**CHAPTER ONE**

**ORGANISMS AND THEIR ENVIRONMENT**

**POPULATION AND POPULATION DENSITY**

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| * Population is the number of living people that live together in the same place. * In biology, a population is all the organisms of the same group or species who live in a particular geographical area and are capable of interbreeding. * Population density is the number of individuals per unit geographical area, for example, number per square meter, per hectare, or per square kilometer. |

**ESTIMATING OF POPULATIONS USING**

1. **QUADRAT METHOD**

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| * A quadrant is a defined area which measures the distribution or number in a population. The size of the quadrant is usually determined by the size of the organisms being counted. The quadrants can be placed randomly in the area and the numbers of organisms in each quadrant is recorded. * Random quadrants are useful to estimate population size of stationary organisms or organisms that do not rapidly move to other areas over long distance. * Quadrant with squares of a fixed area is replaced randomly in an area. The abundance of the organism in that area is counted. Then the size of the whole area is measured and multiplied by the average from the quadrant results. |

**HOW TO ESTIMATE POPULATION OF AN AREA USING QUADRANT METHOD**

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| * Find the area of the quadrant by multiplying its length and width. * Count the total population in each quadrant. * Total population = |

1. **THE CAPTURE MARK RECAPTURE METHOD**

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| This is the method of estimating population size which involves catching a certain number of individuals of a particular species, marking or tagging them in a way in a way that does not affect their life expectancy then releasing them into the wild and after catching another group and counting the number of tagged amongst the recaptured. This method is suited for mobile populations where it is impossible to count all individuals at one time, that is, birds, fish, butterflies. |

1. **TRANSECTS METHOD**

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| A transect line is any line, marked at regular intervals for counting and mapping the number of individuals at different distances along the line.   * A tape or string is laid along the ground in a straight line between two poles as guide to a sampling method used to measure the distribution of organisms. * Sampling is rigorously confined to organisms that are actually touching the line. * Transects are useful as they are used when you wish to illustrate a particular gradient or linear pattern along which communities of plants and or animals change. * They provide a good way of being able to clearly visualize the changes taking place along the line.   **Belt transect**     * It is where quadrants are placed next to each other along the transect to work out species frequency and percentage over along the transect. * Disadvantage of belt transect * It can take a lot of time or lots of people to get a large sample, som,e species may be missed if the sample isn’t large enough. |

**CHAPTER TWO**

**Explain the meaning of the following biological terms**

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| 1. **Primary producers –** These are green plants which are able to make their food by combining carbon dioxide and water in the presence of sunlight energy. 2. **Autotrophs-** These are green plants which are able to produce their own food by combining carbon dioxide and water in the presence of sunlight energy 3. **Consumers-** These are animals that are not able to make their food but depend on already made organic compounds. 4. **Heterotrophs-** These are animals that are not able to make their food but depend on already made organic compounds. 5. **Herbivores-** These are consumers that feed directly on producers/plants.   Examples include goats, cattle, grasshoppers, zebra etc.   1. **Carnivores-** These are consumers/animals that feed on fresh of other animals and examples include lion, leopard, toad, praying mantis, snakes, hawks and owls. 2. **Omnivores-** These are consumers/animals that eat both producers (plants) and fresh of other animals. Examples include human beings, pigs, chicken and cockroaches. |

**What is a food chain?**

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| A food chain is a sequence showing a feeding relationship between producers and consumers. In other words, a food chain is a representation of a feeding relationship between organisms in an ecosystem. |

**IMPORTANCE OF FOOD CHAIN**

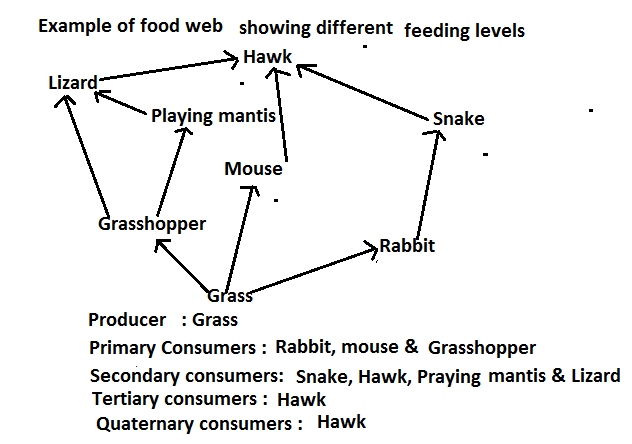
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| A food chain is important as it shows how food energy is transferred from primary producers to the succeeding consumers.  Below is an example of a food chain  Algae small fish catfish man  The arrows show the direction of energy flow and they also mean “eaten by”. For example, in the food chain above, the arrow between the algae and small fish means the algae is eaten by small fish.  When constructing a food chain, always start with the producers, the green plants, followed by consumers.  When studying the food chain it is important to note that the number of organisms, decreases as you move along the food chain from the producers to secondary order consumers, from secondary consumers to third order consumers and from the thirst order consumers to forth order consumers. However, the size organisms from producers to final consumers increase.  Other examples of food chain.  http://ecosystembiology.weebly.com/uploads/1/3/8/0/13806238/food-chain_orig.jpg |

**Explain the meaning of the following feeding levels or trophic levels in a food chain.**

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| 1. **Primary producers-** These are green plants that make their own food by combining carbon dioxide and water in the presence of sunlight energy. 2. **Primary consumers/first order consumers –** These are herbivores that feed on the primary producers 3. **Secondary consumers/second order consumers-** These are animals that fed on primary consumers and be either carnivores or omnivores**.** 4. **Tertiary consumers/third order consumers-** These are carnivores and or omnivores which feed on secondary consumers. 5. **Quarterly consumers/forth order consumers-** These are carnivores or omnivores which feed on tertiary consumers. 6. **Decomposers-** These are microbes that break down dead and decaying matter. Decomposers act on the dead matter of all primary producers, consumers, and even dead decomposers. Decomposers like fungi and bacteria are not allocated to any feeding level. 7. **Detritus-** These are pieces of dead and decomposed matter**.** 8. **Detrivores-** These are organisms that feed on partly decomposed matter. Examples include ants, earthworms, woodlice, fly maggots.   **ATERRESTRIAL FOOD CHAIN**  **http://ecologyofchesapeakebay101.weebly.com/uploads/1/4/4/1/14419382/4893641_orig.jpg?1** |

**FOOD WEB**

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| A food web is the interconnection of several food chains in an ecosystem. It shows a feeding relationship among several species in a natural habitat.  In a natural habitat, there could be several primary producers which are eaten up by more herbivores (primary consumers). Carnivores too feed on more than one animal of prey. |



**What would happen to the population of grass and hawk if all the rabbits were wiped from the habitat because of a disease in the food web constructed above?**

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| The population of grass will increase because number of organisms feeding grass has be reduced by the death of rabbits while the number of hawks will decrease because of starvation due to the decrease of their food by the death of rabbits, |

**ECOSYSTEM**

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| Ecosystem is defined as a community made up of living organisms and non living organisms such as air, water and mineral salts all interacting as a system. In other words, an ecosystem is a complex network of interaction between biotic and abiotic components of a particular location. |

**COMPONENTS OF ECOSYSTEM**

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| Components of ecosystem are  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\ecology-and-ecosystem-new-12-638.jpg  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\COMPONENTS-OF-ECOSYSTEM-class-12-inner-2.jpg**   1. **Abiotic components**   These are all of the non living elements or non organic aspects of the environment (physical environment) that determine what life forms can thrive. They mainly take up the role of life supporter. They determine and restrict the population growth, number, and diversity of biotic factors. Hence they are called limiting factors.  Without the abiotic component, organisms cannot live or survive  Examples of abiotic components are water, the air, the temperature, average humidity, topography and natural disturbances (such as tsunamis, lightning storms, hurricanes and forest fires) and the rocks and the minerals that make up the soil.  Abiotic components are classified into two   1. **Climatic factors**   These include rain, light, wind, temperature , humidity, air etc   1. **Edaphic factors**   These include soil, pH, minerals, topography etc   1. **Biotic components**   The biotic components of an ecosystem refer to all living organisms that have a direct or indirect influence on other organisms in an environment or in ecology. They are the life forms that inhabit it. The life forms of an ecosystem aid in the transfer of energy. They are grouped in terms of the means they use to get energy  Biotic factors can be classified into three main categories   1. **Producers**   These include all autotrophs that make their own food using light energy Examples include green plants, green algae.   1. **Consumers**   These include all heterotrophs that directly or indirectly depend on producers for their food.  Consumers are further categorized as   1. **Herbivores/first order consumers**   These are animal species that feed on plants or primary producers eg cattle, goats, zebra, rabbits, grasshoppers etc.   1. **Carnivores/secondary order consumers**   These are animals that feed on herbivores and examples are rats, foxes   1. **Omnivores/tertiary consumers**   These are third order consumers that feed on secondary consumers. Examples snake, owls, wolves.   1. **Quaternary consumer**   These are last order consumers and they are considered the largest carnivores. They feed on primary, secondary and tertiary consumers. They are animals with little or without natural enemies.   1. **Decomposers**   These include saprophytes which can act on dead matter and decay them for their nutrition. These are responsible for breaking down dead organic matter. Examples include fungi and bacteria.  Biotic and abiotic components interact with each other resulting in transfer and replenishment of energy and nutrients. Biotic elements like plants provide food for other organisms. The soil is the abiotic element which supports the growth of the plants by providing nutrients and other essential elements. |

**ENERGY FLOW IN A FOOD CHAIN**

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| The energy flow from one level to another level in a food chain gives the trophic level of an ecosystem. The producers come at first trophic level followed by herbivores (primary consumers) then small carnivores (secondary consumers) and large carnivores (tertiary consumers) occupy the fourth trophic level.  A tropical level is a hierarchical level in an ecosystem. Each trophic level includes organisms that work through the food chain to gain and lose differing levels of energy. |

**PYRAMID OF NUMBERS**

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| A pyramid of numbers is a graphical representation that shows the number of organisms at each trophic level. It shows the number of individuals at different trophic levels of food chain. It is an upright in the light of the fact that in an ecosystem, the producers are always more in number than other trophic levels.  The pyramid of numbers was advanced by Charles Elton in 1927. Charles pointed out the huge difference in the number of organisms involved in each level of the food chain. Succeeding links of the trophic structure reduce rapidly in number until there are a very small number of carnivores at the top.  Examples of pyramid of numbers are  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\pyramid-of-number.jpg  The reason for the pyramid shape is that there must be enough plants to produce food at the bottom. Otherwise, the entire food chain would collapse. At the higher level, no predator can be as common as its prey.  Below is the diagram showing the pyramid of numbers that is constructed using 10,000 clovers which are eaten by 50 snails which in turn are eaten by 20 Thrush which are eaten by 5 Sparrow hawk.  **`**http://1.bp.blogspot.com/-M-OLXxws82I/UyljCi2eHqI/AAAAAAAAC_E/puf3Vht8dNo/s1600/pyramid+of+numbers.gif  **Importance of pyramid of numbers**  It is used as the basis for ecosystems quantitative analysis in that it helps to estimate how the population of a given species can affect others. |

**PYRAMID OF BIOMASS**

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| * It is a graphical representation of the relative amount of biomass at each trophic level of the ecological system. It indicates decrease of biomass in each trophic level from base to apex of the pyramid. * The pyramid of biomass is a diagram showing the total mass of organism at each trophic level in an environment. * Biomass refers to the quantity of matter in organisms (number of individual’s x mass of each individual). * When constructing the pyramid of biomass, the amount of mass is found by drying the organisms to remove all the water and then weighing it. Primary producers have the highest biomass followed by primary consumers, then secondary consumers, tertiary and lastly the quaternary consumers. This makes it easier to draw the pyramid of biomass to scale. * There is a decrease in the biomass of organisms and an increase in the size of organism as one moves from the primary producer to quaternary consumer in the pyramid of biomass. * Below is the diagram showing the pyramid of biomass constructed using 2 trees which is eaten by 400 caterpillars and eaten by 100 birds which are later eaten by 4 hawks in an ecosystem.   http://4.bp.blogspot.com/-j8pykg1W-KA/VdiMlTSVTaI/AAAAAAAAJws/82Fgf4NoWgE/s1600/pyramid-number-and-biomass.png  The lowest level of this pyramid is occupied by producer and the top of the pyramid is occupied by carnivores.  A pyramid of biomass is constructed by collecting all organisms occupying each trophic level separately and measuring their dry weight. |

**PYRAMID OF ENERGY**

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| Pyramid of energy is a graphical representation of the rates of flow of energy through the different trophic levels of an ecosystem.  **Explain how energy is lost as you move from one trophic level to the next.**   * In any food chain, there is energy transfer from one trophic level to the next. Usually the source of energy, the sun is not included in the food chains. * The sunlight energy is absorbed by green plants which convert it to a chemical energy. The chemical energy is available in the form of food substance such as glucose, starch, cellulose, lipids and proteins. When the herbivores consume plants, the energy to them, and when they are consumed by carnivores the energy is transferred to carnivores. * As you move from one trophic level to the next energy trophic level available energy decreases. There is 90% energy loss, that means only 10% is available to the next trophic level. This is so because not all the energy from the sun is captured by the plant. Only a small portion of light energy is captured by the plants, while the rest is wasted in the following ways  1. Some is reflected from the plant leaf surfaces 2. Some passes straight through the leaf 3. Some is lost in photosynthesis reactions.  * Not all the energy available in the primary producer is transferred to the primary consumers and succeeding consumers because of the following reasons:  1. Much of the plant lignin and cellulose is not digested by the herbivores 2. The primary consumer may not necessarily eat the whole plant, rots and stems may not be eaten up.   The primary consumer loses some energy through respiration and some is lost in excretion in form of urine and dung. Some of the energy is used in locomotion  Example of pyramid of energy  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\unnamed.jpg  Each bar of the pyramid represents the amount of energy per unit area or volume through that trophic level in a given time period. The different trophic levels represent groups of organisms that might compose a food chain. From the bottom-up, they are as follow:   1. **Producers** bring energy from non living sources into the community. 2. **Primary consumer-** Eat the producers 3. **Secondary Consumers-** Eat the primary producers 4. **Tertiary consumers**- Eats the secondary consumers   Energy pyramid shows that energy decreases as one moves through the trophic levels from the bottom to the top of the pyramid. Thus, the energy pyramid is always upward.    **Importance of pyramid of energy**  It shows the total energy flow |

**LIMITATIONS OF ECOLOGICAL PYRAMIDS**

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| 1. It does not accommodate a food web. 2. Saprophytes are not given any place in the ecological pyramid even though they play an important role in the ecosystem. 3. It assumes a simple food chain something that almost never exists in nature. 4. It never takes into account the same species belonging to two or more trophic levels. |

**NUTRIENT CYCLES IN AN ECOSYSTEM**

**CARBON CYCLE**

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**CARBON CYCLE PROCESSES**

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| During carbon cycle   * Carbon moves from the atmosphere to plants in form of carbon dioxide through the process of photosynthesis through stomata. Carbon is used to produce food in the plant. * Carbon moves from the plants to animals through the food chains. The carbon that is in the plants moves to the animals that eat them. The animals that eat other animals get carbon from their food too. * Carbon moves from plants and animals to the soils when they die. During decomposition of the dead bodies, carbon is released into the soil. * Carbon moves from the living things to the atmosphere during exhalation or during respiration. * Carbon moves from the fossil fuels to the atmosphere when fuels are burned. * The carbon from the atmosphere may dissolve in seawater or oceans. |
| **NITROGEN CYCLE**  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\Nitrogen-cycle-11-700x593 (1).png  Nitrogen cycle is a biogeochemical process which transforms the inert nitrogen present in the atmosphere to a more usable form for living organisms.  It involves several processes such as nitrogen fixation, nitrification, denitrification, decay and putrefaction.  The nitrogen gas exists in both organic and inorganic forms. Organic nitrogen exists in living organisms and they get passed through the food chain by the consumption of other living organisms.  **Inorganic forms of nitrogen** are found in abundance in the atmosphere. This nitrogen is made available to plants by symbiotic bacteria which can convert the inert nitrogen into a usable form- such as **nitrates and nitrites**.  **STAGES OF NITROGEN CYCLE**  **Process of Nitrogen Cycle consists of the following steps**   1. **Nitrogen Fixation**   It is the initial step of the nitrogen cycle. Atmospheric nitrogen cycle (N2) which is primarily available in an inert form is converted into usable form -ammonia (NH3).  During the process of Nitrogen fixation, the inert form of nitrogen gas is deposited into soils from the atmosphere and surface waters, mainly through precipitation. Later, the nitrogen undergoes a set of changes, in which two nitrogen atoms get separated and combines with hydrogen to form ammonia (NH4+).  The entire process of Nitrogen fixation is completed by symbiotic bacteria which are known as Diazotrophs. Azotobacter and Rhizobium also have a major role in this process. These bacteria consists of a nitogenase enzyme which has the capability to combine gaseous nitrogen with hydrogen to form ammonia.  Nitogen fixation can occur either by   1. **The atmospheric fixation** -which involves lightening or industrial fixation by manufacturing ammonia under high temperature and pressure condition. 2. Man -made processes primarily industrial processes that create ammonia and nitrogen rich fertilizers.   **Types of Nitrogen Fixation**  The following are three ways how nitrogen can be fixed to be useful for living things   1. **Atmospheric fixation/through lighting**   This is a natural phenomenon where the energy of lightening breaks the nitrogen oxides and is then used by plants.  In other words, lightning converts atmospheric nitrogen into ammonia and nitrate that enter soil with rainfall.   1. **Industrial nitrogen fixation**   It is a man-made alternative that aids in nitrogen fixation by the use of ammonia. Ammonia is produced by the direct combination of nitrogen and hydrogen, and later, it is converted into various fertilizers such as urea.   1. **Biological nitrogen fixation.**   This is where bacteria like Rhizobium (single-celled prokaryotes) and blue-green algae transform the unusable form of nitrogen into other compounds that are more readily usable. Nitrogen -fixing microorganisms capture atmospheric nitrogen by converting it to ammonia which can be taken up by plants and used to make organic molecules. The nitrogen -containing molecules are passed to animals when the plants are eaten. They may be incorporated into animal’s body or broken down and excreted as waste such as urea found in urine. These nitrogen compounds get fixed in the soil by these microbes.   1. **Nitrification**   In this process, the ammonia is converted into nitrate by the presence of bacteria in the soil**.** Nitrites are formed by oxidation of ammonia with the help of nitrosomonas bacterium species. Later, the produced nitrites are converted into nitrates by Nitrobacteria. This conversion is very important as ammonia gas is toxic for plants. Compounds such as nitrates, ammonia and nitrite can be taken up from the soils by plants and then used in the formation of plant and animal proteins.   1. **Assimilation**   Primary producers- plants take in nitrogen compounds from the soil with the help of their roots, which are available in the form of ammonium ions and are used in the formation of the plant and animal proteins. This way, it enters the food web when the primary consumers eat the plants.   1. **Ammonification/decomposition**   When plants or animal die, the nitrogen present in the organic matter is released back into the soil. The decomposers, namely bacteria or fungi present in the soil, convert the organic matter back into ammonium. This process of decomposition produces ammonia which is further used for other biological processes.   1. **Denitrification**   It is the process in which the nitrogen compounds makes its way back into the atmosphere by converting nitrate into gaseous nitrogen. This process of the Nitrogen cycle is the final stage and occurs in the absence of oxygen**.**  Denitrification is carried out by the denitrifying bacterial species Clostridium and Pseudomonas, which will process nitrate to gain oxygen and gives out free nitrogen gas as a byproduct. | |

**IMPORTANCE OF NITROGEN CYCLE**

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| 1. It helps plants to synthesise chlorophyll from the nitrogen compounds 2. It helps in converting inert gas into a usable form for the plants through the biochemical process. 3. In the process of ammonification, the bacteria help in decomposing the animal and plant matter, which is indirectly, helps to clean up the environment. 4. Nitrates and nitrites are released into the soil which helps in enriching the soil with necessary nutrients required for cultivation. 5. Nitrogen is an integral component of the cell and it forms many crucial compounds and important biomolecules. |

**ENVIRONMENTAL IMPACTS OF NITROGEN COMPOUNDS**

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| 1. Increased nitrogen inputs into the soil have led to a lots more food being produced to feed more people- known as the green revolution. 2. Nitrogen in excess of plant demand can leach from soils into waterways. The nitrogen enrichment contributes to eutrophication. 3. It can lead to global warming when the nitrification and denitrification processes are not completed. |

**CHAPTER THREE**

**PLANT STRUCTURE AND FUNCTION**

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| **The roots**   * The roots absorb water and mineral salts from the soil and anchor the plant in the ground.   **The stem**   * The stem supports the plant above the ground and carries the water and minerals to the leaves.   **The leaves**   * Its main functions of the leaves are **photosynthesis** and **gas exchange**. * A Leaf is often **flat**, so it absorbs the most light and **thin** so that the sunlight can get to the chloroplasts in the cells. * Most leaves have **stomata** which open and close. They regulate **carbon dioxide, oxygen** and **water vapour** exchange with the atmosphere.   C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\f3c46fa5c553fa3946fd4f684b7b2f27.jpgC:\Users\new\Desktop\DOWNLOADS\plant-structures.jpg |

**COMPARISON OF MONOCOTS AND DICOTS**

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| **Meaning** | Plants with the seed having only one cotelydon are called as monocots and the plant is called as monocotyledonos | Plants with the seed having two cotyledons are called as dicots and plant is dicotyledons. |
| **Embryo** | Contains one cotyledon | Contains two cotyledons |
| **Flower parts** | The flower parts are present in multiples of three | The flower parts are present in multiples of four or five |
| **Pollen** | Pollen tube contain single pore | Pollen tube has three or more or furrow |
| **Leaves** | The venation of the leaves is parallel | There is the net-like or intersecting type of venation present in the leaf |
| **Stem** | Vascular bundles in the stem are scattered throughout | Vascular bndles in stems are arranged in a ring-like pattern |
| **Woody/Herbaceous** | They are herbaceous | They are both woody as well herbaceous |
| **Examples** | Sugarcane, banana tree, millets, wheat | Tomatoes, lettuce, beans, peas etc |

**INTERNAL STRUCTURE OF THE DICOT STEM**

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| The dicot roots have their xylem in the centre of the root and phloem outside the xylem  The vascular bundles in dicots are arranged in a ring around a central portion of the ground tissues called the pith as shown below  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\biologyanatomy-of-flowering-plantsinternal-structure-of-stems-roots-and-leaves_12.jpg  **Epidermis**  The Internal structure of a typical dicot stem shows the following features:   1. **Epidermis**  * Epidermis is the outermost layer of the stem * It is single layered and lack of chloroplast * Multicellular hairs and stomata are found on epidermis * Outer side of epidermis layer is present which is made up of cutin and is called cuticle. * Epidermis plays a significant role in protection. The diagram below shows the upper epidermis and lower epidermis of the leaf.   C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\biologyanatomy-of-flowering-plantsinternal-structure-of-stems-roots-and-leaves_0.jpg   * The function of the epidermis is that it protects the inner tissues The epidermal layer of the root has no waterproof cuticle as this would prevent the absorption of water. This allows water to be taken up by the root.  1. **Cortex**   In dicotyledonous stem cortex is divided into three parts:  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\biologyanatomy-of-flowering-plantsinternal-structure-of-stems-roots-and-leaves_2.jpg  Functions of the cortex   * It is used for transportation of the materials into the central cylinder of the root through diffusion. * It is used for food storage in the form of starch. * It is responsible for transportation of water and salts from the root hairs to the centre of the root.  1. **Hypodermis**- It is present just below epidermis. Its function is to provide additional support to epidermis. It is also composed of collenchymas and the cells contain chloroplast. So hypodermis is green and photosynthetic 2. **General cortex**. It is composed of parenchyma and the inner most layer of cortex is called endodermis. Its main function is to store food. 3. **Endodermis/starch sheath.** They are barrel shaped. These cells accumulate more starch in stem of dicot. It is a single celled thick layer.   The function of endodermis is to stores food   1. **Pericycle**   This layer is situated in between the endodermis and vascular bundles. It is made up of aclerenchyma and the remaining is composed of parenchyma. The pericycle of   1. **Vascular Bundle**   The vascular bundles arranged in a ring. Each vascular is made up of phloem, cambium and xylem.   1. **Pith**   This is well developed region spreading from ring of vascular bundle to the centre. The cells of this region mainly made up of parenchyma  Function of pith- Storage of water and food. |

