**Stage 2 Biology Teaching and Learning Plan 2018**

This teaching and learning program articulates with learning and assessment plan 1

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| Teacher: |  | Learning Area: | Science | Subject: | Biology | Year level: | 12 | SACE: | Stage 2 |
| Semester: | 1 |  |  |  | |  | |  | |

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| **Timeline**  Week | **Student Understanding** | **Strategies, Contexts, and**  **Activities** | **Summative Assessment Tasks** |
| ***TOPIC: DNA and PROTEINS*** | | | |
| **Term 1**  Week 1 | **DNA STRUCTURE AND FUNCTION**   * Review the differences between prokaryotic and eukaryotic cells. * Describe the structure and functions of DNA * Explain the process of DNA replication | * **Worksheet:** Label diagrams of prokaryotic and eukaryotic cells. * **Formative Research Assignment:** Explore the work of Watson, Crick, Franklin, and Wilkins in the discovery of the structure of DNA. (**SHE** – Communication and Collaboration, Development) * **Class Activity**: Construct and use models of DNA replication. * **Experiment (SIS):** Extraction of DNA (e.g. from peas). Deconstruct: Different sources of DNA for different purposes- best method to extract? |  |
| 2 | **DNA STRUCTURE AND FUNCTION (Cont.)**   * Explain that base-pairing rules and DNA replication are universal * Gene structure: Compare introns and exons * Describe the function of a gene * The process of transcription and translation- and the roles of the components involved | * **Class Activity:** Students demonstrate a conceptual understanding of the process of transcription and translation by becoming codons, anticodons and amino acids in a role-play of protein synthesis. * **Activity:** List some of the end products of genes including functional proteins, tRNA, rRNA and microRNA. |  |
| 3 | **PROTEIN STRUCTURE AND FUNCTIONS**   * Describe the factors that determine the primary, secondary, tertiary and quaternary structure of proteins * Explain how the structure of a protein is critical to its function. * Define the function of various structural and functional proteins (eg. hormones, receptor proteins) | * **Group Activity:** Draw labelled diagrams of the different levels of protein structure. * **Class Discussion:** Discuss examples of structural and functional proteins (e.g. haemoglobin, antibodies). * **Experiment (SIS):** Testing for Nucleic Acids and Proteins. |  |
| 4 | **ENZYME SPECIFICITY**   * Describe the enzyme-substrate complex * Explain how the induced-fit lowers the activation energy needed for reactions to proceed. * Describe how factors such as temperature, and pH affect enzyme function. | * **Research Assignment:** Investigate the design and manufacture of proteins for scientific/medicinal use, such as biochips and targeted chemotherapy. (**SHE –** Influence**,** Application and Limitation) | Summative Practical Investigation and Deconstruct a Problem Task: Conditions affecting enzyme activity. (Week 5) |
| 5 | **PHENOTYPIC EXPRESSION**   * Describe the factors that control phenotypic expression * Describe how differential gene expression controls cell differentiation * Explain the effect of DNA methylation   **EPIGENETIC CHANGES**   * Explain how epigenetic mofications can lead to cancer. | * Class Discussion: Discuss impact of DNA methylation. * **Group Activity:** Explore the work of Professor Stephen Baylin. (**SHE** - Development) * **Research:** Consider some example of diseases caused by epigenetics such as Fragile X syndrome and Rett syndrome. (**SHE –** Application and Limitation) |  |
| 6 | **MUTATIONS**   * Define mutations * Describe the environmental factors that cause mutations * Compare the impact of germ-line cell mutations and somatic cell mutations. | * **Worksheet:** Label a diagram of the cell cycle (including checkpoints). * **Worksheet:** Describe the effect of different mutations on the genetic code and overall protein. * **Oral Presentation:** Describe how a mutation can cause a genetic disease. |  |
| 7 | **BIOTECHNOLOGY**   * Explain how tools such as restriction enzymes, radioactive probes, electrophoresis and plasmids are utilised by geneticists, * Describe the processes of DNA sequencing, PCR and DNA profiling * Describe how new technologies such as CRISPR can be used to edit/transfer genes * Describe the different ways that genes can be transferred between species. * Benefits and limitations | * **Class Activity:** Debate the social and ethical advantages and consequences of the manipulation of DNA and gene therapy. (**SHE –** Application and Limitation**)** * **Group Activity:** Research and devise a table to highlight several transgenic organisms and their uses, for example in food production and the production of human hormones. * **Worksheet:** Draw a timeline showing the historical perspective of selective breeding and more recently transgenic organisms and cloning. (**SHE –** Development, Influence, Application and Limitation) |  |
