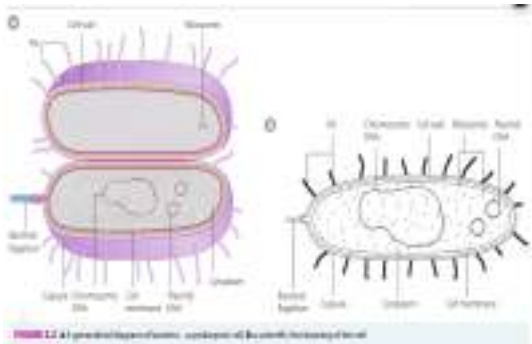
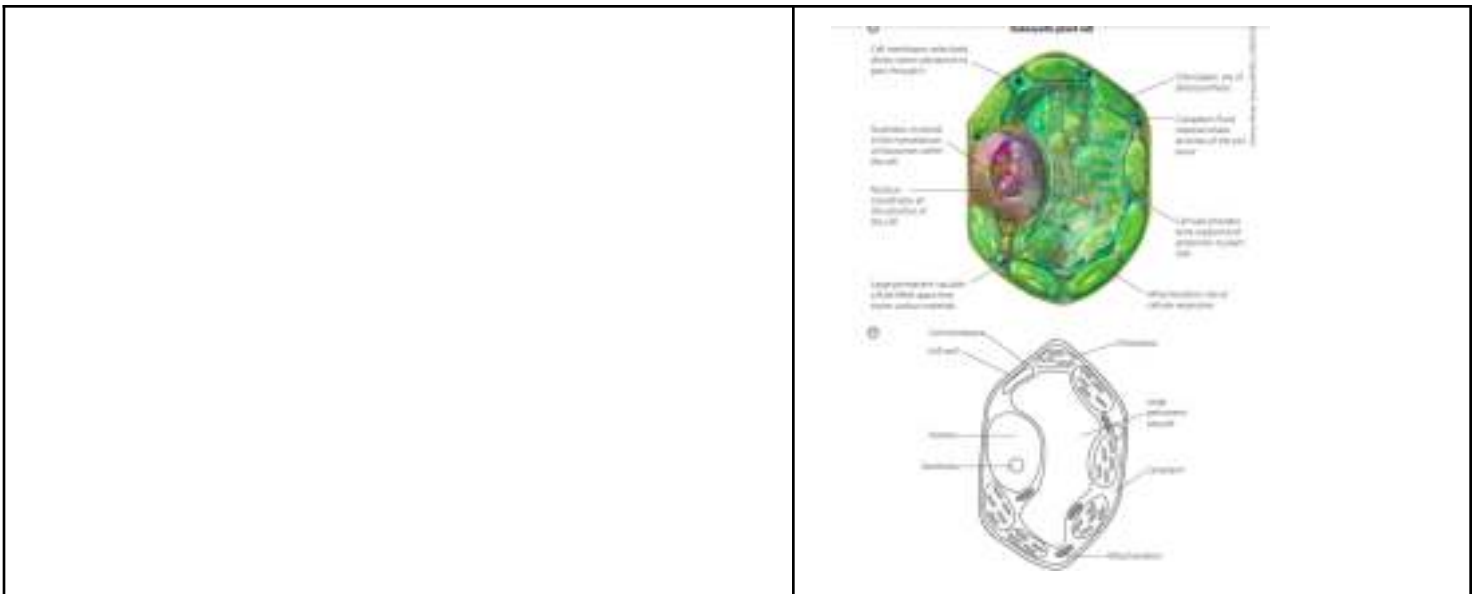


**Module 1 - Cells as the Basis of Life**

- Classified as either Prokaryotic or eukaryotic cells
- Prokaryotic cells have a more simpler structure than eukaryotic cells

Prokaryotic cells	Eukaryotic cells
<p>Prokaryotes are unicellular organisms that Don't have organelles or other internal membrane-bound structures and do not have a nucleus.</p> <p>4 main structures that all prokaryotic cells have</p> <ol style="list-style-type: none"> <li>1. Cell membrane</li> <li>2. Cytoplasm</li> <li>3. Ribosomes</li> <li>4. Genetic material           <ul style="list-style-type: none"> <li>➤ No membrane surrounding the genetic material and therefore no nucleus</li> <li>➤ Genetic material forms large rings called ribosomes</li> <li>➤ Structures</li> </ul> </li> </ol> <p>Cell wall: protects the cell and provides structural support            Pilli: allows them adhere to nearby            Flagella: provide the cell with locomotion            Capsule: layer composed of complex carbohydrates outside the cell wall</p> <ul style="list-style-type: none"> <li>➤ Are unicellular</li> <li>➤ Can be divided into archaea and bacteria</li> <li>➤ similar in both size and shape but different chemical composition</li> <li>➤ Bacteria → beneficial OR harmful</li> <li>➤ archaea → found in extreme and harsh environments</li> </ul> 	<p>Eukaryotic cells are cells that contain a nucleus and organelles            Multicellular- depends on each other to survive</p> <p>Eukaryotic cells are much more complex ➤            It is a membrane bound nucleus which has the genetic material</p> <p>Organelles: All the internal structures that are membrane bound</p> <ul style="list-style-type: none"> <li>➤ Organelles carry out biochemical reactions such as respiration and photosynthesis</li> <li>➤ Are extremely essential</li> </ul> <p>Removal of wastes in Eukaryotic cells</p> <ul style="list-style-type: none"> <li>➤ Some waste products are packaged up by the lysosome and removed via exocytosis.</li> <li>➤ Hormones and enzymes produced by the cell are packaged into vesicles and leave via exocytosis.</li> </ul> <p>Proteasomes</p> <ul style="list-style-type: none"> <li>➤ contain enzymes(proteases) which breakdown proteins</li> <li>➤ found in the cytoplasm and nucleus. E.g Kidney</li> <li>➤ filters blood</li> <li>➤ Reabsorbs proteins, glucose etc.</li> <li>➤ Secretes waste</li> <li>➤ Maintains salt and water balance and pH of the blood</li> </ul>



**TECHNOLOGIES**

Light microscopes	Fluorescence microscopes	Electron microscopes
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Compound light microscopes used in school

Light source passes through the condenser lens and through the specimen and to the convex objective lens where it is magnified

Magnification up to 1500x and resolution up to 200nm are important to see the detail in the specimen

Similar to light microscopes

Extra parts that allow for specificity on a certain area

A fluorescent substance will attach to the structures is specifically being observed and the fluorescent light is directed through filters that separate it from surrounding light

Uses an electron beam instead of light, and electromagnets instead

of lenses

The interaction between the electrons and the object forms a viewable image on a screen. The use of electrons instead of light gives much greater magnification

have a much higher resolving power than light microscopes because electrons have a much shorter wavelength than light

- Digital processing images by microscopes has allowed scientist to view cell differently
  - cell scan software produces three-dimensional representations of cell structure **SIZES OF CELLS**
- 1 cm = 10 mm & 1 mm = 1000 μ & 1 μm=1000 mm **Actual length/Length of drawing = scale**

**ORGANELLES - Eukaryotic**

Membranes - Selective boundaries (Both)

- The cell membrane surrounds the cell contents

in all cells

- Controls passage of water and other chemical

Protoplasm

- The functions essential to life such as making cellular products and respiration
- Living content of a cell surrounded by

- It is selectively permeable allows in certain substances to pass through

membrane

- Contains a liquid called Cytosol
- Composed of nucleus and cytoplasm

coming in and out

- In both plants and animals

Nucleus - The control and information centre (Both)

Endoplasmic Reticulum - Transport and processing of proteins and lipids (both)

- Sphere, oval structure
- Colourless and transparent jelly like
- Usually one nucleus per cell
- Stores information needed to control all cell activities
- Surrounded by double nuclear membrane - Have tiny pores pierced in nuclear membrane that regulate passage of substances between the nucleus and cytoplasm allowing communication
- Flattened interconnected membranes -