**TRANSVERSE-SECTION OF THE DICOT STEM**

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| The transverse section of the dicot stem shows the following features  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\c69f4028be057deda5ae8b82c8728530.gif  The arrangement of vascular bundles in the dicot stem is they form the ring in the diagram above.  **Descriptions of parts of the dicot stem**   1. Epidermis is the outermost single layered covering of stem having no intercellular spaces. It is covered by cuticle to reduce transpiration. 2. In dicot stem, Vascular bundles are arranged in a ring with pith concentrated at the core of the stem rather than being scattered throughout the plant interior. 3. In each vascular bundle, the xylem and phloem are separated by a substance called vascular cambium. 4. Conjoint, collateral end arch and open vascular bundles 5. Ground tissue is differentiated into cortex, endodermis, pericycyle and pith. The cortex provides mechanical strength. 6. 3 to 6 layer of collenchymas tissues present in hypodermis. |

**FUNCTIONS OF THE INTERNAL PARTS OF THE DICOT STEM**

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| The diagram below shows the transverse section of the dicot stem  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\biologyanatomy-of-flowering-plantsinternal-structure-of-stems-roots-and-leaves_12.jpg  **What are the functions of the following parts of the dicot stem?**  The following are the functions of the parts of the dicot stems   1. **Phloem-** It is used for translocation i.e. Transports sugars from photosynthetic leaf cells to sink tissues. In other words, it transports dissolved nutrients in all directions within the plants. 2. **Xylem-** It transports water and mineral s from the roots upward and throughout the plant 3. **Vascular cambium**- It is responsible for the secondary growth of plants. It helps in the formation of new phloem tissues and xylem tissues 4. **Pith**- Storage of water and food. In other words, it stores and transport nutrients throughout the plant 5. **Epidermis**- It protects the stem against water loss, it regulates gas exchange, secretes metabolic compounds**.** 6. **Pericycle-** The function of pericycle cells of vascular plants is to provide support, structure and protection for the plant.   The pericycle cells surround the xylem and phloem in the stem and help to hold the plant upright allowing it to growth.   1. **Vascular bundles**- Transport critical substances to various parts of the plant. Vascular bundles are made up of xylem, phloem and cambium. Xylem transports water and nutrients while phloem transports organic molecules or manufactured food to the storage organs or where it is used. Vascular cambium is involved in plant growth. |

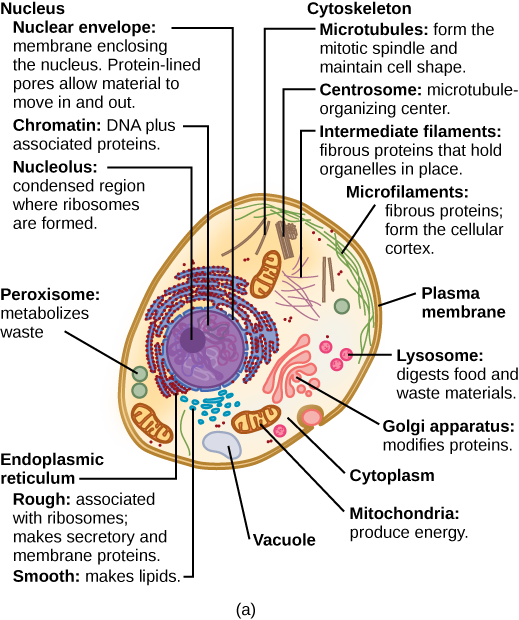
**TRANSVERSE SECTION OF THE MONOCOT STEM**

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| The following diagrams represent monocotyledons stem  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\biologyanatomy-of-flowering-plantsinternal-structure-of-stems-roots-and-leaves_11.jpg**  The vascular bundles in monocots are arranged in scattered bundles throughout the cortex.  **Functions of the epidermis ,vascular bundles, phloem, xylem and ground tissues:**  **Epidermis**  Protect the inner tissues  **Vascular bundles -** Vascular bundle consists of two kinds of cells   1. Xylem which transport water and mineral salts to the leaf. 2. Phloem which transport manufactured food substances from the leaf to other parts of the plant.   The diagram below shows the vascular bundle  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\dicotstem.gif   * The prime function of vascular bundle is the conduction of water and food materials in the primary growth stage of plants.   **Vascular cambium**   * This produces secondary phloem and xylem through cell which increases the diameter of the stem. It helps in the formation of new phloem tissues and xylem tissues   **Phloem**   * It is used for translocation i.e. Transports sugars from photosynthetic leaf cells to sink tissues. In other words, it transports dissolved nutrients in all directions within the plants   **Xylem**   * It transports water and mineral s from the roots upward and throughout the plant   **Ground tissue**   * It transports water from the root hairs to the xylem * It stores starch |

**PLANT CELL AND AIMAL CELL**

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| The cell is the basic unit of all organisms.  The major components of cells include cell wall, cell membrane, chloroplasts, mitochondria, vacuole, cytoplasm and nucleus as shown in the diagrams below.  Animal cell    Plant cell  http://1.bp.blogspot.com/_ATZV16R8qIg/TIDW5kP4E7I/AAAAAAAAABU/Bk9Efs0ndvM/s1600/plant.PNG   * A cell wall is permeable membrane which gives support and shape to a plant cell * Chloroplasts are sites for photosynthesis * Mitochondria are sites for respiration * A nucleus controls activities of the cell. |

**PLANT CELL AND ITS DIFFERENT STRUCTURES**



**PARTS OF THE CELL SEEN UNDER IGHT MICROSCOPE AND THEIR FUNCTIONS**

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| **PARTS** | **FUNCTION** |
| **Cell membrane** | It controls which substances can pass in and out of the cell  It holds the cell content together. |
| **Nucleus** | It controls cell activities |
| **Cytoplasm** | It is a place where activities necessary for life occurs |
| **Cell wall** | It gives support and definite shape to plant cells |
| **Vacuole** | It contains a watery solution known as cell sap that consists of water, mineral salts, sugars and amino acids, which the cell needs to keep the cell firm or turgid.  It has enzymes which speed up the rate of respiration. |
| **Chloroplasts** | It contains a green pigment known as chlorophyll which absorbs sunlight energy necessary for photosynthesis process |
| **Mitochondria** | It is a site for respiration process. It is adapted for this function because it is highly flooded to provide large surface area for chemical reaction. |
| **Ribosome’s** | Manufactures proteins |
| **Endoplasmic reticulum** | Two types  Rough ER- covered with ribosome  Smooth ER- does not have ribosomes |

**PHOTOSYNTHESIS**

**THE EXTERNAL PART OF THE LEAF**

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**FUNCTIONS OF THE LEAVES TO PLANTS**

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| 1. For photosynthesis- to absorb light energy and carbon dioxide to produce glucose (food) 2. Leaves are involved in gas exchange. Carbon dioxide enters the leaf and oxygen and water vapour leave the plant through the stomata. |

**FUNCTIONS AND THEIR ADAPTATIONS OF THE PARTS OF THE CROSS-SECTION OF THE TYPICAL THE LEAF.**

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| C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\1200px-Leaf_anatomy.svg.png  Cuticle  Functions of the cuticle   * It is a waxy layer that prevents water loss by evaporation. * It is transparent and very thin to allow maximum light penetration.   **Adaptation for photosynthesis**  It is adapted for photosynthesis because it is transparent and very thin to allow maximum light penetration   1. **Upper epidermis**   Functions of the upper epidermis   * It produces cuticle that reduces excessive loss of water through evaporation. * It protects internal parts of the leaf   **Adaptation for photosynthesis**  It is adapted for photosynthesis because it is transparent and very thin to allow maximum light penetration   1. **Palisade mesophyll cells**   **Function of the palisade mesophyll cells**  It is the site for photosynthesis process. The palisade mesophyll cells consists of chloroplasts with chlorophyll that absorb the light energy  **Adaptations for photosynthesis**   1. Are packed with large number of chloroplasts for photosynthesis. Chloroplasts are found near the palisade cell surface to maximize light absorption and to reduce the distance that carbon dioxide and oxygen have to diffuse to and from the chloroplast stoma. 2. They have large vacuoles and restrict chloroplasts to a layer near the outside of the cell where they can be reached by light more easily. 3. They are upright elongated and tightly packed in order to increase the surface area for light absorption 4. **Spongy mesophyll cell**   **Function of the spongy mesophyll cells**  They are site for photosynthesis process. These cells are found in the lower part of the leaf.  **Adaptations of the spongy mesophyll cells for photosynthesis**   * They contain few chloroplasts that absorb light energy for photosynthesis to take place * They are loosely packed hence containing large air spaces between them that allow carbon dioxide and oxygen to diffuse between them. The air spaces give these cells a large surface area to maximize the diffusion of carbon dioxide into the cell and oxygen out of the leaf.  1. **midrib vein**   **These consist of xylem and phloem.**  Xylem vessels carry water from the roots to the chloroplasts in the leaves while phloem transport dissolved nutrients such as sugarproduced by photosynthesis away from these cells to the rest of the plant.   1. Lower epidermis   This is a protective layer of cells and hence produces a waxy cuticle.  The lower epidermis contains pores called stomata that allow carbon dioxide and oxygen to move in and out of the plant respectively.   1. **Stomata-** gas exchange into and out of the leaf.   Plants obtain the gases they need through their leaves. They require oxygen for respiration and carbon dioxide for photosynthesis. The gases diffuse into the intercellular spaces of the leaf through pores which are normally on the underside of the leaf-stomata.    The stomata consist of the minute pores called stoma surrounded by a pair of guard cells.  The function of the guard cells is to control the opening and closing of the stoma.  The guard cells tough, flexible and thinner.  **Differences between the guard cells and epidermal cells**   |  |  | | --- | --- | | Guard cells | Epidermal cells | | They are bean-shaped cells surrounding the stomata | They are not bean-shaped | | They contain chloroplasts | They do not contain chloroplasts |   C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\small (1).png  The opening and closing of the stoma depend against the turgor pressure caused by the osmotic flow of water in the guard cells. When the guard cells are expanded, the stomata open and close, when the guard cells lose water.  Stomata normally open when the light strikes the leaf and close during the night.  **Functions of the stomata**   1. Helps in the exchange of gases by opening and closing the pores in the leaves 2. It helps to expel the excess water out from the leaves in the form of water vapor. 3. It allows the uptake of carbon dioxide and give out oxygen during the process of photosynthesis. 4. Based on the weather conditions, it closes or opens its pores to maintain the moisture balance 5. Stomata remain open during the day and closed at night. This closure prevents water from escaping through open pores.   **There are usually fewer stomata found on the upper surface of a leaf. Suggest why this is beneficial to a plant**  This is to reduce the evaporation of water from the plant. Plants have more stomata on the lower epidermis as compared to the upper |

**Adaptations of the leaf for photosynthesis**

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| 1. **They are broad-** The leaves have a large surface area so that more light hits them 2. **The upper epidermis of the leaf**- It is transparent allowing light to enter the leaf 3. **The palisade mesophyll cells**- contain many chloroplasts which allow light to be converted into energy by leaf 4. **The air spaces** in the spongy mesophyll cells allow better diffusion of carbon dioxide into the leaf 5. **Epidermis** to reduce loss of water through evaporation |

**STAGES OF PHOTOSYNTHESIS PROCESS**

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| The photosynthesis process occurs in two stages, light -dependent reactions and the Calvin cycle reactions (light -independent/carbon/dark stage).  Light -dependent stage takes place in the thylakoid membrane or grana of the chloroplast. The diagram below shows the thylakoid where the light dependent stage occurs.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\figure-08-01-05.png  During light -dependent stage, green plants use their chlorophyll to absorb light energy from sunlight. This light energy from sunlight splits water molecules to produce oxygen atoms, hydrogen atoms and ATP (Adenosine Triphosphate that carry energy) in the process known as photolysis. Both hydrogen and ATP are transferred to the second stage of photosynthesis. Some of the oxygen can be used by the mitochondria of plant cells for aerobic respiration. Most oxygen diffuses out of plant cells and out of the leaves through the stomata. The overall effect of photosynthesis is to increase the concentration of oxygen in the earth’s atmosphere.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\small (1).png  Dark stage/carbon fixation  This stage requires energy which is supplied by the ATP made by the light reactions. The ATP is broken down to release energy which is used to combine hydrogen from the light reactions with carbon dioxide and enzymes to produce sugar. The overall process of carbon fixation is summarized in the diagram below  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\small (2).png |

**Importance of photosynthesis process**

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| 1. Plants and other photosynthetic organism form the base of nearly all food chains. 2. Green plants and trees use photosynthesis to make their food from sunlight, carbon dioxide and water in the atmosphere. It is their primary energy. 3. The importance of photosynthesis in our life is the oxygen it produces. Without photosynthesis there would be little to no oxygen on the planet. Organisms require oxygen for respiration reaction. 4. Reduction of carbon dioxide**-** During photosynthesis carbon dioxide leaves the atmosphere and enters the plant and leaves as oxygen. This helps to reduce global warming 5. Food production- Green Plants that carry photosynthesis provide food directly or indirectly for almost all other living things on earth. 6. It helps in industrial activities. 7. During photosynthesis, plants store light energy as chemical energy. Some animals use the chemical energy when they eat plants. Other animals get energy from plants indirectly. |

**ADAPTATIONS OF THE LEAF FOR PHOTOSYNTHESIS**

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| C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\CROSS-SECTION OF THE LEAF.png   * Leaves are broad which makes them to large surface area to absorb light energy from sunlight. * The upper epidermis of the leaf is transparent allowing light to enter the leaf. It allows more light to reach the palisade cells below. * The cells of the palisade layer are neatly packed in rows in order to fit more cells in. * The palisade cells contain many chloroplasts which allow more light to be converted into energy by the leaf. * Spongy mesophyll has large air spaces. The air spaces allow better diffusion of gases to and from the photosynthesizing cells. * The leaf contains stomata which allow carbon dioxide into the leaf and oxygen out. * The air spaces inside the leaf give a large surface area to volume ratio that allows maximum absorption of gases. * The leaf is coated in a waxy cuticle which stops the water vapour escaping through epidermis so that water is used photosynthesis process. * The leaves are thin which provides short distance for carbon dioxide to diffuse into the leaf cells. * The leaves contain network of veins which support the leaves and transport water, mineral ions and sucrose(sugar) * The petiole of the leaf holds it somewhat outward so that it can come into contact with pure air and proper sunlight. * The cuticle - is non-cellular, thin, water proof and transparent. It allows light to pass through while protecting the leaf. |

**Explain the following importance of the adaptation of the leaves for photosynthesis.**

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| 1. **Large surface area-** to maximize light harvesting or to absorb more light energy. 2. **Thin-** to reduce distance for carbon dioxide to diffuse through the leaf and to ensure light penetrates into the middle of the leaf. 3. **Air spaces- to reduce distance for carbon dioxide to diffuse and to increase the surface area of the gas exchange surface inside the leaf.** 4. **Stomata-** pores to allow carbon dioxide to diffuse into the leaf and water to evaporate out(transpiration) 5. **Presence of veins-** veins contains xylem tissue which carries water and minerals and phloem which transport sugars and amino acids away from the leaf**.** 6. **Chloroplasts -** mesophyll cells and guard cells contain many chloroplasts that contain chlorophyll which absorb light energy to allow reactions of photosynthesis occur. 7. **Epidermis is thin and transparent-** To allow more light to reach palisade cells 8. **Thin cuticle made of wax-** To protect the leaf from infection and prevent water loss without blocking out light**.** 9. **Palisade cell layer at the top of the leaf-** To absorb more light and increase the rate of photosynthesis |

**ADAPTATIONS OF PLANTS TO EXTREME ENVIRONMENTS**

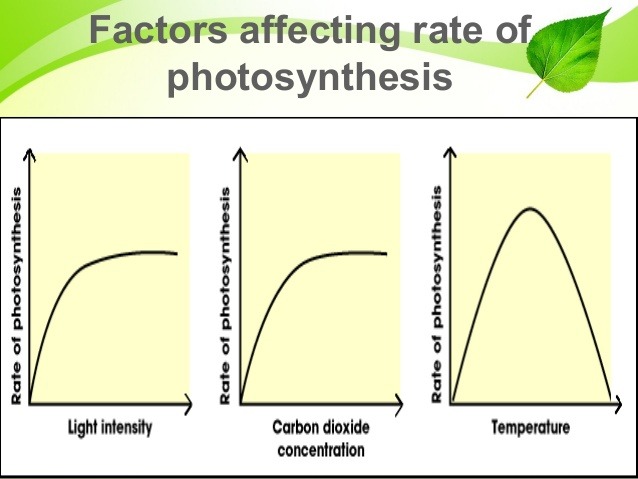
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| Deserts plants  Te figure below shows Cacti that grows in the desert  **C:\Users\new\Desktop\HARRY DOWNLOAD\p04w2qgs.jpg**  Cacti are well adapted for survival in the desert. They have   1. Stems that can store water 2. Widespread or very deep root systems that can collect water from a large surface area ro from very deep underground. 3. Spines which are modified leaves. These minimize the surface area and so reduce water loss. The spines also protect the cacti from animals that might eat them. 4. Very thick, waxy cuticle to reduce water loss by evaporation. 5. Reduced number of stomata to reduce water loss by transpiration**.** |

**Describe the relationship between photosynthesis and respiration.**

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| Photosynthesis makes the glucose that is used in cellular respiration to make ATP. The glucose is then turned back into carbon dioxide which is used in photosynthesis. While water is broken down to form oxygen during photosynthesis, in cellular respiration oxygen is combined with hydrogen to form water. |

**REQUIREMENTS FOR THE PHOTOSYNTHESIS PROCESS**

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| The photosynthesis requires the following things   1. Chlorophyll 2. Sunlight 3. Water 4. Carbon dioxide 5. Enzymes that catalyse the photosynthetic reactions |



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| The main factors affecting rate of photosynthesis are light intensity, carbon dioxide concentration and temperature.  **Light intensity**  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\small (1).pngC:\Users\new\Desktop\DOWNLOADS\small (15).png**  Without enough light intensity, a plant cannot photosynthesize very quickly even if there is plenty of water and carbon dioxide and a suitable temperature.  Increasing the light intensity increases the rate of photosynthesis until some other factors becomes in short supply. At very high light intensities, photosynthesis is slowed and then inhibited but these light intensities do not occur in nature.  **Carbon dioxide concentration**  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\small (2).png**  Carbon dioxide with water is one of the reactants in photosynthesis. As carbon dioxide concentrations increase, so too does the rate of photosynthesis until a certain point where the graph levels off. In other words, if the concentration of carbon dioxide is increased, the rate of photosynthesis will therefore increase.  At lower carbon dioxide concentrations, carbon dioxide is the limiting factor because an increase in carbon dioxide causes an increase in photosynthesis.  At higher carbon dioxide concentrations (plateau of graphs), further increasing the carbon dioxide concentration does not increase the rate of photosynthesis meaning another factor is limiting photosynthesis. In other words, at some point, a different factor may become limiting. Beyond this concentration, further increases in the concentrations in the concentration of carbon dioxide will not result in a faster rate of photosynthesis, and would appear on a graph as a horizontal line  **Temperature**  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\small (3).png  The chemical reactions that combine carbon dioxide and water to produce glucose which are controlled by enzymes. Temperature affects the rate of photosynthesis.  At low temperatures, the rate of photosynthesis is limited by the number of molecular collisions between enzymes and substrates.  At high temperatures, enzymes are denatured. |

**STARCH TEST**

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| The Keep the potted plants in dark for three days or 72hours so that the leaves are destarched.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\photosynthesis-22-638.jpg   1. The destarched leaf is placed in boiling in water to for 30 seconds in order to kill leaf cells and stop chemical reactions. 2. It is boiled in methylated spirit or alcohol to remove chlorophyll. 3. The leaf is placed in boiling water in order to soften it. 4. It is placed on a white tile and placed iodine solution on it in order to test for starch. |

**REQUIREMENTS FOR PHOTOSYTHESIS PROCESS IN GREEN PLANTS**

**EXPERIMENT**

**AIM: to show that carbon dioxide is necessary for photosynthesis process**

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| **Procedure**   1. Keep the potted plants in dark for three days or 72hours so that the leaves are destarched. 2. Place the leaves of the potted plants (a) in a conical flask containing potassium hydroxide or soda lime. The purpose of potassium is to absorb carbon dioxide from the air. 3. Place the leaves of the other potted plant (b) in a conical flask that contains sodium bicarbonate which produces extra carbon dioxide. 4. Leave the plant in sunlight to allow the leaves to photosynthesize. 5. After a few hours, test the particular leaf and some other leaf of the same plant for the presence of starch.   C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\BIEN11006961.png  **Observation**   * The leaf which was inserted in the conical flask that contains potassium hydroxide turns brown and the other leaf contained in a conical flask containing sodium bicarbonate * turns blue-black.   **Conclusion**   * Potassium hydroxide in the conical flask absorbs carbon dioxide; thus, due to the absence of carbon dioxide, the leaf fails to produce starch which proves that carbon dioxide is necessary for photosynthesis. |

**EXPERIMEN**T

**AIM: To show that light is necessary for photosynthesis**

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| **Apparatus and materials required**  A healthy potted plant , a petri dish , beaker containing water, forceps, a water bath, a burner, a piece of wire gauze, a tripod , a box of matches, alcohol , a strip of black paper, iodine solution and clips.  C:\Users\new\Desktop\DOWNLOADS\39607926711_75dc285061_o.png  **Procedure**   1. Take the potted plant and keep it in a dark place for 2-3 days so that the leaves get destarched. 2. Cover a part of one of the leaves with the strip of black paper. Make sure that you cover both the sides of the leaf 3. Now place this plant in sunlight for 3-4 hours. 4. Pluck the selected covered leaf and remove the black paper covering it. This prevents the entry of light. 5. Place this leaf in the beaker and boil it for about 10 minutes. 6. Take out the leaf and wash it under running water. 7. Take out the leaf in the petri dish and put a few drops of iodine solution on it. Now observe the change in colour.   **Observation**  The leaf turns blue-black except in the covered region. As this covered region did not receive light, photosynthesis did not occur. Hence no starch was formed there. The uncovered region received light and starch was formed there due to photosynthesis.  **Result**  Light is necessary for photosynthesis. |

**EXPERIEMENT**

**Aim: To show that chlorophyll is essential for photosynthesis**

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| **Procedure:**   1. Take a potted plant with variegated leaves (whose leaves are partly green and partly white). The green part of the leaf has chlorophyll but the white part of the leaves does not have chlorophyll. C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\Chlorophyll photosynthesis investigation (1).jpg 2. Place this plant in a completely dark place for about three days or 48 hours to destarch its leaves. 3. Take out the potted plant and keep it in bright sunshine for three to four days. 4. Pluck the variegated leaf from the plant and then remove its green colour “chlorophyll” by boiling it in alcohol. The green parts of the leaf get decolourised. So, we get decolourised leaf. 5. Wash the decolourised leaf with hot water to soften it and remove any chlorophyll which may be sticking to it. 6. Test the leaf for starch by pouring iodine solution over the colourles leaf and observe the change in colour of the leaf.   **Observations**   1. The outer part of leaf that was originally white (without chlorophyll) does not turn blue-black on adding iodine solution showing no starch is present in this outer part of the leaf.   **Conclusion**   * From this observation, we conclude that the photosynthesis to make starch does not take place without chlorophyll.   **Observation**   1. The inner part of leaf which was originally green (contained chlorophyll) turns blue-black on adding iodine solution showing that starch is present in this inner part of the leaf.   **Conclusion**   * From this observation, we conclude that photosynthesis to make starch takes place in the presence of chlorophyll. In other words, chlorophyll is necessary for the process of photosynthesis. |

**EXPERIMENT**

**Aim: To demonstrate that oxygen is produced during Photosynthesis**

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| **Materials required**  Beaker, water, test-tube, funnel, hydrilla plant  **Procedure:**   1. Take a beaker to fill it with water and put Hydrilla plant in the beaker. 2. Add 1g of sodium bicarbonate to the water and stir until dissolved. The purpose of sodium bicarbonate in the experiment is to produce extra carbon dioxide. 3. Cut the base of the plants, tie them with a thread and cover them with an inverted funnel in such a manner that the cut end of the plant is towards the neck of the funnel. 4. Keep the whole apparatus in sunlight for some time and observe   C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\oxygen-is-evolved-during-photosynthesis-experiment.jpg  **Observation**  It is observed that some bubbles are coming out continuously from the cut ends of the plant and bubbles are collected at the top of the test tube by displacing the water.  **Results**  On testing, it is confirmed that the gas is oxygen. The liberated gas is evolved due to the breakdown of water in presence of water. |

**CHAPTE 6- TRANSPORT IN PLANTS**

**TRANSPORT IN PLANTS**

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| Transport is a process whereby substances move from one part of a plant to another. These substances are transported from one part of a plant to another through vascular tissues.  The two types of vascular tissues are Xylem and Phloem  The diagram of the tree shows the function of the xylem and phloem:  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\Trans-syst-plants.jpg   * **Xylem** transports water and mineral salts from the roots to the stems and the leaves. * **Phloem** transport manufactured food from the green leaves to all parts of the plant.   The diagram below shows the vascular bundles found in the dicot stem and monocot stem showing xylem and phloem and other parts.  Vascular bundle found in the dicot stem  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\biologyanatomy-of-flowering-plantsinternal-structure-of-stems-roots-and-leaves_11.jpg C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\c69f4028be057deda5ae8b82c8728530.gif  Vascular bundle found in the monocot stem  **Phloem**   * It transports manufactured food from the leaves to all other parts of the plant   **Xylem**   * It transports water and mineral salts from the root to the stem and the leaves. * It provides support to the plant   **Cambium**   * It produces new xylem and phloem tissues.   **Cortex**   * It transports water from the root hairs to the xylem * It stores starch   **Epidermis**   * It provides protection to the internal parts. |

