8.2 - A Local Ecosystem:

1. The distribution, diversity and numbers of plants and animals found in ecosystems are determined by biotic and abiotic factors:

- *Distinguish between the abiotic and biotic factors in the environment:*
  - Biotic Factor: The living factors, eg, trees, birds, predators, etc
  - Abiotic Factor: The non-living factors, eg, temperature, oxygen levels, etc
  - Environment: the surroundings of an organism including abiotic and biotic factors
  - Habitat: The place where an organism lives
  - Community: The organisms found living together in an area
  - Ecology: The study of the relationship between organisms and their environment
- *Compare the abiotic characteristics of aquatic and terrestrial environments:*

Characteristics	Aquatic	Terrestrial
Viscosity: A measure of a medium's resistance to an object moving through it	HIGH VISCOSITY: Difficult for organisms to move through	LOW VISCOSITY: Easy for organisms to move through
Buoyancy: The amount of support experienced by an object	HIGH: Gives support to plants and animals. May help to maintain shape	LOW: Plants and animals need to be able to support themselves
Temperature: Depends on intensity of sun's radiation, which depends on latitude and longitude.	Heats up and cools down more slowly than air. Heat loss and gain is not usually a problem	Temperatures vary more than in water. Daily and seasonal variations may be great
Availability of: a) *Gases* b) *Water* c) *Ions*	a) Depends on temperature, diffusion is slower. More gases available at lower temperatures. Oxygen concentration decreases with depth b) Not a problem. Osmotic differences of fresh and	a) Gases freely available; diffusion is rapid b) Varies, can be a problem for land organisms. Preventing dehydration can be a major problem c) Ions in soil are vital in plant growth

	salt water are important c) Saltwater - 35% of it is dissolved ions (salts). Freshwater - low in ions Organisms must cope with osmotic differences.	
Light penetration:	Decreases with depth. Affects availability of plants in water	Plenty of light available. Dense plant growth can affect light. Very important for plant growth
Pressure variation:	Pressure varies with depth. Increased depth has increased pressure, Few organisms live at great depths	Decreases with height above sea level. Little effect on most organisms.
Availability and type of Substrates: Different types of rocks, soils and sands and other materials from rocks. Vary in their mineral and nutrient levels	Bottom dwellers are affected. Free swimming and surface level organisms are less affected. Turbidity or water affects abundance	Amount and type of soil is important for plants. Soil is also important in providing habitats for ground dwellers and animals that live underground. The slope and rockiness of the land is important
Strength of Natural Forces:	Tide, currents, waves may vary	Winds and rain vary in depth
Availability of Shelter and Space:	Not required for all organisms. Substrate, rocks, vegetation and coral reefs provide shelter. Space is important for animal requiring territory	Most animals require shelter. Some plants require shelter. Space is important for organisms requiring territory, shelter or nesting sites.

- *Identify factors determining the distribution and abundance of a species in each environment:*
  - DISTRIBUTION
    - Where an organism is found in an environment
    - It is usually uneven throughout the ecosystem
    - Organisms are found where abiotic and biotic factors favour them
    - Organisms are distributed where:
      - Survival rate is high
      - Predation is low
      - Requirements for survival are met
  - ABUNDANCE:
    - How many organisms in an ecosystem
    - Not the same throughout environment
    - Changes over time:
      - Increases due to births and immigration
      - Decreases due to deaths and emigration
  - Abiotic Factors Affecting Distribution and Abundance:
    - Light
    - Strength of wind
    - Rainfall
    - Temperature variations
    - Topography
    - Tides, currents and waves
    - Water (amount, salinity, pH)
    - Substrate
    - Space and shelter
    - Oxygen
  - Biotic Factors Affecting Distribution and Abundance:
    - Availability of food
    - Number of competitors

  - Number of mates available
  - Number of predators
  - Number and variety of disease causing organisms