Provides connection between the nucleus and the cell's environment

Rough ER → ribosomes

Smooth ER → no ribosomes

- Main function is to transport but can also synthesis lipids

Ribosomes (both)

Golgi body - packaging and sorting the product(both)

- Are small organelles
- Small size increases surface area
- Made of Chemical RNA and protein
- Carries out the genetically coded instructions of DNA to produce any proteins necessary
- Amino acids are joined in order to form Polypeptides, structural unit of proteins
- Free in the cytoplasm or scatters over the surface of ER

- Does not have ribosomes attached
- Arranged in stacks 4-10
- They package and sort cell products
- Membrane provided act as a packaging label

Lysosomes – digestion and destruction (animal only )

Mitochondria – cellular respiration (both)

- Organelle within the cytoplasm eventually wear out
- They help with the process of reusing and recycling
- Formed by the golgi body
- Contains digestive enzymes so that complex compounds can be broken down to simpler compounds
- Lysosomes can destroy and entire cell→ apoptosis

- Powerhouse of a cell
- Produces energy in the form of energy rich molecules by the process of cellular respiration
- Smaller than the nucleus
- Number of M. depends on how much energy the cell requires to carry out its function
- Energy comes in the form of chemical called ATP (adenosine triphosphate)

<ul style="list-style-type: none"> <li>- Simple compounds building blocks for new organelles</li> </ul>	<ul style="list-style-type: none"> <li>- Surrounded by double membrane</li> <li>Outer membrane: gives shape and allows passage of small substances in and out of the mitochondria</li> <li>Inner membrane: folded into fine, finger like ridges or cristae which increases surface area</li> <li>- Filled with fluid called matrix contains DNA and enzymes that give the feature of replication</li> </ul>
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Vacuoles – storage and support (plant only)

- Large, permanent, fluid filled sacs in the cytoplasm of mature plant cells
- Watery solution→ cell sap
- Surrounded by only single membrane
- For storage and support
- By filling up with water vacuole pushes outwards with cytoplasm placing pressure on the wall → turgid

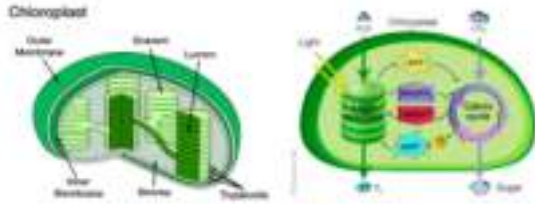
- Cellulose provides strength and support - Cellulose fibres have a little elasticity and are somewhat flexible
- May be thickened with additional chemicals

Cytoskeleton – keeps organelles in place (both)

Chloroplasts – photosynthesis(plant only )

Plant cell wall – shape and support (plant only )

- Green in colour due to chlorophyll
- Responsible for photosynthesis sugar in plants, using the energy of sunlight - Not present in all plants
- Belong to group called plastids
- chloroplasts → green plastids
- Surrounded by double membrane
- Liquid → stroma
- Stacks of membranes → thylakoids
- Single membrane → granum



- Granular structure
- Dense
- Near nucleus in animal cells
- Consists of two centrioles
- Role in cell division

Centrioles – spindle production in cell division( animal only)

- Held in place by network of tiny microtubules, microfilaments and intermediate filaments - Framework for shape of the cell, cell movement, organelle movements and cell division

**AUTOTROPHS:** create their own food (plants)

**HETEROTROPHS:** consume other organisms for food (humans)

**PHOTOTROPH:** uses light as energy source

**CHEMOTROPH:** uses chemicals as energy source

### NUTRIENTS THE CELL REQUIRES

#### Inorganic Compounds

- Water
- Oxygen
- Carbon dioxide
- Nitrogen
- Minerals
- Vitamins
- Ions eg: Na, K, Cl

#### Organic Compounds

Carbohydrates  
Lipids  
Proteins  
Nucleic acids

### CELL MEMBRANES - gateway to cells

- Structure of the cell membrane → mosaic model

**FLUID MOSAIC MODEL**

- Controls what goes in and out between the different environments
- Selectively permeable means that it allows only certain things in
- Concentration of substances remain constant
- Describes the cells membrane as having a Lipid bilayer
- Can flow and change shape
- Some can move sideways or be in a fixed position
- Specialised proteins are embedded in the lipid
  - The lipid components of all membranes allow them to be flexible and repair themselves

**LIPID CONTENT**

- Composed of two layer phospholipids called phospholipid bilayer
  - represented by head and two tails

**Head** → Hydrophilic: water absorbs and dissolving

**Tail** → Hydrophobic: Unable to dissolve in water as they are fatty acid tails

**MEMBRANE PROTEINS**

- Scattered throughout and suspended in the bilayer
- Some proteins may be fixed in placed while others travel freely
- Can function as pores or form of active carrier system or channels for transport or for cell recognition
- Proteins allow for cell to cell interaction and communication
  - Membrane recognition proteins or glycoproteins identify the cell and are called antigens. They allow the immune system to distinguish between foreign particles ( and the body’s own cells.
- **Transport proteins** act like passageways that allow specific substances to move across the membrane. Also involved in cellular communication.
- **Receptor proteins** are different in different types of cells. They cause the cells to respond only to certain signals from substances such as hormones that bind to them, giving them specific functions

E.g For example, in multicellular organisms, adhesion proteins link cells together and help maintain the organism’s three-dimensional structure

**surface-area-to-volume ratio:**

- surface area/volume
- smaller cell = more surface area in relation to volume (higher SA:V)
- larger cell = smaller amount of surface area in relation to volume (lower SA:V)

Into cells	out of cells
<ul style="list-style-type: none"> <li>- nutrients</li> <li>- oxygen</li> <li>- water</li> <li>- gases</li> </ul>	waste <ul style="list-style-type: none"> <li>- carbon dioxide</li> <li>- urea</li> <li>- hormones/mucus</li> <li>- anti-bodies</li> </ul>

**DIFFUSION:** Movement of molecules from a region of high concentration to a region of low concentration until it is balanced

**OSMOSIS:** a type of diffusion which is the movement of solvent/water molecules through a semipermeable membrane.

**ACTIVE TRANSPORT:** movement of molecules from a region of low concentration to a region of high concentration gradient, involving use of energy

**ENDOCYTOSIS:** when a large particle wants to enter a cell, the cell membrane can change its shape to surround the particle and engulf it by this process

**EXOCYTOSIS:** process by which special substances are transported to the external environment of the cell

### Solutions

Hypotonic	low concentration of water compared to outside, water will enter cell (it'll expand)
Isotonic	equilibrium
Hypertonic	high concentration of water compared to outside, water will leave cell (it'll shrivel)

CELLULAR RESPIRATION -

PHOTOSYNTHESIS



Respiration occurs all hours where as photosynthesis occurs only during the day  
 - All living organisms rely on one source of energy  
 ATP

Glucose is broken down in two ways

Anaerobic respiration

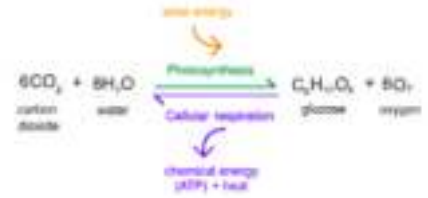
- alcohol/yeast fermentation  
 glucose → ethanol + carbon dioxide + adenosine Triphosphate

Lactic acid fermentation

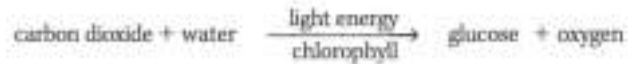
Occurs during strenuous exercise

When more oxygen become available the lactic acid become pyruvate and is then converted by aerobic respiration into carbon dioxide, water and energy

Photosynthesis



Utilises light energy where it is trapped in the chlorophyll in the chloroplasts  
 - Energy breaks apart water and carbon dioxide molecules and into oxygen, glucose molecules and water molecules



Photosynthesis is a series of smaller reactions occurring across two stages

- A light-dependent stage occurs in the grana where light energy splits the water molecules into oxygen and hydrogen.
- The light-independent stage occurs in the stroma where carbon dioxide and hydrogen combine to form glucose