**XYLEM TISSUE**

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| * Xylem is the vascular tissue that transports water and some nutrients from the roots to the stems and leaves. * Xylem cells form long tubes that transport materials and the mixture of water and nutrients that flows through the xylem cells is called xylem sap. * They are composed of hollow, non living cells-continuous lumen. * It provides mechanical support to plant because of lignified walls. The diagram below shows lignin and cellulose or cell of the xylem tissue.   C:\Users\new\Desktop\f3\347972157.jpg   * Xylem consists of tracheids, vessels, xylem parenchyma and xylem fibres  1. Tracheids and xylem vessels are hollow-tube like structures that help in conducting water and minerals. The xylem conducts only in one direction, that is, vertically. See diagram below:      1. The xylem parenchyma is responsible for storing the prepared food and assists in the conduction of water. 2. Xylem fibres are in supportive in function. |

**THE TYPES OF XYLEM TISSUES**

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| Xylem consists of   1. **Xylem tracheids**  * Tracheids are long cells that help transport sap and also provide structural support  1. **Xylem vessel**  * This assist in transporting water. * The vessel elements have perforation plates that connect each vessel element to form one continuous vessel. * They do not contain cytoplasm * Their walls are thickened with lignin to givre support and prevent them from collapsing when conducting water under high pressure * They do not contain nuclei * Their walls have tiny pores called pits  1. **Xylem fibre or sclerenchyma**   They are dead cells and they do not contain protoplast at their maturity.  Cells are with very thick lignified secondary cell wall.  The main function of xylem fibres is to provide mechanical support.  They are two types of xylem fibres which are   1. Fibre tracheids   They are longer than tracheids and have apical intrusive growth.  They have less developed bordered pits.   1. Libriform fibre   They are highly specialized fibres.  They have simple pits on their walls.   1. **Xylem parenchyma**  * This makes up most of soft parts of plants and long fibers that help support the plant * It is the only living component in the xylem * The cells are with plenty of cytoplasm and prominent nucleus. * They have thin cellusic cell wall. * Lignified secondary cell is absent in xylem parenchyma. * Parenchyma in the xylem can store starch, oil and other ergastic substances. * The diagrams below show the structure of the xylem tissues     The diagram below shows the xylem and its parts  C:\Users\new\Desktop\f3\wTjusOrjuJ41L4JQPayb-w_b (1).png |

**FUNCTION OF XYLEM TISSUE**

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| 1. It transports water and mineral salts from the roots to the stems and leaves. 2. It gives mechanical support to the plant. |

**ADAPTATIONS OF XYLEM VESSELS FOR WATER CONDUCTION**

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| * They are hollow to reduce resistance to the flow of water. * They are lignified to strengthen them and prevent them from collapsing while conducting water. * They have narrow lumen to facilitate capillary action. |

**PHLOEM TISSUE**

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| It is the vascular tissue that is made up of some living and dead cells which conduct prepared food materials from leaf to different parts of the plant body**.**  **Phloem tissue consists of two types of cells**  **C:\Users\new\Desktop\f3\images (5).jpegC:\Users\new\Desktop\HARRY DOWNLOAD\small (3).png**   1. **Sieve tubes**  * They are made of living cells called sieve elements arranged end to end with each other. * Sieve elements are separated from each other by structures called sieve plates which have pores or perforations in them. * They have cytoplasmic filaments which aid in the flow of food along the sieve tube. * They do not have nucleus * Their walls are not lignified.  1. **Companion cell**  * They are associated with sieve tubes * The companion cell has dense cytoplasm, nucleus and other organelles. * They produce energy for translocation.   The diagrams below show the structures of the phloem tissues. |

**FUNCTION OF PHLOEM TISSUE**

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| It transports manufactured food substances from the leaves to all other parts of the plant. |

**ADAPTATIONS OF THE PHLOEM TISSUE FOR ITS FUNCTION**

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| 1. It has companion cell with numerous mitochondria which provide energy for translocation. 2. It has sieve plate which provides support to the phloem tissue. 3. It has sieve pores which act as a path way for movement of materials. 4. The sieve elements lack other components of the cell such as nucleus in order to create space for transportation. 5. They have cytoplasmic filaments which aid in the flow of food along the sieve tube. |

**STRUCTURAL DIFFERENCES BETWEEN XYLEM AND PHLOEM**

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| --- | --- |
| Phloem | Xylem |
| 1. It is made up of living cells | It is made up of dead cells |
| 1. Its walls are not lignified | Its walls are lignified |
| 1. It has companion cells | It does not have companion cells |
| 1. It has end walls called sieve plates which are perforated | It does not have end walls/cross walls at the end |

**FUNCTIONAL DIFFERENCES BETWEEN XYLEM AND PHLOEM**

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| --- | --- |
| Phloem | Xylem |
| 1. Transports manufactured food from the leaves to all other parts of the plant | Transports water and mineral salts from the roots to the leaves |
| 1. Does not provide support to the plant | It provides support to the plant |

**COMPARISON CHART OF THE PHLOEM AND XYLEM**

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| Basis for comparison | Xylem | Phloem |
| Meaning | Xylem is the complex tissue of plants, responsible for transporting water and mineral salts from the roots to the stem and leaves | It is the living tissue responsible for transporting manufactured food from the leaves to all parts of the plants. |
| Contains | Dead cells- Parenchyma is the only living cells present in the xylem | Mainly contains living cells- fibers are the only dead cells in the phloem |
| Comprises of | Xylem vessels, fibre and tracheids | Phloem fibers, sieve tubes, sieve cells, phloem parenchyma and companion cells |
| Found | It is located in the centre of the vascular bundle, deep in the plant | It is located on the outer side of the vascular bundle. |
| Kind of movement | Undirectional | Bidirectional |
| Role | * It transports only mineral salts and waters from the roots * Provides mechanical support | * It transports food materials manufactured by green leaves to all other parts of the plants. * It does not provide mechanical support. |

**SIMILARITIES BETWEEN XYLEM AND PHLOEM**

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| * The cell wall is made up of cellulose of both xylem and phloem      * Both contain chloroplast * Both contain vascular tissue which helps in transportation of material throughout the plant. * Both xylem and phloem contain parenchymatous cells. |

**DIFFUSION**

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| * Diffusion is the movement of particles from a region of high particle concentration to a region of low particle concentration. The difference in the concentration of particles between two regions is called a concentration gradient**.** * When particles move from a region of high concentration to a region of low concentration, they are said to diffuse along a concentration gradient. As long as concentration gradient is maintained the movement of particles continues until they reach equilibrium, that is, evenly distributed in the available space. |

**FACTORS AFFECTING THE RATE OF DIFFUSION**

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| * 1. **Temperature-** An increase in temperature increases the movement of particles hence increasing diffusion rate.   2. **Size of particles-** Small particles diffuse faster than large particles.   3. **Difference in concentration of substance-** The steeper the concentration gradient, the faster the rate of diffusion.   4. **Distance a particle has to move-** The shorter the distance over which diffusion takes place, the fater rate of diffusion   5. **Surface area to volume ratio- Th**e higher the ratio, the greater the rate of diffusion.   6. **Thickness of membranes and tissues-** Thin membranes enhance higher rate of diffusion than thick membranes. |

**SIGNIFICANCE OF DIFFUSION**

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| 1. It is involved in movement of gases in and out of plant tissues. Oxygen and carbon dioxide diffuse in and out of plant leaves through stomata by diffusion. 2. It is involved in the absorption of some mineral salts from the soil by diffusion. |

**OSMOSIS**

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| Osmosis is the net movement of water molecules from a region of high concentration of water molecules to region of low water molecules across a semi-permeable membrane**.**  In other words, it is the movement of water molecules from a lower solution (weaker solution) to a higher concentrated solution (strong solution) through a semi-permeable membrane or selectively permeable membrane**.**  **A semi-permeable membrane** allows certain types of particles to pass through it but does not allow other to pass through **(cell membrane in a plant cell).**  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\bj80hvENQr2ax4omxo4C_Osmosis_experiment.jpegC:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\images (2).png**  **A fully permeable membrane** allows both large and small particles to pass through **(cell wall in a plant cell).**  When two solution of different concentration are separated by a semi-permeable membrane. Water flows from less concentrated solution to the more concentrated solution into the semi-permeable until both solutions have the same concentration ratio **(isotonic solution).**  If one solution is stronger than the other it is said to be **hypertonic**. A solution that is weaker than the other is said to be **hypotonic** to the other.  **PLANT CELLS IN AN ISOTONIC SOLUTION**   * 1. If a plant cell is immersed in an isotonic solution such as 55 sucrose solution, there is no net movement of water across the plasma membrane.   2. Water flows across the membrane at the same rate in both directions.   3. The cell’s volume and shape remain constant   C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\isotonic solution.jpg  **PLANT CELLS IN A HYPOTONIC SOLUTION**   1. When a plant cell is immersed in a hypotonic solution such as water, water molecules diffuse into the cell by osmosis. 2. The vacuole gain water, expands and exerts pressure outwards on the cell wall. 3. This pressure is called turgor pressure which causes the plant cell to become turgid. 4. The turgidity of the cells gives the plant mechanical support.     **PLANT CELLS IN A HYPERTONIC SOLUTION**  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\c8iVfqz5Q7W5Pg1wr10w_hypertonicplantcell.png**   1. When a plant cell is placed in a hypertonic solution such as 30% sucrose, water molecules diffuses out of the cell by osmosis. 2. Water is lost from the vacuole and cytoplasm 3. The vacuole and the cytoplasm shrink. The plasma membrane is pulled away from the cell wall. 4. The plant cell becomes flaccid and the plant wilts. This process is called plasmolysis.      1. If the plasmolysed plant cell is immersed in a hypotonic solution, there is net movement of water into the cell. The cell will expand and become turgid again. This process is called deplasmolysis. |

**DEMONSTRATION OF OSMOSIS**

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| **Requirements**  Cellophane paper, beaker, thistle fuunel, strong sugar solution, rubber band, distilled water, clamp and retort stand.  **Procedure**  The mouth of thistle is covered with cellophane paper and some sugar solution is poured into a funnel in an an upside -down position, this is placed in a beaker of distilled water. The stem of the funnel is clamp onto the retort stand.  The level of the sugar solution on the stem of the funnel is marked. The apparatus is allowed to stay for about twelve hours before it is observed.  **Result.**  After twelve hours, the level of the sugar in the stemmed of the funnel has risen.  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\experiment-osmosis-300x214.jpg**  **Explanation**  The cellophane paper acts as a selectively permeable (semi-permeable) and water molecules have passed through it from the distilled water into strong solution by osmosis.  **Conclusion**  Water molecules move from a less concentrated solution or a weaker solution into a more concentrated solution through a slectively permeable mebrane. |

**PLASMOLYSIS**

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| When a cell lies in a solution of high osmotic concentration than in cell sap, the cell loses water and the vacuole shrinks and it pull the cytoplastic tiny away from cell wall. This shrinking of cells is called **plasmolysis** and the cell is referred as **plasmolysed cell.** |

**WHAT HAPPENS WHEN A PLANT CELL/POTATO SSTRIP IS PLACED IN STRONG SUGAR/SALT SOLUTION- HYPERTONIC SOLUTION?**

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| Hypertonic solutions have a higher solute concentration. When plant cells are placed in such solutions, water will move from inside the plant cell to the outside, resulting in the shrinking of the cell- the cell is said to be plasmolysed. This occurs because of osmosis. Water moves from the region where there is high water molecule concentration to a region where there is low water molecule concentration across the semi-permeable membrane. In hypertonic solution, there is less water outside the plant cell, so water within the plant will try to diffuse outside in order to achieve equilibrium. |

**WHAT HAPPENS WHEN THE PLANT CELLS/POTATOO STRIPS ARE PLACED IN DISTILLED WATER (PURE WATER)?**

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| When the plant cells are placed in distilled water, the concentration of water molecules is greater out of the cell than it is in the cell and therefore water moves into the cell and therefore water moves into the cell by osmosis down the concentration gradient. The cell membrane is placed up against the cell wall and the cell is said to be turgid.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\8uInwlItRmqIHosZpSiP_hypotonic-solution-7554_1.png |

**What happens when plant cells/potato are placed in salt solution/salty water?**

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| When the plant cells are placed in the salt solution, there is a higher concentration of water molecules in the cell and a lower concentration in the salt solution and thus creating concentration gradient. Therefore, water moves out of the cell across the partially permeable membrane by osmosis and the cell becomes flaccid as the cell membrane peels away from the cell wall (shrinks away from cell wall). |

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| The process that happens to both slices is called osmosis, which is diffusion of water across the semi-permeable membrane, the potato slice cells possess. The water composition of the environment they are placed in.  The first potato slice is placed in distilled water, which is a high concentration of almost pure water, definitely higher than that which the potato’s cells contain. This solution as hypotonic. The water will diffuse into the cells of the potato, causing them to swell; the cells may be characterized as being ‘turgid’ or swollen.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\8uInwlItRmqIHosZpSiP_hypotonic-solution-7554_1.png  The second potato slice is left open to the air. This solution, or the lack thereof, may be referred to as hypertonic; meaning the water concentration of the potato’s cells is higher than that of the environment the potato is placed in. The water will diffuse out of the potato’s cells, and evaporate into the surrounding air. The potato will become flaccid because the cell membrane has separated from the protective cell wall. It will be limp, flexible, certainly without its previous rigid structure.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\c8iVfqz5Q7W5Pg1wr10w_hypertonicplantcell.png |

**SIGNIFICANCE OF OSMOSIS**

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| 1. It helps plant to absorb water. 2. It brings about transport of water within the plant tissues, that is, from cell to cell. 3. It leads to development of turgor pressure within cells which gives them turgidity. Turgidity helps to support the plant. 4. Helps in opening and closing of stomata. Gurd cells obtain water and also lose water by osmosis to enhance the opening and closing of stomata**.** |

**ACTIVE TRANSPORT**

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| * Active transport is the movement of molecules or ions from a region of low concentration to a region of higher concentration across a living cell membrane**.** * The movement of particles is against the concentration gradient by active transport which requires the use of energy in the form of ATP that is supplied by respiration. Energy is produced in the mitochondria to enable active transport.      * Active transport takes place only in the living cells since the cell must use its own energy to move molecules against a concentration gradient. |

**SIGNIFICANCE OF ACTIVE TRANSPORT**

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| 1. It is involved in the uptake of some mineral salts from the soil. Plant root hair cells take up some mineral ions such as calcium, sodium, potassium, nitrates and magnesium from the soil by active transport. There is high concentration of mineral ions within the root cells than in the soil. 2. It is involved in transport and accumulation of substances in storage tissues such as tubers, seed and fruits. |

**ABSORPTION OF WATER AND MINERAL SALTS IN PLANTS**

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| * Water enters root hair cells by osmosis. This happens when there is a high water concentration in the soil surrounding the root than the cell sap in the cell; water diffuses from the solution into the root hair. The cell sap of the cells in the root hair has higher concentration of mineral salts than the soil water. As the water enters the cell, its water potential becomes higher than in the cell next to it, that is, in the cortex so water moves, by osmosis, into the next cell. * Water vapour evaporating from a leaf creates a kind of suction; its pressure at the top of the vessels is lower than that at the bottom a water move up the stem in the xylem. This creates a transpiration stream, pulling water up the root. * Water moves from xylem to enter leaf tissues down water potential gradient. * The diagram below shows how water is absorbed by plant:   **HOW IS WATER ABSORBED BY PLANT**     * Mineral salts in the soil water enter the root hair by either diffusion or active transport that requires the expenditure of energy. The root hair cells contain a lot of mitochondria which release energy from glucose during respiration in order to provide the energy needed for active transport. * The diagram below shows parts of the root hair that absorb water and mineral salts from the soil water: |

**CYTOPLASMIC STREAMING**

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| * Cytoplasmic streaming is the directed flow of the liquid component of the cytoplasm and organelles around plant cells and uses energy of ATP to move the substances much faster than diffusion. See the diagram below showing cytoplasmic streaming:     This movement aids the delivery of nutrients, genetic information and other minerals to all parts of the cell. |

**TRANSLOCATION**

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| * Translocation is the movement of manufactured food throughout the plant through the phloem. * Photosynthesis produces glucose in the green parts of the plants (leaves). This glucose is converted into sucrose which is transported around the plant in phloem vessel. It needs to be able to reach all cells in the plant so that the sucrose can be converted back into glucose for respiration. * The movement of sucrose and other substances like amino acids around the plant is called translocation which happens between where these glucose and amino acids are made and where they are used or stored. * The diagram below shows movement of water from the roots to the leaves through xylem (transpiration) and the movement of manufactured food from the leaves to the stem and roots through phloem (translocation) |

**COMPARISON OF XYLEM AN PHLOEM**

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| Tissue | Xylem |
| Process | Transpiration |
| What is moved | Moves water and mineral salts from roots to leaves |
| Structure | Columns of hollow, dead reinforced cells |
| PHLOEM | |
| Tissue | Phloem |
| Process | Translocation |
| What is moved | Moves food substances from leaves to rest of plant and stores such as in the roots. |
| **Structure** | Columns of living cells |
| The diagram below shows the roles of xylem and phloem during transpiration and translocation respectively.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\3284761_orig.png | |

**RING BARKING EXPERIMENT ON TRANSLOCATION**

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| The experiment involves the removal of all the tissue outside to vascular cambium (bark, cortex, and phloem) in woody stems except xylem.  Xylem is the only remaining tissue in the girdled area which connects upper and lower part of the plant.  After sometime, it is observed that a swelling on the upper part of the ring appears as a result of the accumulation of food material (see diagram below). If the experiment continues within days, the roots die first. It is because; the supply of food material to the root is cut down by the removal of phloem.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\1.PNG  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\GApwYlO.jpg  In the ring experiment, a ring of bark is scrapped away that also removes the phloem, exposing the xylem. This is demonstrated by a bulge of sugar forms above the ring suggesting that sugar moves down the stem in the phloem. |

**TRANSPIRATION STREAM**

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| Transpiration stream refers to the flow of water in a plant due to transpiration**.** Transpiration is the evaporation of water at the surfaces of the spongy mesophyll cells in leaves followed by loss of water vapour through the stomata.  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\small.png**  Water moves through the xylem vessels in a continuous transpiration stream. Water moves through the root via the stem to the leaves as shown in the diagrams below.  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\Trans-syst-plants2.jpg**  Transpiration produces a tension or **‘pull’** on the water in the xylem vessels by the leaves. Water molecules are **cohesive** so water is pulled up through the plant via the xylem vessel. See the diagram below.  **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\unnamed.png**  **Root hair cells**  The root hairs are where most water absorption happens. They are long and thin so they can penetrate between soil particles and they have a large surface area for absorption of water.  Water passes from the soil water to the root hair cell’s **cytoplasm** by **osmosis**. This happens because the soil water has a higher water potential ( has a higher concentration of water molecules than the cytoplasm of the root hair cell)than the root hair cell cytoplasm:  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\small (3).png   |  |  | | --- | --- | | **Solution** | **Soil water** | | Water potential | High | | Concentration of dissolved solutes | Low | | **Solution** | **Root hair cell cytoplasm** | | Water potential | Low | | Concentration of dissolved solutes | High | | C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\small (2).png  Osmosis causes water to pass into the rot hair cells, through the root cortex and into the xylem vessels. The water loss from the mesophyll cells increases the concentration of the cell sap within the cell. This results in water from the leaf xylem being transported to the cells via osmosis. Water drawn from the leaf xylem is turn replaced by the water that flows upwards from the stem xylem, and this is replaced by the water from the root xylem which is replaced by the water drawn from the root hairs. This movement of water through the xylem is called the **transpiration stream**.  **Functions of transpiration stream**   * 1. Transpiration mineral ions   2. Providing water to keep cells turgid in order to support the plant.   3. Providing water to leaf cells for photosynthesis.   4. Keeping the leaves cool by evaporation   Mineral salts enter the root hairs by **active transport** since it requires the expenditure of energy.  A summary of water uptake, water transport and transpiration:  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\small (4).png | | |

**MOVEMENT OF WATER IN THE XYLEM**

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| **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\movement_of_Water_plant.jpg**  **The four forces that cause the movement of water through the xylem include**   1. **Root pressure**   This is the pressure generated by roots that pumps water and dissolved mineral salts up the xylem until they reach the leaves.   1. **Capillary**   Water tends to rise in the xylem vessels which are very narrow.   1. **Transpiration pull/suction force**   This is the mechanical force that pulls water from below and is generated as a result of transpiration occurring in the leaves. As water evaporates through the stoma in the leaves, it creates a negative pressure/suction/tension in the leaves and tissues of the xylem. This exerts a pulling force on water in the plant’s xylem and draws the water upwards.   1. **Cohesion and adhesion**   Cohesion is the force by which water molecules attract each other while adhesion is the force of attraction between unlike molecules**.**  Cohesion and adhesion forces hold water molecules to the xylem walls such that a long continuous column of water from the roots to the leaves is maintained. |

**TRANSPIRATION**

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| It is the loss of water from the leaves of plants into the atmosphere in form of water vapour. |

**MEASURING THE RATE OF TRANSPIRATION USING POTOMETER**

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| The rate of transpiration is determined using an apparatus called photometer. The instrument measures the rate of absorption of water from the soil. As the shoot above the ground undergoes transpiration, water is absorbed from the photometer causing water column to move from X to Y in the capillary tube. See the diagram of the photometer below.    The rate of transpiration can be determined by measuring the distance moved by water column for a given period of time and then divide distance moved by time taken.  The potometer is set up underwater to avoid unwanted air bubbles in the xylem of the plant which may disrupt the transpiration stream. All joints are sealed with oil to make it as airtight as possible.  Method   1. A single air bubble is introduced into the capillary tubing 2. The tap on the reservoir is opened to add water to push the air bubble back to zero on the scale. 3. A timer is started and a set time measured. 4. The distance the air bubble has travelled along the scale is recorded. 5. The experiment can be repeated with different environmental conditions. |

**HOW TO CALCULATE THE RATE OF TRANSPIRATION**

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| The rate of transpiration can be calculated by measuring the distance travelled by an air bubble in a capillary tube over a given time. The faster the bubble moves, the greater the rate of water uptake- and so the greater the assumed rate of transpiration. |

**IMPORTANCE OF TRANSPIRATION**

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| * 1. **Photosynthesis**   It provides the water needed for food manufactured by photosynthesis in the leaves.   * 1. **Movements of minerals salts throughout the plant**   Transpiration causes water to flow through the plant. As the water flows through the plant, it carries with it the mineral salts dissolved in it which are distributed throughout the plant.   * 1. **Cooling**   Transpiration cools the plant during hot weather since as the water is evaporating it draws heat out of the plant.   * 1. **Uptake of water**   The water lost by transpiration is replaced by water absorbed from the soil which is then distributed to all parts of the plant where it performs various functions in the plant.   * 1. **Support**   The cells in a plant absorb water via osmosis and swell up. This results in a build-up of pressure called turgor pressure and the cells are said to be turgid. Turgid cells are firm and give the plant support. |

**ENVIRONMENTAL FACTORS THAT AFFECT THE RATE OF TRANSPIRATION**

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| **Factor** | **Effect** | **Explanation** |
| Temperature | Increased | Evaporation and diffusion are faster at high temperature, hence increases the rate of transpiration. |
| Humidity | Decreased | Humidity decreases the concentration gradient between the inside and outside of the leaf- this reduces transpiration |
| Wind speed | Imncreased | Moving air removes water vapour, increasing the rate of diffusion of water vapour from the lea. This increases the rate of transpiration. |
| Light intensity | Increased | The stomata open wider to allow more carbon dioxide into the leaf for photosynthesis. |
| Water supply | decreases | The plant stoma will close its stomata. This cuts down the rate of transpiration. Transpiration rate decreases when water supply decreases below a certain level. |

**THE HUMAN DIGESTIVE SYSTEM**

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**DIGESTIVE ENZYMES**

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| Enzymes are proteins that act as biological catalysts that speed up chemical reaction without being changed in the process. |

**PROPERTIES/CHARACTERISTICS OF ENZYMES**

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| 1. All enzymes are protein in nature 2. Enzymes work best within a narrow range of temperature.  * The digestive enzymes in human beings usually work best at about . The temperature which an enzyme works best is called an **optimum temperature.** * When temperature is very high the enzymes are denatured by heat since they are protein in nature. * When the temperature is very low the enzymes become inactive and therefore the reaction rate is slow.  1. Enzymes are specific in the type of reaction they catalyse. Each enzyme can only convert one kind of substrate molecule into one kind of product. 2. Enzymes are catalyst   Enzymes are not changed in the chemical reaction which they catalyse. They are used over and over again.   1. Enzymes are pH dependant. Some enzymes work best in acidic conditions (low pH) e.g. pepsin and others work best in alkaline conditions (high pH) e.g. trypsin. |