- *Describe the roles of photosynthesis and respiration in ecosystems:*
  - Energy needed to sustain ecosystems is obtained from the sun
  - This energy is captured by plants during photosynthesis
  - Photosynthesis uses CO_2 and water to make food - all organisms rely on this
  - Respiration is the process by which cells obtain energy
  - Organic molecules are broken down and energy is produced
  - The organic molecules needed for respiration come from photosynthesis
  - It all relies on the sun
  - Energy is never recycled - it requires constant input
  - Photosynthesis powers ecosystems.
- *Identify uses of energy by organisms:*
  - Synthesis of complex molecules (lipids, proteins, carbohydrates, etc)
  - Growth of cells (includes differentiation, division, elongation, etc)
  - Repair and maintenance of old or damaged cells
  - Active transport of materials across cell membranes
  - Functioning of special cells that need extra energy (nerves, muscles, kidney, etc)
  - Transport or materials within ecosystems (eg, phloem, circulatory systems, etc)
- *Identify the general equation for aerobic cellular respiration and outline this as a summary of a chain of biochemical reactions:*
  - All living things need energy to remain alive
  - Respiration is the breakdown of glucose with oxygen to release energy
  - Carbon dioxide and water are produced as waste products
  - Glucose + Oxygen $\rightarrow$ Carbon Dioxide + Water + Energy
  - Aerobic means requiring oxygen
  - The energy is held in the glucose bonds; when they are broken, energy is released.
  - Respiration involves around 50 different reactions, each catalysed by a different enzyme

- ATP:
  - Adenosine triphosphate (one adenosine attached to three phosphate groups)
  - This is the energy carrier is all cells
  - The energy produced by respiration is kept in these molecules
  - The energy is stored in the phosphate bonds
  - ADP (adenosine diphosphate) + P (phosphate) $\xrightarrow{ENERGY}$ ATP
- For every glucose molecule, 38 ATP molecules are produced
- ADP + P + Glucose + Oxygen $\rightarrow$ Carbon dioxide + Water + ATP
- $38ADP + 38P + C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + 38ATP$
- There are 2 stages in Respiration:
  - <u>Glycolysis:</u>
    - Occurs in cytoplasm
    - Splits the 6-carbon glucose into two 3-carbon molecules (pyruvate - C_3)
    - 2 ATP molecules are gained
    - Does NOT require oxygen
  - <u>Kreb's Cycle:</u>
    - Occurs in the mitochondria
    - Pyruvate is broken down into water and CO_2
    - 36 ATP molecules are gained
    - Oxygen is required

- *Process and analyse information obtained from a variety of sampling studies to justify the use of different sampling techniques to make population estimates when total counts cannot be performed:*
  - A population is a group of similar organisms living in a given area as a time
  - Populations can never be 100% accurately counted; this is because of the difficulty of describing in detail large areas. Also it would be too time-consuming and damaging to the environment
  - Populations are estimated using *sampling techniques*. These make an estimate, which is roughly accurate of the population.
  - <u>Measuring Distribution:</u>
    - A *transect* is used

- This a narrow strip that is placed across the area being studied from one end to another
- The organism on the strip, from one end to another, are recorded and this represents the distribution of organisms for that area

– Measuring Abundance:

- Plants:
  - The quadrat method is used
  - Method: quadrats (squares of a fixed area) are placed randomly in an area.
  - The abundance of the organism in that area is measured
  - Using the formula below, the abundance can be estimated:

$$\frac{\text{Number in Sample}}{\text{Area in Sample}} = \frac{\text{Number in Population}}{\text{Area in Population}}$$

- Animals
  - Quadrat method can't be used, as animals move around
  - Capture recapture method is used instead:

$$\text{Abundance} = \frac{\text{Number Captured} \times \text{Number Recaptured}}{\text{Number Marked in Recaptured}}$$

2. Each local aquatic or terrestrial ecosystem is unique:

- *Examine trends in population estimates for some plant and animals species within and ecosystem:*
  - Area Studied: Grey Mangrove forest at Homebush Bay:
  - As the water level rose, the amount of mangrove seedlings decreased, but the amount of semaphore crabs increased
  - As the water level reduced, the amount of mangrove seedlings increased, but the amount of semaphore crabs decreased
  - This pointed out that mangrove seedlings do not prefer to be covered in water, while crabs do
- *Outline factors that affect numbers in predator and prey population in the areas studied:*
  - The amount of food available
  - The salinity of the water
  - The amount of water available
  - Etcetera, etcetera, etcetera…
- *Identify examples of allelopathy, parasitism, mutualism and commensalism in an ecosystem and the role of organisms in each type of relationship:*
  - <u>Allelopathy:</u>
    - This is the production by a plant of specific chemicals (allelo-chemicals) which inhibit the growth of other plants around it
    - The example studied was the Casuarina. Its leaves contain allelo-chemicals, so as they dropped to the floor, they released the chemicals, preventing the growth of other plants in the area
  - <u>Parasitism:</u>
    - This is a relationship between two organisms where one benefits at the expense of the other organism