**ENZYMES**

- Most enzymes are proteins
- Control metabolic reactions
- biological catalysts – speed up chemical reactions
- Enzymes are protein molecules
- Requires less energy to start reaction due to enzymes → activation energy
- All living cells must maintain a balance despite the differences in internal external conditions
- Most organisms live within a small temperature range
- A protein consists of a long chain of amino acids (called a peptide) which is folded into a 3 dimensional shape

**TWO TYPES OF REACTION**

Anabolic

- Builds up large molecules
- Requires energy
- Endergonic → require energy

Catabolic

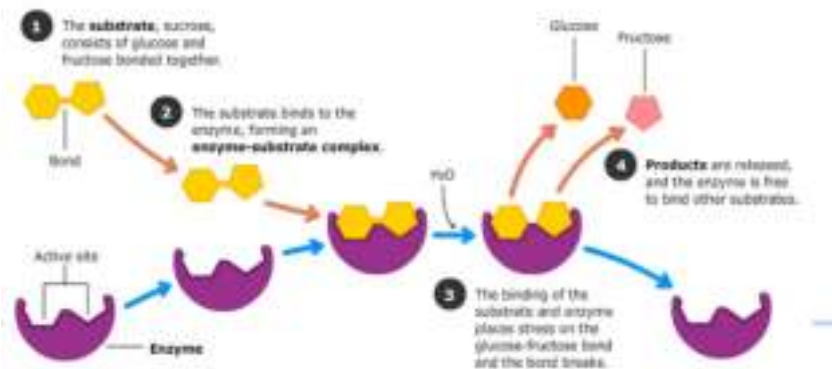
- Breaking down complex molecules into simpler molecules



E.g proteins into amino acids

Exergonic → releases energy

<b>SUBSTRATE</b>	substance that an enzyme reacts with
<b>ACTIVE SITE</b>	part of enzymes surface into which the substrate binds
<b>lock and key model</b>	fit exactly
<b>induced fit model</b>	enzyme changes shape slightly
<b>Coenzyme</b>	is a non-protein molecule that helps to form the active site by binding to the enzyme. Extra piece to help it fit into the active site
<b>Inhibitors</b>	Are chemicals that reduce the rate of enzymatic reactions



<b>REVERSIBLE INHIBITORS</b>	are used to control enzyme activity. Interaction between the substrate and the enzymes controlling the reaction
<b>Competitive inhibitors</b>	This involves competition for the reactive site
<b>Noncompetitive inhibitors</b>	work either to slow down the rate of reaction or block the active site altogether and prevent its function (allosteric inhibition)
<b>Denaturation</b>	At high temperatures the bond break and destroys active site
<b>Saturation point</b>	All active sites are being used so adding more substrate has no effect on reaction rate as $V_{max}$ has been reached

**temperature pH: A measure of acidity**

mammals → 40°C

cells function best at a small temperature range

although as the temperature increases, the rate

of reaction increases until the optimal

temperature is reached. If the cell exceed its

maximum level (60°C) the cell will start to

- Optimum pH - the pH at which the enzyme is most active.

- Enzymes are denatured by extremes of pH, either too alkaline or too acidic. They operate within a very narrow range.

- Changing pH even slightly either side of the

deteriorate and become ineffective optimum, affects enzyme function but it is reversible.

- Greater changes cause irreversible damage (denaturation).

## Module 2 - Organisation of Living Things

**Unicellular:** Exist as a single cell working with other single cells → colonial

**Multicellular:** where many cells depend on each other where they specialised in a certain function and work together to keep the organism alive

### Unicellular organisms

- Contain only one cell ● Can either be prokaryotic or eukaryotic
- Always exposed to the external environments
- Have a high surface area to volume ratio which enable easy movement of substances to carry it its functions
- Wastes can efficiently be removed
  - made up of identical single-celled organisms collectively called a colony

### Colonial organisms Multicellular organisms

- all individuals in the colony are capable of carrying out each function necessary for life ● some contain cells with specialised functions that are coordinated with other cells in colony more efficient functioning
- e.g. volvox, coral, jellyfish
- made up of many different types of cells ● similar cells are grouped together to perform specialised functions → efficient functioning

- specialised cells cannot live independently
- processes of obtaining nutrients and getting rid of wastes in unicellular and colonial organisms rely on diffusion and are less successful and efficient than those in multicellular organisms ● larger in overall size therefore SA: V is smaller ● passive transport is insufficient to address their needs (overcome by functional organisation)

## FORMING SPECIALISED FUNCTIONS

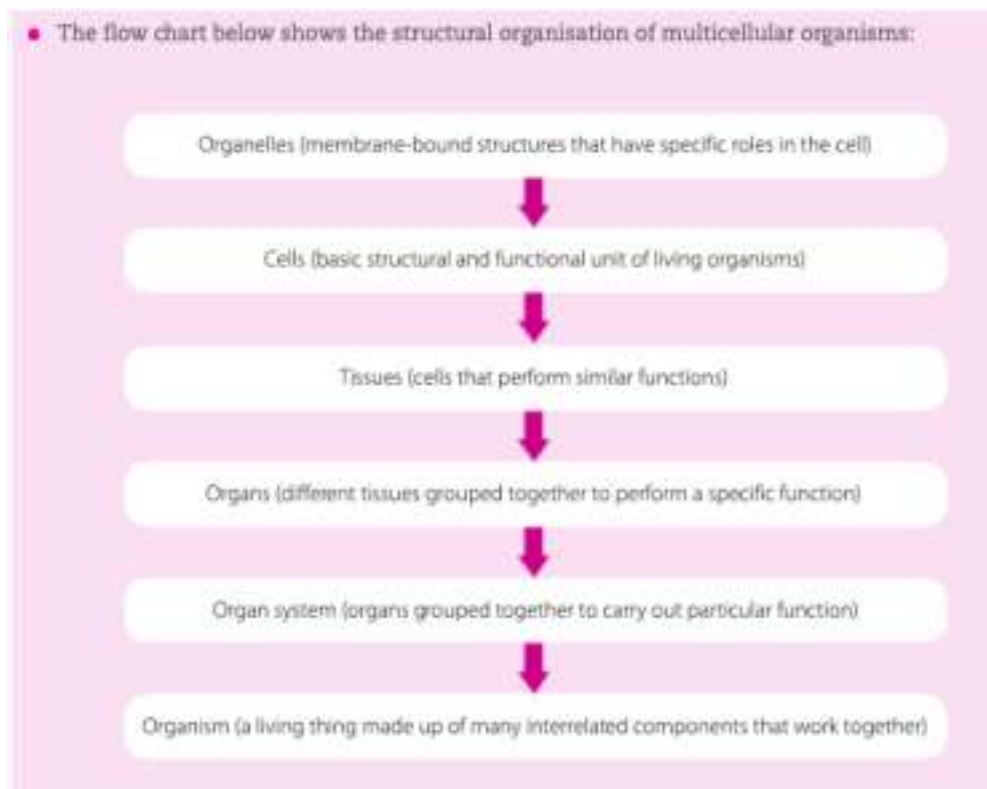
**Cell specialisation:** refers to the particular functions that a cell has.

