Topic 1: A Local Ecosystem

✓ Compare the abiotic characteristics of aquatic and terrestrial ecosystems
Organisms that live in aquatic and terrestrial have a very different apperence (morphology) and way of functioning (physiology). Terrestrial animals have support for living out of water and for transport on land.

Abiotic characteristic	Aquatic environment	Terrestrial environment
Temperature is related to latitude and altitude	Less variation. Cooler with depth. Smaller bodies of water warm faster than larger ones	Great variation during the day, throughout the year and with altitude and location
Pressure	Pressure increases greatly with depth	Atmospheric pressure decreases with altitude
Water	Rapidly available	Varies and can be a major issue for organisms
Dissolved ions (Na^+, Cl^-)	Readily available, may lead to osmotic pressure	May be plentiful or sparse depending on the soil
Gasses that are important for photosynthesis and respiration	Less available in water	Plentiful. Decreases with altitude
Wind, tides and currents	Changes in tides and currents can decrease survival	Wind can reduce the amount of water available by increasing evaporation
Buoyancy is the uplift from the medium	High in water	Low in air
Light is important for photosynthesis	Availability changes with depth	Usually readily available
Viscosity	High in water	Low in air

✓ Identify the factors determining the distribution and abundance of a species in each environment

A population will continue to grow in abundance until it is restricted by a limiting factor. A limiting factor is a rescource that is in short supply and so restricts the growth of a population. Limiting factors include: lack of space, preditors, disease, competition for food between members of the same or other species, physical factors eg whether conditions, availability of water and light etc. The distribution of plants in a marine environment is limited to the area where light penetrates for photosynthesis to occur.

✓ Describe the roles of photosynthesis and respiration in ecosystems

Producers capture light through the process of photosynthesis and is used to combine carbon dioxide with water, making oxygen and forming carbohydrates such as glucose. Glucose is what provides energy to the consumers which is vital for growth and reproduction. In addition, photosynthesis produces oxygen, which is essential for the process of respiration. This is important in ecosystems so that energy can be delivered to cells that can be used in growth, development and reproduction.

✓ Identify uses of energy by organisms

Energy from respiration powers all the processes of life. Some energy is released as heat, which can help keep the animal warm and maintain optimal temperatures for the chemical reactions that occur in cells. Other activities that require the energy from respiration include, growth, muscle contraction and movement, synthesis of complex chemicals, repair of damaged cells, reproduction.

✓ Identify the general equation for aerobic cellular respiration and outline this as a summary of a chain of biochemical reactions

Glucose + Oxygen → Carbon Dioxide + water + energy

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy

Energy-releasing respiration can be called aerobic respiration because it takes place in the presence of oxygen and within cells. It is also referred to as cellular respiration. Glucose and oxygen are converted to carbon dioxide and water and water, with the release of energy.

✓ Examine trends in population estimates for some plant and animal species within an ecosystem

The number in a population may vary throughout the year because eof seasonal changes. For example wales migrate during winter in search of warmer shores. Also many plants die during winter and then recover over spring, so both the wale and plants would have different population trends throughout a year.

✓ Outline factors that affect numbers in predator and prey populations in the area studied

Predator and prey population numbers are closely related and potentially unstable. If there is too much predation, the number the number in each prey population will decrease, or one or more prey species may disappear altogether. These changes are followed by a decrease in the predator population, or the predators will attack a different prey species. If a population of predators is removed from an ecosystem, the prey population may multiply rapidly, leading first to habitat destruction and then to a reduction in the number of prey.

✓ Identify examples of allelopathy, parasitism mutualism and commensalism in an ecosystem and the role of organisms in each type of relationship

Allelopathy occurs in plants. It is where a plant excretes a chemical which may be beneficial or harmful to other plants. Many Australian plants, such as casuarinas and eucalypts, produce allelochemicals the prevent competition from other plants.

Parasitism is a close relationship that occurs between two species. One species, the parasite is benefited by the relationship while the other, the host is disadvantaged. An example of this includes the tapeworm living inside a mammal. The tapeworm is protected and is supplied with food, while the mammalian host suffers from a loss of nutrients.

In mutualism, both organisms benefit from the relationship. Lichen is an example of a close mutualistic relationship between an alga and a fungus. The alga produces food through the process of photosynthesis. The fungus provides a place for the alga to live.

Commensalism is a form of symbiotic relationship in which neither organism is disadvantaged, but one may be advantaged. For example, a shark swimming with a remora fish may not be advantaged but the remora can feed on any scraps that the shark misses.

✓ Describe the role of decomposers in ecosystems

A large part of the recycling of matter which occurs in an ecosystem is carried out by decomposers such as bacteria and fungi. When organisms die of produce wastes, they are broken down into simpler compounds by decomposers. These simpler compounds can then be take up from the soil by plants and reused. Without decomposers, there would be a build up of dead organisms and nutrients would remain locked within them.

✓ Explain trophic interactions between organisms in an ecosystem using food chains, food webs and food pyramids of biomass and energy

Trophic interaction is the term used to describe the interaction where one organism eats another. They also show the flow of materials and energy through and ecosystem. Trophic interactions can be represented graphically by drawing a food chain. Food chains show what organisms eat. Food chains begin with a producer or autotroph. The next level on the food chain is a consumer or heterotroph and is called the first order consumer. First order consumers are always herbivores. The second order consumers and so on are carnivores.

Food webs are more complex than food chains because they show that predators are not limited to one prey species and they indicate that some organisms are consumed by a variety of predators. In many cases a species may be a preditor to one species and the prey to another. Food webs often include decomposers. Food chains and food webs are useful for illustrating the trophic interactions that occur between organisms in an ecosystem, but they give no indication of the relative abundance or size of organisms.

Food pyramids are models that can take account of how biomass (total mass taking up the organisms in a population) and energy vary in trophic interactions. The biomass of a trophic level is estimated by finding the dry weight of an organism in the trophic level then multiplying by the total number of organisms in the population. Biomass for different trophic levels is compared in a biomass pyramid to see how the quantity of matter in living things changes along a food chain. The base of the pyramid represents the matter in producers. The next level shows the biomass of first order consumers and so on to the top of the pyramid.

A pyramid of energy depicts the total energy in trophic levels and shows how energy is lost along a food chain. Energy loss is repeated along a food chain and a energy pyramid is used to represent this.

- ✓ Define the term adaptation and discuss the problems associated with inferring characteristics of organisms as adaptations for living in a particular habitat

Adaptation can be defined as any feature of an organism that increases its chances of survival in the environment in which it lives. These features are built up in a species over a long period of time through the selective pressures placed on the species by environmental factors. There are problems in inferring (assuming) that all useful features have developed as adaptations to a particular environment as it may have always obtained this feature or gained it for a different reason for example the iis is a wetlands bird that has become common in cities eating out of city drains and garbage bins. By looking at its curved beak it could be claimed that it has become perfectly adapted to the urban environment when in fact it is only a recent arrival.