**SALIVARY GLANDS**

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| The function of the salivary glands is to produce digestive juice known as saliva  Saliva contains the following useful substances   * + - 1. Mucus       2. Salts       3. Digestive enzymes known as salivary amylase   **Functions of saliva**   * + - 1. Softens and dissolve food particles       2. Lubricates the food thereby making it easier to swallow       3. It contains digestive enzyme known as **salivary amylase(ptyalin)** that digest cooked starch to maltose   The chemical digestion of starch (carbohydrates) begins in the mouth of the alimentary canal.   * + - 1. It contains salt that provide alkaline environment in which salivary amylase works well. |

**OESOPHAGUS (GULLET)**

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| It is the muscular tube made up of involuntary muscles (longitudinal muscles and circular muscles) which runs from the mouth to the stomach.  The function of the oesophagus is to provide the passage of the food particles from the mouth to the stomach. |

**HOW DO FOOD PARTICLES PASS THROUGH THE OESOPHAGUS TO THE STOMACH**

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| The food is forced down the oesophagus by peristalsis of the walls of oesophagus.  Peristalsis is the contraction and relaxation of the muscles in the walls of the gut which pushes food along the gut.  When the food particle is swallowed, the circular muscles just in front of it relax, so the tube gets wider. The circular muscles just behind the food contract, squeezing it forward. When the circular muscles are contracted, the longitudinal muscles relax and vice versa.  The diagram below shows the peristalsis process in the alimentary canal |

**THE STOMACH**

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| * The stomach is a muscular organ located on the left side of the upper abdomen. * The stomach receives food from the oesophagus. As the food reaches the end of the oesophagus, it enters the stomach through a muscular valve called the **cardiac sphincter** . * The **pyloric sphincter** is a muscular valve that opens to allow food to pass from the stomach to the small intestine. The diagram below shows cardiac and pyloric sphicter muscles of the stomach.      * The diagram below shows the stomach and other related parts of the human digestive system   **Functions of the stomach**   1. It temporary stores food which passes from the oesophagus to the stomach for 2 hours or more. 2. Digestion of food  * The stomach secretes hydrochloric acid and enzymes that digest food. * Stomach contains gastric glands that produce gastric juice that acts on proteins. * Gastric juice contains digestive enzymes pepsin and rennin in young mammals. * **Pepsin** digests **proteins** to **peptones** in the stomach. It begins the chemical digestion of proteins in the stomach of the human digestive system. * **Rennin** solidifies milk in young mammals. * **Function of hydrochloric acid**  1. Kills the bacteria ingested with food 2. Provides an acidic medium (pH 2.0) required for the action of pepsin 3. Activates pepsinogen to pepsin 4. Softens or dissolves any bone that might have been taken together with food. 5. The stomach muscles contract periodically, chunning food to enhance digestion.   **Function of mucus**  Mucus nuetralise hydrochloric acid in the stomach**.** |

**THE PANCREAS IN THE SMALL INTESTINE**

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| **The figure below shows the pancreas and other related parts**    **C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\6GfzvZpFSnqr52TkhdyJ_liver.png**  **Functions of pancreas**   1. **Produces pancreatic juice**  * This is the digestive function of pancreas. * Pancreatic juice contains three digestive enzymes  1. **Pancreatic amylase**   Pancreatic amylase acts on/digests starch to maltose   1. **Trypsin**   Trypsin digests proteins known as polypeptides to peptides   1. **Lipase**   It digests emulsified fats to fatty acids and glycerol   * **Produces insulin and glucagon hormones which regulate sugar level in the blood.**   Pancreas contains **islets of langerhan cells** that secret insulin and glucagon hormones that regulate glucose levels in the blood.   * **Insulin hormone** converts excess glucose when there is high glucose level in the blood to glycogen for storage in the liver. * When there are glucose levels in the blood, islets of langerhan cells of the pancreas produce **glucagon hormone** to convert glycogen back to glucose in the blood for respiration process. * The figure below shows how glucose levels are regulated in the blood.   C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\b7e667512b34323137bdd09056e777c0.jpg   1. **Produces sodium bicarbonate salts**   The function of sodium bicarbonate salts is to neutralize the acidic chyme thereby creating alkaline condition for the enzymes trypsin, pancreatic amylase and lipase to do their job well. |

**THE PANCREATIC DUCT**

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| It transports digestive enzymes and sodium bicarbonate salts to the duodenum to carry out their functions. |

**THE LIVER AND ITS FUNCTIONS**

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| The liver is supplied by two blood vessels  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\img_591edf5cd94c5.png   1. **Hepatic artery**   This blood vessel carries oxygenated blood from the aorta and supplies the oxygenated blood to the liver.   1. **Hepatic portal vein**   This supplies the heart with digested food particles from the small intestine. It transports amino acids, excess glucose, vitamins and mineral salts. The figure below shows the liver, hepatic portal vein     1. **Hepatic vein**   It transports deoxygenated blood away from the liver to the vena cava where the blood returns to normal circulation.  **Functions of the liver**   1. **Control of proteins**  * It regulates the levels of amino acids which form the building blocks of proteins. The liver de-aminates excess amino acids to form urea. * Urea is produced/formed in the liver from the excess amino acids bring broken down called **deamination.**   De-amination is the process where excess amino acids are broken down to form urea in the liver. In other words, **deamination** is the removal of the amino group from an amino acid to produce ammonia. The figure below shows the process of deamination that occurs in the liver.    After deamination**, amino group** combines with carbon dioxide to form ammonia which turns to urea. While the acidic group turns to carbohydrates to provide energy for living cells.  Ammonia + carbon dioxide urea + water   * Urea is transported from the liver by renal artery to the kidney for excretion.  1. **Control of lipids**  * It breaks facts and produces cholesterol and special proteins to help carry fats through the body  1. **Control of sugar**   It converts excess glucose into glycogen for storage with the aid of insulin hormone and glycogen can later be converted back to glucose for energy with the aid of glucagon hormone and to balance and make glucose as needed. The figure below shows how the liver regulates sugar level in the blood.  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\b7e667512b34323137bdd09056e777c0.jpg   1. **Bile production**  * It produces bile that emulsifies fat to increase the surface area for the action of lipase enzyme in the small intestine during digestion. * Bile produced by the liver is stored in the gall bladder.  1. **Storage**  * It processes haemoglobin for use of its iron content/destruction of red blood cells- The liver stores iron. * It stores vitamins A, D and  1. **Body defence**  * It resists infections by making immune factors and removing bacteria from the bloodstream. It detoxifies harmful bacteria. * The liver detoxifies drugs and alcohol and helps remove other toxins such as damaged cells, proteins and old hormones.  1. **Produces proteins need by the body**. It manufactures fibrinogen which assists in blood clotting.   **Function of the Gall bladder**   * It stores bile produced by the liver   **Function of the Common bile duct**   * It transports bile to the duodenum where it emulsifies fats   **Function of the Hepatic portal vein**   * Transports digested food nutrients such as glucose, amino acids and vitamins to the liver. |

**ADAPTATIONS OF THE SMALL INTESTINE (ILEUM)**

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| **Adaptations** | **Importance** |
| It is very long | This gives a large surface area on which food is absorbed |
| It is highly folded | This increases the surface area for absorption of the products of digestion |
| It contains villi, finger- like projections | This increases the surface area for absorption of the products of digestion |
| It has muscular walls to facilitate peristalsis | This exposes the villi to digested food |

**THE VILLUS**

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| The villus is the actual place where food is absorbed into the blood in the small intestine. The diagram below shows the longitudinal section through a villus. |

**ADAPTATIONS OF THE VILLUS FOR FOOD ABSORPTION**

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| **Features** | **Importance** |
| 1. Has thin epithelium | **This makes diffusion of food faster** |
| 1. Has dense network of blood capillaries | This ensures continuous blood flow in the villus into which food diffuses and carries digested food away from the small intestine. The blood capillaries absorb glucose and amino acids and transport them away to the liver via hepatic portal vein. |
| 1. Has lacteal | This absorb fatty acids and glycerol and transport them away through the lymphatic vessels |
| 1. Has many mitochondria | Provides mitochondria for the uptake of digested food by active transport. |

**THE LARGE INTESTINE (COLON)**

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| The large intestine consists of two parts namely the colon and the rectum. The rectum stores faeces before it can be egested trough the anus during defecation.  Faeces is composed of undigested roughage materials, food which may not be digested, dead cells from the alimentary, unwanted mineral salts, bile pigments, living and dead bacteria.  Functions of the large intestine   * + - 1. It reabsorbs water from the gut content. This makes the content of the large intestine to become hard.       2. It absorbs vitamins that are produced by colonic bacteria such as vitamin K.       3. It absorbs some mineral salts |

**ASSIMILATION**

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| It is the process by which the body uses up absorbed products of digestion. These absorbed nutrients include glucose, amino acids and fatty acids and glycerol. |

**WHAT HAPPENS TO GLUCOSE, AMINO ACIDS AND FATTY ACIDS AND GLYCEROL AFTER ABSORPTION?**

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| **Glucose**   * It is oxidized to release energy * Excess glucose is converted into glycogen and stored in the liver and muscles. It is insulin hormone produced by the pancreas that converts excess glucose into glycogen for storage in the liver. * Some of the glucose is combined with nitrogen compounds to form proteins in the body. * Other glucose remains in the general blood circulation such as blood sugar thereby controlling osmotic pressure of blood.   **Amino acids**   * They are used in the synthesis of bodily proteins such as haemoglobin. * They are used in the growth and repair of worn out tissues. * When glucose and fats are unavailable (during starvation), amino acids are oxidized to release energy. * Excess amino acids are deaminated by the liver cells to form nitrogenous wastes such as urea in the liver.   **Fatty acids and glycerol**   * Fatty acids and glycerol are combined to form fats. * Fats are broken down in the absence of sugars to provide energy to the body. * Some fats are stored underneath the skin where they insulate the body against heat loss. |

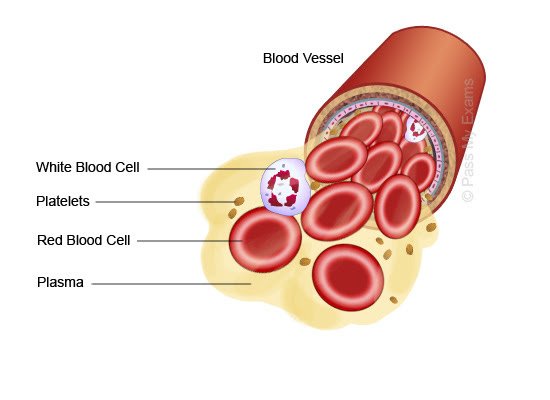
**ABNORMAL CONDITIONS OF THE DIGESTIVE SYSTEM**

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| 1. **Diarrhoea**   This is a disorder where an individual passes watery stool.  **Causes of diarrhea**  It is caused by:   1. Food poisoning 2. Allergy to certain food substances 3. Drug abuse such as the use of alcohol. 4. Some diseases such as cholera, typhoid and diabetes.   **Control of diarhoea**  It can be controlled by   1. Treatment of disease infections using appropriate antibiotics 2. Oral rehydration where an individual is given rehydration solution orally and frequently so as to replace lost fluids**.** 3. **Ulcers**  * This is a problem whereby small wounds develop on the lining of the alimentary canal. * Ulcers can be found in the gullet, the stomach and the small intestine.   **Causes**  It is caused by   1. Infections by certain bacteria that attacks the walls of intestine. 2. Over production of acids in the stomach. The acid corrodes the stomach walls. 3. Use of drugs such as painkillers 4. Eating spicy foods that increase acidity in the stomach 5. Stress that results to over production of stomach acids,   **Control**  It can be controlled by   1. Eating a diet with less acids and spices. 2. Using anti-acid drugs to neutalise the acidity 3. Controlling emotional stress 4. Avoid excessive use of strong painkillers 5. **Hear burn**  * This is a burning feeling on the lower part of the chest followed by a sour or a bitter taste on the throat. * Heart burn develops when the acid contents of the stomach flows back into the oesophagus.   **Causes**  It is caused by   1. Over eating 2. Eating too fast 3. Pregnancy 4. Stress 5. Eating spicy food 6. Smoking and use of alcohol 7. Drinking coffee and other carbonate drinks 8. Eating acid foods such as citrus fruits   **Control**  It can be controlled by   1. Avoid taking alcohol and smoking 2. Avoid eating spicy or too salty foods. 3. Avoid stress 4. Avoid carbonate and acid drinks 5. **Indigestion**   This is a disorder where the food eaten takes too long to be digested thereby making the abdomen to be overly full**.**  **Causes**  It is caused by   1. Inadequate enzyme secretion 2. Anxiety 3. Over eating 4. Eating excessively spicy   **Symptoms**   1. Abdomen often over full 2. Accumulation of gases in the abdomen hence causing bloating. 3. Discomfort or pain in the abdomen.   **Control**   1. **Nausea and vomiting** 2. **Constipation** |

**THE HUMAN CIRCULATORY SYSTEM**

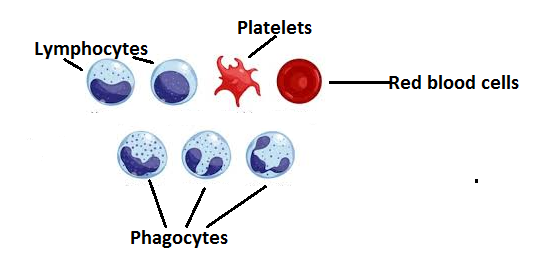
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| The following are the functions of the circulatory system   1. Transport of oxygen , food substances, carbon dioxide and hormones 2. Distribution of het 3. Defence against infection |

**COMPOSITION OF BLOOD**

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| http://www.biologymad.com/BloodCirc/BloodC12.gif   * Red blood cells transport oxygen from the lungs to the body tissues in the form of oxyhaemoglibin. * White blood cells fight against germs in the body. * Platelets assist in blood clotting on the wound. * Blood plasma transports food substances from the small intestines to the body tissues, hormones from endocrine to the target organs, waste matters to the excretory organs etc. |
| * It is made of 55% of blood plasma and 45% blood cells. * The solid part of the blood consists of red blood cells and white blood cells. It also contains fragments of large cells called platelets. |

**The following are the five components of blood**

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1. **BLOOD PLASMA**

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| * Blood is the liquid part of the blood. * It consists of 90% water and 10% different molecules that dissolve in water. * The following are the substances that dissolve in blood plasma  1. food substances such as glucose, amino acids and fatty acids and glycerol 2. vitamins and mineral salts from digestion 3. waste substances like carbon dioxide and urea 4. hormones like adrenaline and insulin hormones 5. enzymes and antibodies 6. proteins such as albumin, fibrinogen, globulins. |

**FUNCTIONS OF THE BLOOD PLASMA**

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| 1. it transports carbon dioxide from the body tissues to the lungs for excretion in the form of hydrogen carbonate ions 2. It transport waste matters produced in the body tissues to the excretory organs. 3. It transports hormones from the endocrine glands to the target organs. 4. It transports antibodies from where they are produced to the site of infection. 5. It transports nutrients from the small intestine to the liver either for storage or for further transport to the cells in the body. |

1. **RED BLOOD CELLS**

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| * They are biconcave disc in shape- The advantageous of this shape to red blood cells is it provides a large surface area for trapping adequate oxygen. * They do not contain nucleus * They have a ref pigment known as haemoglobin. * They are very many in number. * The red blood cells are made in the red bone marrow of the bones of the sternum and ribs. * The diagram below shows red blood cells   http://2.bp.blogspot.com/-pTt3SZq3JE4/UY0dCYvh_UI/AAAAAAAACN8/l69ftGZHTEc/s1600/red+blood+cell.png  The two factors the number of red blood cells in the body and these include   1. **Altitude-** The higher the altitude the more will be 2. **The state of health of a person**. People with severe anaemia or malaria have fewer red blood cells. |

**THE FUNCTION OF THE RED BLOOD CELLS**

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| 1. it transports oxygen in the form of oxyhaemoglobin from the lungs to the body tissues   **adaptations of red blood cells in transporting oxygen**   1. It contains haemoglobin that has affinity for oxygen and combines oxygen with haemoglobin to form oxyhaemoglobin.   The formation of oxyhaemoglobin occurs in the lungs under low oxygen concentration in the lungs.   1. They are numerous hence increasing the surface area for trapping oxygen 2. They are small and flexible which enable to easily squeeze along the smallest capillaries. 3. They have biconcave shape which increases the surface area for transportation of oxygen and carbon dioxide. 4. They lack nucleus and other organelles such as ribosome’s. This increases the surface area for transportation of oxygen. 5. It contains antigens A and B on its surface areas. |

1. **WHITE BLOOD CELLS**

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| * They are used in fighting against infection * They are larger in size as compared to red blood cells * They lack hemoglobin * They have nucleus * They are made in the bone marrow inside bones, spleen and lymph glands**.** * They are two types of white blood cells, **the phagocytes** and **lymphocytes.** * The phagocytes have lobe nucleus. The diagram below shows the phagocyte * The lymphocytes have spherical nucleus. The diagram below shows lymphocytes   C:\Users\new\Desktop\CHIVANGA\291007051.jpg   * The diagrams below show both the phagocytes and lymphocytes.   Phagocytes    Examples of phagocytes include neutrophil eosinophil and basophil  Examples/types of lymphocytes include  **T-lymphocytes – T- cells attack viruses**  **B-lymphocytes-** Produce antibodies which combine with germs which are then engulfed by phagocytes |

**SECOND LINE OF DEFENSE/INTERNAL DEFENSE MECHANISM**

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| It is the natural immunity that become into operation when the germ has gained entry into the body after the first line of defence has been defeated.  The second line of defence is provided by the **action of the phagocytes** and **the action of lymphocytes/antibodies.**   1. **Action of the phagocytes**   Phagocytes are white blood cells which destroy germs by engulfing and digesting them in the blood and tissues. Other phagocytes are attached to walls of lymph nodes where they destroy germs in the lymph. The diagrams below represent phagocytes.     1. **Action of lymphocytes/antibodies**   Lymphocytes are white blood cells that produce antibodies which destroy, disintegrate or inactivate pathogens.  The following are the types of lymphocytes   1. **B-lymphocytes**   They produce antibodies that destroy germs by either dissolving them or neutralizing them.   1. **T-lymphocytes**   They either attack pathogens directly or produce chemicals which coordinate the activity of all cells in the immune system.   1. **T-helper cells**   They are middlemen in the immune response. When they get activated, they secrete cytokines that regulate or help effectors lymphocyte function. HIV attack T-helper cells.  **HOW T-CELLS WORK**  **T-cells** are a subset of lymphocytes that play a large role in the immune system response. T stands for thymus, the organ in which their final stage of development occurs.   1. **Cytotoxix T-cells** destroy infected cells. These cells function as “killer” because they are able to destroy target T-cells which express specific antigens that they recognize. These cells are important in fighting viral infections and tumours. They are able to find and then destroy cells infected with a virus or a cancerous cell. Cytotoxic or T-killer cells do their work by releasing lymph toxins which cause celllysis. 2. **T-helper cells-** They are middlemen in the immune response. When they get activated, they secrete cytokines that regulate or help effectors lymphocyte function. 3. **Regulatory T-cells/Suppressor T-cells**- They suppress activation of the immune system and maintain immune system homeostasis. Failure of regulatory T- Cells to function properly may result in autoimmune diseases in which the immunocytes attack cells in the body. |

**HOW DO PHAGOCYTES DIFFER FROM LYMPHOCYTES IN TERMS OF THEIR FUNCTION?**

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| Phagocytes fight against infection by engulfing disease causing microbes such as bacteria while lymphocytes fight against infection by releasing antibodies which combine with germs which are then engulfed by phagocytes. |

1. **PLATELETS**

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| It is used for blood clotting oat the site of the wound. |

**BLOOD CLOTTING**

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| 1. **Blood clotting**   Blood clotting is the mechanism that prevents blood loss from the broken vessels. When blood vessel is broken, platelets or damaged cells release chemical substance known as **prothrombin** into the blood plasma and causing the production of enzyme **Thrombin**. **Thrombin** turns the soluble plasma **fibrinogen** into its insoluble fibrous form **Fibrin**. **Fibrin** binds together platelets and blood cells to form a **clot** at the site of the wound. When a clot is formed, it blocks further loss of blood and prevents microorganism entering the body through the point of injury. This reduces chances of infection. |

1. **BLOOD SERUM**

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| * It is the blood plasma without fibrinogen. * It is used for testing blood groups at the hospital. |

**THE HEART**

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| * The heart is a muscular organ which pups blood around the body. * The heart is made up of the special type of muscles called cardiac muscles. * The cardiac muscle is special and is adapted for its function because it contracts continuously without getting fatigue. It is myogenic since its contraction is started by muscle itself and not by nerves.     **Coronary artery**   * This is the blood vessel that supplies the muscles of the heart with blood containing nutrients and oxygen. * When the coronary artery is blocked by the fat clots, heart failure occurs since the heart receives insufficient oxygen and food nutrients for energy production9for pumping action).   **Coronary vein**   * This is the blood vessel that takes the deoxygenated blood from the heart back into the venacava.   **PERICARDIUM CAVITY**   * It is the cavity in which the heart is found. The pericardium is covered with two membranes called **pericardial membranes.** * The function of the pericardial membranes is to protect the heart.   **PERICARDIAL FLUID**   * This is the fluid found between the pericardial membranes and its function is to reduce friction between the two membranes as the heart beats. |

**THE INTERNAL STRUCTURE OF THE HUMAN HEART**

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| **C:\Users\new\Desktop\New download\20170322_2212211.jpg**   * The heart is composed of four chambers, two chambers on the right and the other two chambers on the left.   **SEPTUM**   * Septum is the central wall that separates completely the right and left halves of the heart. * The function of the septum is to prevent blood on the right from mixing with blood that is on the left side of the heart.   **THE ATRIA/AURICLES**   * These are the upper chambers of the heart which include the **right atrium and left atrium.** * The upper chambers, the atria are small with thin walls because they just receive blood which they pump to the ventricles. * The right ventricle receives deoxygenated blood from the body through superior and inferior vena cava. * Therefore, the function of the vena cava is to transport deoxygenated blood from the rest of the body to the heart.   **THE RIGHT VENTRICLE AND LEFT VENTRICLE**   * The ventricles are the lower chambers which are relatively larger or thicker than the upper chambers, the atria. * The function of the ventricles to pump blood out of the heart. * The left muscles of the left ventricle are thicker than those muscles of the right ventricle because the left ventricle exert greater pressure or force on blood when they contract pushing blood to a longer distance, that is to the rest of the body while the right ventricle while the right ventricle pumps the blood to a shorter distance, to the lungs.   **PULMONARY ARTERY**   * The pulmonary artery transports deoxygenated blood from the right ventricle to the lungs.   **PULMONARY VEIN**   * The pulmonary vein transports oxygenated blood from the lungs to the left atrium.   **THE BISCUPID VALVES AND TRISCUPID VALVES**   * The **Tricuspid valves are** the valves which control the opening between the right the right atrium and right ventricle. * The **Bicuspid valves** are the valves which control the opening between the left atrium and left ventricle. * The semi-lunar valves are the valves at the base of aorta and pulmonary artery. * The function of the valves is to prevent the back flow of blood |

**BLOOD CIRCULATION IN THE HUMAN HEART**

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| * Blood from the body tissues enters the right atrium **vena cava.** * The blood from the body has very little oxygen dissolved in it because most of the oxygen has been used up for respiration by the tissues. * The blood that is carried in the vena cava from the body to the heart is deoxygenated blood since it is rich in carbon dioxide. This deoxygenated blood **is dark red in** colour. * The right atrium contract to push the deoxygenated blood into the right ventricle via triscupid valve. * The right ventricle contracts thereby exerting **systolic pressure** on blood and pushing it to the lungs through pulmonary artery. * In the lungs, blood gives up carbon dioxide and picks up and combine with oxygen to form **oxyhaemoglobin.** The oxygenated blood from the lungs is said to be **bright re**d in colour**.** * The oxygenated blood from the lungs enters the left atrium through the **pulmonary vein.** * The portion of the circulatory system where blood flow to the lungs from the heart and back is called **pulmonary artery.** * The left atrium pumps blood into the left ventricle via **bicuspid va**lve. The left ventricle contracts and pushes the blood to all parts of the body except the lungs through the aorta. * The circulation of blood from the heart to the tissues and back is called **systematic circulation.** * The mammalian heart is acting as a double pump. |