**Differentiation:** is the process that a stem cell goes through to become specialised

- When becoming specialised they differentiate
- All specialised cells originate from stem cells
- Stem cells are undifferentiated
- Stem cells can be found in embryos where they are known as embryonic stem cells/ adult cells
- requirement for well-developed communication and coordination between the many specialised cells
- Cell structure is related to the particular function of the specialised cell

The type of cell that is formed is determined by the location of the undifferentiated cells in the organism and the particular genes that are switched on

### Structural organisation of multicellular organisms



## ANIMAL CELLS

<p><b>epithelial</b></p>	<ul style="list-style-type: none"> <li>- covers body surfaces, protects organs and forms glands</li> <li>- cells are densely packed and can occur in either single sheets or layers</li> <li>- does not contain blood vessels</li> <li>- relies on underlying connective tissue for nutrients</li> <li>- two distinct surfaces             <ol style="list-style-type: none"> <li>1. surface that is exposed to exterior of body cavity</li> <li>2. surface that is exposed to adjacent tissue</li> </ol> </li> <li>- cells of epithelial tissue are organised very close to each other, aiding their role as barriers to injury and infection</li> <li>- may also be specialised for absorption or secretion</li> </ul>
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**connective** - Can vary in function and form it takes

- all connective tissues share common characteristic of an extracellular matrix with cells scattered through it
  - matrix is made up of protein fibres collagen (for strength) and elastin (for flexibility)
  - provides support, ensures that different parts of body are bound together and protects against damage
  - different types of connective tissue vary in density and the way cells are

	<p>specialised</p> <p>Types: fibrous connective tissue, loose connective tissue, adipose tissue, cartilage, bone and blood (differences are due to arrangement of cells and their specialised structure and function e.g. adipose, cartilage, collagen)</p>
<p><b>nervous</b></p>	<p>nervous system: brain, spinal cord and peripheral nerves which contains nervous tissue</p> <p>highly specialised for communication between all parts of the body - nerve cells (neurons) are highly specialised for their function of passing messages to other cells and itself</p> <ul style="list-style-type: none"> <li>- neurons consist of multi-branched dendrites and an axon that extends out from cell body</li> </ul>

<p><b>muscle</b></p>	<p>contains muscle cells called muscle fibres → Contractions of muscles three types: skeletal, cardiac, smooth – contain proteins actin and myosin which interact with each other to cause the cells to lengthen and shorten</p> <p><u>skeletal muscle</u>: long, have striations (light and dark areas) which are caused by arrangement of actin and myosin. attached to bones and their contraction causes movement in the organism. Voluntary → conscious movement</p> <p><u>cardiac muscle</u>: present in heart and have striations (light and dark areas). Individual cells have connection functions that are necessary for coordinated beating of the heart. involuntary → automatic</p> <p><u>smooth muscle</u>: do not have striations and their contractions push substances through specialised organs such as gastrointestinal tract, the blood vessels and urethra which leads to bladder. involuntary → Automatic</p>
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### Plant cells

<p>The organs of a plant can be grouped into three systems:</p>	<ol style="list-style-type: none"> <li>1. The shoot system is the part of the plant above the ground. It supports the plant, enables the transport of substances around the plant, exchanges gases, and carries out photosynthesis and reproduction. Organs that are part of the shoot system include the leaves, the stem and the reproductive organs.</li> <li>2. The root system is that part of the plant below the ground. It is responsible for absorbing water and nutrients from the soil for the use of the rest of the plant. The roots, including the root hairs, are organs of the root system.</li> <li>3. Sometimes plants are said to have a third system – the vascular system for transport. It is made up of xylem and phloem vessels</li> </ol>
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<p><b>meristematic</b></p>	<ul style="list-style-type: none"> <li>- found at tips of roots and shoots</li> <li>- cells divide to produce new growth</li> <li>- cell differentiation to produce specialised cells</li> <li>- cube-shaped and very small</li> </ul>
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<p><b>Dermal</b></p>	<ul style="list-style-type: none"> <li>- protects plant tissues</li> <li>- can be found on outer layers of stems, roots and leaves</li> <li>- protects plant from damage and controls interactions with plants surroundings</li> <li>- epidermal layer is outermost layer of dermal tissue</li> <li>- secretes waxy layer called cuticle which is vital to reduce water loss from plant</li> <li>- wide variety of epidermal cells and most lack a chloroplast. They can also produce fine hairs on the surfaces of leaves and stems (trap a layer of air next to the leaf, preventing flow of air and decreasing evaporation of water from the leaf. other types = contain</li> <li>- substances that are harmful to insects that feed on them)</li> <li>- some have very fine projections called root hair which increase surface area for movement of water into root, increasing water and mineral intake</li> </ul>
<p><b>vascular</b></p>	<ul style="list-style-type: none"> <li>- responsible for transport of substances around plant</li> <li>- found in roots, stems and leaves</li> </ul> <p>two main types: xylem and phloem  <b>xylem</b> transports water and mineral salts from roots to leaves  <b>phloem</b> transports products of photosynthesis around the plant.</p>
<p><b>ground</b></p>	<ul style="list-style-type: none"> <li>- all internal cells of a plant other than the vascular tissue</li> <li>- bulk of plant tissue and consists of a variety of different cell types that are specialised for food storage, support and photosynthesis</li> </ul>

**BODY SYSTEMS**

<p><b>Circulatory</b></p>	<ul style="list-style-type: none"> <li>- delivers oxygen and nutrients to tissues</li> <li>- equalises temperature in the body</li> </ul>
<p><b>Respiratory</b></p>	<ul style="list-style-type: none"> <li>- removes carbon dioxide from the body</li> <li>- delivers oxygen to the blood</li> </ul>
<p><b>Excretory</b></p>	<ul style="list-style-type: none"> <li>- performs the breakdown and discharge of wastes in the body</li> </ul>

<b>Digestive</b>	<ul style="list-style-type: none"> <li>- processes food for use by body</li> <li>- removes waste from undigested food</li> </ul>
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### Autotroph structure and function

<b>vascular plants</b>	they possess a transport system to move substances from one part of the plant to another
<b>Non-vascular plants</b>	(such as mosses) do not possess specialised structures for support and transport
<b>autotrophs</b>	produce their own organic compounds from inorganic compounds surrounding them
<b>heterotrophs</b>	must consume other organisms for organic substances for energy

**Xylem** responsible for the transport of water, along with water-soluble nutrients and minerals, absorbed from the soil through the root system.

**Phloem** is conductive tissue composed of thin-walled cells that transport sugars, in the form of dissolved sucrose, and other plant products from one part of a plant to another

- The main functions of the root system are anchoring the plant and absorbing water and inorganic nutrients from the soil.
- The root system is usually underground. The roots have a very large surface area that allows water and inorganic mineral salts to be absorbed efficiently.

There are three main types of tissue in the stem:

- Dermal tissue is the outer layer of the stem.
- Vascular tissue consists of the xylem and phloem tissue organised in vascular bundles.
- Ground tissue is all the parts of the stem that are not dermal tissue or vascular tissue.

<b>leaf tissue</b>	structure function
<b>cuticle</b>	thin waxy waterproof layer protects inner cells, prevents water loss and allows sunlight to penetrate for photosynthesis

epidermis	transparent and usually thin protects inner cells, prevents water loss and allows sunlight to penetrate for photosynthesis
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epidermis and cuticle	contains guard cells surrounding stomata regulates gas exchange and water loss – waxy cuticle protects leaf from excess water loss and the opening/closing of stomata controls the amount of gas and water entering/exiting
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mesophyll	<ul style="list-style-type: none"> <li>palisade: tightly packed column shaped cells with many chloroplasts, close to epidermis</li> <li>spongy: loosely packed, rounded cells with fewer chloroplasts, with air spaces around cells</li> </ul> <p>photosynthesis gas exchange, including diffusion of CO<sub>2</sub> throughout leaf</p>
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xylem and phloem tubular vessels transports fluids

<b>XYLEM PHLOEM</b>
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Two main elements: xylem tracheids and xylem vessels separated by parenchyma and fibre.

- Consist of cells stacked on top of each where the transverse (horizontal) walls have broken down and the cell contents have died to leave a hollow tube.

- The walls of the xylem are strengthened and thickened to prevent collapse by rings or spirals of lignin.

- The pits are very thin areas of the xylem that allow for the sideways movement of water and minerals - Tracheids are elongated, narrow cells with tapered ends. They have walls thickened with lignin and no perforated plates.