        - The example studied was the pimple wasp. It lays its eggs on the leaves of the mangrove. The larvae eat through the leave when they hatch and the leaf is damaged
    - Mutualism:
        - A relationship between two organisms where both of them benefit
        - The example studied was lichen. This consists of a fungus and an alga joined together. The fungi provides structure and the alga provides food
    - Commensalism:
        - A relationship between 2 organisms where only one benefits, and the other get no harm and no benefit
        - The example studied is the golden orb-weaving spider and the dewdrop spider. The weaving spider makes a web, and catches its prey with it. It leaves scraps behind. The dewdrop spider eats the leftovers.
- *Describe the role of decomposers in ecosystems:*
    - Decomposers are the rubbish cleaners of the ecosystems
    - They feed on the left overs of other organisms, dead organisms and decaying organisms and their wastes.
    - They enable the materials of decomposition available to plants
    - They keep the biomass in circulation.
- *Explain trophic interactions between organisms in an ecosystem using food chains, food webs and pyramids of biomass and energy:*
    - Trophic interactions are feeding relationships between organisms
    - A FOOD CHAIN represents the flow of energy from one living thing to the next
    - Food chains start with producers (plants), which are eaten by herbivores, which are eaten by carnivores.
    - The first consumer is the organism that eats the first other organism. It is usually a herbivore
    - FOOD WEBS are a complex set of interacting food chains within an ecosystem
    - Ecosystems are composed of food webs, not just food chains.
    - At every step of a food chain, energy is lost
    - It is lost as heat, and wastes

  - This is represented in an energy pyramid, as the lowest level is the biggest, and the levels shrink as they go up
  - At every step of the food chain, biomass (mass of organisms) is lost
  - Biomass is lost as undigested material and wastes
  - This is also shown in a biomass pyramid
  - Biomass pyramids and energy pyramids are usually similar in ecosystems
- *Define the term adaptation and discuss the problems associated with inferring characteristics of organisms as adaptations for living in a particular habitat:*
  - An adaptation is a feature of a organism that makes it well suited to its environment and its lifestyle
  - Adaptations can be:
    - Structural: A physical characteristic relating to the structure of an organism
    - Physiological: Relating to the way an organism functions
    - Behavioural: How an organism relates to it environment
  - Adaptations are always genetic; they are the result of natural selection
  - Problems associated with inferring characteristics of organisms include:
    - If you do not know the environment an organism lives in, then saying a characteristic is an adaptation is just guesswork
    - Sometimes, organisms gain features that are advantageous to its survival, but are a result of the organism's live experience. This is not an adaptation, as adaptations are always genetically based
- *Identify some adaptations of living things to factors in their environment:*
  - Some frogs burrow into soils to prevent drying out
  - Marsupial hopping mice have deep burrow to keep cool
  - Kangaroos have internal respiratory organs
  - Etcetera, etcetera, etcetera…
- *Describe and explain the short-term and long-term consequences on the ecosystem of species competing for resources:*

  - Competition in ecosystems is the struggle between organisms for the same resource
  - Competition can be between members of the same species or between members of different species.
  - In the short-term, competition reduces the chance of survival and restricts the abundance of all competitors
  - In the long-term, one of the competitors will eventually be more successful and drive out or significantly reduce the numbers of other competitors
- *Identify the impact of humans in the area studied:*
  - In Homebush Bay, significant industrialisation and urbanisation has drastically changed the natural environment
  - The bay has been almost destroyed, and the wetlands have been almost totally removed from the bay
  - Sedimentation of the river has also been done
  - Dredging the bay for land reclamation has also been done by humans.