- ✓ Identify some adaptations of living things to factors in their environment

There are different types of adaptations including structural, physiological and behavioural. Structural adaptations are the anatomical features of an organism that assist it to survive. For example a fish has a streamlined body which enables it to move freely with reduced friction through water. Physiological adaptations are metabolic features of an organism that assist it to survive. For example, a fish produces mucus which covers its body and allows water to flow over its scales. Behavioural adaptations are things that an organism does (or doesn't do) that assist it to survive. For example, a fish swims into seagrass beds to avoid detection by a nearby preditor.

- ✓ Identify and describe in detail adaptations of a plant and an animal from the local ecosystem

✓ Describe and explain the short term and long term consequences on the ecosystem of species competing for resources

Competition can be for food, nesting sites, mates, water, light or shelter. Competition for lack of food resources can often resulting in death which can ultimately affect the abundance of a species. Often there is competition between members of different species. Over the short term, if one species has an advantage over another it will limit the growth of that population. Over the long term, competition may lead to the extinction of the disadvantaged species.

✓ Identify the impact of humans in the ecosystem studied

Human impact comes from; increased hard surface areas leading to greater run off, fishing and bait collection, which reduces the numbers of of target species, pollution by fertilisers and pesticides from garden run off, pollution of local bodies of water called eutrophication where nutrients (often sewerage) cause excessive plant growth uses up all the oxygen in the water and kills most plants and animals, use of landfill for house and parks, introduction of species, increased frequency of fires.

Topic 2: Patterns in Nature

The Theory of Spontaneous Generation

- Living things come to existence from non-living things

- Developed in the 17th Century
- That some animals such as warms and frogs could spontaneously emerge from mud or water, or that maggots develop from rotting meat
- In the 19th Century this theory was proven wrong when Luis Pasteur's experiments proved that micro organisms arose only from other micro organisms.
- As a Result the "Cell Theory" was developed which emerged the scientific basis for the "germ theory of infections"

✓ Outline the historical development of the cell theory, in particular, the contributions of Robert Hooke and Robert Brown

The Cell Theory

- The Cell Theory was first created in 1839 by German biologists Mattias Schleden and Theodor Schwann.

The Cell Theory

1. Cells are the smallest units of life
2. All living things are made up of cells

In 1858 Rudolf Virchow added that:

3. All cells come from pre-existing cells

Robert Hooke

Robert Hooke had a significant effect in the history of science. In the 17th Centaury, Hooke became the first person to record his study of cells through the use of his microscope.
Hooke was the first person to describe cells and he described them to look like honeycomb and that the 'pores' of cells consisted of many little boxes. He first identified and named the cell.

Robert Brown

Robert Brown also had significance in his discovery of cells, and the development of the cell theory. His work in 1831, made him the first person to describe the cells nucleus as a large body found inside the cell, he also was the person to give the nucleus its name.

1600
First microscope

1665
Robert Hooke further developed microscope

1672

Marcello Malpighi stated that all plants are built of chambers

1685
Anton Van Leeuwenhoek discovered bacteria in saliva

1831
Robert Brown first described the nucleus

1858
Rudolf Virchow said that in order for life to come about there must be a cell that was there before the current cell

1880
Walther Flemming first described mitosis

1960-Today
Xray microscope developed and used to observe cells

✓ Describe evidence to support the cell theory

By the 1880's, the accepted idea was that plants and animals were composed of globules, called cells, and formless material. Brown had enhanced this idea by describing nuclei in cells or orchid plants. This idea as then extended by two German biologists.

In 1838, Matthias Schleiden suggested that cells were the basic structural unit of all plant matter. Matthias Schleiden and Theodor Schwann both agreed that both plant and animal tissues have a cellular organism. They then studied cells and concluded that all living things consist of one or more organised structures that are called cells or of products of cells, and that cells are the basic functional unit of life. Through Rudolf Virchow's studies a third point about cells were made. He proposed that new cells come from existing cells. That is, where a cell arises, there must have previously existed just as an animal can spring only from an animal.

In 1862, Luis Pasteur carried out experiments that conclusively disproved the old idea of spontaneous generation, and supported the view that new cells are produced by existing cells.

✓ Discuss the significance of technological advances to development in the cell theory

Technological advances around the time of the development of the cell theory lead to the discovery of chromosomes and further discovery of the nucleus. Further technological advances in 1933 when the electron microscope was invented let more detailed observations of all structures to be made. Laser scanning and 3D imaging software have improved our

knowledge of cell and tissue structure. The X-ray was the final development which allowed he shape and structure of biological molecules such as protein to be determined.

Cell theory- Technological Advancments
Most cells are so small that a microscope is needed to see them. The cell theory was gradually developed over 300 years. This depends on the technology and its advancements with microscopes. Advancements included, increased magnification of the lenses, improvements in resolution and development of stains.

- ✓ Identify cell organelles seen with current light and electron microscopes

There are many different types of microscopes but they can be divided into 2 types: The light microscope, and the electron microscope.

The Light Microscope

Identify organelles seen with current light microscopes

The Light Microscope revealed that cells are not empty, and that protoplasm (the contents of a cell) is not uniform in structure. Cytoplasmic organelles can be studies with a light microscope. Other organelles are the nucleus, chloroplast, contractile vacuole, and the stigma. The best light microscope shows mitochondria, however not in enough detail to be studied.

The Electron Microscope

Identify organelles seen with current electron microscopes
Electron microscopes uses a beam of electrons to enable us to see cells and their contents at extremely high magnification, and with great clarity. Electron microscopes can be used to examine things such as the internal structure of cells (transmission electron microscopes), as well as the surface features of objects (scanning electron microscopes).
Organelles that can be viewed under an electron microscope but not under a light microscope include, golgi body, cell wall, ribosomes, and cell membranes, as well as mitochondria to some extent.

- ✓ Describe the relationship between the structure of cell organelles and their function

- Organelles are the functional units of cells
- All organelles are surrounded by membrane

Organelles seen under the light microscope:
Nucleus: Contains chromosomes; information in the chromosomes is used to control the development and functioning of the whole cell. It contains the DNA and hereditary material.
Cell Membrane: Forms the boundary between the cytoplasm and the outside environment; controls the entry and exit of substances to and from the cell.

Cytoplasm: Contains many organelles; is where most cell activity is carried out.
Cell Wall: Gives Protection, support and shape to the cell.
Chloroplasts: Contains green pigment called chlorophyll, and are the site of food manufacture (photosynthesis) in plants
Chromoplasts: Produce the colours of plants
Leucoplasts: Store nutrients such as starch
Vacuoles: Store water and other substances
Ribosomes: Tiny organelles that are the site of production of proteins

Organelles seen under the electron microscope, and not light
Mitochondrion: An organelle composed of many folded layers of membrane. Mitochondria are involved in the energy transformation in cell. Mitochondria have their own DNA and ribosomes
Golgi Body: Where final synthesis and packaging of protein occurs before secretion.
Endoplasmic Reticulum: A network of two nearly parallel membrane separated by a narrow space. Ribosomes are often visible with dense dots, were there are these dots, it is known as rough ER.

