# Module 1
## Cells as the Basis of Life

### Module 1 Section 1 Cell Structure

<table>
<thead>
<tr>
<th>Course</th>
<th>Content</th>
</tr>
</thead>
</table>
| **Examining a variety of prokaryotic and eukaryotic cells (ACSBL032, ACSBL048)** | **Cell theory**: the cell theory is an important theory in the field of biology. The cell theory states:  
- All organisms are made up of cells  
- New cells are produced from existing cells  
- The cell is the smallest organisational unit of a living thing  

There are two types of cells- Prokaryotic and eukaryotic  

**Prokaryotic**: Prokaryotic cells are relatively small and primitive. They do not possess **membrane-bound** structures. Prokaryotic cells are represented by two domains: **Bacteria** (bacteria and blue algae) and **Archaea** which includes extremophiles.  

Bacterial cell walls are typically composed of a carbohydrate protein material called **peptidoglycan**  

**Eukaryotic**: Eukaryotic cells are relatively larger and more complex than prokaryotic cells. They possess **membrane-bound organelles** such as a nucleus, mitochondria and lysosomes. Eukaryotic organisms include:  
- Protista-unicellular organisms  
- Fungi  
- Plantae  
- Animalia.  

Heterotrophic: feeding on others  
Autotrophic: feeding itself  

**Cytology**: is the study of cells. Cytologists use a variety of tool and techniques to study cells the main tools used are:  
- **Light microscopes**: Uses light and a system of lenses to
technologies that are used to determine a cell’s structure and function.

- **Electron microscope**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Light Microscope</th>
<th>Electron Microscope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnifying power</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Cost</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Level of expertise needed</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Can living specimens be observed</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>
**Cell size:** Most cells are only visible under a light microscope, and their size is usually measured in micrometres (μm). There are 1000 micrometres in 1 millimetre (mm). REALLY IMPORTANT

Typical cell sizes are:
- Bacterium: 0.1-1.5 μm long
- Human: 8-60 μm long
- Plant: 10-100 μm long
- Paramecium (a single eukaryotic): about 150 μm long
- Cell Membrane (differs between cells) 0.004-0.1 μm thick

**Biological Drawing**
Drawing should be:
- Made in grey lead pencil
- Large
- Fully labelled with the name of the specimen, the type of preparation and the magnifications.
- Given a size perspective so that comparisons can be made between specimen size—draw each specimen in relation to the size of the field of view observed

<table>
<thead>
<tr>
<th>Organelles</th>
<th>Description and function</th>
<th>Found in both plants and animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nucleus</td>
<td>Large spherical organelle, controls cell activities (contains DNA)</td>
<td>yes</td>
</tr>
<tr>
<td>Mitochondria</td>
<td>Features folded inner membrane; site of aerobic stages of cellular respiration (contains some DNA)</td>
<td>yes</td>
</tr>
<tr>
<td><strong>Organelle</strong></td>
<td><strong>Description</strong></td>
<td><strong>Location</strong></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Ribosomes</td>
<td>Tiny spherical organelles; site of protein synthesis; not membrane bound</td>
<td>yes</td>
</tr>
<tr>
<td>Endoplasmic reticulum (ER)</td>
<td>Network of membranes involved in protein transport within cells; ER encrusted with ribosomes is called ‘rough’ ER</td>
<td>yes</td>
</tr>
<tr>
<td>Golgi apparatus</td>
<td>Stacks of flattened membranous sacs; modifies and packages substances in preparation for secretion from cell</td>
<td>yes</td>
</tr>
<tr>
<td>Chloroplast</td>
<td>Site of photosynthesis (contains chlorophyll)</td>
<td>Plant cells only</td>
</tr>
<tr>
<td>Lysosomes</td>
<td>Membrane-bound organelles that produces digestive enzymes; break down complex compounds into simpler molecules</td>
<td>Animals, Plants (some evidence)</td>
</tr>
<tr>
<td>Vacuoles</td>
<td>Membrane-bound compartments that keep a variety of substances separate from cell contents (large in plant cells, small in animal cells)</td>
<td>yes</td>
</tr>
<tr>
<td>Cilia</td>
<td>Short and hair-like; generally present in large numbers; rhythmic waves create movement of substances over cell surface, or movement of the cell</td>
<td>yes</td>
</tr>
<tr>
<td>Flagellum</td>
<td>Long and hair-like; generally singular or present in small numbers; rhythmic contraction enable movement of cell</td>
<td>yes</td>
</tr>
<tr>
<td>Cell wall</td>
<td>Rigid structure surrounding cell; composed of cellulose in plants limits cell expansion when fully turgid; contributes to structural support of plant</td>
<td>Plant cells only</td>
</tr>
<tr>
<td>Cell membrane</td>
<td>Semipermeable, flexible barrier; controls cell input and outputs</td>
<td>yes</td>
</tr>
</tbody>
</table>
**Organic chemicals**
Organic chemicals are based on the element carbon which form chains, rings and networks and build complex molecules needed to make a living cell. There are four main types of organic chemistry:

- Carbohydrates
- Lipids (fats and oils)
- Nucleic acids (DNA and RNA)
- Proteins (polymers made from amino acids)

**Carbohydrates**
- Monosaccharides (mono = one, saccharide = sugar) glucose ($C_6H_{12}O_6$)
- Disaccharides (di = two) sugar made from TWO monosaccharides joined together
- Polysaccharides (poly = many) huge molecules joined in chain networks. Examples are: Starch (made by plants), Glycogen (made by animals) and Cellulose (made by plants)

**All organic molecules contain**
1. Sugar which contains: Carbon/Hydrogen/oxygen
2. Carbohydrates which contains: Carbon/Hydrogen/oxygen
3. Fats which contains: Carbon/Hydrogen/oxygen
4. Proteins which contains: Carbon/Hydrogen/oxygen/nitrogen

**The structure of the cell membrane**
The membrane structure is a phospholipid. Phospholipids consist of phosphate and a lipid (fat).