### SHOOT SYSTEMS

- Is a living tissue

- Comprised of two main elements: sieve tube elements and companion cells - Sieve tube element - has a cytoplasm but no nucleus or mitochondria - Arranged end to end to form a tube - Have a sieve plate at either end - Companion cell - controls the activity of

the sieve tube element, providing it with the energy to carry out transport of the sap and keeping it alive



- The transport of sugars is known as translocation

- The main function of the leaf is to absorb sunlight and carry out photosynthesis to produce the organic compound glucose
- The thin, flat structure and orientation of the leaf maximise surface area for absorption of sunlight
- A waxy cuticle minimises water loss from the leaf
- Palisade cells containing many chloroplasts are lined up vertically near the upper surface of the leaf to absorb sunlight
- Spongy mesophyll cells are loosely and irregularly organised to allow easy movement of

### GAS EXCHANGES

Respiratory surface - They are a specialised surface for gaseous exchange in contact with the external environment

- A large surface area is needed for fast diffusion and to compensate for small SA:V ratio achieved through folding and flattening
- A moist thin surface reduces the distance across which diffusion occurs and moist so that the oxygen and carbon dioxide is dissolved
- It is close to transport system for efficient dispersal to all cell

Fish	IN
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### Mammals

gases through the leaf

- Transport tissue in the leaf is organised into veins. This provides support as well as a pathway for the movement of water and the products of photosynthesis
- Guard cells, which are often more numerous on the underside of the leaf, change shape to open and close 'pores' known as stomata
- The gases oxygen and carbon dioxide are exchanged between the inside and outside of the leaf through stomata
- All plant cells carry out cellular respiration both at night and during the day. - Oxygen produced in photosynthesis is used in this process.

Habitat - Water is already dissolved in water but is at a low concentration compared to the concentration of oxygen in the air

- Oxygen varies depending in water depth, temperature and surface area of water exposed to air
- Solution

internal gills with one way flow of water

- Water flows over the gills gas exchange takes place
- Each gill has 2 rows of filaments to increase SA for

Air  
spi  
val  
op

- habitat - dry → dehydration is a problem
- Solution - Internal respirator systems (lungs) with a large surface area
- Multiple lobes
  - branching (trachea → bronchus → bronchioles → alveoli)
  - Folding and villi in the alveolar sacs

#### Gas exchange

- Occurs across a thin cell barrier
- By diffusion across a concentration gradient
- Breathing occurs as a result of the

concentration of the diaphragm

<p>exchange - Gas exchange occurs across a concentration gradient</p>	<p>closing) and enter the trachea which branch into tracheoles to increase the SA for gas exchange. Ends of the tracheoles contain a watery fluid to dissolve the gases Gases diffuse directly into and out of cells</p>	<p>exchange. The moist lining of the mouth acts as a surface for gas exchange Skin - The main surface for gas exchange in the aquatic environment. It is thin moist and well supplied with blood vessels</p>
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**COMMONALITIES between skin, gills, trachea and lungs**

- All the respiratory organs have a large surface area to get enough oxygen.
  - All the respiratory organs have thin walls for easy diffusion and exchange of respiratory gases.
- All the respiratory organs like skin, lungs and gills have a rich blood supply for transporting gases. But only in the tracheal system of respiration, air reaches the cells directly.

**MAMMALIAN DIGESTIVE SYSTEMS**

- There is a relationship between the length and complexity of their digestive systems of vertebrates in relation to their diet
- More complex diets → longer digestive tract and the longer digestion takes (specialised structures)

**Carnivores**

- Eat meat
- MEat is low in carbohydrates, high in protein and fat and contain more energy per kg than plants
- Food doesn't need to stay in the digestive system as long
- Small intestine usually short in comparison to body size

**TYPES OF TEETH**

- Incisors → cutting or shearing food into small chewable pieces
- Canines → ripping and tearing at tough foods
- Premolars → chewing and grinding food
- Molars → chewing and grinding food

**PROCESS OF DIGESTION**

<p>Chemical</p>	<p>Mechanical</p>
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<ul style="list-style-type: none"> <li>- Process of using digestive enzymes to chemically breakdown the food</li> <li>- Trying to obtain glucose, complex carbohydrates, amino acids, fatty acids and nucleotides</li> </ul>	<ul style="list-style-type: none"> <li>- Physical breakdown of food particles</li> <li>- mouth→ chewing, grinding</li> <li>- Stomach→ the churning motion</li> </ul>
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**PATHWAY THROUGH THE DIGESTIVE SYSTEM**

<p><b>Mouth</b></p>	<ul style="list-style-type: none"> <li>- Teeth breakfast into smaller pieces</li> <li>- Salivary amylase released into the mouth where enzymes can start the chemical breakdown</li> <li>- Food formed into ball shape call bolus</li> </ul>
<p><b>Oesophagus</b></p>	<ul style="list-style-type: none"> <li>- travels along the soft-walled, muscle-ringed tube to the stomach - Muscular contractions also move the bolus by a process called peristalsis.</li> </ul>
<p><b>stomach</b></p>	<ul style="list-style-type: none"> <li>- there are narrow openings whose opening and closing are controlled by circular sphincter muscles</li> <li>- Once inside the stomach, relaxation and contraction of the stomach walls continue mechanical digestion</li> <li>- Continues the mechanical breakdown in an acidic environment - Evolves into mixture known as chyme which include pepsin to continue chemical breakdown</li> </ul>
<p><b>Small intestines</b></p> <p><b>Absorption Digestive tract</b></p>	<p>The highly folded small intestine contains 3 main regions:</p> <ul style="list-style-type: none"> <li>- the duodenum (at the start of the small intestine)</li> <li>- the jejunum (middle section)</li> <li>- ileum (end region)</li> <li>- bile is released into the duodenum</li> </ul> <ul style="list-style-type: none"> <li>- Absorption of substances mostly occurs in the jejunum section of the small intestine</li> <li>- The products of digestion, including amino acids, glucose, fatty acids and glycerol, move into the transport systems of the body in the small intestine</li> <li>- The pancreas releases many different digestive enzymes and bicarbonate ions.</li> <li>- Other enzymes complete the chemical breakdown of larger molecules. - Most absorption of products of digestion occurs in the jejunum. - Villi are microscopic projections on the wall of the jejunum that are one cell thick.</li> <li>- Small molecules diffuse or are actively transported through the walls of the villi into the capillary or lymph vessels to be distributed throughout the body.</li> </ul>

<b>Large intestines</b>	<ul style="list-style-type: none"> <li>- The large intestine has two main sections: the colon and the rectum - the remaining undigested material moves to the large intestine - Water and mineral salts are absorbed from the large intestine into the bloodstream.</li> <li>- The remaining undigested material is called faeces and is stored in the rectum before being eliminated from the body.</li> <li>- Digestive products absorbed into the body are used in many different ways, including for structural purposes and for energy storage</li> </ul>
<b>Liver</b>	<ul style="list-style-type: none"> <li>- Bile produced by the liver and stored in the gallbladder emulsifies fat</li> </ul>

	molecules to increase surface area for breakdown
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<b>NUTRIENT/GAS REQUIREMENT</b>	<b>AUTOTROPH</b>	<b>HETEROTROPH</b>
Oxygen gas	Diffuses into the plant across cell surfaces	Diffuses through the respiratory surface
Carbon dioxide gas	Diffuses into the plant	Not required
Water	Diffuses into roots	Ingested into the digestive system
Glucose	Produced by photosynthesis	Ingested into the digestive system as either simple or complex carbohydrates, and absorbed into the bloodstream
Proteins, lipids	Produced by the plant from glucose and mineral ions	Ingested into the digestive system and absorbed into the bloodstream as amino acids, fatty acids or glycerol
Mineral ions	Move into the plant through the roots by diffusion and active transport	ingested into the digestive system and absorbed into the bloodstream

- Autotrophs and heterotrophs require gases and nutrients to maintain efficient and effective

metabolic function

- Both heterotrophs and autotrophs require inorganic and organic substances, water and oxygen gas. Autotrophs also require carbon dioxide gas
- Heterotrophs need to take in all of their nutrients. Autotrophs produce their own organic nutrients using the energy from the sun, but need to obtain water, mineral ions and the gases carbon dioxide and oxygen
- Autotrophs manufacture their own glucose and other organic substances from inorganic nutrients
- Heterotrophs must obtain all of their organic nutrients by consuming autotrophs or other heterotrophs

