**Stage 1 Biology Program 4. This Program articulates to LAP 4.**

**Topics 2 and 3.**

**Semester 2: 10 credit**

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| Science Understanding | Activities/Teaching Strategies | SIS | SHE |
| Week 1-2What is an infectious disease?What is a pathogen?How do we become infected by a pathogen?How do pathogens cause disease?  | Discussion on what distinguishes infectious disease from non-infectious diseases including genetic and lifestyle diseasesUse examples of pathogens to describe how pathogens may be transmitted between hosts e.g. air = common cold (through droplets) or faeces = Salmonella or worms. Consider the lifecycles of pathogens in your pets: e.g. cats and toxoplasmosisPathogens are not limited to humans- plants and other organisms have pathogens too- discuss examplesDescribe how pathogens and host cells recognise each other.Explain that some pathogens enter cells to survive and reproduce.Describe the basic concept of molecular recognition e.g. pathogens binding to cellular receptors. Explain that some pathogens must enter cells to ensure their survival, replication and to evade the immune system. | Look at diagrams or photographs of the different types of pathogens e.g. bacteria, viruses etc.Use animations to model the entry of viruses and other pathogens into cells. E.g. (<http://highered.mheducation.com/sites/0072556781/student_view0/chapter18/animation_quiz_1.html>)Consider and deconstruct the methods that scientists study pathogens and their recognition of cells. |  |
| 3-4Infectious Disease: epidemics and pandemics  | Look at world maps with historical and more recent epidemics and pandemics. Brainstorm the factors that may be different in relation to the control of disease spread in these scenarios.Describe the interrelated factors that can determine the spread of infectious disease including:* persistence of the pathogen within hosts
* the transmission mechanism
* the proportion of the population that are immune or have been immunised
* mobility of individuals of the affected population.
 | Pose questions and investigate with the use of computer modelling how infectious disease can become an epidemic or pandemic e.g. cholera. Consider the limitations of these models.Simulate the spread of disease using a simple model or practical. Consider how epidemiologists would determine which factors are occurring in an epidemic. |  |
| Week 5-6Investigating disease outbreaks. | Discuss the ethics of controlling the spread of disease* quarantine
* access to medications/vaccine
* location of outbreak
* resources available

Evaluate strategies to control the spread of diseases* site planning
* water supply
* sanitation
* food supply
* education
* resources available

How would you determine which strategy would be the most appropriate in different scenarios? (Deconstruct the scenarios associated with these strategies, consider limitations, methods, ethics etc.) |  | **Summative SHE Task**: Case Study: Teacher selected or Student selectedRisk, Spread and Controle.g. Ebola, SARS, bubonic plague, cholera etc.  |
| Week 7-10The Human Immune System: Physical Barriers, Innate and Adaptive (Acquired)  | Distinguish between self vs non-self (foreign) antigens, after defining the concept of an antigen.Extension opportunity: consider the role of MHC in the recognition of antigens.Importance of physical barriers to prevent entry of pathogens, the role of the innate or non-specific immune system and the need for specific immune responses with the adaptive immune system.The immune system has many interdependent parts, that work together to ensure pathogens do not cause disease.Use a disease example to:Describe the function of the components of the innate (non-specific) immune system include: * complement system
* inflammatory response
* phagocytes
* natural Killer Cells.

Describe the function of the components of the adaptive (acquired) immune response include: * B-lymphocytes
* T-lymphocytes
* antibodies
* memory cells
* secondary lymphoid organs.