- The lipid Bilayer acts as the basic structure for a cellular membrane
- The lipid a Bilayer comprises of two layers of phospholipid molecule
- Each phospholipid molecule has hydrophobic end (tail) and a hydrophilic end (head)
These molecules have various functions:
- Receptors for messenger chemicals
- Identification makers, so your body knows its own cells from any foreign invaders
- To help chemicals get through the membrane.

Module 2 Section 2 Organisation of living things

Diffusion
- Describes the movement of particles from regions of high concentrations to low concentration down a concentration gradient
- Occurs down a gradient

Simple diffusion
- Simple diffusion molecules move directly through the membrane without any assistance
- Example: Oxygen diffuses in blood

Facilitated Diffusion
Factors affecting Diffusion

1. **Concentration gradient**: diffusion rates will be higher when there is greater differences.
2. **Distance**: Diffusion over a shorter distance occurs at a greater rate than that over a large distance.
3. **Surface area**: The rate of diffusion is greater when there is a larger surface area.
4. **Physical barrier**: Thick barriers slow down the rate of diffusion whereas a thinner barrier enhances the rate of diffusion.
5. **Temperature**: Particles at a greater temperature have a greater rate of diffusion until a certain point where they will denature.

Osmosis

- The movement of water molecules from an area of high concentration to low concentration across:
  - Semipermeable membrane
  - Passive process
  - Down concentration gradient

**Diffusion diagram**

![Diffusion diagram](image)
**Osmosis diagram**

- Hypertonic = has a high concentration of solutes
- Isotonic = has an equal concentration of solute
- Hypotonic = has lower concentration of solute

**Osmosis and diffusion**

Osmosis is the movement from water high to low concentration while diffusion is the movement of any other substance from high to low concentration.

**Photosynthesis**

- Only occurs in plants (autotrophs)
- Converts solar energy into glucose for use in cellular respiration

**Cellular Respiration**

- Occurs in all organisms (autotrophs and heterotrophs)
- Uses glucose as a fuel source to release ATP to power metabolism

**Photosynthesis Equation**

\[
\begin{array}{c|c|c|c}
\text{Carbon dioxide} & \text{Water} & \text{Sugar} & \text{Oxygen} \\
6\text{CO}_2 & 6\text{H}_2\text{O} & \text{C}_6\text{H}_{12}\text{O}_6 & 6\text{O}_2 \\
\end{array}
\]

(Only plants)
examining the roles of active transport, endocytosis and exocytosis

| **Active transport** | Uses energy (ATP) to occur  
|                     | Moves from lower concentration to high concentration  
|                     | Formation of fruits/ storage for starch  
|                     | Kidney function  |

| **Endocytosis** | When a section of cell membrane wraps around substance for import into the cell, pinching of to form a vesicle inside the cytoplasm  |

| **Pinocytosis** | Refers to a similar process related to the import of liquid droplets.  |

| **Exocytosis** | Is the opposite of endocytosis and involves vesicles, such as those associated with the Golgi apparatus, merging with the cell membrane to facilitate the export of substances  |
Relating the exchange of materials across membranes to the surface-area-to-volume ratio,

**Surface-area to volume**
When substances enter or leave cells, the rate at which they move is determined by the number of factors, these include:
- Concentration: a steep concentration gradient causes faster diffusion
- Temperature: higher temperature increase the rate of movement of molecules
- Surface-area to Volume ratio: (SA:V)

**Rates of diffusion**
- Faster diffusion will occur if
- SA:V is large
- Concentration gradient is large

**Must know this example for exam**

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The smaller an object, the larger its SA:V ratio
- Cells need to be small to allow for efficient diffusion of substances. Flatter shapes will also have larger SA:V ratios.

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Learn Por: 4g vs. 1g vs. All white
Investigate cell requirements, including but not limited to: Matter, including gases, simple nutrients and ions and Removal of wastes

<table>
<thead>
<tr>
<th>Substance</th>
<th>Examples</th>
<th>Function in cells</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inorganic Compounds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>H₂O</td>
<td>All chemical reactions in organisms take place in solution in water. Water has high heat capacity</td>
</tr>
<tr>
<td>Oxygen</td>
<td>O₂</td>
<td>Oxygen is needed for efficient energy supply. Achieved by the process of cellular respiration. It is taken in as a gas by terrestrial organism and in solution by aquatic ones.</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>CO₂</td>
<td>Carbon Dioxide is the main source of the carbon atoms for organic molecules, usually starting with the carbon fixation by photosynthesis in autotrophs. CO₂ is taken into plant leaves as a gas, converted to sugars and eventually returned to the atmosphere in the carbon cycle</td>
</tr>
</tbody>
</table>
| Minerals           | Nitrogen Phosphorus Iron Magnesium | N is used for protein and nucleic acid synthesis  
P is used for nucleic acid synthesis and is an important component of cell membranes  
Fe is a component of haemoglobin in red blood cells  
Mg is a component of chlorophyll                                                                                                                                 |
<table>
<thead>
<tr>
<th>Organic Compounds</th>
<th>Carbohydrates</th>
<th>Lipids</th>
<th>Proteins</th>
<th>Nucleic Acid</th>
<th>Vitamins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates</td>
<td>Basic building blocks are monosaccharides contain C,H,O,B</td>
<td>Carbohydrates provide an energy source to cells that can be accessed relatively easily</td>
<td>Lipids are used for long term energy storage and insulation, and are structural components of membranes</td>
<td>All enzymes are proteins. Proteins also play important structural roles</td>
<td>Vitamin C prevents scurvy Vitamin D facilitates the uptake of calcium into bones. Bone vitamins have an important role in enzyme function, for example as coenzymes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enzymes</th>
<th>Enzymes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined as protein molecules that act as a catalyst without being changed in the process.</td>
<td></td>
</tr>
<tr>
<td>Each has a 3rd dimensional shape, which fits its “Substrate Perfectly”</td>
<td></td>
</tr>
</tbody>
</table>

Investigate the effects of the environment on enzyme activity through the collection of primary or secondary data.
Conduct a practical investigation to model the action of enzymes in cells

- Enzymes will only catalyse with one particular reaction
- Enzymes only work effectively in a relatively narrow range of temperature and pH (acidity)
Discuss suitable forms of energy, including light energy and chemical energy in complex molecules.