**HOW THE HEART WORKS**

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| * The function of the heart is to receive and pump the blood. * The heart receives blood when its muscles relax and pumps the blood when its muscles contract. * Pumping and receiving of blood by the heart occurs in the repeated sequence known as heart beat or cardiac cycle. |

**CARDIAC CYCLE**

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| * **Cardiac cycle** is the period of time that begins with contraction of the atria and ends with relaxation of the ventricles. The cardiac cycle has two alternating phases known **as systole** and **diastole.** * **Diastole** is the period of relaxation that occurs as the chambers fill with blood. **Diastole** is when the muscles of the heart chambers relax for them to receive blood. When the heart chambers are relaxed, blood will flow into the atria and ventricles from the veins, which are higher in pressure. The lack of pressure in the ventricle, the tricuspid valves and bicuspid valves open which allow blood from the atria into the right and left ventricles respectively. * See the diagram below showing diastole**.**   **C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\Heart-diastole.jpg**   * **Systole** is the period of contraction that the heart undergoes while it pumps blood into circulation. **Systole** is when the muscles of the heart chambers contract to pump out blood**.** Increased pressure in the ventricles closes the tricuspid valves and bicuspid valves and as a result, the pressure pushes blood opening the semi lunar valves allowing the blood to move to the rest of the body and the to the lungs from the left ventricle through aorta and from the right ventricle to the lungs through pulmonary artery**.** During systole, the ventricle contract increasing the pressure that pushes the blood into the lungs from the right ventricle and into the aorta from the left ventricle. * **Figure below shows systole**   C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\Heart-systole.jpg |

**PULSE RATE**

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| Pulse rate is the number of times the heart beats per minute.  Effect of physical activity on pulse rate   * The normal average heart beat of an adult person at rest is 72 beats per minute. This is known as pulse rate and it increases during a vigorous activity. * An increased heart beat helps to circulate blood with oxygen and glucose needed to produce energy for the vigorous activity in the muscle tissue faster and takes away carbon dioxide and other wastes away from the tissue. |

**THE BLOOD VESSELS**

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| Blood vessels are the passage of the blood.  The three types of blood vessels are arteries, veins and blood capillaries:  C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\chapter-8-transport-in-humans-lesson-2-types-of-blood-vessels-2-728.jpg  **ARTERIES**   * They carry blood away from the heart. * Arteries branch to form a network of smaller arteries called arterioles. * They have thick muscular wall to withstand and maintain higher pressure of blood flowing through them. * They have a thick layer of muscle and elastic fibres which contract and relax to adjust their diameter as the blood flow through them. * They have narrow lumen to maintain higher pressure of blood inside them. * They have no valves * Blood flows in arteries with high pressure because of the force exerted by the pumping action of the heart. * They carry oxygenated blood except the pulmonary artery.  1. **VEINS**  * These are blood vessels that carry blood towards the heart. They are branched to venules. * They have thin walls * They have wide lumens. The wide lumen reduces resistance to the flow of blood and provides more space to the flow of blood. * They have valves at interval. The function of the valves is to prevent the back flow of blood. * Blood is kept moving forward in the veins by the contraction of muscles around them. When the skeletal muscles contract during movement, they squeeze the veins. This helps to push blood back to the heart. * Blood flows in the veins with low pressure since the pumping effect of the heart is not felt. * They carry deoxygenated blood except the pulmonary vein.   C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\image002.jpg   1. **CAPILLARIES**  * These are network of blood vessels which link the arteriole and venous systems. * They have one cell thick walls. This enables useful substances such as oxygen and glucose and wastes such as carbon dioxide to diffuse through them easily. The capillaries are places of exchange of substances in the blood. * They have the narrowest lumens. This ensures that blood moves slowly through them giving more time for exchange of substances. * They have no elastic tissue or smooth muscles. This ensures efficient diffusion of materials and also enables the capillaries to penetrate between individual cells. * They form a dense network. This creates a large surface area over which exchange of substances takes place. * They transport from arterioles to the venules. * The blood capillaries supply the body cells with their requirements, and take away waste products. * The figure below shows types of blood vessels   C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\3289630_orig.jpg |

**ABNORMALCONDITIONS ASSOCIATED WITH CIRCULATORY SYSTEM**

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| 1. **Heart attack**  * This occurs when blood flow to the heart is blocked. * A heart attack occurs when a blocked coronary artery prevents blood rich in oxygen from reaching the heart. * A coronary artery may become blocked as a result of building up of fatty substances or by fat clot inside it. The fatty substances narrow the artery and slow down the flow of blood. * The risk of developing heart attack is increased by  1. Poor diet that contains high levels of cholesterol or saturated fatty acids in blood. The fatty acids clot in the coronary artery. 2. Smoking 3. Lack of physical exercise 4. Stress 5. **Cardiac arrest**  * It occurs when the heart suddenly stops pumping blood around the body. * Cardiac arrest may follow after heart attack. This happens when there is a complete blockage in the coronary arteries and there is no oxygen supply to the heart. * A person with cardiac arrest loses consciousness and has no pulse. Death occurs within minutes if the victim does not receive treatment.  1. **High blood pressure- hypertension**  * High blood pressure is a condition whereby the pressure of the blood flowing in the blood vessels is higher than normal. * Blood pressure is caused by  1. Mental stress 2. Anxiety 3. Heavy smoking- Smoking constricts blood vessels. 4. Obesity 5. Diabetes 6. Excessive salts in food. 7. Excessive alcoholic drinking.   Too much pressure causes the bursting of blood capillaries in the brain which leads to stroke.   1. **Fainting**  * It is a temporary loss of conscious and posture. * It occurs when there is temporary insufficient blood flow to the brain. * It most often occurs when blood pressure is too low and the heart doesn’t pump a normal supply of oxygen to the brain. * It is caused by  1. Emotional stress 2. Dehydration 3. Pooling of blood in the legs due to sudden changes in body position. 4. Panic 5. Low blood sugar 6. Violent coughing due to rapid changes in blood pressure 7. It may result from severe heart, brain, metabolic and lung disorders. 8. **Heart failure**  * It is a condition in which the heart muscle is unable to pump enough blood to meet the needs of the body. * It is caused by  1. Fatigue and weaknesses 2. Shortness of breath 3. Irregular heart beat. 4. Reduced ability to exercise. 5. Chest pains 6. **Arteriosclerosis**  * It is a condition when the wall of the arteries becomes thick, hard and less elastic due to the clotting of fats along the artery wall. * It is caused by  1. High cholesterol 2. Diabetes 3. Obesity 4. Smoking 5. Lack of exercise 6. A family history of early heart disease 7. An unhealthy diet. 8. **Varicose Veins**  * These are enlarged, swollen veins that often appear on the legs and feet. * It occurs when the valves in the veins do not work properly so blood does not flow effectively. * It is caused by  1. Congenital condition where people are born with defective veins. 2. Any injuries causing obstruction of venous blood flow. 3. Infections and inflammation of veins. 4. Obesity. Being overweight put added weight on the veins. 5. Prolong standing or sitting. Blood doesn’t flow well if you are in the same position for long periods. |

**WAYS OF PREVENTING PROBLEMS ASSOCIATED WITH CIRCULATION SYSTEM**

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| 1. Avoid smoking 2. Reducing the amount of high cholesterol foods by eating less. 3. Reduce salt intake to prevent high blood pressure. 4. Exercise regularly to strengthen the heart and improve circulation of the blood. 5. Learn to be organized to avoid stress. 6. Avoid alcohol consumption. 7. Managing your weight by doing exercises and eating healthy foods. This will help to reduce body weight. |

**LYMPHATIC SYSTEM**

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| **It is the additional transport besides the blood transport in the body.**  **It consists of**   1. **Lymph (fluid)** 2. **Lymph vessels** 3. **Lymphatic organs**     **TISSUE FLUID**   * Tissue Fluid is a leaked plasma * Blood capillaries have tiny holes between the cells in their walls which cauise plasma to leak out from the blood. * On the arterial end there is high blood pressure because of two factors  1. The pumping action of the heart exerts a force on the blood which creates high blood pressure since the blood on arterial side comes from the heart. 2. AS blood flows from arteries to the arterioles to the capillaries it flows from wider lumens to narrowest; this creates high blood pressure on the arterial side.  * This high blood pressure forces some plasma fluids to seep out from the blood across the walls of the capillaries to the cells surrounding tissue cells. This fluid spreads throughout the tissue cells and it is called **tissue fluid.** * Tissue fluid contains water, glucose, oxygen, fatty acids, glycerol, amino acids, vitamins, hormones and some white blood cells. These white blood cells can squeeze out of capillaries by amoebic movement. * Red blood cells however, although they are small, cannot squeeze out of the capillaries because they cannot change their shape very much. Large protein molecules such as prothrombin and fibrinogen are too large to go through the walls of capillaries. These materials are held bac into capillaries.     C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\capillaries.jpg |

**FUNCTION OF TISSUE FLUID**

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| 1. It supplies oxygen to tissue cells. 2. It supplies nutrients such as glucose to tissue cells. 3. It carries carbon dioxide and other wastes away from tissue cells to the blood for excretion 4. It cleanses dirt such as dead tissue cells around the tissue cells and poured them to lymph vessels which are more permeable than capillaries. |

**THE LYMPH**

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| Lymph is the tissue fluid that is drained into lymph vessels. |

**FORMATION OF LYMPH**

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| * Some of the tissue fluid is reabsorbed back into the circulation at the venule end of the capillary by osmosis. The remaining tissue fluid is drained into the lymph capillaries. Once inside the lymph capillaries, the fluid is called **lymph.** * Lymph consists of water, dissolved nutrients such as glucose, waste material materials and red blood cells. * Lymph capillaries join to form lymph vessels which have valves that prevent the back flow of lymph. * Lymph vessels return the lymph into blood circulatory system through subclavian veins which bring blood back from the arms. * Lymph is also found in pleural and pericardial cavities. In these places, the lymph  1. Supplies oxygen to the organs it encloses, the lungs. 2. Supplies food nutrients to the organs it encloses. 3. Acts as lubricant, preventing friction between surfaces. |

**FLOW OF LYMPH**

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| * Lymph vessels have semi lunar valves that ensure that the lymph along and the semi-lunar valves that ensure that the lymph travels in one direction only. * The contraction of surrounding muscles helps to squeeze the lymph along and the semi- lunar valves prevent the back flow of lymph. |

**LYMPHATIC ORGANS**

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| The Lymphatic system is composed of several organs that are involved in providing immunity to the body against diseases. They include   1. **The lymph nodes-**  * They filter the lymph before it is returned to the blood. * They contain phagocytes which engulf and digest any bacteria which have gain access to lymph vessels.  1. **The tonsils**  * They have lymphocytes that provide protection against harmful substances and pathogens that may enter the body through the nose or mouth.  1. **The spleen**  * It produces lymphocytes * It destroys worn out red blood cells  1. **The thy**mus  * It produces a hormone, thymosin, which simulates maturation of lymphocytes in other lymphatic organs. |

**IMPORTANCE OF LYMPHATIC SYSTEM**

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| * It transport excess tissue fluid back to the blood. * It produces lymphocytes which protect the body against diseases. |

**LOCOMOTION**

**HUMAN SKELETON**

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| **C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\skeleton.jpg**  **The human skeleton is made up two main parts**   * 1. **Axial Skeleton:** It is in the median longitudinal axis of the body which includes skull, vertebral column, sternum and ribs. It has 80 bones.   **The skull**     * The skull consists of sevral small bones joined through joints called sutures to form cranium. **C:\Users\new\Desktop\HARRY DOWNLOAD\figure-38-03-01.jpe** * The cranium encloses and protects the brain.   **Vertebral column**  **C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\spine3-BB.jpg**  **C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\2223c4f93dc6c3c928af50b7a85562b4.jpg**  **CERVICAL VERTEBRAE**  It has 7 vertebrae. The Atlas is the first cervical vertebra. The function of the Atlas is that its supports the skull.  The atlas is a ring of bone made up of two lateral masses joined at the front and back by the anterior arch and the posterior arch.  The figure shows Atlas.    **AXIS**  The Axis is the second cervical vertebra or C2. It is blunt tooth-like process that projects upwards. It is also referred to as the ‘dens’ or odontoid process. The Axis provides a type of pivot and collar allowing the head and atlas to rotate around the dens/axis**.**  The figure below shows Axis.    **The main functions of the cervical spine are**   1. To support the weight of the head. 2. To hold the rib cage and protect the heart and lungs.   **C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\lumbar_vertebra-BB.jpg**  The Lumbar has 5 vertebrae and are numbered L1-L5. They are much larger in size to absorb the stress of lifting and carrying heavy objects.  **Functions of the lumbar vertebrae**   * Lumbar vertebral are large and sturdy for attachment of the strong muscles in the lower back * The main function of the lumbar spine is to bear the weight of the body   **Sacrum and coccyx region**  **C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\s01.jpgC:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\sacrum_SIJoints_labeled13321761_m.jpg**  The main function of the sacrum is to connect the spine to the hip bones. They are 5 sacral vertebrae which are fused to form a ring called the pelvic girdle.  **Coccyx region**  The four fused bones of the coccyx or tailbone provide attachment for ligaments and muscles of the pelvic girdle.  **Functions of the vertebral column**   1. It protects the spinal cord from external physical forces. 2. It supports the head 3. It provides point of attachment for pelvis and ribcage   **Ribs and sternum**      **At the back-** there are12 thoracic vertebra forming the part of the back bone  **At the front-** breast bone or sternum. Enclosed by ribs which starts from the vertebral column at the back to the sternum in the front on both sides and the muscles between the ribs (intercostal muscles)  **Above- thoracic inlet-** the opening at root of neck in which blood vessels and nerves enter and leave the chest cavity.  **Below-diaphragm- the musclular organ that separates the chest cavity from abdomen.**   * Ribs and the sternum and vertebral column form a rib cage * The function of the rib cage is  1. It encloses and protects the heart and lungs against mechanical injury. 2. It provides a strong framework onto which the muscles of the shoulder girdle, chest, upper abdomen and back can attach. 3. It assists in respiration. It encloses the thoracic activity which contains the lungs. An inhalation is accomplished when the muscular diagram at the floor of the thoracic, contracts and flattens, while the contraction of intercoastal muscles lift the rib cage up and out.    1. **Appendicular skeleton:** It is present on the lateral side of the axial skeleton. It has 126 bones. 4. **The axial skeleton** 5. **The appendicular skeleton** |

**Functions of the human skeleton**

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| 1. It provides posture and shape to the entire human body 2. It provides a rigid surface to attach the muscles to the tendons 3. Protect internal organs such as the spinal cord, the brain and the lungs. 4. Helps in the movement of the sternum and the ribs thus helping in the process of breathing. |

**JOINT**

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| A joint is a place where two or more bones meet. The diagram below shows a joint and its related parts. **http://1.bp.blogspot.com/-GXZnvUOl8r8/UYQVB9QjesI/AAAAAAAABwY/phN36QKmAb4/s1600/2-synovial_joint.gif**  **Functions of cartilage**   1. Covers the end of the bones which joints form thereby absorbing shock and prevent friction during movement 2. Connects ribs to the sternum 3. Provides support to structures such as nose and ear. |

**TYPES OF JOINTS**

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| **Two main categries of joinmts are**   1. **immovable joints**  * These are joints that do not allow movement of bones to occur. They are also called **fixed joints.** * They join bones that form the cranium. The bones are fused by a protein called collagen   Examples are sutures in the human skull   * The skull consists of sevral small bones joined through joints called sutures to form cranium. * The cranium encloses and protects the brain.  1. The joint between sacrum and pelvic girddle      1. **Movable (synovial ) joints**   These are joints that allow some movements of the bones  Fout types of synovial joints are   1. Hinge joints 2. Ball and socket joints 3. Glidding joints 4. Pivot joints (peg and socket joint) |

**HINGE JOINT**

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| These are joints which allow movement of bones in one plane only.  Examples of hinge joints are   1. **Knee joint**      1. **The elbow joint**     **http://handtherapy.com.au/wp-content/uploads/2016/09/Elbow.jpg** |

**BALL AND SOCKET JOINT**

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| These are joints where the rounded head of one bone fits into a socket or activity of another bone allowing movements in all planes.  Examples are  **C:\Users\new\Desktop\DOWNLOADS\665765_628769_ans_5471da8dc86b4ffe8eea38e9476ee059.gif**  **Function of cartilage**   * Covers the end of the bones which joints form thereby absorbing shock and prevent friction during movement * Connects ribs to the sternum * Provides support to structures such as nose and ear.   **Function of ligament**   * The function of the ligament is that it holds two bones together at the joint. * The special property of the ligament is that it is very strong and elastic that is can stretch when the bones move.   **Function of synovial membrane**   * Synovial membrane is a thin membrane which encloses the joint. * The function of synovial membrane is to secretes synovial fluid   **Function of synovial fluid**    **Shoulder joint**  **C:\Users\new\Desktop\DOWNLOADS\Figure_38_03_10.jpg** |

**GLIDING JOINT**

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| * These are joints that allow slight movements of the bones. They are found in between the vertebral bones. * They allow slight bending of the backbone. * They are also found in the carpals of the palm and the tarsals of the foot. |

**PED AND SOCKET JOINT- PIVOT JOINT**

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| * It is found between the first and the second vertebrae in the neck. * It allows rotation of the bend. |

**MUSCLES**

1. **SKELETAL MUSCLES/VOLUNTARY MUSCLES**

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| * These are muscles which are under the control of the human body. * They are attached to the bones of the skeleton through tendons * These muscles are in the form of stripes and hence they are striated, * They contract suddenly and powerfully but they get tired quickly * They contract by conscious control of the brain * They are responsible for the movement and locomotion in the human body. |

**PROPERTIES OF SKELETAL MUSCLE**S

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| 1. **Extensibility-** It is the ability of muscles to extend when it is stretched 2. **Elasticity**- It is the ability of the muscles to return to its original structure when released 3. **Excitability**- It is the ability of the muscles to respond to a stimulus. 4. **Contractibility-** It is the ability of the muscle to contract when in contract with a stimulus. |

**FUNCTIONS OF THE SKELETAL MUSCLES**

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| 1. They are responsible for body movement such as typing, breathing, extending the arm, writing etc. The muscles contract which pulls the tendons on the bones and causes movement 2. They maintain body posture 3. They protect the internal organs and tissues from any injury and also provide support to these delicate organs and tissues. 4. They regulate the body temperature. After a strenuous exercise, the body feels hot. This is due to the contraction of skeletal muscles which converts energy into heat. |

**ANTAGONISTIC MUSCLES**

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| * These are muscles which work in pairs. When one set of antagonistic pair of muscles contracts, the other relaxes. Such movement is known as antagonistic movement or antagonism. * Muscles are attached to the bones at two points by means of the **tendon**s. * Bending of the arm at elbow joint is called **flexio**n and the muscle that causes this movement is called **flexor**. * Straightening of the arm at elbow joint is called **extension**, and the muscle that causes this movement is called **extensor.** * In figure below, one member of the pair of antagonistic muscles at elbow joint is the **bicep muscle** that lies in front of the humerous, its upper end has two tendons hence the name biceps which have their origin on the shoulder blade of pectoral girdle. The lower end of the bicep has a single tendon attached to the radius. * The **triceps muscl**e lies behind the humerus. It has its origin on the shoulder blade and humerus has three tendons, hence the name triceps. Its lower end continues as a single tendon inserted on the ulna. * The biceps and triceps are referred to as **antagonistic muscles**. This means that they never contract or relax at the same time. When one contracts, the other is relaxed. When the lower arm is straightened at the elbow, we say that the arm is **extended**. When the arm is bent at the elbow, we say the arm is **flexed.**   C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\insertion_and_origin.jpg  The **contraction of the biceps** causes the forearm to be pulled upward and this flexion of the forearm at the elbow is effected only when the triceps muscle relaxes at the same time as the biceps contracts.  Similarly, **contraction of the triceps** and **relaxation of the biceps** bring about extension or straightening of the forearm at the elbow.  When the arm is **extended,** **the triceps muscles are in contracted state** and so they are tight and short in length. The biceps muscles on the other hand are **relaxed and therefore stretched.**  In order for the arm to be flexed, the biceps muscles contract, therefore shortening. This causes them to pull against the radius. This action raises the lower part of the arm. The triceps must relax and stretch to allow the movement of the arm to take place.  **AGONIST VS ANTAGONISTIC MUSLES**  C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\download.jpeg  http://1.bp.blogspot.com/-MJdK6jhFnzU/T5sGIWH_JuI/AAAAAAAABDE/Nll7Ka6pSR8/s1600/Antagonistic+Muscles+-+Resistance+Training+-+Fitness+for+You.png  Agonistic muscles are muscles that produce movement through contraction. When they contract, it causes the triceps to be relaxed while causing the arm to be raised upwards while the antagonistic muscles are muscles that when they contract at elbow joint, they cause the biceps to be relaxed causing the arm to be straightened.  **Function of the Tendon**  Function of the tendon that attaches muscles to the bones. It special property is that it is very strong and inelastic. It is made of collagen fibbers. |

1. **INVOLUNTARY MUSCLES/SMOOTH MUSCLES**

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| * These are muscles that are not under our will control. They are muscles that contract involuntarily. * Examples of involuntary muscles in the body are  1. Muscles of the alimentary canal 2. The blood vessels 3. Bladder 4. The iris in the eyes |

1. **CARDIAC MUSCLES**

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| * The cardiac muscles are specialized type of muscles that forms the hearts are only found in the walls of the heart. * They contracts and release involuntarily, responsible for keeping the heart pumping the blood around the body. * The special property of cardiac muscles is that they never get tired. |

**INJURIES TO BONES**

**Define the term fracture.**

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| * A fracture is a broken or cracked bone which occurs as a result of a heavy impact against the body. |

**Explain two types of fractures.**

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| **http://www.gizoffer.com/wp-content/uploads/2018/09/compund-fracture.jpg**   1. **Simple fractures or closed fracture**   This fracture where the broken bone remains beneath and does not pierce through the skin.   1. **Compound fractures**   This is the type of fracture where the broken bones pierce through the skin. This causes the wound to bleed and swell. |

**Describe how to perform the First Aid for fractures.**

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| * Before taking an injured person to hospital, a straight or smooth piece of wool called a splinter can be placed next to the injury and tied along to prevent further movement of the bones which can make the wound worse. * Then support the injured part with a sling. |

**INJURIES TO JOINTS**

**Explain two types of injuries which occur at joints.**

1. **Sprains**

**Describe how the sprain is brought about.**

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| * Sprains are injuries that occur at joints and they occur when a wrist or an ankle is suddenly twisted. * The joint is suddenly pulled or twisted which causes a tear or injury to the ligaments that help keep the joint in place. They can be very painful |

**Describe how to perform the First Aid for sprains.**

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| * Ice or cold water can be applied to a sprain to reduce pain, swelling or bleeding of tissue * A sprain is taken care of by carefully applying a supporting bandage at the joint and giving it enough rest so that the damaged tissue can heal. |

1. **Dislocations**

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| * This is the type of injury that occurs when a bone moves out of its position at a joint. It usually occurs at the shoulder or knee joint. |

**Describe how to perform the First Aid for dislocations.**

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| * A dislocated joint is usually managed by carefully and skilfully pushing the dislocated bone back into position. It is best done by a qualified First Aider. A sling can also be tied along the area to support the weight away from the joint. |

**LOCOMOTION IN BIRDS**

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| * Birds can swim, walk and fly * Birds have wings which enables them to fly. * Birds have legs which are used for walking or hopping. * The most common type of locomotion in birds is flying. |

**ADAPTATIONS OF BIRDS FOR FLIGHT**

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| * They have streamlined body. This makes to move on air with less resistance to air current. * They have large and powerful pectoral muscles that attach the wing to the body to the body of the bird efficient movement of the wing. * They have hollow bones which make them lighter while in flight. * They contain air sacs which make them lighter while in flight. * The forelimbs of birds are modified to wings. The wings have feathers which create a large surface for flight. * They have large a large sternum which have deep keel to which the breast muscles are attached. * Their body is covered with feathers which help to insulate the birds, helping them to stay warm so that they can produce enough for flight. |

**TYPES OF FLIGHT IN BIRDS**

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| 1. **Flapping flight**  * Wings are flapped up and down * When wings are flapped up, the movement is called **upstroke.** * When the wings are flapped down, the movement is called **down stroke.** See down stroke and upstroke below.   C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\Hummingbird-and-its-flight-apparatus.png   1. **Gliding flight**   In gliding flight, the wings are out-spread. Spreading of wing of wings increases the surface area which creates resistance below the wing in order to generate lift.  The wings are also used as **aerofoils.** The distance over the top of the wing is greater than the distance over the bottom of the wing so air on top move faster than the bottom. This makes the downward pressure on top of the wing less than the upward pressure on the lower surface of the wing hence there is a net upward force.   1. **Soaring flight**   The bird spreads out its wings in soaring movement to allow upwards thermal air currents to lift the bird allowing it to gain height without moving its wings. |