- ✓ Identify the major groups of substances found in living cells and their uses in cell activities

Inorganic Substances:
Cells contain some inorganic substances. These are water, salts and oxygen as well as various metals.
Organic Substances:
Carbohydrates:

- Compounds consisting of Carbon, Hydrogen, and oxygen.
- Important source of energy in cells and are broken down into glucose when energy is required.
- When humans eat too many carbohydrates, it is stored as fat
- Some carbohydrates are used in plant structure
- There are 3 main types of carbs:
  Monosaccharides- simplest carbs (sugar: glucose, fructose, ribose)

They are soluble in water and building block of more complex carbs
Disaccharides- also simple carbs (double units of sugar: Sucrose, lactose, maltose)
Polysaccharides- (starch, cellulose) They are insoluble in water

Lipids:

- Lipids (fats) contain carbon, hydrogen, and oxygen as well but never in the same ratio as carbs.
- Lipids contain very little oxygen
- They are usually insoluble in water
- Lipids includes, fats, oils, waxes and steroids
- Fats contain twice as much energy as carbohydrates

Lipid	Properties	Uses
Fats	Usually solids at SLC Highly saturated	Used as stores of energy eg. Fat tissue
Oils	Usually liquids at SLC unsaturated (plants)	Used as stores of energy eg. Coconut oil
Waxes	More common in plants than animals	Used as waterproof coating on plants/fruit
Steroids	Many important roles in plants and animals	Form part of membrane eg. Cholesterol

Proteins:

- Proteins are the most abundant organic molecules in cells. They assist in growth and repair.
- Proteins contain carbon, hydrogen, oxygen, and nitrogen
- Proteins are large molecules made up of smaller molecules called amino acids, joined by peptide bonds to form a polypeptide.
- Nucleic acids contain linked sugar molecules, nitrogen bases and phosphate groups
- There are two types of neucleic acid
  Deoxyribonucleic acid (DNA which contains deoxyribose sugar)
  Ribonucleic acid (RNA which contains ribose sugar)

✓ Identify that there is movement of molecules into and out of cells

Every cell is surrounded by the cell membrane. The cell membrane regulates the flow of substances in and out of the cell. It is differentially or selectively permeable; that is, only certain substances can cross it.
Hydrophilic: water-loving
Hydrophobic: water-hating

✓ Describe the current model of membrane structure and explain how it accounts for the movement of some substances into and out of cells.

The cell membrane is a thin sheet composed of two layers of a special type of lipid called phospholipid. The sheet is very fluid and the phospholipids can move about quite easily within it. Other lipids such as cholesterol are also found within the membrane. Phospholipids have both hydrophilic and

hydrophobic components to it. Proteins are scattered between the protein bilayer. Proteins are capable of movement between the membrane.

✓ Compare the processes of diffusion and osmosis

Both osmosis and diffusion involve the passive spreading of molecules from where they are more concentrated to areas where they are less concentrated. Osmosis is the movement of only a solvent through a semi-permeable membrane. However, diffusion is the spreading of any molecule, whether liquid or gas, and diffusion occurs whether or not a membrane exists.

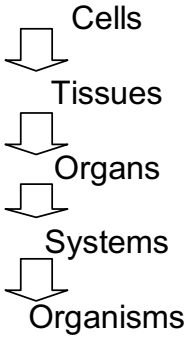
✓ Explain how the surface area to volume ratio affects the rate of movement into and out of cells

The surface are to volume ratio is the amount of surface area of an object compared with its volume or surface area per unit volume. As an object becomes smaller, its surface area to volume ratio becomes larger. This fat is significant for biological systems from organisms to cells. The smaller the cell, the greater the SA:V, the larger the cell, the smaller the SA:V.

Cells obtain their nutrients and release wastes by diffusion through the cell membrane, or the whole surface area of the cell. A large SA:V is better for cells because then there is enough surface area to supply the volume of the cell with nutrients and remove wastes at a rate that is fast enough to keep the cell alive.

$\frac{\text{Surface Area}}{\text{Volume}} = \frac{\text{Surface area should be large to transport nutrients and wastes}}{\text{Volume should be smaller so less demand for nutrients and wastes}}$

- ✓ Identify some examples that demonstrate the structural and functional relationships between cells, tissues, organs and organ systems in multicellular organisms



Multicellular organisms are made up of many cells. In multicellular organisms different cells become specialised to perform different functions. Different types of cells have different structures and activities, but the work together as a coordinated whole.

Eg. One lining cell ⇨ A lining tissue for example, in the mouth, or on the outside of a leaf.

A nerve cell ⇨ A nerve tissue such as that in the brain.

Organs are made up of tissues. They are the parts that go together to build up organisms.

Systems are groups of organs that work together. Each system does and overall job. Eg. The circulatory system. Its overall job is to move fluids around your body. Some of its organs are the heart, arteries and veins.

Muscle cell ⇨ Tissue from stomach wall ⇨ the stomach ⇨ digestive system

- ✓ Distinguish between autotrophs and heterotrophs in terms of nutrient requirements

There are many different types of cells. They can be determined as heterotrophs or autotrophs, in regards to their energy obtainability. Autotrophic means self feeding. Plant cells which contain chloroplasts are able to produce their own nutrient through the process of photosynthesis. Heterotrophic means that they gain energy off feeding on other things. They must obtain the substances they need from their external environment. All heterotrophic organisms depend ultimately on the ability of autotrophs to synthesise organic materials.

- ✓ Identify the materials required for photosynthesis and its role in ecosystems

The materials requires for photoynthesis are Carbon Dioxide, water and light. The products of photosynthesis are glucose and oxygen. All living things depend on this process to provide energy. Green plants get energy directly

through photosynthesis, whilst animals obtain their energy indirectly through the food they eat.

- ✓ Identify the general word equation for photosynthesis and outline this as a summary of a chain of biochemical reactions

The word equation for photosynthesis is:

$6CO_2 + 12H_2O \Rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$

Light reactions:

Radient energy from sunlight is absorbed by the chlorophyll pigments in the chloroplasts of green plant cells and is converted to chemical energy. Some of this is used to split water molecules to hydrogen and oxygen.

Water $\xrightarrow{\text{light}}$ Hydrogen + Oxygen

Light independent reactions:

Hydrogen released from light reactions combines with carbon dioxide to form sugars. This process is a chain of biochemical reactions requires energy. This energy is supplied by some of the energy absorbed by light in light reactions or from energy stores ATP in the plant.

Hydrogen + Carbon Dioxide $\xrightarrow{\text{light}}$ Sugars

These reactions occur in the stroma.

- ✓ Explain the relationship between the organisation of the structures used to obtain water and minerals in a range of plants and the need to increase the surface area available for absorption

In an aquatic environment, water and minerals can be absorbed across the whole surface of the plant. In most terrestrial plants, water and minerals, are obtained through the root systems, which also anchor the plants in the soil. Plant roots need to increase the surface area over which absorption can occur. They achieve this by having a branching structure, and root hairs just behind the root tips.