Biochemical processes in Cells

Cell functions rely on chemical reactions that occur within and between cells. The chemical reaction that occurs in an organism are known as biochemical processes (Metabolism) which can be divided into two main types of processes:

1. **Endergonic** processes that require a net input or use of energy. (Photosynthesis)
2. **Exergonic** processes that result in a net output or release of energy. (Cellular Respiration)

Module 2 section 3 Organisation of living thing

<table>
<thead>
<tr>
<th>Features</th>
<th>Unicellular</th>
<th>Colonial</th>
<th>Multicellular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>single-celled organism consisting of only one cell Tissues.</td>
<td>Unicellular organisms that stay together and share resources.</td>
<td>comprised of more than one cell, specialised cells and tissues</td>
</tr>
</tbody>
</table>
investigating structures at the level of the cell and organelle relating structure of cells and cell specialisation to function

<table>
<thead>
<tr>
<th>Examples</th>
<th>Bacteria and other prokaryotes</th>
<th>Volvox; sponges coral and algae</th>
<th>All complete organisms animals and plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advantages</td>
<td>Small size fast and efficient reproduction</td>
<td>Small size injury or death of cell doesn’t affect all the organisms Fairly easy to reproduce</td>
<td>Can be larger cellular respiration</td>
</tr>
<tr>
<td>Disadvantages</td>
<td>Will die if injured</td>
<td>simple</td>
<td>reproduction</td>
</tr>
</tbody>
</table>

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

- Organs are structures made up of two or more tissues organized to carry out a particular function, and groups of organs with related functions make up the different organ systems

- **Cellular differentiation** is the process by which a less specialized cell becomes a more specialized cell type. ... **Differentiation** occurs many times during the development of a multicellular organism. The organism changes from a single zygote to a complex system of tissues and cell types.

- **Cell Specialisation** and Organism Organisation. Multicellular organisms contain a wide range of different cells. Every cell is specialised to perform its function as best as possible.
justify the hierarchical structural organisation of organelles, cells, tissues, organs, systems and organisms

All multicellular organisms have a hierarchical structure of organisation. Their cells are organised into tissues, different tissues are organised into organs, and organs are organised into organ systems. ... Nervous tissue; for example, nerve tissue in the brain made of nerve cells called neurons.

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

**Autotrophs:** possess the ability to produce their own organic nutrients but need to take in the required organic nutrients

**Heterotrophs:** must take in the required organic and inorganic nutrients.

**Monocot stem vs Dicot stem**
There are 2 major divisions in plant structure. Monocotyledon and Dicotyledon

**Monocotyledons:** lowering plants whose seeds typically contain only one embryonic leaf, or cotyledon

**Dicotyledons:** a flowering plant with an embryo that bears two cotyledons (seed leaves). Dicotyledons constitute the larger of the two great divisions of flowering plants, and typically have broad stalked leaves with net-like veins
investigate the function of structures in a plant, including but not limited to:
- tracing the development and movement of the products of photosynthesis

<table>
<thead>
<tr>
<th>movement of the products of photosynthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phloem</strong>: conducts food made in the leaves to all other parts of the plants</td>
</tr>
<tr>
<td>The movement of nutrients is conducted via the phloem through a method called source to sink.</td>
</tr>
<tr>
<td><strong>Source to sink</strong>: Pressure flow, the mechanism by which through the phloem sugars are transported from high pressure areas full of nutrients to those of low nutrient areas.</td>
</tr>
</tbody>
</table>

investigate the gas exchange structures in animals and plants through the collection of primary and secondary data and information, for example: (ACSBL032, ACSBL056)

<table>
<thead>
<tr>
<th>gas exchange structures plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants exchange gas through a process called cellular respiration which requires (oxygen) and produces (carbon dioxide)</td>
</tr>
<tr>
<td>Plants main organs of gas exchange are leaves via the Stomata (Tiny pores in epidermis).</td>
</tr>
<tr>
<td>Stomata have guard cells that open and close to regulate water loss. Stomata are commonly found on the underside of the plant.</td>
</tr>
</tbody>
</table>

**Gas exchange structures in Animals**

- Small animals (usually aquatic) can exchange via **diffusion**
- Insects have a system of small tubes (trachea) that allow and get gas to the cells controlled by opening and closing of spiracles along the insects body
- Fish have **gills** with a very large (SA:V ratio) which are incredibly efficient at extracting (oxygen). This is maximised via current counter exchange (swim against the stream)
- Terrestrial organisms (reptiles, birds, mammals) have **lungs** composed of many spherical alveoli. This creates a large (SA:V ratio) in contact with capillaries to facilitate efficient gas exchange.
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
  The process by which a plant turns carbon dioxide and water into glucose and oxygen.

<table>
<thead>
<tr>
<th>Photosynthesis Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide + Water → Sugar + Oxygen</td>
</tr>
</tbody>
</table>

6CO₂ | 6H₂O | C₆H₁₂O₆ | 6O₂ |

**transpiration-cohesion-tension theory**

**Cohesion, Adhesion, Transpiration**

**C.A.T**

Forces of **cohesion** keep water molecules connected while the forces of **adhesion** allow water molecules to stick to the side of the **xylem**. **Transpiration** sucks the connected water molecules up through the plant and evaporate out via the **stomata** in the leaf. Similar principal to how a straw works.
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

### Chemical digestion

<table>
<thead>
<tr>
<th>Chemical digestion</th>
<th>Physical digestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Pancreas - Pancreatic amylase</td>
<td>● Teeth</td>
</tr>
<tr>
<td>● Salivary glands - Salivary amylase</td>
<td>● Peristalsis</td>
</tr>
<tr>
<td>● Gastric juice</td>
<td>● Bile (because they reduce large fat cells to small cells)</td>
</tr>
<tr>
<td>● Protein enzymes</td>
<td>● Sphincter</td>
</tr>
<tr>
<td><strong>Endopeptidases and exopeptidases</strong></td>
<td>● Stomach</td>
</tr>
</tbody>
</table>

### Physical digestion

- Teeth
- Peristalsis
- Bile (because they reduce large fat cells to small cells)
- Sphincter
- Stomach

### Autotrophs

*Autotrophs:* possess the ability to produce their own organic nutrients but need to take in the required organic nutrients.