| 8 |  | Revision of topic concepts | **Summative Test:**  DNA and Proteins |
| ***TOPIC 2: CELLS AS THE BASIS OF LIFE*** | | | |
| 9 | CELL STRUCTURE AND FUNCTION   * Define the cell theory * Describe the structure and function of the cell membrane | * Class Activity: Illustrate the structure of the cell membrane. * Practical: Observe cells using microscope. |  |
| 10 | * Compare prokaryotic and eukaryotic cells (review) * Describe the structure and function of organelles in eukaryotic cells * Compare the structure of plant and animal cells | * Class Activity: Use animations or video clips to highlight the differences between prokaryotic and eukaryotic cells. |  |
| 11 | **ENERGY FLOW**   * Compare energy flow of autotrophs with heterotrophs. * Write equations for photosynthesis, aerobic respiration, lactic acid fermentation and alcohol fermentation * Explain how the ATP/ADP conversion provides energy for use in cells. | * **Group SIS:** Investigate factors affecting anerobic respiration using yeast in solution or in a ‘bread dough’ mix. Deconstruct a problem. Do different yeasts really result in differernt results for each food application? |  |
| **Term 2**  Week 1 | **MOVEMENT OF SUBSTANCES**   * Explain the different processes of movement through the cell membrane (eg. osmosis, diffusion). * Discuss the factors that affect the movement of substances | * **Practical (SIS):** Demonstrate the affect that the size of agar cubes has on the rate of diffusion |  |
| 2 | **BIOCHEMICAL PROCESSES**   * Describe how the structure of mitochondria and chloroplasts is essential for cell metabolism. * Explain the reasons for energy pathways and how these pathways can be achieved   **CHEMICALS AND CELLS**   * Discuss possible benefits and/or harmful effects of chemicals that human beings use. | * **Worksheet:** Illustrate different energy pathways and discuss the impact of faulty enzymes * **Group Assignment:** Discuss the effects of chemicals such as cyanide, antibiotics, herbicides, and insecticides on cell metabolism. (**SHE –** Influence, Application and Limitation) |  |
| 3 | **CELL DIVISION - ASEXUAL**   * Review DNA replication * Describe the process of mitosis * Compare mitosis and binary fission | * Class Activity: View animations and use models to show the processes of binary fission and mitosis. * Practical (SIS): Examine the stages of mitosis in onion root tip cells. |  |
| 4 | **CELL DIVISION - SEXUAL**   * Describe the process of meiosis. * Explain the importance of crossing over and independent assortment in meiosis. * Compare the products of meiotic and mitotic cell division. | * **Class Activity:** Use models to represent the arrangement and movement of chromosomes during meiosis. * **Class Discussion:** Discuss the genetic manipulation of somatic and germline cells. (**SHE** – Influence, Apllication and Limitation) |  |
| 5 | **CELL CYCLE AND CELL CULTURING**   * Describe the gene products and checkpoints that regulate the cell cycle * Describe the impact of carcinogens on the cell cycle * Describe techniques of cell culturing and discuss contemporary uses. | * **Social Analysis:** Investigate the effect of carcinogens (eg. tobacco smoke, some dioxins, and asbestos) on human health and what can be done to reduce their use. (**SHE** – Influence, Application and Limitation) * **Ethical Debate:** Discuss both sides of the argument for the use of HeLa Cells (**SHE –** Influence, Application and Limitation) |  |
| 6 |  | Revision of topic concepts | **Summative Test:**  Cells as the Basis of Life |
| ***TOPIC: HOMEOSTASIS*** | | | |
| 7 | **MAINTAINING INTERNAL ENVIRONMENT**   * Define homeostasis * Give examples of tolerance limits and discuss impacts outside these limits | * **Group SIS (Over two weeks):** Investigate the effect of salinity, pH, temperature or other factors on seedlings. Deconstruct a problem: Seeds and Farming. * **Video:** Science Nation – Extreme Microbes |  |
| 8 | **DETECTING AND RESPONDING**   * Describe the role Nervous and Endocrine systems * Describe the different sensory receptors | * **Mini-Experiments (SIS):** Testing our Receptors |  |