**THE WING DOWN MUSCLE AND WING UP MUSCLE**

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| **UPSTROKE (THE WING UP MUSCLE)**  During down stroke, the pectoralis major muscles contract pulling the wing downwards and the pectoralis minor muscles relax. The feathers overlap in way as to trap much air so much air so that there is more resistance below the wing to generate lift.  **UPSTROKE**  During upstroke, the pectoralis minor muscles contract pulling the wing upwards and the pectoralis major relax.  The flight feathers overlap in a way as to let air pass between them so that air resistance is reduced below the wing. AS a result there is no upthrust and the force of gravity pulls down the bird so that it loses height. |

**UPSTROKE AND DOWN STROKE**

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| **UPSTROKE**  During down stroke, the pectoralis major muscles contract pulling the wing downwards and the pectoralis minor muscles relax. The feathers overlap in way as to trap much air so much air so that there is more resistance below the wing to generate lift. See the diaghram for the down stroke below:    **UPSTROKE**  During upstroke, the pectoralis minor muscles contract pulling the wing upwards and the pectoralis major relax.  The flight feathers overlap in a way as to let air pass between them so that air resistance is reduced below the wing. AS a result there is no upthrust and the force of gravity pulls down the bird so that it loses height. |

**FLIGHT FEATHERS**

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| * These are feathers that are attached to the wings and they help in flight of birds. * They are large and have even margin * They have large quill**.** * **The diagram below shows the flight feather** |

**DOWN FEATHERS**

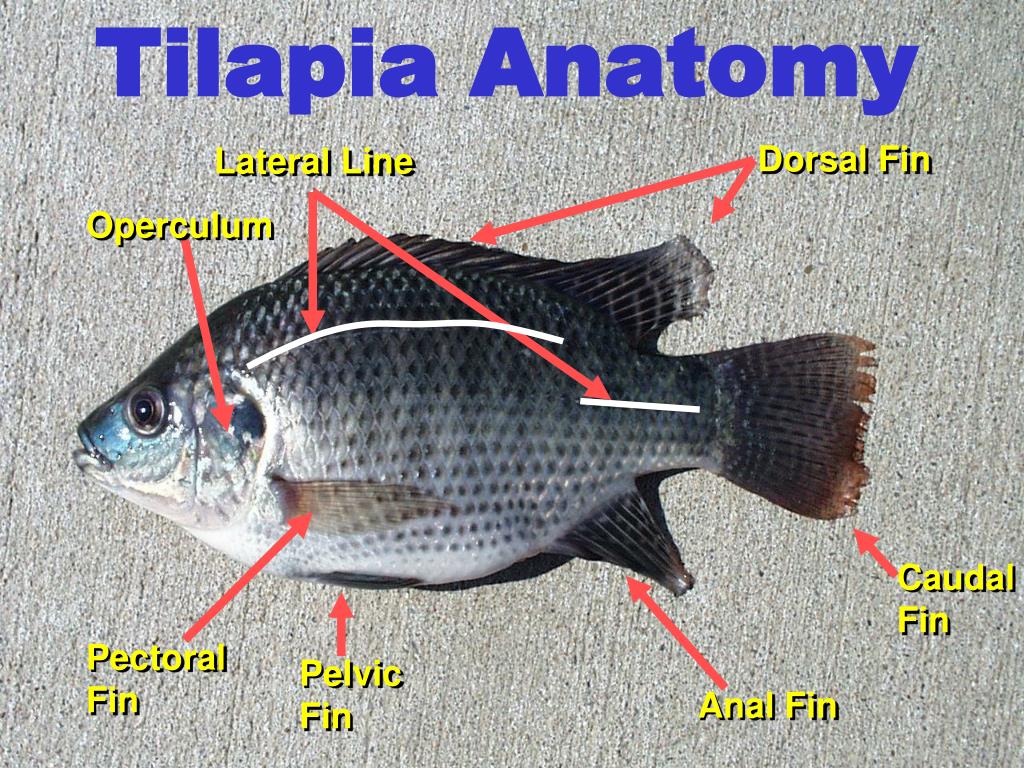
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| These are feathers that cover the rest of the body of the bird.  They are small and have uneven margin  They have small quill |

**PROBLEMS FACED BY THE BIRDS DURING FLIGHT**

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| 1. Force of Drag   It is overcome by   * They have streamlined body. This makes to move on air with less resistance to air current.  1. Force of Gravity |

**LOCOMOTION IN FISH**

**THE SDTRUCTURE OF THE TILAPIA FISH**

**The diagram shows the Tilapia fish and its locomotory features**

**Functions of paired fins (pectoral fins and pelvic fins)**

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| 1. They are used for changing direction 2. They allow fish to move up and down (pitching) 3. They act as brakes or enable the fish to stop. 4. They help the fish to prevent unnecessary pitching casued by water current |

**UNPAIRED FINS (DORSAL FIN AND VENTRAL FIN)**

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| They prevent yawning of the fish. Yawning is the tendency of the fish to move side by side as the fish swims. |

**Swim bladder**

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| The swim bladder controls buoyancy (able to float and sink) and depth at which the fish swims in water.  The swim bladder contains air. When it is full of air, the fish swims upwards and float while it is empty of air, the fish sinks into water. |

**ADAPTATIONS OF FISH FOR LOCOMOTION**

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| 1. Fish has streamlined shape which reduces force of drag as its forward in water. 2. The scales overlap facing backwards. They help the fish to reduce drag in water as it moves forwards. 3. They have paired fins which act as elevators and brakes to fish as it moves in water. 4. They have unpaired fins, that is, dorsal fin and ventral fins, which control pitching of fish in water. 5. They have caudal fin which helps to propel the fish forward. 6. They have swim bladder which control buoyancy of fish in water. 7. They have a flexible coloumn which allows the fish’s body to curve during locomotion. |

**THE REPRODUCTIVE SYSTEM**

**Define the term reproduction.**

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| Reproduction ensures the continuation of similar kinds of species, generation after generation |

**TYPES OF REPRODUCTION**

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| 1. **SEXUAL REPRODUCTION**   This is the type of reproduction that involves the fusion of male and female gametes to form a zygote through which a full organism develops. The male gametes produced by testes are known as sperms while the female gametes produced by ovary are known as ova or eggs.  In the first step of reproduction is the fusion of a sperm and an ovum. The process of the fusion of a sperm and an ovum is known as fertilization. During the fertilization, the nuclei of the sperm and the egg fuse together and form a single nucleus that results into the formation of the fertilized egg also known as zygote through which a new full organism develops.   1. **ASEXUAL REPRODUCTION**   This is the type of reproduction in which only a single parent gets divided into two new offspring’s. Examples include **Hydra** and **Amoeba**  In Hydra, the individuals develop the buds, therefore, this type of asexual reproduction is known as budding. It shown below  In amoeba, nucleus gets divided into two nuclei; therefore, such kind of asexual reproduction is known as binary fission. The figure below shows binary fission in the amoeba. |

**HUMAN MALE REPRODUCTIVE SYSTEM**

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| C:\Users\new\Desktop\CHIVANGA\cbse_class_10_imp_bio_diagram10.jpg |
| 1. **Testis:**  * Sex organ that produces sperm in a process called **spermatogenesis** , and male sex hormones (**testosterone**). * Each testis contains about 250 functional units called lobules; each lobule contains about 4 **seminiferous tubules** where spermatogenesis occurs.  1. **Accessory sex glands** 2. **Seminal vesicles:** secrete an alkaline solution that makes up 60% of the semen volume; this seminal fluid contains fructose (nutrient for the sperm) and prostaglandins (substances that stimulate uterine contraction during sexual excitation). 3. **Prostate gland:** secretes a slightly acidic, milky white fluid that makes up about 30% of semen volume; this fluid helps neutralize the pH of semen and vaginal secretion. 4. **Bulb urethral gland:** secretes a clear lubricating fluid that aids in sexual intercourse. 5. **Urethra:** A tubule located inside the penis for urine excretion and semen ejaculation .Contains smooth muscle that performs rapid peristalsis during ejaculation . 6. **Penis:** A copulatory organ that is responsible for delivering the sperm to the female reproductive tract. Contains 2 erectile tissues called **corpus cavernosa** and **corpus spongiosum** , where the latter one enlarges and forms the glans penis due to increased blood flow during sexual excitation |

**HUMAN FEMALE REPRODUCTIVE SYSTEM**

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| C:\Users\new\Desktop\CHIVANGA\cbse_class_10_imp_bio_diagram11.jpg   1. **Ovary**   The ovaries serve two purposes   1. They produce eggs(ova) 2. They secrete oestrogen and progesterone hormones which regulate the maturation of eggs and help in producing bodily changes during puberty. 3. **Oviduct/fallopian tube**   These are tubes leading from the ovaries to the uterus.  **Functions of fallopian tube**   1. They are important for transmitting eggs from the ovary to the uterus/passage for the ovum to the uterus. They are adapted for this function because they are lined up with cilia hairs that push the ovum towards the uterus. 2. They are site for fertilization and initial development of the baby 3. **Uterus**    * + 1. Prepare for implantation and development of the embryo        2. Under the stimulation of oxytocin, contracts during labor to expel the fetus into the vagina 4. **Cervix**   The base of uterus is closed by a narrow passageway called **cervix** to prevent the entry of foregin substances   1. **Vagina**   The vagina is a muscular hollow tube that extends from the vagina opening to the uterus.  It has muscular walls which can allow it to expand and contract.  The vagina’s muscular walls are lined with mucous membranes which keep it protected and moist.  **Functions of the vagina**  The vagina serves three purposes:   1. for copulation(It’s where the penis is inserted during sexual intercourse) 2. It’s the pathway (the birth canal) through which a baby leaves a woman’s body during childbirth 3. It’s the route through which menstrual blood leaves the body during periods (allowing menstrual blood to leave the body). |

**THE STRUCTURE/CHARACTERISTICS OF THE SPERM**

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| Sperms are gametes or sex cells that are produced in the testes of male human beings and animals.  Like a female gamete, sperm carries a total of 23 chromosomes that are produced as a result of a process known as meiosis.  A sperm cell consists of a head, body and a tail. Each of these parts is equipped with various molecules and smaller structure that allow the sperm as a whole to function properly  C:\Users\new\AppData\Local\Temp\WPDNSE\{00000008-0001-0001-0000-000000000000}\Schematic-diagram-of-the-structure-of-mammalian-sperm.png  Sperm cells are gametes or sex cells which are produced in the testes of the male human beings and animals.  Like the female gametes, sperm carries a total of 23 chromosomes that are a result of a process known as meiosis. Both egg cells and sperm cells are involved in the sexual mode of reproduction.   1. **Nucleus**   It contains 23 chromosomes that determine the characteristics of the new organism once the sperm fuses with the ovum during fertilization.   1. **Head**   The head of the nucleus contains an enlarged haploid nucleus, the frontward part of which is enveloped by a cap-like structure, acrosome.  **Function of acrosome**  It contains enzymes that break up egg membrane so that the head  penetrate the ovum to allow fertilization   1. **Middle piece**   It contains tightly packed mitochondria that provide the energy requires for swimming.  The middle piece of the sperm is called power of sperm because it gives energy to the sperm to swim in the female genital tract.  **Function of mitochondria**  Numerous mitochondria are present in the middle piece of the sperm which creates energy for the movement of tail or flagellum.   1. **Tail**   **It is very long necessary for swimming or locomotion.**  **Function of the tail**  It is responsible for the vigorous movement of sperm towards ovum or it helps the sperm to swim in the female genital tract.   1. **Streamlined body shape**   The sperm has streamlined body that allows it to move rapidly to reach the target egg cell. The stream lined shape reduces the force of drag during movement   1. **Motility**- It is mobile. The sperm’s beats gently from one side to another as the cell moves along what may appear to be a straight path. |

**ADAPTATIONS OF THE SPERM FOR ITS FUNCTION**

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| 1. **It has streamlined body-** The sperm has streamlined body that allows it to move rapidly to reach the target egg cell. The stream lined shape reduces the force of drag during movement 2. **It has tightly packed mitochondria-** The middle piece of a sperm carries about 70 mitochondria which creates energy required for locomotion. 3. **The tail**- It has very long tailresponsible for the vigorous movement of sperm towards ovum 4. **Acrosome**- It contains enzymes that break up or to digest egg membrane which helps promote fertilization 5. **It has haploid nucleus-** It allows it to form a diploid nucleus upon fertilization with an egg. |

**ADAPTATIONS OF THE SPERM FOR LOCOMOTION**

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| 1. **It has tightly packed mitochondria-** The middle piece of a sperm carries about 70 mitochondria which creates energy required for locomotion. 2. **The tail**- It has very long tailresponsible for the vigorous movement of sperm towards ovum |

**SPERM AND OVUM**

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**MAMMALIAN OVUM**

**DIFFERENCES BETWEEN MAMMALIAN SPERM & MAMMALIAN OVUM**

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| --- | --- |
| **Sperm** | **Ovum** |
| Streamlined line body shape | oval shape |
| Has tail | No tail |
| Has head | No head |
| Has mitochondria in the middle piece | No middle and hence no mitochondria |
| It is mobile | Immobile |
| size - Smaller than the sperm | Bigger than the sperm. It contains food reserve |

**SIMILARITIES BETWEEN MAMMALIAN SPERM & MAMMALIAN OVUM**

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| Both have   1. Nucleus 2. cytoplasm 3. Cell membrane |

**MENSTRUAL CYCLE & ROLES OF HORMONES**

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| Menstruation is the shedding of the lining of the uterus accompanied by bleeding. It starts during puberty and permanently stops at menopause. It is 28 days cycle. It begins with the first day of bleeding which is counted as day 1.  Menstrual bleeding lasts 3 to 7 days, averaging 5 days.  Menstrual cycle is regulated by hormones which include   1. **Follicle Stimulating Hormone**   It is produced by the Pituitary gland  **Function**  It promotes the development of Graafian follicle cells in the ovary.   1. **Luteinizing Hormone**   It is produced by the Pituitary gland  **Function**   1. It causes ovulation 2. It causes the development of corpus luteum 3. **Oestrogen hormone**   It is produced by the ovaries  **Function**  It stimulates the thickening of the uterine walls or its is responsible for uterine lining development   1. **Progesterone hormone**   It is produced by corpus luteum in the ovary  **Function**  It maintains pregnancy by stimulating the thickness of the uterine wall after fertilization has occurred. It prepares the uterine lining for implantation.  Menstrual cycle has three phases   1. Follicular phase (before the release of the egg) 2. Ovulatory phase (egg release) 3. Luteal phase (after egg release)   **THE STAGES OF MENSTRUAL CYCLE**  The chart below illustrates the changes in a woman’s body during the menstrual cycle**.**     1. **Follicular phase (before lease of the egg)**   During this stage, the level of oestrogen and progesterone hormone decreases in the in the blood, and this causes menstruation. The decrease in the level of oestrogen and progesterone causes the top layers of the thickened uterus break down and are shed, and menstrual bleeding occurs.  During the same period, the pituitary gland produces Follicle Stimulating Hormone hence its level increases slightly in the blood. The secretion and its increase in the blood, stimulates the development of follicle cells in the ovary.  Each follicle contains an egg. Later in the stage, as follicle Stimulating Hormone level decreases, only one follicle continues to develop. This follicle produces **Oestrogen.**   1. **The ovulatory phase**   This stage begins with the increase in Luteinizing Hormone and Follicle Stimulating Hormone. The Luteinizing and Follicle Stimulating Hormone are at their peak in the middle of the cycle (14th day) and cause the rupture of Graafian follicle cells to release ovum. This phase is ovulatory phase.  The function of Luteinizing Hormone is to stimulate egg release (ovulation) which usually occurs 16 to 32 hours after the surge begins.  During this phase, the oestrogen hormone level decreases` and the progesterone level starts to increase.   1. **Luteal phase**   The remains of the Graafian follicles get converted into the corpus luteum that secretes progesterone for the maintenance of the uterine lining. During the luteal phase, Pituitary gland starts producing Luteininizing hormone and follicle Stimulating hormone which increase their levels in the blood. During this phase, the oesttrogen level is high. Progesterone and oestrogen cause the lining of the uterus to thicken more, to prepare for possible fertilization.  If the egg is not fertilized (in the absence of fertilization), the corpus luteum degenerates and no longer produces progesterone, the oestrogen level decreases, the uterus lining breaks down and are shed and menstrual bleeding occurs, the start of a new menstrual cycle.  If the egg is fertilized, the corpus luteum continues to function during early pregnancy. It helps maintain the pregnancy. |

**FERTILISATION/CONCEPTION**

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| C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\oogenesis and spermatogenesis[9].jpg  Fertilization is the fusion of male and female gametes to form a zygote. Fertilization occurs in the oviduct after the egg has been released from the ovary where it is produced.  During copulation, semen is liberated by the penis into the vagina. The mobile sperms swim swiftly and pass through the cervix and then enter into the uterus and finally reach the fallopian tube (oviduct). In this region, the fertilization takes place which occurs only when the ovum and sperms are transported simultaneously to the oviduct/fallopian tube. This is the reason that all copulations do not lead to fertilization and pregnancy.  The diagram below shows how fertilization takes place in the oviduct of the female reproductive system.    In other words, fertilization can be defined as the fusion of haploid male gamete (sperm) and a haploid female gamete (ovum) to form a diploid zygote   * Within an hour after sexual intercourse, sperm would have traveled from the vagina, through the cervix, into the uterus and uterine tube. During this journey, the **acrosome** on the head of spermatozoa would be worn off, releasing **acrosin** enzyme by the time sperm are attached to the outer coatings of the ovum. * The head of the penetrated sperm is now detached from its mid piece and tail . It will then rupture , releasing 23 chromosomes in the form of long strands of DNA molecules . * The chromosomes from the sperm and ovum now unite to form a complete set of genetic makeup for the offspring – 2 haploid cells   (Sperm and ovum) are now joined to become a single diploid celled **zygote.** Fertilization is now complete.  The fertilized egg divides to form an embryo. The embryo attaches to the lining of the uterus. It begins to develop into a foetus and finally into a baby.  **THE DEVELOPMENT OF FOETUS IN THE UTERUS**    The foetus relies upon its mother as it develops. It needs   1. protection against knock and bumps and temperature changes 2. Oxygen for respiration 3. Nutrients -food and water   The foetus is protected by the **uterus** and the **amniotic fluid**, a liquid contained in a bag called the **amnion.** |

**THE ROLE OF PLACENTA**

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| * The placenta is an organ responsible for providing oxygen and nutrients, and removing waste substances. * It grows into the wall of the uterus and is joined to the foetus by the umbilical cord. * The mother’s blood does not mix with the blood of the foetus but the placenta lets substances pass between the two blood supplies by diffusion. These include  1. Oxygen and nutrients diffuse across the placenta from the mother to the foetus. 2. Carbon dioxide and other waste substances diffuse across the placenta from the foetus to the mother.   The blood of the mother and foetus do mix but substances diffuse across the placenta**.** |

**THE STRUCTURE AND FUNCTIONS OF THE PLACENTA**

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| **Umbilical cord**  Function of the umbilical cord is that it is the passage of materials from the maternal blood to the foetal blood and vice versa through the placenta.  The umbilical cord is not directly connected to the mother’s circulatory system. Instead, it joins the placenta which transfers materials to and from the mother’s blood by diffusion without allowing direct mixing.  The umbilical cord contains two blood vessels   1. **The umbilical vein** carries oxygenated, nutrient rich blood from the placenta to the foetus. It has high concentration of oxygen, amino acids, glucose, vitamins and antibodies from the placenta to the foetus. 2. **The umbilical artery** carries deoxygenated nutrient depleted blood from the foetus to the placenta. It has concentration of carbon dioxide, urea but low concentration of glucose, amino acids and fatty acids |

**PREGNANCY**

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| * A zygote is formed about 12-24 hours after ovulation. This single cell, still the same size as the original ovum, continues to travel through the uterine tube toward the uterus by the action of cilia along the inner lining of uterine tube. * About an hour after fertilization is complete, mitotic cell division **occurs**, dividing the zygote into a cluster of smaller cells. * Soon after implantation , layers of membrane begin to form outside the embryo * Stimulates the corpus luteum in the ovary for the secretion of estrogens and progesterone, until the placenta is fully developed and can secrete estrogens and progesterone. * **Amnion** – the middle membrane that secretes amniotic fluid for nourishing the embryo and to act as the lubricants. * **Placenta** – the outermost membrane that protects the embryo and foetus, allows exchange of nutrients and wastes between foetal and maternal blood, and secretes estrogens and progesterone to maintain pregnancy * As the placenta develops, it secrets large quantities of estrogen and progesterone.   Placental estrogen and progesterone:   1. Stimulate the uterine lining to continue development. 2. Maintain the uterine lining. 3. Inhibit secretion of FSH and LH from the Ant. pituitary gland. 4. Stimulates development of the mammary gland. 5. Inhibit uterine contractions (progesterone). 6. Enlarge the reproductive organs (estrogen). |

**FACTORS CONTRIBUTING TO LABOR PROCESS**

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| * As the time of birth approaches, secretion of progesterone declines, and its inhibiting effect on uterine contractions may lessen. * Decreasing progesterone concentration may stimulate synthesis of prostaglandins, which may initiate labour. * Stretching uterine tissues stimulates release of oxytocin from the Pituitary gland. * Oxytocin may stimulate uterine contractions and aid labor in its later stages. * As the foetal head stretches the cervix, a positive feedback mechanism results in stronger and stronger uterine contractions and a greater release of oxytocin. * Positive feedback stimulates abdominal wall muscles to contract with greater and greater force. * The fetus is forced out through the birth canal to the outside. |

**THE IMPORTANCE OF BREAST FEEDING**

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| Breast milk   * + Has perfect nutrients   + Is easily digested;   + Is efficiently used   + Protects against infection   **Breastfeeding**   * + Helps bonding and development   + Helps delay a new pregnancy   + Protects mothers’ health   + Costs less than artificial feeding   **Psychological benefits of breastfeeding**   1. **Emotional bonding**    * Close, loving relationship between mother and baby    * Mother more emotionally satisfied    * Baby cries less    * Baby may be more emotionally secure 2. **Development**    * Children perform better on intelligence tests   **Benefits for baby**   * + 1. Breast milk is the most complete form of nutrition for infants. A mother's milk has just the right amount of fat, sugar, water, and protein that is needed for a baby's growth and development. Most babies find it easier to digest breast milk than they do formula.     2. As a result, breastfed infants grow exactly the way they should. They tend to gain less unnecessary weight and to be leaner. This may result in being less overweight later in life.     3. Premature babies do better when breastfed compared to premature babies who are fed formula.     4. Breastfed babies score slightly higher on IQ tests, especially babies who were born pre-maturely.   **Benefits for mother:**   * Nursing uses up extra calories, making it easier to lose the pounds of pregnancy. It also helps the uterus to get back to its original size and lessens any bleeding a woman may have after giving birth. * Breastfeeding, especially exclusive breastfeeding (no supplementing with formula), delays the return of normal ovulation and menstrual * Breastfeeding lowers the risk of breast and ovarian cancers, and possibly the risk of hip fractures and osteoporosis after menopause. * Breastfeeding makes your life easier. It saves time and money. You do not have to purchase, measure, and mix formula. There are no bottles to warm in the middle of the night! * A mother can give her baby immediate satisfaction by providing her breast milk when her baby is hungry. * Breastfeeding requires a mother to take some quiet relaxed time for herself and her baby. * Breastfeeding can help a mother to bond with her baby. Physical contact is important to newborns and can help them feel more secure, warm and comforted. * Breastfeeding mothers may have increased self-confidence and feelings of closeness and bonding with their infants. |

**Colostrums**

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| **Property of colostrums and its importance**  • Antibody rich - protects against allergy & infection  • Many white cells - protects against infection  • Purgative - clears meconium  - helps to prevent jaundice  • Growth factors - helps intestine to mature  - prevents allergy, intolerance  • Rich in Vitamin A - reduces severity of infection |

**Disadvantages of artificial feeding (bottle feeding)**

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| * Interferes with bonding * More diarrhoea and persistent diarrhoea * More frequent respiratory infections * Malnutrition; Vitamin A deficiency * More allergy and milk intolerance * Increased risk of some chronic diseases * Obesity * Lower scores on intelligence tests * Mother may become pregnant sooner * Increased risk of anaemia, ovarian cancer, and * breast cancer in mother |