- Autotrophs require carbon dioxide and water vapour and produce oxygen

**compare the nutrient and gas requirements of autotrophs and heterotrophs**

**Autotrophs:**
-Requires carbon dioxide and water vapour for photosynthesis
-Produces oxygen as a byproduct

**Heterotrophs:**
-Requires organic nutrients provided by autotrophs
-Cannot produce oxygen

**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

**Chemical digestion**

- Pancreas - Pancreatic amylase
- Salivary glands - Salivary amylase
- Gastric juice
- Protein enzymes
- **Endopeptidases and exopeptidases**

**Physical digestion**

- Teeth
- Peristalsis
- Bile (because they reduce large fat cells to small cells)
- Sphincter
- Stomach

**compare the nutrient and gas requirements of autotrophs and heterotrophs**

**Autotrophs:**
- Requires carbon dioxide and water vapour for photosynthesis
- Produces oxygen as a byproduct

**Heterotrophs:**
- Requires organic nutrients provided by autotrophs
- Cannot produce oxygen
**Heterotrophs**: must take in the required organic and inorganic nutrients. Work in reverse for gas requirement.

- Heterotrophs require oxygen and through respiration exhale carbon dioxide and water vapour.

| 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 | Investigate transport systems in animals and plants by comparing structures and components using physical and digital models, including but not limited to:|  
| Transport system in Animals: | Transport system in Plants: |  
| The system of structures in vertebrates consisting of the heart, blood vessels, and lymphatics, by which blood and lymph are circulated throughout the body. | Plants have two transport systems the (Phloem) which transports the nutrients via source to sink theory and photosynthesis. The (Xylem) transports the water within the plant via respiration from both the root and the leaves. The leaves stomata let water exit. |  
| Macroscopic structure |  
| Investigate the exchange | Gas exchange structures in animals and plants |
of gases between the internal and external environments of plants and animals

**Plants**
- Gas exchange occurs through the **stomata**
- Balance required between gas exchange and water conservation
- Light is the main factor that causes the stomata to open and close
- Low level of water will cause the stomata to close

![Stomata diagram](image)

**Animals**
- Large surface area
- Thin, most surfaces
- Close proximity to transport system
- Concentration gradient maintained

Mammals - **Alveoli** in lungs are the gas exchange
Fish- gills are the gas exchange structures.

Insects exchange gases via pores called **spiracles** which lead to **tracheal tubes**, which then branch into smaller tubes called **tracheoles**.

The tracheoles bring air directly to and from the cells of the insect. Blood is not involved in the transport of gases in an insect.

**Respiratory structure of Insects**

**The tracheal system**

*compare the structures vascular systems in plants and animals*
and function of transport systems in animals and plants, including but not limited to:

<table>
<thead>
<tr>
<th>Plant</th>
<th>Vascular tissue consists of two main features: the xylem (transport of water through C.A.T) and the Phloem (transport of organic nutrients (sucrose)).</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.A.T</td>
<td>Cohesion, Adhesion, Transpiration</td>
</tr>
<tr>
<td>Animal vascular systems</td>
<td>Open: Transport fluid leaves the vessels, enters body cavity and bathes the organs</td>
</tr>
<tr>
<td></td>
<td>Closed: Transport medium remains enclosed in the system of vessels at all times with heart providing the driving force.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>compare the changes in the composition of the transport medium as it moves around an organism</th>
<th>Composition of blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>As blood moves around the body, it changes its percentage of particular components</td>
<td></td>
</tr>
<tr>
<td><strong>Lungs</strong></td>
<td>Oxygen increases/Carbon dioxide decreases</td>
</tr>
<tr>
<td><strong>Stomach/Intestines</strong></td>
<td>increase in glucose/Increase in protein/increase in carbohydrates/Increase in vitamins and mineral.</td>
</tr>
<tr>
<td><strong>Oxygen decrease/Carbon dioxide increase</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Kidney</strong></td>
<td>Decrease in nitrogenous wastes</td>
</tr>
<tr>
<td><strong>Brain</strong></td>
<td>Decrease in glucose and oxygen increase in carbon dioxide.</td>
</tr>
<tr>
<td><strong>Muscles</strong></td>
<td>Decrease in glucose and Oxygen.</td>
</tr>
</tbody>
</table>
Module 3 Biological diversity

predict the effects of selection pressures on organisms in ecosystems, including:

- **Abiotic** factors are the non-living ecological factors e.g. rocks, wind speed that have an impact on the ecosystem
- **Biotic** factors are living organism impact of the ecosystem

<table>
<thead>
<tr>
<th>BIOTIC components</th>
<th>ABIOTIC components</th>
</tr>
</thead>
<tbody>
<tr>
<td>- <strong>Food availability</strong> (alligator diet consists of fish, frogs and Invertebrates)</td>
<td>- <strong>Temperature of the air/water</strong> (particularly important as alligators are cold-blooded)</td>
</tr>
<tr>
<td>- <strong>Competition</strong> (with snapping turtles and herons for food and other alligators for space/ food/ mates)</td>
<td>- <strong>Climate</strong> (rainfall, humidity, wind... all affect the gator’s activity)</td>
</tr>
<tr>
<td>- <strong>Disease</strong> (caused by bacteria, viruses or fungi)</td>
<td>- <strong>Sunlight</strong> (intensity as well as length of day/night)</td>
</tr>
<tr>
<td>- <strong>Parasites</strong> (such as flatworms)</td>
<td>- <strong>Oxygen available</strong> (they need it for respiration)</td>
</tr>
<tr>
<td>- <strong>Plants</strong> (eg. bald cypress, swamp gum, lily pads - provide shade, protection and habitats for prey, recycle nutrients, absorb CO2 and provide O2)</td>
<td>- <strong>pH and salinity</strong> (could affect its drinking water supply, also indirectly in terms of food availability and plant activity)</td>
</tr>
</tbody>
</table>

investigate changes in a population of **Selective pressure** is competition for survival as successful variations or traits survive and reproduce.
organisms due to selection pressures over time, for example: (ACSBL002, ACSBL094)