Examples could include HIV, Influenza or HerpesCompare the difference between the innate (non-specific) and adaptive immune systems can be explained by the role of memory cellsCompare passive and active immunity and the science behind vaccinations | **Summative Practical Investigation**: Deconstruct and Design Practical: Hand Soaps Useful website: http://www.nuffieldfoundation.org/practical-biology/how-good-your-toilet-paper systems in HumansUse graphs to analyse how the immune system responds to pathogens after vaccination using the memory cells of the adaptive immune system.  |  |
| Term 2, Week 1-2Multicellular OrganismsCells acquire specific structure and functions through **cell differentiation.**Recognise that:* cells in a multicellular organism are genetically identical.
* gene expression is responsible for cell specialisation.
 | Unicellular vs Multi-cellular: Bacteria, Fungi, Protists, Plants and AnimalsExplore, using examples,:* how gene can be switched on/off
* repressor proteins
* gene expression during embryo development.
 | Practical:Construct a model microarray of gene expression and analysis expression data.(<http://www.ashg.org/education/gena/GeneExpression_L3_corrected.pdf>) | Investigate gene therapies to prevent or correct the expression of genes that result in genetic diseases (e.g. cancer or cystic fibrosis). |
| Week 3Hierarchical Structure of Multicellular Organisms | Use examples from plants and animals to explain organisation of cells into tissues, tissues into organs, organs into systems.Illustrate the relationship between the structure and function of cells, tissues, organs and/or systems.Organ systems in a multicellular organism are interdependent and function together to ensure the survival of the organism.Compare other multicellular organism systems to the structure and function of human systems. | Practical: Look at specimens of cells from different tissues and organisms from various organisms using the microscope.Practical: Use virtual or actual organ dissections e.g. virtual frog dissection or hands-on practical activity using goat/sheep heart or kidneys or flower dissection.View videos to show the functions of cells, tissue and organs.  |  |
| Week 4-6Exchange Surfaces in Animals, including HumansRespiratory SystemIn animals, the exchange of gases by diffusion between the internal and external environments of the organism is facilitated by the structure and function of the respiratory [system](http://www.australiancurriculum.edu.au/glossary/popup?a=SSCSBI&t=System). Excretory SystemIn animals, the excretory system is responsible for the removal of wastes..Digestive SystemIn animals, the digestive system is responsible for the breakdown and absorption of nutrients required for survival.Circulatory SystemIn animals, the transport and exchange of materials is facilitated by the structure and function of the circulatory [system](http://www.australiancurriculum.edu.au/glossary/popup?a=SSCSBI&t=System).  | Consider examples of materials taken in and released by multicellular organisms. Discuss the features of exchange surfaces that enable them to function efficiently:* thin
* moist
* large surface area
* blood supply in close vicinity

Consider the structure of alveoli in Human lungs and compare to gills in fish. Describe the process of diffusion as a passive process that does not require additional input of energy.Recognise that the respiratory and circulatory systems are interconnected and function together.Describe the structure and function of nephrons in the kidney in the human excretory system.Explain the importance of filtration and reabsorptionRelate the structure of organs of the digestive system to their function.Describe the structure and function of villi in the human digestive system.Construct a table to summarise the major macromolecules (eg. proteins), their monomers (eg. amino acids) and their specific digestive enzymes (eg. proteases) Describe how different nutrients are absorbed through the villi by various transport processes including diffusion, active transport and endocytosis.Compare digestive systems from various animals (e.g. ruminants, insects and birds).Compare the role of blood capillaries and lymph capillaries in the exchange of materialsExamine the structural differences between arteries, veins and capillaries.Compare the circulatory systems of different animals, such as insects, fish, birds, frogs.  | Practical: Use organs from sheep (or similar) to:* show the connection of the circulatory and respiratory systems
* inflate the lungs
* perform a lung dissection
* examine the blood vessels connecting the heart to the lungs.

Practical: Use the Balloon Lung investigation to model the respiratory system. Consider tidal volume, residual volume and vital capacity.Consider the applications of these types of experiments (e.g. medical, sporting etc.)**Summative Practical Investigation**: Completion: Investigate digestive enzymes and factors that may affect their function (e.g. amylase and pH or lipase and temperature).Practical:Dissect a fish to investigate the circulatory system of a non-mammalian animalPractical: Dissect a mammalian heart (e.g. pig, cow, sheep or goat).Practical: Investigate the effect of exercise on heart rate. | Consider the use of live or deceased donors for organ transplants. Discuss the ethical considerations of live organ donations. Explore innovative technologies, such as 3D bio-printers to produce kidneys that are genetically matched to the recipient. Research how pacemakers and other devices have saved the lives of many waiting for a heart transplant. |
| Week 7-8Lifestyle Choices impacts on the functioning of organs and systems. | Discuss the effects of different lifestyle choices have on the functioning of different organs e.g. smoking and lungs or in pregnancy or energy drinks and the digestive system etc.Investigate the consequence of uncontrolled cell division that may results from lifestyle factors such as exposure to carcinogens (e.g. lung cancer and its link with smoking). |  | Investigate lifestyle diseases related to the respiratory system (emphysema, lung cancer, pneumonia, asthma). Consider questions such as: Is there a difference between the lung capacities of non-athletes to athletes? What are the benefits of exercise for the individual?  |
| Week 7-8Exchange Surfaces in Plants | Examine the structure and function of the different cell types in a leaf.Gases are exchanged mainly via stomata. Their movement within the plant is by diffusion and does not involve the plant transport [system](http://www.australiancurriculum.edu.au/glossary/popup?a=SSCSBI&t=System). In plants, the uptake of nutrients and water is facilitated by the structure of the root system. | Practical: Look at stomata and chloroplasts using a microscope (e.g. nail varnish impressions)- the density of stomatal density, examine the guard cells.Practical: Examine the structure of roots and root hairs in different plants. |  |