| 9 | **DETECTING AND RESPONDING (Cont.)**   * Describe the structure and function of the nerve pathway * Describe the role and pathway of reflex responses * Using examples, describe negative feedback | * **Class Activity:** Research the biological basis of Alzheimer’s or Parkinson’s disease and how this relates to treatment (**SHE –** Influence, Application and Limitation) * **Mini Experiments (SIS):** Testing our reflexes |  |
| 10 | **ENDOCRINE SYSTEM**   * Describe the stimulus-response model * Describe the role and action of hormones (eg. insulin and glucagon, thyroxine, ADH, TSH, adrenaline) * Diabetes | * **Worksheet:** Use a flow diagram to represent the components of the stimulus-response model * **Class Discussion:** Consider the negative consequences of using hormones in medicinal situations. | **Summative Practical Investigation:** Investigate the effect of plant hormones on plant growth. |
| **Term** **3**  Week 1 | **NERVOUS AND ENDOCRINE SYSTEM**   * Compare the nervous and endocrine systems * Discuss how the two systems work together and independently   + Control body temperature   + enable osmoregulation   + maintain blood sugar levels   + monitor carbon dioxide to maintain constant pH | * **Practical (SIS):** Kidney Dissection   -consider the ethical and safety issues of using animal organs   * **Poster:** Illustrate the effect of ADH on the nephron |  |
| 2 |  | Revision of topic concepts | **Summative Test:**  Homeostasis |
| ***TOPIC: EVOLUTION*** | | | |
| 3 | **LIFE ON EARTH**   * Discuss evidence of when life began on Earth (eg. fossils) * Describe spontaneous forming membranes and ribozymes * Describe the Theory of Endosymbiosis | * **Class Activity:** Compare the characteristics of all known life forms * **Review:** Structure and function of mitochondria and chloroplasts * **Research:** The work of Nobel Prize winners Altman, Cech and Jack Szostak. (**SHE –** Communication and Collaboration, Development) | **Summative Science as a Human Endeavour Investigation:** Select a topic related to Human Endeavour |
| 4 | **COMPARATIVE GENOMICS**   * Describe techniques of obtaining evolutionary relationships between species * Draw and/or analysis simple phylogenetic trees. | * **Class Activity:** Develop a time-line for biological change (e.g. Nuffield activity) * **Assignment:** Research one innovative technologies utilised in comparative genomics (**SHE –** Influence) |  |
| 5 | **REPRODUCTIVE ISOLATION**   * Define a species * Describe reproductive isolating mechanisms | * **Class Activity:** Discuss the limitations of the species definition * **Practical (SIS):** Separate pictures given into pre- and post- zygotic mechanisms. |  |
| 6 | **GENETIC VARIATION**   * Describe the impact of mutations on a species * Explain how meiosis also ensures variation * Explain the impact of natural selection | * **Class activity:** Students describe the impact that many different abiotic and biotic selection pressures have on organisms. Deconstruct activity: How can you show that antiseptics act as selecting agents? * **Field Trip (SIS):** Analyse food webs and selection pressures existing within local ~~Onkaparinga~~ wetlands. (**SHE –** Influence, Application and Limitation) * Experiment (SIS): Natural Selection modelling- analysis of data, limitations of models. |  |
| 7 | **EVOLUTIONARY CHANGE**   * Describe how micro changes leads to macro-evolutionary changes * Define genetic drift and gene flow * Explain the process of speciation | * **Assignment:** Research Darwin & Wallace and their contribution to the understanding of evolution. (**SHE –** Communication and Collaboration, Development) |  |
| 8 | **CONVERGENT AND DIVERGENT EVOLUTION**   * Define convergent, divergent and adaptive radiation * Describe the process of succession | * **Worksheet:** Consider examples of populations with reduced genetic diversity including cheetahs and Tasmanian devils. (**SHE –** Application and Limitation) |  |
| 9 | **HUMAN IMPACT**   * Give examples of human activities that have caused or may threaten the extinction of species. * Ensure the students recognise that humans have an ethical obligation to prevent species extinction. | * **Class Brainstorm:** Investigate local, national or global human activities that have had (or are having) a significant effect on species * **Essay:** Research and describe the steps being taken to preserve species.. (**SHE –** Application and Limitation) |  |
| 10 |  | Revision of topic concepts | **Summative Test:**  Evolution |