- ✓ Explain the relationship between the shape of leaves, the distribution of tissues in them and their role

Plants use specialised structures to obtain materials required for photosynthesis from their environment.

Tap roots: Tap root systems have a main root from which latera root emerge. Eg carrots, beetroot, and parsnips.

Fibrous roots: Fibrous roots form a network of roots close to the soil surface. They may spread out widely to anchor the plant, helping to bind the soil to prevent erosion.
Cluster roots: Groups of tiny roots. These are groups of many tiny roots. They increase the surface area for the uptake of mineral ions in nutrient-poor soils. Eg banksias.

- ✓ Describe the role of teeth in increasing the surface area of complex foods for exposure to digestive chemicals

In mammals, digestion begins in the mouth, where, teeth cut and grind food into smaller pieces. The larger SA:VR of the smaller pieces allows faster, more efficient absorption of saliva which contains amylase to break down starch for digestion.

- ✓ Explain the relationship between the length and overall complexity of digestive systems of a vertebrate herbivore and a vertebrate carnivore with respect to:
  - the chemical composition of their diet
  - the functions of the structures involved

A complex digestive system supports a complex diet of an animal. As the diet of a carnivore is much more complex than that of a herbivore, digestion requires a more complex system to digest its food to obtain nutrients. The length of a carnivores system is longer to obtain sufficient amounts of nutrients out of their complex foods.

- ✓ Compare the roles of respiratory, circulatory and excretory systems

System	Role	Example in humans
Respiratory	Gaseous exchange, to obtain oxygen and get rid of Carbon Dioxide	Made up of lungs, trachea and muscles that draw air into lungs
Circulatory	Transport, to distribute nutrients and other substances around the organism's body, providing for the need	Made up of heart and blood vessels that make a continuous circuit throughout the body; blood carries oxygen and nutrients as well as wastes; blood also carries

	of cells and removing wastes	hormones that regulate body processes and components to fight disease
Excretory	Waste removal, to rid the organism of unwanted substances, particularly those such as urea that become poisonous if they accumulate	Urinary system removes unwanted urea, salts and water (in urine); skin removes mainly salts and water (in sweat); respiratory system removes carbon dioxide and some water (exhaled in air)

- ✓ Identify and compare the gaseous exchange surfaces of in and insect, a fish, a frog and a mammal
- Mammals have lungs and breathe atmospheric air. The respiratory surface is called the alveoli is where most gaseous exchange occurs. The alveoli provide a large respiratory surface area and gases readily diffuse across the thin cell layer.
- Fish have gills that exchange dissolved gases with water around them. Fish take in water through the mouth and release it out the gills. The gill contains many stacked layers, which provides a large surface area.
- Frogs and tadpoles have soft moist skin. They have a good blood supply right under their skin so gases are efficiently exchanged directly through the skin surface.
- Insects have a tracheal system that enables individual cells (rather than a whole system) to exchange gases. Air is passed through a network of tubes deep into the insect's tissues. Air enters through openings called spiracles that are spaced along the insect's body. Trachea divide into tiny branches called tracheoles. They have a large SA:VR and are moist to allow diffusion. The trachea is lined with chitin, which is impermeable and keeps the airways open.

- ✓ Explain the relationship between the requirements of cells and the need for transport systems in multicellular organisms

In multicellular organisms, cells have a range of difficulties in exchanging substances with the external environment. Transport systems help cells to overcome this. The circulatory system collects materials and delivers them to places within the organi sm where they are needed. At the same time, the circulatory system collects wastes and transports them to places where they can be excreted.

Print work so far and add notes

- ✓ Compare open and closed circulatory systems using one vertebrate and one invertebrate as examples

	Open	Closed
Types of organism system is present in	Molluscs (invertebrates)	Fish, amphibians, reptiles, birds and mammals
Components	Heart, vessels (veins and arteries), valves.	Capillaries, arteries, vessels, valves, heart
Fluid transported	Wastes, oxygen	Nutrients, carbon dioxide, oxygen
Efficiency	Less, limit the size of invertebrates	More, effective circulatory system to overcome small SA:VR
Transport of substances	Two systems required. Open circulatory system is supplemented by tracheal system	One system. Closed circulatory system transports nutrients, oxygen, carbon dioxide and wastes
Nature of system	Hemolymph is pumped at low pressure directly into the main body cavity	Blood remains within tubes and material diffuse in and out of

	where it slowly flows about the cells. The blood is collected by open vessels like drains, which carry the blood back to the heart	blood through walls of capillaries. Blood is pumped at high pressure from the heart through the arteries to the micro circulation

✓ Identify mitosis as a process of nuclear division and explain its role

Mitosis is the process in which identical nuclei for new cells form. The cell's chromosomes in the nucleus replicate and two daughter cells are created. Mitosis is essential in both unicellular and multicellular organisms for growth and repair. The different phases of mitosis is explained on the next page.

✓ Identify the sites of mitosis in plants, insects and mammals

- In plants, mitosis occurs in the root tip to make the root system grow longer and in vascular bundles, to increase the diameter of the stem. It is also found around damaged tissue for repair.
- In insects it is found throughout the cell during metamorphosis and around damages tissue for repair
- In mammals mitosis is found throughout the organism, particularly in infants and adolescents, as they develop to adulthood; in skin; in the lining of the digestive, respiratory and reproductive tracts; in bone marrow, where new blood cells are formed; and around damaged tissue for repair.

✓ Explain the need for cytokinesis in cell division

Cytokinesis is the division of the cytoplasm cell that usually accompanies a nuclear division. Although mitosis divides a nucleus into two new nuclei, cytokinesis ensures that each new nucleus is embedded in cytoplasm containing essential organelles and surrounded by a cell membrane.

✓ Identify that nuclei, mitochondria and chloroplasts contain DNA

While most DNA in the cell is stored in the nucleus, there are other organell es (chloroplasts and mitochondria) that also contain information, or DNA. Like the nucleus, mitochondria and chloroplasts are able to replicate and divide. The DNA in mitochondria and chloroplasts is passed on to new cells during cytokinesis, when the cytoplasm divides.

Topic 3:
Life on Earth

✓ identify the relationship between the conditions on early Earth and the origin of organic molecules

- The surface and interior of early earth were continuously changing due to gravitational forces, heat from radioactivity, and the constant bombardment of the surface by meteorites.
- The earth cooled and oceans formed. Volcanic eruptions filled the atmosphere with water vapour, carbon monoxide, ammonia, hydrogen and hydrogen sulphide
- Atmosphere was anoxic (no oxygen), because the small amounts available quickly reacted with metals such as iron and sulphur.
- The atmosphere was subject to high levels of ultraviolet radiation and constant violent lightening. This energy input was rich in hydrogen and hydrogen compounds which could have produced simple chemicals, or biomolecules.

✓ discuss the implications of the existence of organic molecules in the cosmos for the origin of life on Earth

Conditions such as those on early Earth in which simple organic molecules can form are called prebiotic conditions. These conditions are likely to have existed on other planets and moons. This suggests that organic molecules, and perhaps life forms originating from them, may occur in other parts of our universe. Ironically, the conditions on present-day Earth, called oxidising conditions, no longer support the spontaneous formation of organic molecules on early Earth was an essential precursor for the origin of life on Earth.