Example **Cane Toads**
The cane toad is an invasive species introduced in 1835 used to control cane beetles. When introduced to Australia its initial pressure was water stress. Cane toads response was to selectively breed with those who have longer legs as they had the successful traits in order to survive which resulted in higher reproduction with those with long legs.

Example **Prickly pear**
Initially used as a dye in Queensland. The prickly pear became sustainable in Australia’s ecosystem as is suited Australia’s conditions. The prickly pear selective pressure came down to its reproduction rate which came from its production of flowers. In response the prickly pear that could produce more flowers was the successful trait for survival and reproduction.

**Great Barrier Reef:**
Coral bleaching caused by lack of oxygen in water, as a result of higher temperatures (global warming).

| **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,** | **1. structural adaptations:** any feature that is physical / concerns how it was built e.g. fur, claws, teeth, feathers, how many eyes, etc.

2. **physiological adaptations:** Actions taken by organisms that are consciously controlled e.g. nocturnal hunting patterns

3. **behavioural adaptation:** Any process that occurs within the body which is not consciously controlled e.g. heart beat, ability to produce urine. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Example <strong>Red kangaroo</strong></td>
<td><strong>Example Red kangaroo</strong></td>
</tr>
<tr>
<td><strong>including:</strong></td>
<td><strong>structural adaptations</strong></td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td><strong>structural</strong></td>
<td>tail, robust high crowned molars, dense fine fur.</td>
</tr>
<tr>
<td><strong>physiological</strong></td>
<td></td>
</tr>
<tr>
<td><strong>behavioural</strong></td>
<td></td>
</tr>
</tbody>
</table>

| **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 | **natural selection:** | The process in nature by which, according to Darwin’s theory of evolution, only the organisms best adapted to their environment tend to survive and transmit their genetic characters in increasing numbers to succeeding generations while those less adapted tend to be eliminated. |

Darwin found seven different species of finches which condescended the church and gods “made the world perfectly” because there were seven different species of the same bird. This allowed Darwin to compose the theory of evolution and explain the variation through natural selection.

Species: Not able to interbreed

Speciation:
Due to Isolation = time and changing environment.

There needs to be a change or selective pressure/variation in the environment that are favourable to lead to differential survival, otherwise no change will take place. Reproduction of these survivors leads to an increase in the frequency of the favourable variant.
<table>
<thead>
<tr>
<th>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</th>
<th><strong>Biological diversity:</strong> How many different types of species there are and the number or different variation within a species this is in response to survival of any organism is dependent on many factors most of these factors are in the form of abiotic and biotic aspects of the ecosystem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyse how an accumulation of microevolutionary changes can drive evolutionary changes and speciation over time, for example: [ACSB034, ACSBL093]</td>
<td><strong>Microevolution:</strong> is the change in allele frequencies that occurs over time within a population. This change is due to four different processes: mutation, selection (natural and artificial), gene flow and genetic drift.</td>
</tr>
</tbody>
</table>

**Horses** belong to a group known as the “odd toed” ungulates which includes rhinos, zebras and donkeys. A complete fossil record allows us to trace ancestors effectively and see its microevolutionary changes.

**Trend in evolution**

1. Decreased number of toes from the Hyracotherium which had 4 toes to the modern day Equus which has 1 toes/ hoof. This was in response to predators as the equus needed to become faster and over different terrain which the single toe provided as it helped run quickly over hard ground.

Platypuses have hair, webbed feet, a beaver-like tail, duck-like bills and lay eggs. Now their microevolutionary changes were driven due to their available dietary they went from

61 million years ago- Monotrematum sudamericanum-medium size + teeth

26 million years ago- Obdurodon Insignis medium size + teeth
### Explain, using examples, how Darwin and Wallace’s Theory of Evolution by Natural Selection accounts for:

<table>
<thead>
<tr>
<th>Type of Evolution</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convergent evolution</td>
<td>Shark and dolphin, Cat and Dog</td>
</tr>
<tr>
<td>Divergent evolution</td>
<td>Marsupials e.g. Kangaroos</td>
</tr>
</tbody>
</table>

### Investigate, using secondary sources, evidence in support of Darwin and Wallace’s Theory of Evolution by Natural Selection:

**Comparative Anatomy:**
- Allows us to observe similarities that suggest a common ancestry between divergent species
- Can reveal divergent or convergent adaptations

**Fossil Records:**
- It gives an order and approximate date of when
Natural Selection, including but not limited to: biochemical evidence, comparative anatomy, comparative embryology and biogeography techniques used to date fossils and the evidence produced.

Species lived via radiometric dating and the law of superposition.

Radiometric dating:

- Is one of the ways to determine precise date of the fossils by measuring the number of half lives elapsed.

Comparative embryology is the similarity in birth e.g. laying eggs is similar between ducks and other birds.

Cane toad

Antibiotic resistant bacteria

1. Antibiotic is given
2. Most bacteria dies but some survive
3. Mutations occurs (the survived reproduce)
antibiotic-resistant strains of bacteria

4. Mutation now resistant to antibiotic

Module 4 section 4 Ecosystem Dynamics

Patterns of macroevolution

- **Phyletic gradualism** - evolution occurs by the gradual accumulation of small changes. The intermediate stages of evolution not represented by fossils merely testifies to the incompleteness of the fossil record.