## COMPONENTS OF CIRCULATORY SYSTEMS

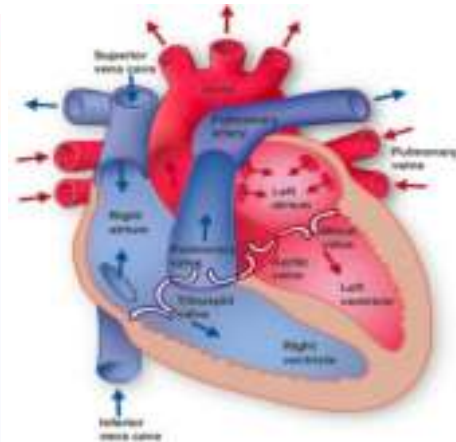
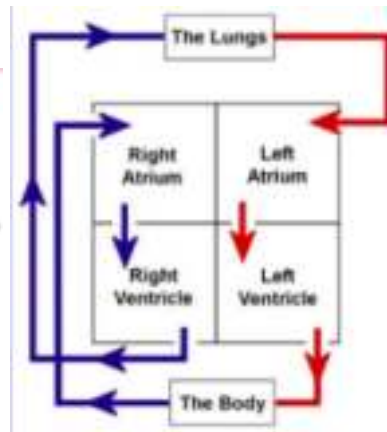
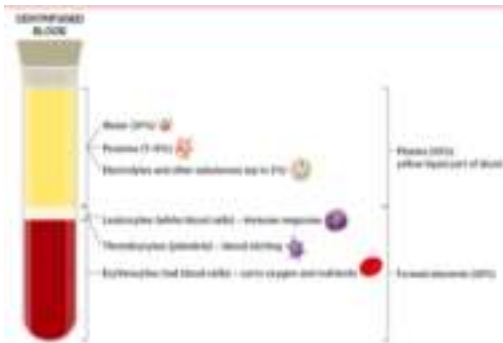
Vascular System

In mammals, this consists of the blood vessels and blood.

- Arteries → arterioles → capillaries → venules → veins

Components of blood are plasma, erythrocytes, thrombocytes and leukocytes

Erythrocytes	Carry nutrients and oxygen throughout the body
Thrombocytes	Clump together to make blood clot
Leukocytes	are the body's immune response to foreign invaders



## OPEN AND CLOSED CIRCULATORY SYSTEMS

- Role of the circulatory system is to supply nutrients and remove waste products from organisms.
- Circulatory systems are more efficient than simple diffusion, particularly for multicellular organisms

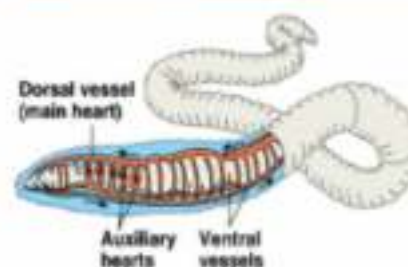
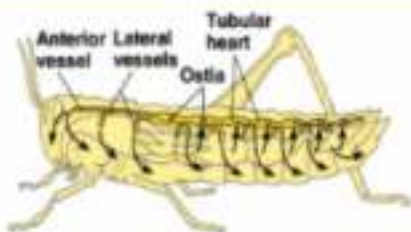
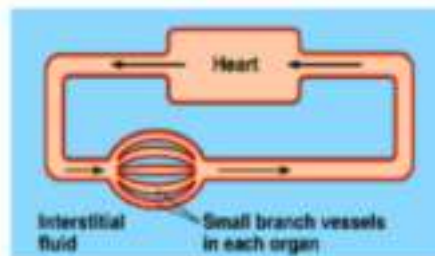
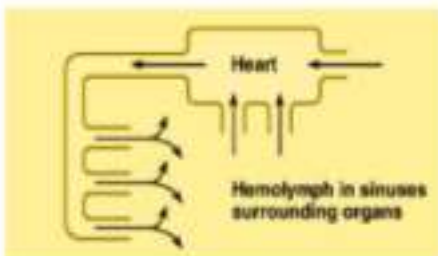
Three types of vessels:

1. arteries (carry blood away from the heart),
2. capillaries (the link between the arteries, the organs and the veins)
3. veins (take blood back to the heart)

- Interstitial Fluid - fluid outside the circulatory system containing nutrients, gases and waste - High pressure, efficient transport suitable for large, active organisms

Open circulatory systems	Closed Circulatory systems
<ul style="list-style-type: none"> <li>- Blood is contained in vessels for some of the time</li> <li>- Blood leaves the vessels to bathe the tissues and then returns to the vessels</li> <li>- Found in invertebrates such as insects, spiders, crabs and snails</li> <li>- Fluid is pumped by a vessel (heart) through short vessels that empty into empty spaces (sinuses) in the body cavity</li> </ul>	<ul style="list-style-type: none"> <li>- Called a closed system because the blood never leaves the vessels although the oxygen and nutrients do.</li> <li>- Found in vertebrates including mammals, birds, reptiles and amphibians</li> </ul>

<ul style="list-style-type: none"> <li>- Transport fluid is called hemolymph (a clear fluid without R.B.C.)</li> <li>- Exchange is by diffusion between the haemolymph and the cells</li> <li>- Haemolymph returns to the heart through small holes</li> <li>- Transport is slow and inefficient as it occurs under low pressure</li> </ul>	<ul style="list-style-type: none"> <li>- Involves a pumping mechanism (heart) with 2, 3 or 4 chambers</li> </ul>
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(a) Open circulatory system

(b) Closed circulatory system

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### Module 3 - Biological Diversity

#### SELECTIVE PRESSURE

- Changes in the environment result in some resources becoming limited and organisms have to compete for these resources.

- Those individuals within a population that have random variations that make them better suited to survive in the changed environment are more likely to survive.
- If the variation has a genetic basis then it will be passed onto offspring.
- Over several generations, only individuals with the variation survive and the population will become different to the original population.
- Selective pressures drive natural selection.

Selective pressures can include:

Abiotic Factors	Biotic Factors
<ul style="list-style-type: none"> <li>- Temperature</li> <li>- light intensity</li> <li>- soil type</li> <li>- water availability</li> </ul>	<ul style="list-style-type: none"> <li>- competition for the same limited resources</li> <li>- predators and availability of prey</li> </ul>

<ul style="list-style-type: none"> <li>- gas availability.</li> </ul>	
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## Adaptation

- a characteristic that makes an organism suited to its' environment
- a random change that is beneficial

Three types:

1. Structural
2. physiological (function)
3. behavioural

## Inferring characteristics of adaptations

- an organism's current characteristics may have been developed a long time ago when the habitats were different
- not all characteristics are adaptations
- without knowing past environments in detail (hard to ascertain from fossil records) it is difficult to suggest adaptations

## Convergent evolution:

is the process whereby organisms not closely related, independently evolve similar traits as a result of having to adapt to similar environments or ecological niches.



<p>Why are keystone species important to the environment?</p>	<p>Certain species that are critical to the survival of other species within the same ecosystem.  → It is the organism that helps hold the system together. → Without keystone species, some ecosystems would be very different as they would not be able to adapt to environmental changes. → ecosystem could come to an end or invasive species could dominate, shifting the ecosystem in a new direction.</p>
<p>Why are keystone species often the focus of conservation efforts?</p>	<p>As if the keystone species disappeared from the ecosystem no other species would be able to fill its ecological niche hence the ecosystem would change and possibly see the introduction of invasive species.</p>

An example of how humans affect the biotic selection pressures in an environment.

biotic selection pressures within an environment. As the land is constantly being exploited, rates of survival and reproduction of various species will experience a decline.

Why do human activities have such far reaching consequences for so many species?

Overpopulation, pollution and deforestation are some of the many human-induced activities that affect the

They damage ecosystems which species are reliant upon for survival for their own benefit. E.g. orangutans in Indonesia become endangered due to humans deforesting to gain palm oil for profit opportunity.