✓ describe two scientific theories relating to the evolution of the chemicals of life and discuss their significance in understanding the origin of life

and

✓ discuss the significance of the Urey and Miller experiments in the debate on the composition of the primitive atmosphere

Theory 1:
The chemicals for life came from outer space- a cosmic origin (Panspermia).
Scientists believe that the earth was heavily bombarded with meteorites during the early years of its formation. When certain types of meteorites called carbonaceous chondrites were first analysed in the 1970's they were found to contain organic molecules, including amino acids. This provides evidence of the existence of organic molecules elsewhere in the cosmos. It is possible that meteorites falling on the early Earth could have contributed some of the organic molecules required by living systems.
Theory 2:
The chemicals of life were formed on Earth
Urey and Miller's experiment was the experiment performed to support this theory. Urey and Miller hypothesised that simple organic molecules could spontaneously form under conditions thought to exist on early Earth. They set up a chamber simulating the early atmosphere. After a week they tested samples from the experiment and reported finding amino acids. The importance of Urey and Miller's experiments was that they designed experiments to test the existing hypothesis of Haldane and Oparin of the origin of organic molecules of Earth. The research of Urey and Miller led to other scientists to investigate in this area, pushing forward knowledge about the beginning of life. Their results supported the theory that organic molecules form in the primitive atmosphere of early Earth.

✓ identify changes in technology that have assisted in the development of an increased understanding of the origin of life and evolution of living things

Some technological advances that have assisted in the development of an increased understanding of the origin of life and the evolution of living things are:

1. The invention of the electron microscope, which is used to closely examine meteorite samples and microfossils.
2. Radioactive dating, which enables more accurate dating of fossils and rock sediments
3. the development of deep-sea vessels, such as ALVIN, which led to the discovery of the previously unknown deep-sea vents

4. The invention of the mass spectrometer, which quickly and accurately analyses the chemical composition of samples (Urey and Miller had to rely on paper chromatography to separate and analyse their samples in the 1950's)
5. space travel to the moon and the planets, which has given information about the conditions found in other parts of our solar system that may be suitable for life

✓ identify the major stages in the evolution of living things, including the formation of:

1. Organic molecules

4 billion years ago. Simple organic molecules may have formed spontaneously. These molecules accumulated in the anoxic environment and combined into more complex organic molecules.

2. Membranes

3.5-4.0 billion years ago. Appeared when certain complex compounds were mixed. These structures held larger molecules together so that increasingly complex reactions became more likely. Membranes surrounding organic molecules could protect and control the movement of materials in and out of the evolving cells. A membrane bound collection of

organic molecules became able to reproduce itself, beginning the development of a procaryotic cell.

3. procaryotic heterotrophic cells

2.5-3.5 billion years ago. Procaryotic cells have no internal membrane bound organelles. They are simple one-celled organisms consisting of cytoplasm surrounded by a cell wall and membrane, and having a strand of DNA attached at some point. Some of these cells probably became capable of absorbing other early cells and became preditors or parasites.

4. procaryotic autotrophic cells

2.0-2.5 Billion years ago. The development of autotrophic prokaryotic cells such as cyanobacteria caused major changes in in the Earth's atmosphere. These cells were self feeding. They carried out photosynthesis from carbon dioxide, water and energy from the sun. With the development of autotrophs, oxygen became more abundant, and within a billion years free oxygen began to accumulate in the atmosphere.

5. eucaryotic cells

1.2-1.4 billion years ago. Eucaryotic cells developed, with their membrane-bound organelles such as nuclei, chloroplasts and mitochondria. It is hypothesized that chloroplasts and mitochondria were once free-living prokaryotic cells that were absorbed into eukaryotic cells. (Endosymbiotic hypothesis). Eucaryotic cells have different forms- they can be plant, animal or fungal cells. Eucaryotic plant cells, as autotrophs, contributed to continuing changes in the composition of the atmosphere.

6. colonial organisms

1.5 billion years ago. As free oxygen concentrations increased and time passed, these organisms grouped together to form loose ssociations or colonies of organisms. Colonial animals may have formed when division during reproduction did not lead to separation of cells.

7. multicellular organisms

1.0-0.5 billion years ago. The next stage was the development of true multicellular organisms with, cell specialization and differentiation of cells into tissues and organs with specific functions.

✓ describe some of the palaeontological and geological evidence that suggests when life originated on Earth

Palaeontological evidence (fossil evidence): Fossils provide evidence of the diversity and abundance of organisms at different throughout Earth's history. They reveal organisms that are now extinct, and provide evidence of changes that have occurred in species over time. This provides information about environments in the past.

Geological evidence: Geological evidence comes from rocks and landforms such as banded iron formations, red beds and uraninite. Banded iron formations show there were fluctuating levels of free oxygen available from the time of their formation. They were formed in aquatic environments that were rich in soluble iron, and consist of alternate layers of iron-rich and silicon rich deposits. Red beds are layers of sandstone stained with iron oxide. The presence of iron oxide shows that there was free oxygen in the atmosphere from 2.3 billion years ago. Uraninite is a compound called uranium dioxide that occurs in ancient rocks. It can only be formed in an anoxic atmosphere. When the atmosphere contains free oxygen, a different compound called uranium oxide forms. The geological evidence provides information about when Earth's atmosphere changed from anoxic to oxic, and helps scientists to predict when photosynthetic organisms evolved.

✓ explain why the change from an anoxic to an oxic atmosphere was significant in the evolution of living things

When all oxidisable surface rock had been saturated with oxygen, oxygen began to accumulate until an ozone layer formed around the earth. The significance of the change from an anoxic atmosphere to an oxic atmosphere was that anaerobic organisms declined. As oxygen levels rose, photosynthetic organisms became more abundant. There was great significance in the change as an ozone layer formed protecting organisms from the harmful effects of ultra violet radiation. Anaerobic organisms evolved that produced energy more efficiently by respiration. Greater metabolic activity became possible and organisms could be more active. The result was an increase in the size and complexity of organisms. The presence of oxygen in the atmosphere inhibits the formation of complex organic molecules such as amino acids.

✓ discuss the ways in which developments in scientific knowledge may conflict with the ideas about the origins of life developed by different cultures

The belief of the beginning of time and the creation of life differs in almost all cultures, so when scientific knowledge developed a new idea of the way in which the Earth was formed came about which conflicted with the more traditional beliefs. Religious and Cultural explanations are based on cultural beliefs and experiences, not on scientific evidence. Therefore, it is likely that cultural and scientific ideas about the beginning of life conflict with each other.

✓ describe technological advances that have increased knowledge of procaryotic organisms

Without technological advances, procaryotic organisms would have remained unknown. Technological advances that have increased the knowledge of procaryotic organisms include:

1. Microscopes: The existence of procaryotic organisms was not found until microscopes were capable of magnifying them. Electron microscopes have made the internal structure of procaryotic cells visible.

