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

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

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

|  |  |  |  |
| --- | --- | --- | --- |
| **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 |