Plant Adaptation	Type of Adaptation	Environmental Factor Adaptation is Suited To	How Adaptation Assists Survival
<p><b>Deciduous trees losing their leaves in Winter</b></p>	<p>Physiological</p>	<p>Very cold environments, water shortages and lower availability of sunlight</p>	<p>Reduce the risk of ice forming with and between their cells.  Deciduous trees lose their leaves and go into a period of dormancy</p>
<p><b>Thick Cuticle Covering Leaves</b></p>	<p>Structural</p>	<p>Excessive sunlight</p>	<p>It has reflective properties to reduce the amount of evaporation, making the epidermal cells waterproof to prevent water loss by evaporation</p>

<p><b>Active Secretion of Salt Deep Root System</b></p>	<p>Physiological</p>	<p>Concentration of salt in any environments such as mangroves</p> <p>Highly salty water supply.</p>	<p>Even in small concentrations the soils water has damaging effects in cell structure and its metabolism. Plants that are adapted to saline environments are called halophytes. Plants can either use salt tolerance (salt accumulation) or salt avoidance (salt exclusion) as strategies to survive in environments where they are exposed to high salt concentrations. Prevents dehydration and helps maintain homeostasis.</p> <p>Able to access water supplies deep underground. The plant will be able to withstand heavy winds and soil erosion will be prevented. Anchor the plant in a windy environment. Obtain water and get nutrients.</p>
<p><b>Sunken Stomata in Hairy Leaves</b></p>	<p>Structural</p>	<p>Moist air and water vapour</p>	<p>Sunken stomata allows moist air to be trapped in the pit, reducing the difference in osmotic pressure outside the stoma and in the leaf. Hairs trap water vapour from transpiration, creating a humid microclimate that reduces transpiration.</p>

Behavioural adaptation in animals	Physiological adaptations in animals:	Structural adaptations of animals:
Red Kangaroo: It rests during the day. Other kangaroos lick their wrists where their blood vessels are close to the	Octopus: secretes ink when threatened to prevent any predators from seeing it	Fennec Fox: has large thin ears that allows cool blood to easily pass through the ears and cool down the fox. A thick

surface with the evaporating saliva having a cooling effect. It takes the heat energy to cause the evaporation. Puffer fish: puff up to scare away predators	escape location. Camouflage helps it match its environment to hide from its predators and prey.	coat keeps them warm at night, furry feet reduces contact between sensitive skin and the hot sand. (lives in the African desert)
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- Endosymbiosis = one organism actually living inside the other
- Mitochondria and Chloroplasts were originally free living bacteria
- Over millions of years of evolution, they have become more specialized and today they cannot live outside the cell.
- They still have their own DNA, a remnant of their original genome.

### Advantages of Being Multicellular

- allows an organism to exceed the size limits imposed by diffusion: single cells with increased size have a decreased surface-to-volume ratio and have difficulty absorbing sufficient nutrients and transporting them throughout the cell. Multicellular organisms thus have the competitive advantages of an increase in size without its limitations.
- They can have longer lifespans as they can continue living when individual cells die. - Multicellularity also permits increasing complexity/specialization by allowing differentiation of cell types within one organism.

### Influence of Selective Pressures

- Presence of increasing levels of O<sub>2</sub> inhibited growth of anaerobes therefore their numbers declined

### Aerobic respiration is more efficient than anaerobic respiration

- more energy available to organisms
- increased complexity and size of organisms (development of multicellular organisms).

### SPECIATION

Speciation is difficult to study since it takes a very long time – it occurs over geological time scales

Speciation is thought to occur mainly by allopatric speciation:

1. A population is divided by a natural barrier (new river, mountain, or other environmental

change.)

2. The two isolated populations accumulate genetic differences over time, eventually they cannot mate together anymore = 2 new species

### sympatric speciation:

1. Two populations that overlap geographically will usually interbreed, stopping speciation 2. Sometimes they will develop an isolating mechanism that stops one group mating with the other, forming two groups

e.g. Queensland fruit flies – both occur in the yellow region

### Developing species can become isolated from each other in a number of ways

1. Geographically: different preferred habitats
2. Temporally (Bactrocera fruit flies)
3. Behaviourally: e.g. a bird not recognizing a slightly different mating call

Speciation does involve natural selection.

When two populations are diverging, individuals who mate with members of the other group (the “wrong” group) usually produce

- less progeny or
- infertile progeny (e.g. mules)
- or “confused” offspring (which mating call do they listen to?)

### Evolutionary change is usually referred to as either:

Microevolutionary	Macroevolutionary
small incremental changes affecting a population within a species	fundamental changes that create significant differences between many species.

## EVOLUTION - THE EVIDENCE

### Biochemical Evidence

This involves comparing the sequence of bases in chemicals found in cells to establish evolutionary relationships.

1. Amino acid sequencing
2. DNA- DNA hybridization
3. DNA sequencing

DNA sequencing is now the most common type of evidence used as it has become cheaper and easier.

### Comparative Anatomy

Homologous Structures	Analogous Structures
<ul style="list-style-type: none"><li>- structures with a similar pattern</li><li>- suggest a common ancestor</li><li>- result from divergent evolution</li></ul>	<ul style="list-style-type: none"><li>- Have similar structure and function</li><li>- Evolved independently</li><li>- Result of convergent evolution</li></ul>

## Vestigial Structures

- Evolutionary remnants of body parts that no longer serve a useful function - Evidence of common ancestry

E.g Tailbone in humans, Pelvic bones in snakes and whales

## Biogeography

- The study of the geographical distribution of organisms
- Following on from Darwin's Theory, species should resemble those that share a similar habitat or that lived in a common area before being split up. Eg: ratite birds & Gondwana

## Wallace's line

- The bird species in North-western Indonesia are most similar to those on the mainland. - The bird species in South-eastern Indonesia are most similar to those on the Australian mainland.
- In earlier times when the water level was higher, these islands remained separated. - These regions are on different tectonic plates and have only recently come together.
- The number of toes that the horses have has changed over time and the body size
- The reduction in the number of toes is an advantage for animals such as the horse as it increases the speed at which the animal runs and therefore have an increased chance of survival in the population
- Mutations and genetic drift has caused genetic variation which contribute to evolution as mutations change the frequency of a gene, which is genetic drift resulting in possible speciation and evolution if a population becomes isolated and reproduces based on these changes to the gene pool.
- Genetic drift: variation in the frequency of different genotypes in a small population with this change as a result of chance-like mutations.

PLATYPUS	HORSE
<ul style="list-style-type: none"><li>● Evolution of platypus is an example of macroevolution</li><li>● Evolution of platypus is significant because it shows that the modern platypus is more specialised than its early ancestors.</li><li>● The fossil record provides evidence for platypus evolution however, it is limited.</li></ul>	<ul style="list-style-type: none"><li>● The evolution of the horse is an example of microevolution</li><li>● The evolution of the horse is significant because it shows a branching nature</li><li>● An extensive fossil record provides evidence</li></ul>

## FOSSIL EVIDENCE

The preserved remains, impressions or traces of organisms found in ice, amber, coal deposits or rock.

## Index Fossils

Also known as an indicator fossil

A commonly found fossil from similar sites for which an absolute age has been determined.

If an Index fossil is found it indicates that the rocks at each site are of a similar age.

## Fossils can be dated using 2 methods

### 1. Relative dating

The sequence in which fossils are laid down in rock reflects the order in which they formed, with the oldest rocks in the lower (bottom) layers.

This is called The Law of Superposition.

Relative Dating: Determines the chronological sequence and is able to show which organisms lived together.

Limitations

- Does not give the actual age
- Sedimentary rock layers can be disturbed by geological events such as uplifting, folding, faulting and earthquakes.

### 2. Absolute Dating

Provides a more accurate estimate of age (not an exact date).

Types: radiometric dating, thermoluminescence and electron spin resonance (ESR).