2. Biochemical analysis: has enabled DNA sequencing and amino acid sequencing to be used to classify procaryotic cells, without depending on structural features.

3. Deep-sea Exploration: Vessels capable of diving to the depths of the oceans, and have led to discoveries of new forms of life (the thermophiles) around the hydrothermal deep-sea vents.

✓ describe the main features of the environment occupied by one of the following and identify the role of this organism in its ecosystem:

1. Archaea

Archaea all live in extreme environments and can be described as extremophiles. Many are anaerobic (do not require oxygen for survival. There are three main types of archaea which are classified by the type of environment they live in:

2. Methanogens: Produce methane as a waste product. They are found in environments that contain little oxygen. They use hydrogen as their main source of energy.

3. Halophiles: Live in environments that have high salt (hypersaline) concentration, such as salt lakes and the dead sea. They use the sun for energy photosynthesis.

4. Thermophiles: Live in areas of extreme high temperatures. They use sulfur as an energy source.

5. Eubacteria

Most bacteria belong to the group eubacteria. They live in water, soil, air, and on and in many other organisms. Some can be harmful and cause disease, but most are harmless or even advantageous to other organisms. Eubacteria play a major role as recyclers and decomposers in their ecosystems. Eubacteria is ecologically important for baterial photosynthesis for the production of oxygen and many mineral deposits. Eubacteria also exists in our intestines providing Vitamin K.

6. Cyanobacteria, including those that form stromatolites

Cyanobacteria are photosynthetic. They live singularly or in colonies (stromalites form colonies and live in warm shallow waters). Stromalites are important because fossils of stromalites are thought to be evidence of the oldest photosynthetic organisms on Earth. Cyanobacteria are also responsible for nitrogen fixation, which is turning nitrogen gas into ammonia and nitrates. The resulted products of fixing nitrogen have been important for the growth of plants, rice and beans.

7. nitrogen-fixing bacteria

Nitrogen-fixing bacteria take atmospheric nitrogen and change it into a form that plants can use. This mutualistic relationship provides for the plant and provides the bacteria with a protected environment and sugar from the plant's photosynthesis.

Nitrogen-fixing bacteria are a vital part of our environment, as it provides the plants with energy to grow, this keeps them alive. This is important as plants give out oxygen and are important part of our ecosystem as many other organisms survive of this life form. Therefore it keeps our whole plant and healty.

8. methanogens

Methanogens: Produce methane as a waste product. They are found in environments that contain little oxygen. They use hydrogen as their main source of energy.

The roles of methanogens in their environment are: to help digest cellulose, in the carbon cycle methanogens consume acetate, natural greenhouse gas, which could cause global warming.

1. deep-sea bacteria

Deep-sea bacteria are thermophiles that live in hydrothermal vents in the depths of the ocean. They require high temperatures for growth. Thermophiles use sulfur as and energy source. Deep-sea bacteria are thje

primary producers (chemoautotrophs) in the deep-sea food web. Some organisms feed on them directly, while others formed a symbiotic relationship with the bacteria. The organism provides the shelter and the bacteria provide the nutrients.

✓ explain the need for scientists to classify organisms

Scientists classify things for three main reasons:

1. to divide the millions of organisms into manageable groups
2. to create a naming system that is recognised internationally
3. to reflect the evolutionary pattern

✓ describe the selection criteria used in different classification systems and discuss the advantages and disadvantages of each system

Classification System	Separates/Description	Advantages	Disadvantages
Two-Kingdom	Plants and animals. Based on whether the organism autotrophic or heterotrophic	Simple, easy to use system	Organisms that challenged the definition of a plant or animal, eg fungi and protozoa have features of both
Three-Kingdom	Plants, animals and	Accounted for	Still doesn't

	monera (procaryotic organisms)	procaryotic organisms such as cyanobacteria	account for fungi which are eucaryotic
Four-Kingdom	Plants, animals, monera and fungi. Fungi are no longer considered a plant because they do not contain chlorophyll and are not photosynthetic	Accounted for fungi	Unicellular and multicellular organisms are grouped together
Five-Kingdom	Plants, animals, monera, fungi and protists	Accounted for prists which are unicellular but eukaryotic	
Six-Kingdom	Plants, animals, fungi archaea, eubacteria and protests. Separates monera into archea and eubacteria		

✓ explain how levels of organisation in a hierarchical system assist classification

Classification systems use a hierachial system in which organisms are placed into groups at different levels, according to the features they share. A branching pattern or 'tree' emerges which assists us to see the relationship between organisms.

✓ discuss, using examples, the impact of changes in technology on the development and revision of biological classification systems

Light microscope: The structure of cells were able to be studied for the first time aiding in classification. Enables cellular structure to be analysed.
Electron microscope: Enabled monera to be studied and classified.

Biochemical analysis: Enabled the separation of monera kingdom into archaea and eubacteria by analysis of cell composition
Chemical and genetic analysis of DNA and proteins: helps to study and compare organisms.

✓ describe the main features of the binomial system in naming organisms and relate these to the concepts of genus and species
Many organisms are known under two names. A common name, which varies depending on location, and a scientific name, which consists of a genus name followed by a scientific name. The scientific name is usually printed in italics. As there are two names, it is called a binomial system.

✓ identify and discuss the difficulties experienced in classifying extinct organisms
Difficulties due to fossilisation: Fossilisation is usually incomplete. During fossilisation, most of the organism is lost; only hard parts of the organism are likely to be preserved. This means that not all organisms present at that time could be found as fossils, and the older the fossil the more likely it is that the material available will be insufficient for classification.
Difficulties due to extinction: If an animal is extinct, scientists cannot compare it to a fossil to see how it functioned and behaved. The classification of some organisms is not on the basis of their structural features, but on how they reproduce. Other organisms are classified on the basis of their metabolism

✓ explain how classification of organisms can assist in developing an understanding of present and past life on Earth
Classification is not just a system for naming organisms but also a system to compare and identify organisms. Extinct organisms that share common features with living organisms reflect evolutionary pathways. By classifying an organism, a judgement is made on the relationship between past and present-day organisms.

Topic 4: The Australian Biota

✓ identify and describe evidence that supports the assertion that Australia was once part of a landmass called Gondwana, including:

1. matching continental margins

A look at the shape of continents on a world map reveals that some of the continents seem to be like pieces of a jigsaw puzzle. This evidence suggests that the continents were once joined together and then drifted apart.

2. position of mid-ocean ridges

According to this theory, Earth is made of gigantic plates of oceanic and continental crust. These gigantic plates are relatively thin and are cracked into separate plates. These plates float on top of the Earth's mantle. In some areas, new crust forms as magma well up to the surface, and in other areas crust is destroyed as it sinks into the mantle. These as areas are called mid-ocean ridges. Earth is surrounded by a magnetic field that can flip and reverse its direction. Scientists noticed that that the pattern of magnetic fields of rocks and that the magnetic fields were identical on both sides of mid-ocean ridge. This suggests that new crust is simultaneously pushed out on each side of ocean ridges.