- **Punctuated Equilibrium** - evolutionary history consists of geologically long periods of stasis with little or no evolution, interrupted or “punctuated” by geologically short periods of rapid evolution.

Module 4 section 4 Ecosystem Dynamics

investigate and determine

Biotic: Biotic factors are the living things that an organism shares the ecosystem with, including **plants**. **Animals** and **bacteria**. Species may be affected directly or indirectly by each other.
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  

Abiotic: Abiotic factors are unevenly distributed throughout an ecosystem and include temperature, pressure, lights availability, water availability, wind and soil nutrient levels.

### Relationship between the abiotic and biotic factors

- Every living thing exists within a framework of biotic and abiotic factors called an ecosystem  
- An ecosystem consists of the interaction of living things with each other and with their nonliving environment

### Impact of abiotic and relationship to biotic factors

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>In aquatic environments</th>
<th>In terrestrial environments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity</td>
<td>Water has a high viscosity so it make it more difficult for organisms to move through it.</td>
<td>Air is low viscosity so it makes it easier for organisms to move through it</td>
</tr>
<tr>
<td>Buoyancy</td>
<td>Buoyancy of water offers support to both animals and plants. This helps maintain their shape and enables some organisms to function at different depths</td>
<td>Air support minimal support to both animals and plants so they must have strong structures and maintain shape</td>
</tr>
</tbody>
</table>
| Temperature variation| Large bodies of aquatic environments heats up more slowly than air while small bodies of water still heats up more | More temperature variations as the energy needed to heat air is much less than that of water  
Easier to reach higher temperatures and lower |
<table>
<thead>
<tr>
<th><strong>populations in ecosystems due to predation, competition, symbiosis and disease</strong></th>
<th>slowly than air however the has a higher temperature variation</th>
<th>temperatures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pressure variation</strong></td>
<td>Pressure in water increases rapidly with depth. Changing depth rapidly may be difficult for many organisms</td>
<td>Pressure decreases in air with and increase in height. Basically the higher you go the less pressure you feel</td>
</tr>
<tr>
<td><strong>Availability of gases</strong></td>
<td>Gas availability in water is low and depends on the temperature. Diffusion is slower. Oxygen availability affects the number and distribution of aquatic organisms.</td>
<td>Gas availability is rarely a problem as it is everywhere in terrestrial environments</td>
</tr>
<tr>
<td><strong>Availability of water</strong></td>
<td>Water availability is rarely a problem in aquatic environments but the osmotic effects of fresh and saltwater are important to organisms.</td>
<td>Availability of water is low and dependent on where organisms live This affects the distribution of terrestrial plants and animals and their adaptations</td>
</tr>
<tr>
<td><strong>Availability of ions</strong></td>
<td>Saltwater environments contain 3.5% dissolved salts. Mostly salt, duh, (sodium chloride) Freshwater environments have low ion concentration.</td>
<td></td>
</tr>
<tr>
<td><strong>Light penetration</strong></td>
<td>Light falling on water may reflect, scatter or be absorbed. Light penetration decreases rapidly with depth.</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Availability and type of substrates</strong></td>
<td>Bottom dwellers are affected by the type and amount of substrate available. Free swimming and surface level aquatic organisms are less affected, although the amount of sediment in water is important</td>
<td></td>
</tr>
<tr>
<td><strong>Strength of natural forces</strong></td>
<td>Some organism cannot survive in moving water while other cannot survive without moving water</td>
<td></td>
</tr>
<tr>
<td><strong>Availability of shelter</strong></td>
<td>Not all organisms require shelter. The Substrate, rocks, vegetation and coral reefs may provide for those that do</td>
<td></td>
</tr>
<tr>
<td><strong>Availability of space</strong></td>
<td>May be a limiting factor in some aquatic environments, especially for animals requiring territory.</td>
<td></td>
</tr>
</tbody>
</table>

**Biotic impacts**

**Predation**: a predator-prey relationship e.g. killer whale eating sea birds

**Competition**: when two or more organisms use one or more resources in
common such as **food, shelter, and mates** this is referred to as **competition**.

- **Intraspecific** competition: members of their own species.
- **Interspecific** competition: members of another species.

**Allelopathy**: is the production of specific biomolecules by one plant that can be beneficial or detrimental to another plant.

**Symbiotic Relationships**: term used for interactions in which two organisms live together in a close relationship that is beneficial to at least one or more of them

- Mutualism- both species in the relationship benefit from association (+/+)
- Commensalism- one species benefits and the other is unaffected (neither harmed nor helped) (+/0)
- Parasitism- one species benefits and the other suffers (usually) non-lethal damage (+/-)

**the ecological niches occupied by species**

The part of the ecosystem that the organism occupies is called a niche. Niche refers to all the resources that a species uses, both biotic and abiotic factors.

For example: the niche of a koala is the time of day it is most active or sedentary, the number and types of leave it eats and the size and type of tree it lives in

- **Competitive exclusion principle**: no two species can occupy the same niche

**predicting consequences for populations in ecosystems due to predation, competition, symbiosis and disease**

- Predation, competition, symbiosis and disease have consequence for population
**Consequence of predation**

Predators affect the distribution and abundance of their prey.

To summarise, when there are a large number of prey available, the predator population increases in size. As prey are consumed, their numbers decline, leading to a shortage of food for the predators, whose numbers consequently also decline.

**Consequence of competition**

Competition between species for resources affects reproduction and survival rates. Population fluctuations can be directly linked to the competing species and their resource.

**Consequence of symbiosis**

The process of symbiosis has profound consequence for all life on earth. Symbiosis contributes to:

- Increased evolutionary diversification
- The development of new species from integration of their genetic material with each other
- Sources of new capabilities for organisms, which enhance evolutionary “fitness”

Therefore, symbiosis allows an increase in biodiversity and therefore more resilient ecosystems.