Radiometric dating	determines the proportion of a radioisotope within a rock sample as radioactive decay
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	occurs at a known rate.
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Electron Spin Resonance (ESR)	Thermoluminescence
<ul style="list-style-type: none"><li>- dates calcium carbonate in limestone, coral, fossil teeth, molluscs and egg shells</li><li>- Used for up to 300,000 yrs</li><li>- Absolute Dating Rock Layers</li></ul>	<ul style="list-style-type: none"><li>- Used for cooking hearths , pottery and fire treated tools up to 500,000 yrs old.</li><li>- the emission of light from an object when heated.</li><li>- The older an object the more light that is emitted.</li><li>- only useful for human evolution</li><li>- destroys the sample</li></ul>

Palaeontology	The study of fossils and all aspects of extinct life
Geology	The study of the origin, history and structure of the Earth as recorded in the rocks.
Why study past environments?	To see the influence of past changes in the environment on the evolution of living things and to infer possible future effects of environmental change on living things.

### Changes in the Distribution of Australian Species

- After Australia separated from Antarctica the continent was covered by closed rainforest ● As the continent moved northwards, the climate became drier and so the area of rainforest shrank, replaced by open forests, woodlands and scrublands, dominated by eucalyptus and acacia
- In semi-arid regions, mulga, tussock and hummock grasses became dominant
- By 2 mya, more than half of the continent was arid desert or semi-arid scrubland
- The record of climate change has been explored in detail at Riversleigh in Queensland.
- Rocks and fossils at this site cover 25 mya to 40 000 years ago.
- They preserve the record of climate change in this region from tropical rainforest to arid for much of the year except during monsoon season.
- Fossils at this site confirm that Australia was covered by broad leaved rainforest

Origins of Australian Flora	Origins of Australian Fauna
<ul style="list-style-type: none"> <li>● Present on the continent when it separated from Gondwana</li> <li>● Migrated from South East Asia to Australia</li> <li>● Introduced species with the arrival of humans</li> </ul> <p>E.g Tree fern from Gondwana, Introduced Bitou Bush</p>	<ul style="list-style-type: none"> <li>● Present on the continent when it separated from Gondwana</li> </ul> <p>Eg: frogs, reptiles, monotremes, marsupials, emus and lyrebird ● Introduced by traders and aborigines ( 4 000 ya) eg: dingoes</p> <ul style="list-style-type: none"> <li>● Introduced by Europeans (120 ya)</li> </ul> <p>eg: horse, fox, rabbit</p> <ul style="list-style-type: none"> <li>● Migrated from Asia when sea levels were low and land bridges were exposed (15 mya and 40 - 30 000 ya) Eg: snakes, rats, mice and bats.</li> </ul>

### Ecological niches

- All the biotic and abiotic resources that a species uses
- An organism's role in an environment
- How an organism uses resources, responds and interacts with other species
- Can be fundamental or realised eg: koalas
- Competitive Exclusion Principle - no two organisms can occupy the same niche in an ecosystem at the same time
- Competition may be intraspecific(within a species) or interspecific(between species) - All species compete for nutrition, shelter and mates
- Predation, competition, symbiosis and disease have consequences for populations.

## Predicting Consequences - food webs

Short-term consequences	When two species compete for a resource, the short-term effect is a decrease in population numbers.
Long-term consequences	If the trend of one species successfully out-competing another species continues, the long periods of decreased reproduction rates and increased deaths will eventually lead to the elimination of the 'losing' species in that area, and on the larger scale possible extinction.

### Possible causes of extinction

Inability to adapt to change, being outcompeted for resources, human activity, mass extinction events

### Contributors of mass extinction

Atmospheric circulation, climate, meteorite impact, volcanism, air temperature, ocean acidification, water oxygen levels, rise in sea level

### The Impact of Biotic Factors

Factors that affect numbers in predator prey populations

Variables that influence population size

- Birth rate
- Death rate
- Immigration rate
- Emigration rate

Growth Rate = (Births + Immigration) - (Deaths + Emigration)

### Symbiosis

- food, protection, cleaning, transportation
- organisms that coexist where at least one benefits
  1. Parasitism → One is benefits the other harmed
  2. Mutualism → Both benefit
  3. Commensalism → one is benefited the other unaffected

### Types of Distribution

Regular, Random, Clumped

### Possible factors that affect numbers of predator prey populations

- Number of predators competing for the same prey
- Availability of prey's food
- Birth rate (time to reach maturity to reproduce, size of litter, no. of reproductive cycles) -
- Death rate
- Number of males and females
- Size of ecosystem
- Movement between ecosystems
- Availability of shelter



## - Human impact

<b>Competition</b>	<ul style="list-style-type: none"><li>- When two or more organisms use a resource in common eg: food, shelter, mates, nesting sites</li><li>- Usually for a resource that is in limited supply</li><li>- May be direct (physical aggression) or indirect (eg:leave scent markers)</li><li>- Can be intraspecific (own species)eg: competition for mates or interspecific (other species) eg: introduced species.</li></ul>
<b>Allelopathy</b>	<ul style="list-style-type: none"><li>- a means by which plants successfully compete with other plants for space</li><li>- Space = more water, more soil, more sunlight</li><li>- chemicals (called allelochemicals) are released by a plant which inhibit the growth and development of surrounding plants</li></ul>

**Ecology** - The study of relationships between different organisms and between organisms and the environment.

- These relationships determine distribution and abundance.
- Population density reflects the total number of organisms the ecosystem can support. - Can identify trends in populations and then predict possible impacts of changes to the ecosystem (natural or through development)

### Sampling techniques for pop. estimation

- Plant populations are relatively easy to count as they are immobile.
- It is difficult to obtain a total count for a mobile population such as that of birds, insects and animals.
- Seasonal and tidal variations also make it difficult to obtain total counts.
- Affected by abiotic and biotic selective pressures

### Sampling Techniques

<b>Transects - Used for plants or immobile animals</b>	<b>Profile Sketch</b>
<p>The red line represents the north/south transect.</p> <p>The yellow line represents the east/west transect.</p> <ul style="list-style-type: none"><li>- Can also do strip transects</li></ul>	<p>The transect diagram illustrates the type of data which is collected using a continuous line transect .</p> <p>This notes every individual which touches the line. The data is displayed in the form of a diagram, using symbols for different species, which are drawn to scale. This is a useful way of being able to clearly visualise what changes are taking place along the line. It enables patterns of zonation in species along the</p>

line to be picked out.

### Quadrats Mark - Release - Recapture (animals)

A quadrat is (usually) a 1m x 1m square used to estimate populations when numbers are too high to count individually.

Use representative areas to estimate the whole population.

A number of random quadrats are counted, averaged and then the percentage coverage of the ecosystem is used to estimate the entire population.

If numbers are too high you can use the % coverage method to estimate.

#### Assumptions

- There is no population change through migration, birth, death between sampling.
- All animals are equally able to be caught/trapped.
- Marked animals are not affected in their ability to move and mix with the remaining population.

#### FUTURE ECOSYSTEMS

- Human impacts on ecosystems
- Hunting
- Overfishing
- Agriculture (habitat destruction)
- Urbanisation (habitat destruction)
- Nest predation
- Introduced species
- Pollution
- Human impacts

#### Threatened with extinction

- 11% of birds
- 18% of mammals
- 5% of fish
- 8% of plants

Approximately 50% of mangrove ecosystems globally have been transformed or destroyed by human activity

## **Human causes of Coral depletion**

Pollution runoff: nitrates from fertilizers, oil spills

Exploitation: Over 90% of saltwater aquarium fish are taken directly from reefs

Increased water temperatures: Global warming, Increased El Nino

Direct destruction: Boats, fishing nets, removal of coral for sale

Invasive species

- With the increase in ease of travel and shipping, one of the greatest threats by human us the introduction of invasive species

Tropical rainforests

- Each year approximately 7.8 million acres of rainforest are destroyed
- 137 species going extinct each day
- The soil is poor with most of the nutrients existing in the trees and pant