3. spreading zones between continental plates

The age of rock was also related to mid-ocean ridges. The youngest rocks were found at mid-ocean ridges, and their age increased with distance from the ridge (seafloor spreading). This appeared to be due to volcanic magma. As new rock forms at mid-ocean ridges and older rock is subducted at plate edges, so the crust moves and carries Earth's continents.

4. fossils in common on Gondwanan continents, including *Glossopteris* and *Gangamopteris* flora, and marsupials

If similar fossils are found on different continents it can be inferred that these continents were once close together or there was some way for the organisms to travel between these continents. Glossopteris is the most important Gondwanan fossil. The plants survival through the ice age was partly due to its ability to shed its foliage. Its fossils are found in Australia, Antarctica, India, Africa and South America. Similar marsupial fossils have also been found in Antarctica, Australia and South America and support the theory that these continents were once joined together as Gondwana.

5. similarities between present-day organisms on Gondwanan continents

As well as finding similar fossils that show past links between the Gondwanan continents, it is possible to see links through the organisms that are found on these continents today. The marsupials are a group of pouched animals that are found in great diversity in Australia. They are also found South America and New Guinea. There are also similarities in the plants found on the Gondwana continents.

✓ discuss current research into the evolutionary relationships between extinct species, including megafauna and extant Australian species
Megafauna is the name given to a group of large animals that have become extinct worldwide over the last 50000 years. It included marsupials, reptiles and snakes. Africa is one of the few continents to retain some megafauna, including elephants, giraffes and rhinoceros. In Australia there were many species of megafauna such as the diprotodon, a type of giant wombat, giant echidnas, giant snakes, and giant kangaroos.
There are two current theories being studied to explain the disappearance of these animals:
Climate change: The climate in Australia has increased. The megafauna were not adapted to these conditions and gradually died out.
Hunting by humans: Megafauna were large and slow moving. This made them easy prey and they were hunted to extinction.

✓ discuss examples of variation between members of a species

Every individual in a population has done difference. Variability within a population is essential for the process of evolution, for it is on the differences between individuals that the environment places selective pressures. When the environment changes, these variations may enable some members of the species to survive and reproduce. Through the process of specialisation (mutation) this may lead to the formation of a new species. Eg a Gazelle that has slightly larger thigh muscles for jumping may be able to escape preditation long enough to produce offspring. This offspring may carry this feature into the next generation. These variations may be carried for generations with no apparent benefit to the organisms. If there is a change in the environment, however, they may lead to the individual being better adapted to the changed environment. If there is no individual that is adapted to the new conditions the species will die out. However, if a number of individuals have features that allow them to survive then they will be the ones to reproduce. The environment has selected these individuals as the 'fittest' through the process of natural selection.

✓ identify the relationship between variation within a species and the chances of survival of species when environmental change occurs

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✓ identify and describe evidence of changing environments in Australia over millions of years

1. Fossil records: Finding fossils of aquatic organisms in a now arid area suggests that the area was once very different from what it is today. Similarly, the fossils of tree-dwelling animals suggest that they lived in an environment that was present when the animal was alive. Fossil evidence has shown that Australia was once covered with forests that have been replaced over time by desserts and grasslands.

2. Tree Rings: The tree rings are circular patterns seen when a cut is made across a tree trunk. The rings are annual and arise because the tree stops growing during winter, when it is without leaves. Tree rings give information about climatic conditions that were present while the trees were growing. If the rings are far apart it means that the conditions were ideal for growth. By matching rings from existing trees and exampling the rings on fossil logs it is possible to see how the climate has changed over time.

3. Dating Techniques: Certain elements, such as uranium (parent element) slowly decay at a fixed rate (daughter element). The time taken for half of the material to decay is known as the half-life of the element. It is possible to work out the age of the material from the ratio of radioactivity between parent and daughter elements. This is called radiometric dating and is used to date fossils and rock sediments so that different regions can be compared.

Glaciers: When a glacier moves across a landscape it leaves behind tell-tale markings of its passage. Evidence of a glacier is a good indication that the area was cold for a long period of time.

Ice cores: When ice freezes it traps bubbles of atmospheric gases. By analysing the gas trapped in ice it is possible to work out the level of carbon dioxide in the atmosphere at the time the ice was formed. These ice layers can be dated to provide information about greenhouse gases and global warming.

✓ identify areas within Australia that experience significant variations in temperature and water availability

Australia is a land of extremes. There are long periods of drought followed by floods. There are deserts, alpine regions and wet tropical rainforests. The desert areas may experience great variations in temperature, being hot during the day and freezing at night. The alpine regions have temperatures that vary from below freezing in winter to hot in summer. There is an increase in dryness and in temperature extremes as you travel inland, and temperatures increase as you go north. The highest annual rainfall occurs in Tasmania, and the northern tropical zones have wet and dry seasons. Some areas in the interior of Australia such as Alice Springs do not have any rain for years and then receive floods.

✓ identify changes in the distribution of Australian species, as rainforests contracted and sclerophyll communities and grasslands spread, as indicated by fossil evidence

When Australia was part of Gondwana, the land mass was temperate and moist. The fossil evidence shows that plants such as Glossopteris and Gangamopteris were common. Australia, South America, Africa, New Zealand and Antarctica were covered with mixed forests, including tree ferns and Antarctic beech, Nothofagus. The conditions were obviously very different from present day. There were temperate forests growing in Antarctica were today there were no plants at all. In Australia large forests have been replaced with grasslands as the continent has dried. The present-day vegetation is described as sclerophyllous. Sclerophyllous plants are hard from secondary thickening, and don't collapse inwards when water is scarce. This is an example of an adaptation to survive arid conditions with unreliable rainfall.

✓ discuss current theories that provide a model to account for these changes

There are 3 theories used to explain the changes that occurred in the distribution of Australian species these are:

1. Continental drift: explains climate change
2. Natural Selection: Favouring those species most suited to the changing environment; these survived to pass on their genes to the next generation
3. Adaptive radiation: Explains the spread of species. As species become extinct, they left behind a smaller number of species, which then spread out to use the uninhabited environments.

✓ discuss Darwin's observations of Australian flora and fauna and relate these to his theory of evolution

Darwin was a man who was on the HMS beagle which travelled around the world. While on his travels, Darwin collected many specimens and fossils. He studied the organism's adaptations to their environments. From his observations of Australia's flora and fauna, Darwin commented on the similarity between marsupials and animals living in similar habitats in the northern hemisphere. He described this as convergent evolution. This type of evolution produces organisms that look alike because they live in similar environments and therefore have the same selective pressures acting on them. They are not closely related.

✓ distinguish between the processes of meiosis and mitosis in terms of the daughter cells produced

Both mitosis and meiosis are types of cell division. In mitosis a single division results in the formation of two genetically identical diploid daughter cells. This type of cell division in multicellular organisms brings about growth and repair. It is also the basis for asexual reproduction. In mitosis, two divisions result in four haploid daughter cells, each of which are genetically different. Meiosis is the first stage in the formation of gametes in sexual reproduction in animals and flowering plants.