For example: coral reefs are only possible because the coral (animal) has a symbiotic relationship with photosynthetic algae.

**Consequence of disease**

Can be defined as the process that adversely affects the normal function of tissue in a living organism.

The effect of an emerging disease on an ecosystem is to alter the balance of the food web.
measuring populations of organisms using sampling techniques (ACSBL003, ACSBL015)

explain a recent extinction event (ACSBL024)

sampling techniques

Transect: A sample technique used to estimate the population by using a straight line that cuts across the area studied and along which the organism can be counted and described.

Quadrate: A technique used to estimate population size by using a square or rectangular plot to count organisms within it.

\[
\text{Size of population} = \frac{\text{Number in quadrat} \times \text{Total area}}{\text{Area of quadrat}}
\]

Capture mark and recapture: A technique used to estimate the population size of a mobile animal by capturing, marking and recapture.

\[
\text{Size of population} = \frac{\text{Number in 1st capture} \times \text{Number in 2nd capture}}{\text{Number tagged in 2nd capture}}
\]

Extinction of the megafauna

Overhunting by humans

- Fossil evidence of human arrival coincides with a disappearance of megafauna
- But little fossil evidence of kill sites

Climate Change

- Megafauna would be less able to adapt to decreased water availability and a change in vegetation
- But similar results not seen with previous ice ages

analyse palaeontological evidence

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Feature</th>
</tr>
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<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>
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

| Rock art |
|---------------------------------
| ![Rock Art Image](image1.png) |
| ● Longest unbroken art tradition in the world (40,000 years old) |
| ● Record evidence of climate and organisms in their art |
| ● Changes in types and abundance of organisms observed |

| Geological |
|-------------------
| ![Geological Image](image2.png) |
| ● Principle of stratigraphy law of superposition, law of lateral continuity, Law of original Horizontality, Law of Cross-cutting relationship |
| ● Volcanic ash |
| ● Banded iron formation |
| ● Paleo Oils |

| Ice Cores |
|-------------------
| ![Ice Cores Image](image3.png) |
| ● As snowfall year after year, gases and particles from the atmosphere are trapped within it. |
| ● Particles such as wind-blown dust and pollen, volcanic ash, radioactive particles and bubbles of atmospheric gas provide excellent proxy data from the past climates of earth |
| ● Best places for sampling must be where the temperature never rises above 0 degrees celsius. |

| Radiometric dating |
|-------------------
| ● Process whereby scientist determine the age in years of a fossil, rock or mineral |
| ● Isotopes decay at predictable rates (half-life) that allow scientist to estimate the age of mineral and fossil samples. |
| ● Fossils themselves may contain radioisotopes such as carbon-14 and uranium-238 that can be used for dating |
have been used to determine evidence for past changes, for example: (ACSBL005) radiometric dating
gas analysis

- Fission tracking dating
- Luminescence dating

**Gas Analysis**
- Scientist can use data from ice cores to reconstruct atmospheric concentrations of certain gases, particularly carbon dioxide and oxygen
- Levels of carbon dioxide in the atmosphere have long been recognised as a key factor in the temperature of the atmosphere.
- Helps scientist to infer past global temperature based on proportions of gases as well as ratios of isotopes of certain gases.

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: (ACSBL0)

<table>
<thead>
<tr>
<th>Small mammals</th>
<th>Sclerophyll plants</th>
</tr>
</thead>
</table>
| - Many Australian mammals marsupials resemble placental mammals in the northern hemisphere (Europe and North America)  
- This is thought to be a result of convergent evolution  
- Australian ecosystem are intimately linked with the movement of continents and the subsequent effects of climate  
- Australian mammal fossil sites include Naracoorte in South Australia as well as Riversleigh, Queensland | - Australia’s climate has alternated between warm/wet cycles and cold/dry cycles  
- This in turn has influenced the pattern of vegetation which has gone from tropical rainforest with broad-leafed plants to predominantly open grassland and desert with sclerophyll as the dominant plant life |
### 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
- Evaluating hypotheses that account for

### Changing Australian Ecosystems: Abiotic and Biotic Changes Overtime

**Key Concept:**

If the climate in a habitat changes, distribution and abundance of living things within that habitat also tend to change.

The distribution and abundance of present-day plants in Australia reflect three main origins:

1. Those already on the continent when it split from Gondwana
2. Those that dispersed from South East Asia to Australia
3. Introduced species

The origin of animals that led to present-day fauna are:

1. Original Residents
2. Asian immigrants arrived when sea levels were low 15 mya and 40,00-30,00 years ago
3. Those introduced by immigrant traders or late Aboriginals 4000 years ago
4. Those introduced by Immigrant by European Immigrants 200 years ago

Identified trends: Organisms that are better suited to a new environment survive and new species may evolve.
<table>
<thead>
<tr>
<th>identified trends</th>
<th>• Extinction: When the world wide abundance of a species = 0 (duh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>investigate changes in past ecosystems that may inform our approach to the</td>
<td>• Introduced species are animals and plants that have been brought in from overseas</td>
</tr>
<tr>
<td>management of future ecosystems, including:</td>
<td>• Land clearing is the removal of native vegetation for development</td>
</tr>
<tr>
<td>the role of human-induced selection pressures on the extinction of species</td>
<td>• Habitat loss due to introduced species and land clearing is leading to the extinction of some species</td>
</tr>
<tr>
<td>(ACSBL005, ACSBL028, ACSBL095)</td>
<td>• Habitat loss is affecting biodiversity</td>
</tr>
<tr>
<td>models that humans can use to predict future impacts on biodiversity</td>
<td>• Paleontological evidence can be used to predict future distribution of organisms</td>
</tr>
<tr>
<td>(ACSBL029, ACSBL071)</td>
<td>Key Points</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Models to predict future impacts on biodiversity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Baseline information, representing the state of the environment prior to the</td>
</tr>
<tr>
<td>impacts and changes brought by the settlement. Know as Equilibrium model</td>
</tr>
<tr>
<td>2. Measurement of changes since that point of time are then examined</td>
</tr>
</tbody>
</table>