**CONTRACEPTIVE METHODS- BIRTH CONTROL**

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| **Birth control** is a voluntary regulation of conception. **Contraception** is any method used in birth control to prevent fertilization of the ovum.  The most common contraceptive methods and their success rate –   1. **Abstinence** is done by male and female where sexual intercourse is avoided.   **Advantages**   |  | | --- | | * Highly effective * No side effects, as with other methods * No cost * Can increase intimacy between partners |   **Disadvantages**   |  | | --- | | * May be difficult to abstain from all sexual activity for extended periods of time |  1. **Vasectomy** is done by male where the vas deferens tubes are cut to prevent sperm transport.      1. **Tubule ligation** is done by female where the uterine tubes are tied or cut to prevent ovum transport and passage of sperm. 2. **Birth control pills** is taken by female in which daily moderate level of estrogens suppress the ovarian and menstrual cycles. It prevents release of egg, and blocks sperm from meeting egg. Oral contraceptive pills should be taken one pill every day. They are most effective when no pills are missed, the pill is taken at the same time every day, and each new pack of pills is started without a delay     Advantages   1. Safe 2. Good method while breastfeeding      1. **Intrauterine Devices** (IUDS) (IUDs or IUCDs) are small, flexible plastic devices that are inserted into the woman’s uterus. The most common IUDs contain copper, and they work by preventing sperm from reaching an egg. The purpose of IUD is to prevent sperm from meeting the egg. Depending on the type, IUDs can provide protection for 5 to 12 years.     **Advantages**   1. Nothing to put in place before intercourse 2. Some do not change hormone levels 3. Some may reduce period cramps and make your period lighter. For some women, periods stop entirely 4. Can be used while breastfeeding 5. Can be used for an extended period of time (5 years and up) 6. The ability to become pregnant returns quickly once IUD is removed   Disadvantages   1. Large initial cost 2. Some IUDs can cause hormonal side effects similar to those caused by oral contraceptives, such as breast tenderness, mood swings, and headaches 3. **Condom** used by male or female is impermeable to sperm during ejaculation. Barrier methods are either devices (male and female condoms) that physically block sperm from reaching an egg, or chemicals (spermicides) that kill or damage the sperm in the vagina. The effectiveness of barrier methods greatly depends on people’s ability to use them correctly every time they have sex.   **Male condom Female condom**    **Advantages of male condom**   * Prevents both pregnancy and sexually transmitted infections including HIV/AIDS * Effective when used correctly every time you have sex * Condoms also could prevent the transmission of sexually transmitted diseases].   **Advantages of female condom**   1. Female-controlled 2. More comfortable to men, less decrease in sensation than with the male condom 3. Offers protection against STIs (covers both internal and external genitalia) 4. Can be inserted before sex 5. Stronger than latex   **Disadvantages of female condom**   1. Not aesthetically pleasing 2. Can slip into the vagina or anus during sex 3. Difficulties in insertion/removal 4. Not easy to find in drugstores or other com­mon sources of condoms 5. Higher cost than male condoms 6. **Diaphragm and / or foam** is used by female block the entrance of sperm into the cervix. 7. **Withdrawal method (or coitus interrupts)** is done by male in which the penis is withdrawn from the vagina before ejaculation occurs.     **Advantages**   1. No supplies 2. No side-effects 3. Can be used at any time   **Disadvantage**  Not as effective as other methods   1. **Rhythm method (75%)** is done by female where sexual intercourse is performed only before ovulation and about a week after ovulation occurs, there are three ways to time ovulation. Fertility awareness methods require a couple to know the fertile days of the woman’s menstrual cycle — the days when pregnancy is most likely to occur. During these fertile days the couple must avoid sex or use a barrier method to prevent pregnancy. 2. **Norplant**   Contraceptive implants are inserted under the skin of a woman’s upper arm and provide continuous, highly effective pregnancy protection for 3 to 5 years, depending on the type of implant. Hormones from the tubes blocks sperm from reaching egg and prevents release of egg. When this time is over, new implants can be inserted during the same visit that the old set is removed.    **Advantages**   |  | | --- | | 1. Do not have to take every day 2. Progestin only-no estrogen related side-effects Safe to use 3. Lasts up to 3 years |  1. Safe to use 2. One of the most effective methods  * Can be removed any time if you want to get pregnant   **Disadvantages**   |  | | --- | | * Insertion may be uncomfortable (The implant is a small flexible rod that is in­serted right under the skin of the inner arm.) * Progestin-related side effects   • Large initial cost |  1. **Female sterilization**  * Specially trained provider makes one or two small cuts to reach the tubes that carry eggs to the womb. Cuts or blocks the tubes. The womb is not removed. Can be done right after you have a baby as well as other times.   Female and male sterilization are permanent methods of contraception. Sterilization involves a relatively simple surgical procedure that provides life-long protection against pregnancy. Sterilization is appropriate for men and women who are certain they do not want more children. |

**PROBLEMS ASSOCIATED WITH REPRODUCTION**

1. **Sexually transmitted diseases (STDS)**

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| Formerly called venereal diseases (VDs). They are bacterial or viral infections that are spread through sexual contact.  These include   1. **Gonorrhea**  * Caused by bacterium named *Neisseria gonorrhoeae*. Bacteria invade the mucosal layer of reproductive and urinary tracts. * Most common symptoms in male is urethritis (infection of urethra)**,** resulting in painful urination. * Symptoms in female include abdominal discomfort, vaginal discharge, and uterine bleeding. * Penicillin and tetracycline antibiotic drugs are effective, but sometimes bacteria might be resistant to these drugs.  1. **Syphilis**  * Caused by a bacterium named *Treponema pallidum* . It can be transmitted from mother to fetus where the fetus usually will be stillborn or die after birth. * Bacteria penetrate mucosal layer and skin easily, and enter into blood and lymph. * Incubation period is about 12 weeks, after which a red, painless lesion appears on external genitalia . * If untreated, pink skin rash will appear all over the body. Fever, joint pain, anaemia, hair loss will occur if still untreated. * Final stage of development occurs after a 10-years latent period – bacteria invade central nervous system, blood vessels, bones, skin, and other organs – which might lead to death. penicillin is the only known treatment , but only effective during early stages of symptoms   **5. Chlamydia**   * Caused by a bacterium named *Chlamydia trachomatis*. * Responsible for 25-50% of all pelvic inflammation. * Each year about 150,000 infants are born with the disease (in these cases, Chlamydia becomes a "congenital disease” where the fetus acquires the bacteria from mother's vagina during the birth process). * **Symptoms** are often unrecognized – urethritis , vaginal discharge , * Abdominal pain, painful urination and intercourse, and irregular menstruation. * Infants tend to develop pneumonia. * Treatment is tetracycline. |

1. Sterility
2. Fistula
3. Cervical cancer
4. Maternal death
5. Abnormal menses

**THE HUMAN LIFE CYCLE**

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| Humans use two types of cell division to ensure that DNA is passeddown from cell to cell during reproduction.  During mitosis a cell doubles its DNA before dividing into two cells.  In meiosis, the chromosomes in a gamete cell are reduced by half. |

**MITOSIS**

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| * Mitosis is a nuclear division of the ordinary cell that results in the production of diploid daughter cells. In other words, mitosis is a process where a single cell divides into two identical daughter cells. * Mitosis is a type of cell division in which one cell (the mother) divides to produce two new cells (daughter cells) that are genetically identical to itself. * Mitosis is described as somatic cell division because it occurs in soma cells (ordinary cells) * The figure below shows mitosis process. * Diploid daughter cells are the cells that contain full number of chromosomes of the parent cell. |

**FUNDAMENTAL FEATURES OF MITOSIS**

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| The following are the fundamental features of mitosis:   * + - Involves one cell division     - Results in two daughter cells     - Results in diploid daughter cells- chromosome number remains as the same as parent cell.     - Daughter cells are genetically identical.     - Occurs in all organisms except viruses     - Creates all body cells-somatic cells apart from the gametes     - Prophase is much shorter     - No recombination/crossing over occurs in prophase.     - In metaphase individual chromosomes -pairs of chromatids line up along the equator.     - During anaphase the sister chromatids are separated to opposite poles. |

**STAGES OF MITOSIS PROCESS**

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| **Mitosis occurs in five stages:**   * 1. **Interphase:** the start of mitosis, the DNA of each chromosome replicates. Each chromosome then reorganizes into paired structures called sister chromatids, with each member of the pair containing a full copy of the DNA sequence.   2. **Prophase:** the sister chromatids condense, thickening until they appear joined at a single site, known as the centromere.   3. **Metaphase**: the sister chromatids line up in the middle of the cell.   4. **Anaphase**: the chromatid pairs split apart at the centromere, and each half of the pair then moves toward opposite poles of the cells.   5. **Telophase:** the final stage of mitosis, a nuclear membrane forms around the chromosomes at each pole of the cell.   + Mitosis ends with the formation of two new cells, each with a matching full set of chromosomes.   + The cytoplasm divides; the cell membrane pinches inward ultimately producing two daughter cells (**Cytokinesis**). |

**MEIOSIS (REDUCTION CELL DIVISION)**

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| * Meiosis is a process where a single cell divides twice to produce four cells containing half the original number of chromosomes of that of parent cell. * Meiosis is described as **reduction cell division** because it reduces the chromosome number of the parent cell to half in the daughter cells. * The figure below shows meiosis process |

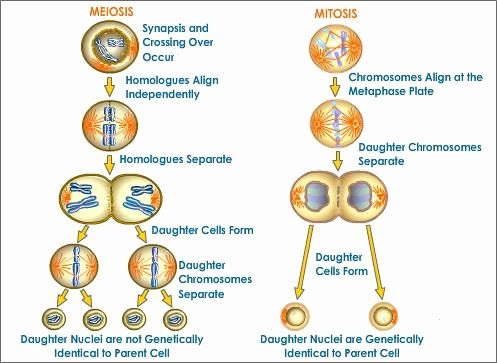
**STAGES OF MEIOSIS**

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| **Meiosis comprises two successive nuclear divisions.**  **FIRST DIVISION OF MEIOSIS**:   * 1. **Prophase I:** Each chromosome duplicates and remains closely associated. These are called sister chromatids.   2. **Metaphase I**: Homologous chromosomes align at the equatorial plate.   3. **Anaphase I**: Homologous pairs separate with sister chromatids remaining together.   4. **Telophase I**: Two daughter cells are formed with each daughter containing only one chromosome of the homologous pair.   **SECOND DIVISION OF MEIOSIS**:   * 1. **Prophase II**: DNA does not replicate.   2. **Metaphase II**: Chromosomes align at the equatorial plate.   3. **Anaphase II**: Centromeres divide and sister chromatids migrate separately to each pole.   4. **Telophase II**: Cell division is complete. Four haploid (n) daughter cells are obtained.   Meiosis ensures that reproduction will produce a zygote that has  received one set of chromosomes (n) from each parent to form |

**FUNDAMENTAL FEATURES MEIOSIS**

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| 1. Involves two successive cell divisions 2. Results in four daughter cells 3. Results in haploid daughter cells which have the chromosome number is halved from the parent cell. 4. Daughter cells are genetically different 5. Occurs only in animals, plants and fungi 6. It produces gametes (eggs and sperms) only 7. Prophase 1 takes much longer 8. Involves recombination/crossing over of chromosomes in prophase 1. 9. During anaphase 11 the sister chromatids are separated to opposite poles. |

**MITOSIS AD MEIOSIS**



**SIMILARITIES BETWEEN MITOSIS AND MEIOSIS**

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| * Have diploid parent cell * Both consists of interphase, prophase, metaphase, anaphase and telophase stages * Both in metaphase individual chromosomes (pairs of chromatids) line up along the equator. * Both during anaphase the sister chromatids are separated to opposite poles. * Ends with cytokinesis. |

**FUNDAMENTAL DIFFERENCES BETWEEN MITOSIS AND MEIOSIS**

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| **MITOSIS** | **MEIOSIS** |
| Involves division of body(soma) cells | Involves division of sex cells |
| Division of a cell occurs once | Division of cell occurs twice |
| Produces two daughter cells | Produces four daughter cells |
| Produces diploid cells | Produces haploid cells |
| Daughter cells are genetically identical | Daughter cells are genetically different |

**CHROMOSME NUMBER**

**How do you calculate chromosomes of the ordinary cell or the gamete of an organism?**

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| * Diploid cell has 2n chromosomes while the haploid has n chromosomes. * Given the number of the ordinary cell of an organism divide by 2 to get the number of chromosomes found in its haploid cells (gametes). * Given the number of chromosomes in the gamete of an organism, to find the number of chromosomes in the diploid cell or ordinary cell, you have to multiply the number of chromosomes found in the gamete (haploid cell) by 2. * The number of chromosomes does not correlate with the apparent complexity of animal or a plant. * In humans, for example, the diploid number is 2n = 46 (that is 23 pairs). The sperm of a man has 23 chromosomes or an ovum has also 23 chromosomes half of the diploid cell. This means that the haploid cell has half the chromosomes of the diploid number of the chromosomes. * The ordinary cell of a dog has 78 pairs of chromosomes and its gamete (an egg or sperm has 39 chromosomes. |

**THE STRUCTURE AND FUNCTIONS OF THE CHROMOSOMES**

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| Chromosomes are threadlike structure molecules that carry hereditary information (carrying genetic information in the form of genes) found in the nucleus of most living cells, Chromosomes contribute to the division of cells and they are of prime importance as they carry the genes which are the hereditary material.  Each chromosome consists of protein substance known as Deoxyribonucleic Acid (DNA) which contains an organism’s genetic instructions passed down from parents.  During cell division, each DNA strand is duplicated and the chromosomes condense to become visible as distinct pairs of chromatids joined at the centromere.  The figure below shows the chromosomes.    DNA is protein molecule found in the chromosome that encodes all the information every cell needs.  Humans have 23 pairs of chromosomes. The human being’s ordinary cell has 23 pairs of chromosomes and 46 chromosomes in total in the ordinary cell.  Twenty two pairs, the autosomes, are the same in either sex and are numbered from 1- 22. The 23rd chromosome pair is called the sex chromosome, this chromosome pair consists of two X chromosomes in women, and men have one X + one Y chromosomes.  During fertilization, gametes from the sperm combine with gametes from the egg to form a zygote. The zygote contains sets of 23 chromosomes for the required 46 chromosomes. |

**GENETICS & INHERITANCE**

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| Genetics is the study of the principles of **heredity and variation**. A unique genetic code is found in the DNA of each organism and is passed on to the offspring during reproduction. Since there are **two parents** required for sexual reproduction, **genetic variation** will occur to ensure survival of the fittest.  **The Role of Gametes in Inheritance**     * DNA molecules on the chromosomes consist of sections called **genes** * Each gene contains the hereditary **traits,** e.g. skin and hair colour, height, body structure and blood group are represented by the genes on each of the two homologous chromosomes. * **What is a trait?** A **trait** is a characteristic that can vary from one individual to the next (e.g., eye color) * During the process of Meiosis, **haploid** gametes are produced and the gametes will contain one set of genes * During fertilization, the gametes fuse and a **diploid zygote** results * One set of genes will come from the female parent (maternal) and one set from the male parent (paternal) |

**MENDEL’S THREE LAWS.**

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| * + - 1. **Law of Dominance**   When two homozygous individuals with one or more sets of contrasting characters are crossed, the characters that appear in the F1 hybrids are dominant characters and those do not appear in F1 are recessive characters.  The **Principle of dominance states that** some alleles are dominant and others are recessive.  **Dominant** traits are expressed if only one allele is present. (Capital letter, first letter of trait ex. **Tall= T)**  **Example -** Tall allele **(T)** is dominant and short allele is recessive **(t).If the tall plants are crossed bred with short plants all F1** generation will be tall even though Tt. Both **TT and Tt** plants are Tall    **Law of Segregation**  Law of Segregation states that the hereditary factors (genes) making up a pair are separated out during the time of gamete formation, that is, only one factor or gene of each pair goes into a given gamete.  In other words, the Law of Segregation states that when any individual produces gametes, the copies of a gene separate, so that each gamete receives only one copy. A gamete will receive one allele or the other.  This principle is also known as **Law of purity of *gametes*,** because gametes are always pure for a given pair. They have only one gene(factor) of each pair.  See the diagram below    Mendel stated that each individual has two factors for each trait, one from each parent. The two factors may or may not contain the same information.  If the two factors are identical, the individual is called **homozygous** for the trait.  If the two factors have different information, the individual is called **heterozygous**. The alternative forms of a factor are called **alleles**. The genotype of an individual is made up of the many alleles it possesses. An individual's physical appearance, or phenotype, is determined by its alleles as well as by its environment. An individual possesses two alleles for each trait; one allele is given by the female parent and the other by the male parent. They are passed on when an individual matures and produces gametes: egg and sperm. When gametes form, the paired alleles separate randomly so that each gamete receives a copy of one of the two alleles. The presence of an allele doesn't promise that the trait will be expressed in the individual that possesses it. In heterozygous individuals the only allele that is expressed is the dominant. The recessive allele is present but its expression is hidden.  **Example 1**  In the cross between Red flowered and White flowered plants, the F1 plants possess factors for both Red and White flower colours. But during gamete formation, they got separated. Some of the gametes will have factor or gene 'R' while other have r.  Example 2  Pure tall plants are homozygous and, therefore/possess genes (factors) TT; similarly dwarf possess genes tt. The tallness and dwarfness are two independent but contrasting factors or determiners. **Pure tall plants** produce gametes all of which possess gene **T** and dwarf plants t type of gametes.  During cross fertilization gametes with **T** and t unite to produce hybrids of F1 generation. These hybrids possess genotype **Tt**. It means **F**1 plants, though tall phenotypically, possess one gene for tallness and one gene for dwarfness. Apparently, the tall and dwarf characters appear to have become contaminated developing only tall character. But at the time of gamete formation, the genes **T (for tallness)** and **t (for dwarfness)** separate and are passed on to separate gametes. As a result, two types of gametes are produced from the heterozygote in equal numerosity. 50% of the gametes possess **gene T** and other 50% possess **gene t**. Therefore, these gametes are either pure for tallness or for dwarfness. (This is why the law of segregation is also described as Law of purity of gametes).  Gametes unite at random and when gametes are numerous all possible combinations can occur, with the result that tall and dwarf appear in the ratio of 3 :1.  **Example 3**     * + - 1. **Law of Independent assortment**   The Law of Independent Assortment, also known as **"Inheritance Law"**, states that alleles of different genes assort independently of one another during gamete formation. |

**MENDELIAN DEVIATION**

Mendelian deviations or exceptions or anomalies includes

* 1. **Incomplete dominance**

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| * It is the situation in which both alleles do not display a dominant trait over the other resulting in a fine combination. * **Incomplete Dominance** (**Blending Inheritance)**-The hybrid does **not** resemble either parent but instead is a blend of parental traits. * Genes show incomplete dominance when the heterozygous phenotype is intermediate. * In cases of incomplete dominance, the inheritance of a dominant and a recessive allele results in production of intermediate characteristics. Mendel always observed complete dominance of one allele over the other for all the seven characters, which he studied, in garden pea. * **For example**, four-o’clock paint plants may have red, white, or pink flowers. Plants with red flowers have two copies of the dominant allele **R** for red flower color (**RR**). Plants with white flowers have two copies 16 of the recessive allele **r** for white flower color (**rr**). Pink flowers result in plants with one copy of each allele (**Rr**). * A cross between red and white flowered plants produced plants with intermediate flower colour i.e. pink colour in F1 and a modified ratio of 1 red: 2 pink: 1 White in F2.   **INCOMPLETE DOMINANCE**    **C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\unnamed.gif**  **Parents Red flower x White flower**  **RR x ww**    The above diagram is well illustrated by the punnet squares below  **Parents Pink flower x Pink flower (self-pollinated)**  **Rw x Rw**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Genotypes |  | RR | | F1 offsprings | |  | gametes | R | R | | ww | w | Rw | Rw | | w | Rw | ww |   F1 Rw pink flower  **Parents (F1) Pink flower x Pink flower (F1 X F1)**  **Rw x Rw**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Genotypes |  | Rw | | F2 offsprings | |  | gametes | R | R | | Rw | R | RR | Rw | | w | Rw | ww |   F2 1 Red (Rr) **:** 2 Pink (RR) **:** 1 White (rr) |

**COMPLETE DOMINANCE**

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| Mendel always observed complete dominance of one allele over the other for all the seven characters, which he studied, in garden pea.  A cross between red and white flowered plants produced plants with intermediate flower colour i.e. pink colour in F1 and a modified ratio of 1 red: 2 pink: 1 White in F2. See the diagram below    In case of codominance both alleles express their phenotypes in heterozygote greater than an intermediate one. The example is AB blood group in human. The people who have blood type AB are heterozygous exhibiting phenotypes for both the IA and IB alleles. In other words, heterozygotes for codominant alleles are phenotypically similar to both parental types.  The main difference between codominance and incomplete dominance lies in the way in which genes act. In case of codominance both alleles are active while in case of incomplete dominance both alleles blend to make an intermediate one. |

**Example of co dominance inheritance**

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| Co dominance is a form of inheritance wherein the alleles of a gene pair in a heterozygous are fully expressed. As a result, the phenotype of the offspring is a combination of the phenotype of the parents. Thus, the trait is neither dominant nor recessive.  Inheritance of blood groups, blood groups are determined by three types of genes, Genes A, B and O but genes A and B are both dominant genes and gene O is a recessive gene.  In case of codominance both alleles express their phenotypes in heterozygote greater than an intermediate one. The example is AB blood group in human. The people who have blood type AB are heterozygous exhibiting phenotypes for both the IA and IB alleles. In other words, heterozygotes for co-dominant alleles are phenotypically similar to both parental types.  The main difference between co- dominance and incomplete dominance lies in the way in which genes act. In case of co-dominance both alleles are active while in case of incomplete dominance both alleles blend to make an intermediate one. |

* 1. **Lethal genes etc**.