Haploid: a single set of unpaired chromosomes

Diploid: two of each chromosome present (one from father, one from mother)

✓ compare and contrast external and internal fertilisation

For organisms that carry out sexual reproduction (meiosis), there must be the joining of haploid sex cells in the process of fertilisation. Fertilisation can be external or internal.

1. External Fertilisation: This takes place outside the body of the organism. Many aquatic organisms release gametes simultaneously into the surrounding water, in hope that they can meet and be fertilised (spawning). In External fertilisation millions of small gametes are released and the chances of fertilisation are low.

2. Internal fertilisation: Most common form of fertilisation. Fertilisation occurs in the female body, so that there is a greater chance of the gametes finding each other in the confined space, and so that females can produce fewer eggs. For fertilisation to occur, there needs to be a watery medium present. The colonalisation of the land could not have occurred until there was internal fertilisation and longer a dependence on water for reproduction.

✓ discuss the relative success of these forms of fertilisation in relation to the colonisation of terrestrial and aquatic environments

The fossil records reveal that life began in the sea. Today most aquatic animals still have external fertilisation. They have cyclical breeding seasons so that males and females are ready to release gametes at the same time (spawning). The move from the sea to the land made external fertilisation a problem as the gametes would dry out very fast. The male penis developed on many animals such as insects, reptiles, birds and mammals, which allowed the male gametes to be inserted into the females watery medium. Then the female developed an embryo or the ability eggs suitable for the external environment. Plants have internal fertilisation. Pollen is transferred to the stigma by wind, birds, mammals or insects. The pollen then grows a tube down into the female parts of the flower until it reaches the ovum. The male gamete is released down the tube until it reaches the ovum. Some plants live in moist areas and the gametes swim through the thin film of water to another plant. It is important to know that some form of watery medium is needed for fertilisation to allow for transport and survival.

✓ describe some mechanisms found in Australian flora with reference to local examples for:

1. pollination: Pollination is the transfer of pollen containing the male sex cells, to the female sex cells in the ovary of a flower to allow internal fertilisation. In Australian flora, pollination may be by wind, insect, birds or mammals.

Wind: Stamens release large amounts of pollen, containing the male sex cells into the air. Some of the pollen falls onto the stigma of a receptive plant.

Insects: Bees are attracted to the colour and nectar of the flower. AS they go from flower to flower they transfer pollen.

Birds: Birds are attracted mainly to red flowers

Mammals:

2. Seed dispersal: Once pollination has occurred, male sex cells pass through pollen tubes and fertilise ova within the ovary of the flower. Each new embryo starts to divide and becomes a seed, and the ovary turns into a fruit. The fruit protects the seed. There are many ways in which seed dispersal occurs. Some fruit are capable of exploding sending the seed far from its parent plant. Some fruit can float sending away from parent plant. Some are sticky or covered in spines and barbs. These stick to passing animals and get carried away. Some are sweet and so get eaten and get excreted elsewhere. Banksias seeds get caught by the wind and carried away.

3. Asexual reproduction: Plants use a variety of methods asexual reproduction. Some plants produce extensions called runners or stolons, which are capable of taking root and starting a new plant. Other plants such as tree ferns asexually produce produce spores which are capable of growing into new plants. Asexual reproduction only requires one parent. There is no need for elaborate mating rituals or the timing of spawning. The new plants formed are genetically identical to the parents and each other.

✓ Describe some mechanisms found in Australian fauna to ensure fertilization and survival of the embryo and of the young after birth.

The production of haploid gametes by meiosis is the first step in the reproduction cycle of animals. Gametes have to unite in the process of fertilization. Usually, sperm cells can swim and are attracted to the larger egg cell. Animals have very elaborate mating and protective rituals.

Eg. Animals use caressing, smells, colours ext. to attract the opposite sex. Some excrete a smell to warn same sex that the female is his. Protection on the embryo and young can be with the stomach, the mother looking after eggs, a pouch etc.

✓ explain how the evolution of these reproductive adaptations has increased the chances of continuity of the species in the Australian environment

Marsupials expend a small amount of energy on the development of the embryo when compared to placental mammals. When the seasons are good, kangaroos can produce offspring very quickly. In Australia there often are seasons of drought followed by seasons of rain. Marsupial reproduction is adapted for these conditions. During drought the female reproductive system goes into a dormant state that is revived when conditions improve. The short gestation period is another adaptation to changing conditions, enabling rapid reproduction to occur when rains come.

✓ describe the conditions under which asexual reproduction is advantageous, with reference to specific Australian examples

Asexual reproduction is advantageous when the conditions are stable. In an unchanging environment, the offspring of a successful parent have features that make them likely to survive for example:

- Seagrasses grow by sending out rhizomes that take root and form new plants. This strategy works well until there are changes in the environment, such as human impact on habitat. Then this lack of variation makes the species vulnerable.
- Alga has become a noxious pest because of its rapid asexual vegetative growth. This plant can regenerate asexually from a piece of plant tissue that is 1mm in size. Any attempt to remove this species breaks it into pieces that are all capable of regenerating into whole organisms.
- The crown-of-thorns starfish can generate a whole new organism from one of its arms.
- Corals on the Great Barrier Reef also use asexual reproduction when conditions are favourable. Many of these organisms are able to use budding to produce another coral

Asexual reproduction allows rapid colonisation of an area after there has been an impact such as bushfire. Australian native plants regrow rapidly after a fire from epicormic shoots (dormant bud in the trunk) and lignotubers (fire-resistant of some native plants), quickly producing a population to take advantage of the changing conditions.

✓ explain the importance of the study of past environments in predicting the impact of human activity in present environments

Study of the past shows that there have been five or six mass extinctions. Now we are facing the possibility of another mass extinction, caused by humans. The geological time scale uses these mass extinctions to mark the end of each period of geological time. The knowledge that there have been catastrophic events in the past that have nearly wiped out all life is a wake-up call to humans. With this knowledge of the past and applying it to present and future environments, scientist can devise methods of protection and conservation.

✓ identify the ways in which palaeontology assists understanding of the factors that may determine distribution of flora and fauna in present and future environments

Palaeontologists supply information from the fossil record of the distribution of fauna in the past. This assists us to understand the factors that may determine the distribution of flora and fauna in present and future environments. This information includes the knowledge of climate change. Evidence shows that as Australia drifted northwards, the climate dried out effecting flora and fauna. Similarly humans have affected the climate with the destruction of the ozone layer and this had altered flora and fauna. This information can be used to reduce the impact of habitat destruction of species.

✓ explain the need to maintain biodiversity

Biodiversity is the variety and number of living forms that exist in an area. It is also the genetic diversity of species as well as the diversity of species as well as the diversity of their ecosystems. Biodiversity is essential for maintaining the functions of natural systems on Earth, such as providing clean water, air, productive soil and recycling matter. Many human activities depend on biodiversity, for example, agriculture, forestry, fisheries and tourism, construction, textile manufacturing and medicine. Today there is an international concern that the rate of loss of biodiversity on the planet is increasing, the main cause being human interaction.