matter.  **Skills and Application Task: Test on Topic 1** | Practical: Investigate how microbes are affected under various conditions in bread, cheese and yoghurt making. | Research Task: Investigate innovations that have been beneficial to humans in medicine.  Discuss the historical perspective of recombinant DNA technology, e.g. Pasteur and fermentation or the discovery of PCR. |
| **Term 2, Week 1 - 2** | | | |
| Ecosystems: An introduction | Discuss the meanings of the terms: species, population, community, and an ecosystem.  Reproductive Isolation is required for an organism to be considered a “species”.   * Discuss the limitations of this definition of a species.   Describe the various ecosystems in Australia and globally, e.g. compare Arid Zones in Australia to other.   * Distinguish between biotic and abiotic components of ecosystems. * Compare the characteristics of at least two ecosystems. |  |  |
| **Week 3** | | | |
| Classification of Living Organisms | Examine and compare morphological features of organisms that are more or less closely related.  Use biological (dichotomous) keys to classify organisms.   * Distinguish between scientific names and common names for species. * Recognise that very closely related species have similar scientific names. |  | Research the limitations and refinements of the current nomenclature system. |
| **Week 4** | | | |
| Adaptations for survival | Compare structural, behavioural and physiological adaptations of different species from specific environments.  Adaptations enable organisms to survive. | Visit the Zoo or Botanical Gardens to investigate the many interrelated factors of ecosystems, classification, relationships (food webs, etc.), biotic and abiotic factors, etc.  Practical: Simulations of characteristics to demonstrate survival, e.g. bird beaks or different food types or Pepper Moth simulations using white paper and newspaper. |  |
| **Week 5** | | | |
| Energy Flow in Ecosystems | Represent the water cycle, and biogeochemical cycles for elements such as nitrogen, phosphorous and carbon.  Discuss how humans can interfere with natural cycles. |  | Research innovative methods of bio-recycling of waste.  Examine the implications for the future of species including the human population. |
| **Week 6-7** | | | |
| Relationships between species are important for survival.  Ecosystems include populations of organisms that each fills a specific ecological niche. | Describe a niche in terms of key indicators within the ecosystem, including habitat, feeding relationships, and interactions with other species.  Explain the significance of keystone species in their ecosystem.   * Relate the concept of a keystone species to the large impact that would be experienced by an ecosystem if numbers of the keystone species were to decline substantially.   Discuss species conservation and how humans impact the survival of various species. |  | **Summative: SHE TASK**  Research local examples of keystone species such as Grey nurse shark (Carcharias taurus), and the Red-tailed cockatoo (Calyptorhynchus banskii).  http://www.australiangeographic.com.au/topics/wildlife/2014/09/australias-keystone-endangered-species |
| **Week 8** | | | |
| Ecosystems can change over time | Describe examples of succession   * Compare primary and secondary succession. | Practical: Observe the natural progression of mould on bread or fruit. |  |
| **Week 9-10** | | | |
| Populations at Risk | Consider how the destruction of habitats as a result of human activity speeds changes in ecosystems and impacts on biodiversity.  Populations with reduced genetic diversity face increased risk of extinction.  Explain why genetic diversity is important for a species’ survival in a changing environment.   * Consider “genetic bottlenecks”   Examine human activities that have contributed to the lack of genetic diversity in some species.  **Skills and Application Task: Test on Topic 4** | Graphically represent trends in key environmental variables, including:   * atmospheric CO2 * air and sea temperature * pH of the sea * polar ice cover.   and extrapolate trends over the coming decades. | Research the plight of the orang-utan, or other large animal that has become endangered due to habitat destruction.  Research specific endangered species that have limited genetic diversity and discuss the implications for the species. Examples of species with limited genetic diversity include cheetahs (Africa), Gilbert’s potoroo (SW Australia) and the Black Robin (NZ).  Research some of the steps being taken to improve the chances of survival of endangered species. |