Population growth models

Scientist recognise three main models used to predict population growth in
the role of changing climate on ecosystems

- **Geometric Growth**: When the environment is ideal and there are no factors that limit expansion of the population in geometric growth (There is a fixed rate of population increase within a given time) (Population sizes are compared to the previous year at the same time)
- **Exponential Growth**: When growth is intermittent during the year but resources are still unrestricted, the growth rate is exponential. The shape of this growth rate is always an (J shape)
- **Logistic Growth**: This is the most common way in nature that population grow. There is an initial growth in the population but this slows down because there is competition limited resources. The graph is a (S shape)

The equation to calculate the population (N) at any time (t) in the future is: 

\[ N(t) = N(0) \Lambda^t \]

- \( N(t) \) = The population size at time
- \( N(0) \) = The initial population size (t=0)
- \( \Lambda \) = Geometric growth rate
- \( t \) = Time in years

Role of changing climate on ecosystems

**Key Points**

- The atmosphere traps solar radiation throughout the day, storing it at night and preventing catastrophic temperature differences between day and night
- The greenhouse gas effect is a natural part of earth’s climate
- The enhanced Greenhouse gas effect occurs when there is an increase in the concentration of greenhouse gases in the atmosphere
- The burning of fossil fuel for energy has led to an increase in greenhouse gases
- Changes in the composition of the atmosphere affect the...
investigate practices used to restore damaged ecosystems, Country or Place, for example: mining sites, land degradation from agricultural practices

Hydrosphere- all water on Earth in all states (ice, liquid and vapour)
Lithosphere- the outer rigid crust of the earth
Atmosphere- all the gases surrounding Earth
<table>
<thead>
<tr>
<th>Problem</th>
<th>Issues</th>
<th>Control measures</th>
</tr>
</thead>
</table>
| SOIL EROSION | • Cleaning of vegetation  
• Cultivating the soil  
• Saline soil  
• Flood irrigation  
• Introduced species  
• Soil compaction by machinery and hard hooves | • Use minimum till/direct drilling techniques  
• Don’t leave soil fallow for long periods  
• Reduce stocking rates for livestock and employ rotational grazing  
• Retain stubble after harvest  
• Grow crops on slopes  
• Channels and terraces to store and redirect water  
• Repair buffer strips to reduce riverbank erosion  
• Make windbreaks  
• Use drip irrigation instead of flood irrigation |
| SALTINATION  | • Removal of deep rooted vegetation  
• Irrigation  
• Water table rises  
• Destroys soil biota | • Replant deep-rooted perennial plants  
• Use drip irrigation instead of flood irrigation  
• Mulch garden beds  
• Plant salt-tolerant plant species  
• Time sprinkler systems |
| EUTROPHICATION | • Run-off of fertilisers, detergents and organic waste (manure) into waterways | • Reduce run-off into streams of nitrogen and phosphorus-containing detergents |
| INTRODUCED SPECIES | • Accidental and deliberate introductions | • Quarantine and border control methods  
• Use methods of control such as biological |
| LAND CLEARING | • Urban development  
• Agriculture | • Replant deep-rooted native vegetation  
• Re-establish ground cover |
EXAM

● DETERMINE DIFFERENT ORGANELLES UNDER A DIFFERENT MICROSCOPE

● DETERMINE THE SIZE (AREA, DIAMETER, RADIUS) UNDER FIELD OF VIEW

● DETERMINE CELL DIFFERENT ORGANELLE AND THEIR FUNCTIONS
  ● KNOW THE STRUCTURE OF PHOSPHOLIPID BILAYER

● DIFFUSION AND OSMOSIS (KNOW THE DIFFERENCE AND HYPERTONIC ECT)
  ● SURFACE AREA TO VOLUME RATIO
  ● PHOTOSYNTHESIS AND RESPIRATION
  ● ENZYMES

● ORGANISATION OF LIVING THINGS- UNICELLULAR, MULTICELLULAR, COLONIAL + EXAMPLES (E COLI, HUMAN WITH MULTIPLE SPECIALISED CELLS, VOLVOX)
  ● Xylem phloem
  ● CELL SPECIALISATION
  ● EG-CELL, HEART TISSUE, CIRCULATORY SYSTEM, HUMAN
  ● AMPHIBIANS INSECTS ANIMALS FISH: GAS EXCHANGE
  ● Structures and function of transports system in animals and plants
    ● Closed and open transport systems

● Compare the changes in the composition of the transport medium as it moves around an organism

● Anatomy of the heart (arteries move away from the heart, capillaries cell thick in diameter and efficient diffusion) large SA=V Veins thin muscular wall valves prevent backflow of blood - Return to heart
  ● CHANGES IN THE COMPOSITION OF BLOOD

● ABIOTIC AND BIOTIC FACTORS (EFFECTS AND IMPACTS ON ECOSYSTEM)
  ● CANE Toads and PRICKLY PEAR
  ● ADAPTATIONS (STRUCTURAL, PHYSIOLOGICAL, BEHAVIOURAL)
  ● NATURAL SELECTION AND ITS VARIANTS IN A SPECIFIC EXAMPLE
    ● SPECIATION
- Convergent and divergent species
- Punctuated equilibrium and gradualism
- Biochemical Comparative anatomy, comparative embryology, Biogeography proving evolution
- Radiometric dating and relative dating
  - Demonstrate how natural selection occurred for bacteria and Frogs
  - TRANSECT, QUADRAT, CAPTURE AND RECAPTURE
- Aboriginal Rock paintings and rock structure formation in regards to what evidence it provides
  - Radiometric dating
  - Gas analysis
- Sclerophyll plants and platypus
- Management of future ecosystems the role of human induced selection pressure
- Climate change (THE IMPACT OF DROUGHT CAUSE EFFECT AND HOW TO SOLVE)

Potential extended response
- (justify how humans have impacted the environment and how it is evident within the ecosystem)