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| Gene, which causes the death of its carrier when in homozygous condition, is called lethal gene.  Mendel’s findings were based on equal survival of all genotypes. In normal segregation ratio of 3:1 is modified into 2:1 ratio. Lethal genes have been reported in both animals as well as plants.  In mice allele for yellow coat colour is dominant over grey. When a cross is made between yellow and grey a ratio of 1:1 for yellow and gray mice was observed. This indicated that yellow mice are always heterozygous. Because yellow homozygotes are never born because of homozygous lethality. Such genes were not observed by Mendel. He always got 3:1 ratio in F2 for single gene characters.  Lethal genes can be recessive, as in the aforementioned mouse experiments. Lethal genes can also be dominant, conditional, semilethal, or synthetic, depending on the gene or genes involved. See below |

**MONOHYBRID CROSS**

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| * A cross is made between two true-breeding parents differing for a single trait, producing an F1 generation. These plants are intercrossed to produce an F2 generation. * A cross is made between two true-breeding parents differing for a single trait, producing an F1 generation. These plants are intercrossed to produce an F2 generation * A monohybrid cross is a genetic mix between two individuals who have homozygous genotypes or genotypes that have completely dominant or completely recessive alleles which result in opposite phenotypes for a certain genetic trait. * Monohybrid crosses are used by geneticists to observe how the offspring of homozygous individuals express the **heterozygous** genotypes they inherit from their parents. Typically this mix determines the dominant **genotype**. * A monohybrid cross can also signify a genetic mix between two individuals who have heterozygous genotypes. These crosses confirm the dominance of an **allele**.   **EXAMPLE 1**    **EXAMPLE 2**   |  | | --- | | **EXAMPLE 2** | |

**THE TESTCROSS**

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| Test cross is used as a tool to find out the genotype of the unknownindividual. For example, a Red flowered plant may be either homozygous [RR] orheterozygous [Rr], Its genotype can be determined by test cross. The Red flowered plantof unknown genotype is to be crossed with a White flowered plant If we get only Redflowered plants among the offsprings in F2, the Red parent plant is homozygous If weget both Ted flowered and White flowered plants among the offsprings, the Red floweredparent plant is heterozygous.  Because some alleles are dominant over others, the phenotype of an organism does not always reflect its genotype. A recessive phenotype (yellow) is only expressed with the organism is homozygous recessive (gg). A pea plant with green pods may be either homozygous dominant **(GG)** or heterozygous (**Gg)**. To determine whether an organism with a dominant  phenotype (e.g. green pod color) is homozygous dominant or heterozygous, you use a ***testcross*.**  The breeding of an organism of unknown genotype with a homozygous recessive. If all the progeny of the testcross have green pods, then the green pod parent was probably homozygous dominant since a **GG x gg** cross produces **Gg** progeny. If the progeny of the testcross contains both green and yellow phenotypes, then the green pod parent was heterozygous since a **Gg x gg** cross produces **Gg** and **gg** progeny in a 1:1 ratio. The testcross was devised by Mendel and is still an important tool in genetic studies. |

**BACK CROSSES**

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| In Mendelian inheritance, the F2 offsprings are obtained by self-pollinating the F1 hybrids. But the F1 hybrids can be crossed with either of the two parents of the parental generation. **Such crosses between F1 individuals [Rtf and theirparents [RR] or [rtf** **are known as Back crosses** |

**DOMINANT AND RECESSIVE GENES**

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| **Dominant** – It is an allele that masks the presence of a recessive allele in the phenotype. Dominant alleles for a trait are usually expressed if the individual is homozygous dominant or heterozygous.  **Recessive** – allele whose phenotypic expression is “hidden” when a dominant allele is present  **Hybrid** – offspring from a cross between two “pure” lines of different, competing phenotypes  **Dominant trait:** A heterozygous offspring will display the dominant trait because it will **dominate** over the other recessive gene of the allele pair, e.g.: red colour will **dominate over** the gene for white colour, so the offspring will look red.  **Dominant traits** are shown with a capital letter and Recessive traits are shown with a lower case letter  The **dominant allele** is always written with a capital letter: **R** = red and the recessive is written in lower case **r** = white.  **Homozygous dominant alleles** means that both genes are the **same** for the same dominant trait. It will be represented by **RR,** which represents both the genes for red flowers. The offspring will be red because **two dominant genes** are present.  **Heterozygous alleles** means that **one gene is dominant** and **one gene is recessive** for the same trait, e.g. red flowers. It will be represented by **Rr,** which represents one gene for red and one gene for white. The offspring will display red flowers, because red is **dominant** over white.  Mendel discovered that by crossing white flower and purple flower plants, the result was not a hybrid offspring. Rather than being a mix of the two, the offspring was purple flowered. He then conceived the idea of heredity units, which he called "factors", one which is a recessive characteristic and the other dominant. Mendel said that factors, later called genes, normally occur in pairs in ordinary body cells, yet segregate during the formation of sex cells. Each member of the pair becomes part of the separate sex cell. The **dominant gene**, such as the purple flower in Mendel's plants, will hide the **recessive gene**, the white flower.  After Mendel self-fertilized the F1 generation and obtained **the 3:1 ratio**, he correctly theorized that genes can be paired in three different ways for each trait; **AA, aa, and Aa**. The capital **A** represents the dominant factor and lowercase **a** represents the recessive. |

**GENOTYPE**

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| **Genotype** is the genetic make up of an individual. In other words, genotype is the genetic makeup of an organism, a description of the genes it contains. The genotype of an individual is made up of the many alleles it possesses.  **Gene** – unit of heredity; controls a trait that determines a phenotype, **Locus** – the location of a particular gene on a chromosome. **Alleles** – alternative versions of a gene  **HOMOZYGOUS AND HETEROZYGOUS**  Mendel stated that each individual has two factors for each trait, one from each parent. The two factors may or may not contain the same information.  If the two factors are identical, the individual is called **homozygous** for the trait.  If the two factors have different information, the individual is called **heterozygous**.  **Homozygous** means to have **2 identical** alleles for a trait. Ex. TT or tt True-breeding pea plants are homozygous.  **Heterozygous** means to have **2 different** alleles for a trait. Ex. Tt Hybrid plants are heterozygous.  **Therefore, homozygous** are individuals carrying two identical alleles (RR or rr) while **heterozygous** are individual organisms bearing different alleles (Rr).  **Homozygous genotype-** This refers to a genotype carrying two dominant or two recessive alleles. One allele is inherited from the father and the other from the mother. Examples include AA, BB, RR, WW, aa, bb, nn etc  **Heterozygous genotype-** This refers to the genotype carrying one dominant and one recessive allele.Examples include Aa, Rr, Ww, Bb, Hh etc |

**PHENOTYPE**

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| P**henotype** is the physical appearance of the individual produced by the genotype in cooperation with the environment. In other words, **phenotype** is the characteristics that can be observed in an organism determined by interaction of genes and environment. An individual's physical appearance, or phenotype, is determined by its alleles as well as by its environment.  Phenotyoe refers to the physical traits that are observed in an organism which are the outcome of the expression of the genes of individuals.  Examples Sickle cell trait, Red flower, White flower etc  Genes provide potential, but environment determines whether that potential is realized. This is illustrated below |

**DIFFERENCES BETWEEN HOMOZYGOUS & HETEROZYGOUS**

|  |  |
| --- | --- |
| **Homozygous** | **Heterozygous** |
| Consists of two copies of same allele that codes for particular trait. | Consists of two different copies of alleles that code for a particular trait. |
| Consists of either allele pairs but not both | Consists of both dominant and recessive allele |
| Self-breeding results in the same traits over generations | Self-breeding results in the combination of traits. |
| Produces a single gamete | Produces two types of gametes |
| The two types are homozygous dominants and homozygous recessive | The three types of heterozygous alleles complete dominance, incomplete dominance, and co dominance. |

**DIFFERENCES BETWEEN GENOTYPE AND PHENOTYPE**

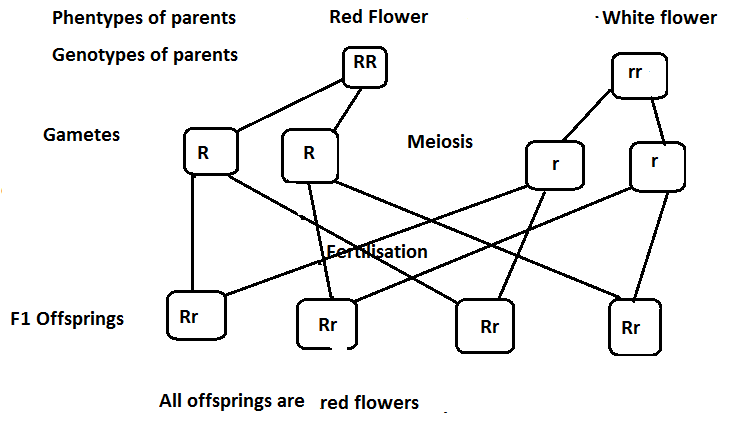
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| **Genotype** | **Phenotype** |
| It refers hereditary information of the organism in the form of gene in the DNA and remains the same throughout the life | It refers to the visible characteristics of an organism**.** |
| Same genotype produces same phenotype | Same phenotype may or may not belong to same genotype |
| Present inside the body as genetic material | Expression of genes as the external appearance |
| It is inherited from the parent to the offspring. | It is not inherited from the parent |
| It can be determined by scientific methods. | It can be determined by observing the organism |
| It is affected by genes | It is affected by genotype and environmental conditions. |

**MONOHYBRID CROSSES & GENOTYPIC & PHENOTYPE RATIOS**

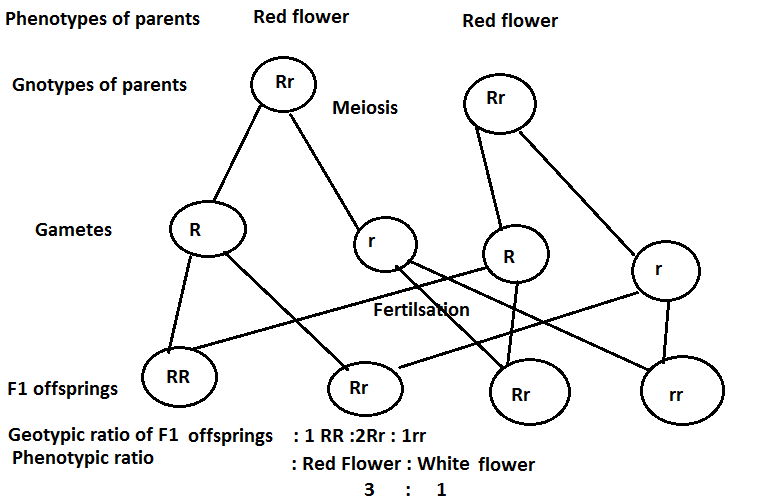
* + **P generation (or P1)** = parental generation
  + **F1 generation** = first generation offspring (from *filial*)
  + **F2 generation** = second generation offspring

**EXAMPLES**

1. A hozygous dominant red flower is crossed with a homozygous recessive white flower. Write down the genotypes of the parent, gametes, and F1 offsprings. What are the phenotypes of the F1 offsprings.

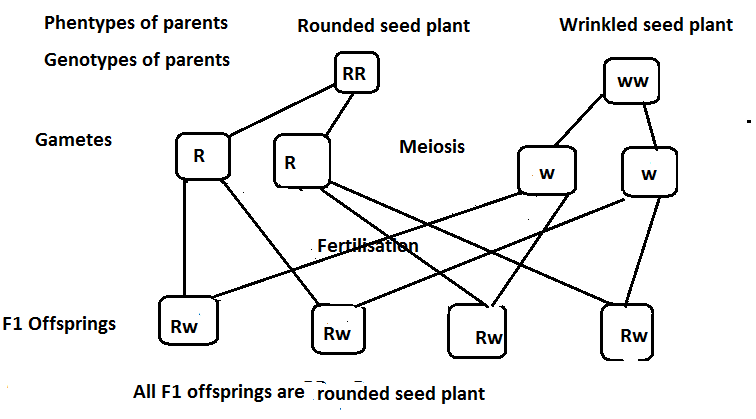


1. If the F1 offsprings were self-pollinated, what would be the genotypic and phenotypic ratios of the F2 offsprings? Show the workings.

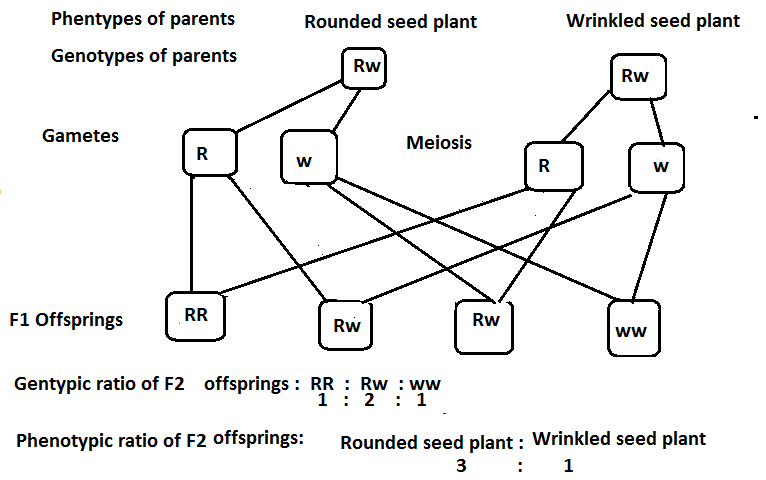


A hozygous dominant rounded seed plant is crossed with a homozygous recessive wrinkled seededplant. All F1 offsprings are rounded seed plantys.

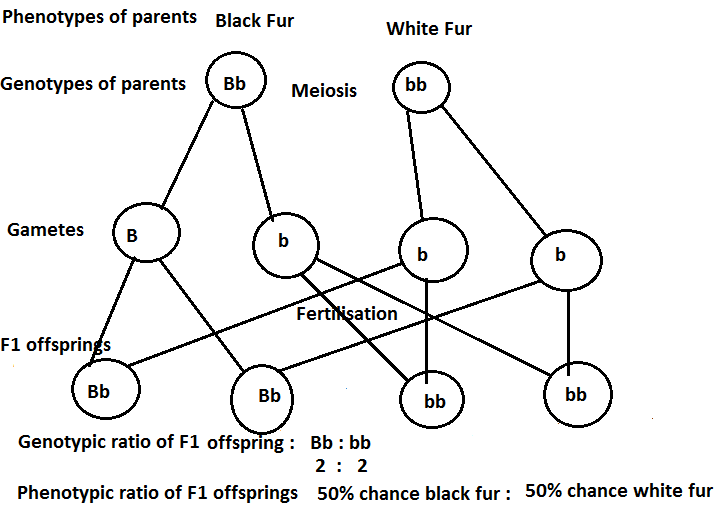
* + 1. What are the genotypes of the parent and F1 offsprings? Show your workings.



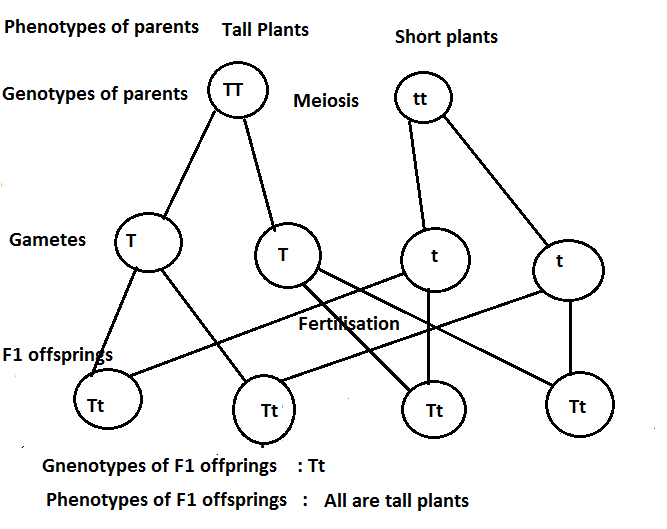
* + 1. If the F1 offsprings were self-pollinted, what would be the genotypic and phenotypic ratios of the F2 offsprings?



In guinea pigs, black fur (B) is dominant to white (b), cross Bb x bb and determine genotypic ratio for the offspring.



In pea plants, Tall stems (T) are dominant to short stems (t), cross a homozygous tall plant with a homozygous recessive plant, what are the genotypes and phenotypes of the F1 offsprings?



In plants, tall(T) is dominant to short (t) . Perform the followoing cross: Tt x Tt. What is the probality of producing short plant?

|  |
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| Phenotype Tall plants x Tall Plants  Genotypes Tt x Tt    Genotypes Phenotypes  TT Tall Plant  2 Tt Tall Plant  tt Short Plant  Phentypic ratio : 75% chance Tall : 25 % chance Short  Genotypic ratio 1 TT : 2 Tt : 1 tt  25% TT : 50% Tt : 25% tt |

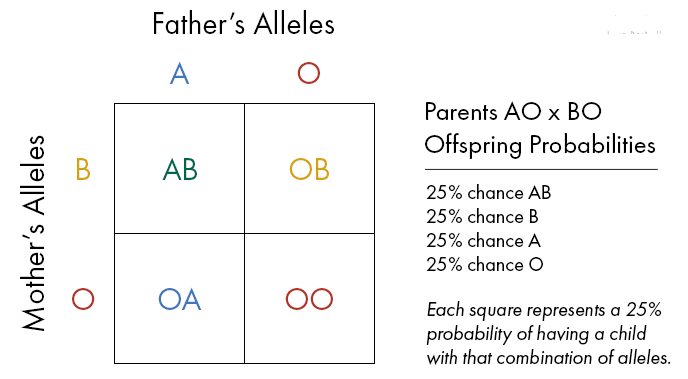
In labrador retreivers the allele for a black coat colur (B) is dominant over the allele for a brown coat colour (b). If a brown labrador retriver is crossed with a heterozygous black labrador retriver, what will be genotypic ratio and phenotypic ratio of the F1 offsprings?

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| The Father must have Blood Type AB with genotype AB and the mother must have blood Type A with genotype AO to have the child with Blood Type B as shown the Punnett Square below | | |
| Gametes | O | 0 |
| A | AO | AO |
| B | BO | BO |
| **F1 Genotypes F1 Phenotypes**  2AO Blood Type A  2BO Blood Type B  Therefore, the mother’s genotype must be AO of Blood Type O in order to two children with Blood Types A and B and not to a child with Blood Type O. | | |

**INHERITANCE OF BLOOD GROUPS**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Blood groups are inherited from our biological parents in the same way as eye colour and other traits.  Within the ABO Blood Group system, the A and B genes are co-dominant, that is, these will be expressed wherever the gene is present. The gene O is recessive and only expressed when neither A or B is present. Each biological parent donates one of the two genes ABO genes to their child.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Genotype of blood group** | | **Condition** | | **Phenotype** | | **AA** | | **Homozygous** | | **Blood group A** | | **BB** | | **Homozygous** | | **Blood group B** | | **AB** | | **Heterozygous** | | **Blood group AB** | | **OO** | | **Homozygous** | | **Blood group** | | **AO** | | **Heterozygous** | | **Blood group A** | | **BO** | **Heterozygous** | | **Blood group B** | |   **C:\Users\new\AppData\Local\Temp\WPDNSE\{000030F6-0001-0001-0000-000000000000}\images (16).png** |

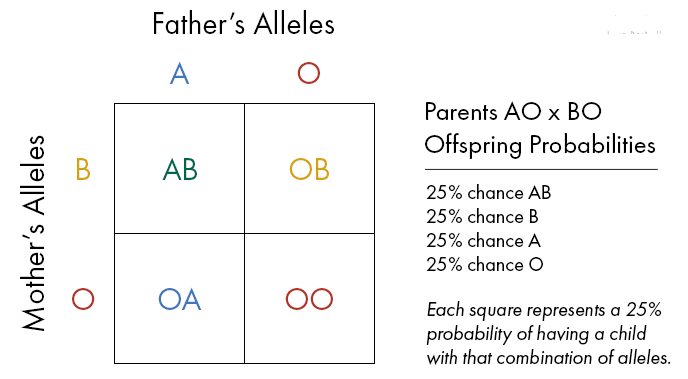
A woman with type A blood (genotype AO) is married to a type B person (genotype BO). Show the cross. What proportion of their children will have?



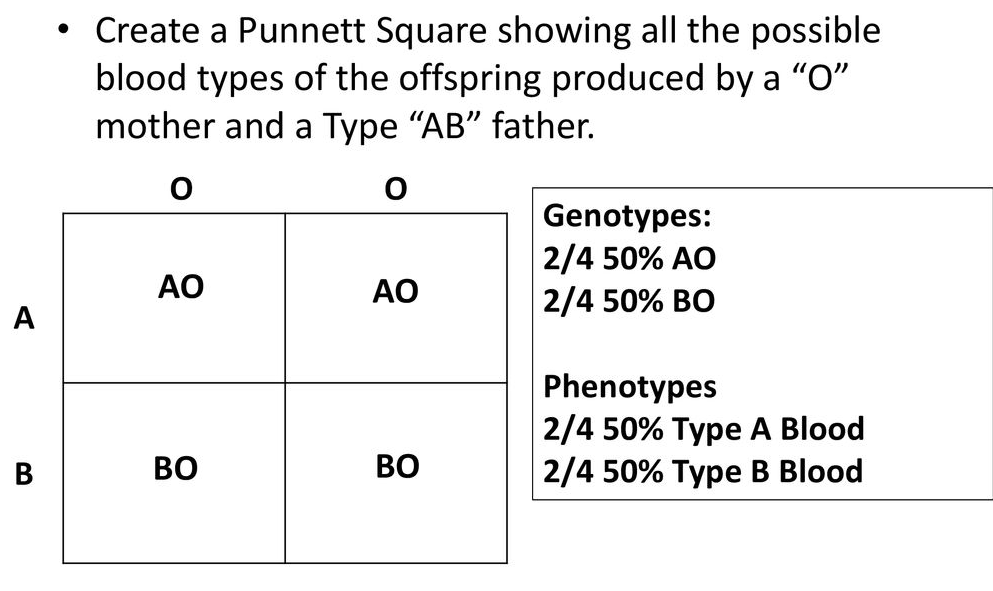
A man has type B blood (genotype BO) is married to a woman with type O blood. Show the cross. What proportion of their children will have?

|  |  |  |
| --- | --- | --- |
| The Father must have Blood Type AB with genotype AB and the mother must have blood Type A with genotype AO to have the child with Blood Type B as shown the Punnett Square below | | |
| Gametes | B | 0 |
| O | BO | OO |
| O | B0 | OO |
| **F1 Genotypes F1 Phenotypes**  2OO 50% chance Blood Type O  2B0 50% chance Blood Type B  Therefore, the mother of Blood Type O genotype and the father of Blood Type B with genotype (BO) can have 2 children with Blood Type O and 2 children of Blood Type B. | | |

A man with type A blood with genotype **(AO)** is married to a woman also with type B blood with genotype **(BO).** Show the cross. What proportion of their children will have?



A man with type AB blood is married to a woman also with type O blood. Show the cross. What proportion of their children will have?



A woman with type A blood is claiming that a man with type AB is the father of her child who is type B. Show all the possible crosses. Could this man be the father of the child? How? Assuming that he is the father, what must the mother’s genotype be?

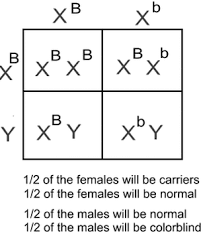
|  |  |  |
| --- | --- | --- |
| The Father must have Blood Type AB with genotype AB and the mother must have blood Type A with genotype AO to have the child with Blood Type B as shown the Punnett Square below | | |
| Gametes | A | 0 |
| A | AA | AO |
| B | AB | BO |
| **F1 Genotypes F1 Phenotypes**  AA Blood Type A  AB Blood Type AB  AO Blood Type A  B0 Blood Type B  Therefore, the mother’s genotype must be AO of Blood Type to hear a child with Blood Type B. | | |

A man with type AB blood is married to a woman with type O. They have two natural children and one adopted child. Jane has type A blood, Jordan has type B blood, and Marlin has type O blood. Which child was adopted? How do you know?

|  |  |  |
| --- | --- | --- |
| The Father must have Blood Type AB with genotype AB and the mother must have blood Type A with genotype AO to have the child with Blood Type B as shown the Punnett Square below | | |
| Gametes | O | 0 |
| A | AO | AO |
| B | BO | BO |
| **F1 Genotypes F1 Phenotypes**  2AO Blood Type A  2BO Blood Type B  Therefore, the mother’s genotype must be AO of Blood Type O in order to two children with Blood Types A and B and not to a child with Blood Type O. | | |

**SEX- DETERMINATION INHERITANCE**

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| * Most chromosome pairs consist of identical (homologous) partners. * In humans, there is one pair of chromosomes in which the partners noticeably differ from each other. These are called the sex chromosomes because they determine the differences between males and females. * In human females, the sex chromosomes consist of two **X** chromosomes, while males have an **X** chromosome and a shorter **Y** chromosome with many fewer genes. * A male’s **X** chromosome may contain a recessive allele associated with a genetic disorder, such as hemophilia and red-green color blindness in humans. * Males do not have a normal second copy of the gene on the **Y** chromosome to mask the effects of the recessive gene, and disease typically results in the above cases. * Genes that are carried by either by either sex chromosome are said to be sex linked. Men normally have an X and Y combination of sex chromosomes while women have two X’s. Since only men inherit Y chromosomes, they are the only ones to inherit Y-linked traits.   **Sex Determination**  Somatic Cells-46 chromosomes/cell (23 Pairs)  44 Autosomes (22 Pairs)  2 Sex Chromosomes (1 Pair)  X chromosome-Female, Y Chromosome-Male   * XX-Normal Female, XY-Normal Male   Normal female   |  |  |  |  | | --- | --- | --- | --- | | Normal male | Gametes | X | X | | X | XX | XX | | Y | XY | XY | |  |  |  |   Genotypic ratio : 50% chance XX : 50% CHANCE XY  Phenotypic ratio: 50% Normal male : 50% Normal female  Female to Male ratio should be the same however it is not; **106 Males:100 Females**-The **Y** chromosome is smaller and lighter in weight then the **X** chromosome. **Y** sperm can swim slightly faster then the **X** sperm so more **Y** sperm will reach the egg. There is a somewhat better chance that the **Y** sperm will fertilize the egg. |

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**GAMETE FORMATION**

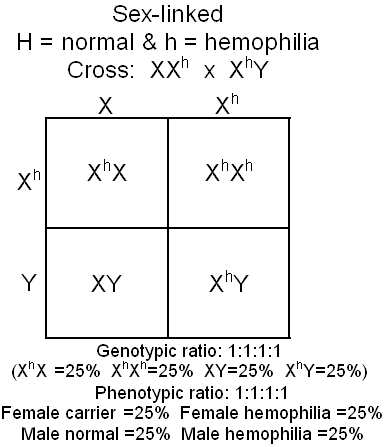
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| **Crossing over** is the exchange of genetic material between homologous chromosomes that results in recombinant chromosomes during sexual reproduction. Happen during prophase I This will guarantee that **all gametes are different.** |

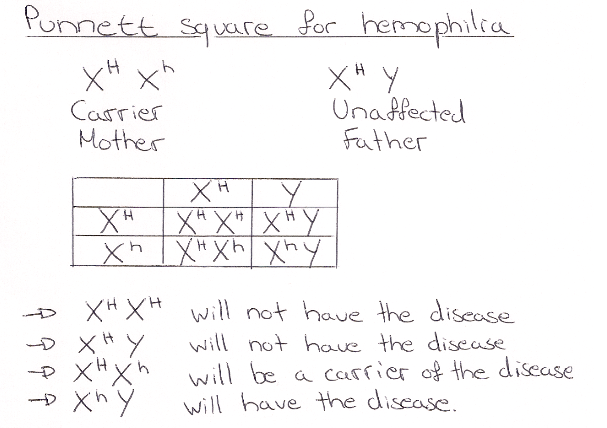
**ABNORMAL GAMETE FORMATION**

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| Non-Disjunction- Failure of chromosome pairs to separate during Gamete formation |

**INHERITANCE OF SICKLE CELL ANAEMIA**

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| Sickle cell trait is caused by the recessive gene, , that is responsible for the abnormal haemoglobin and gene is responsible for normal haemoblobin.  The abnormal haemoglobin is when the red blood cell become hard and sticky and look like a C-shaped farm tool called a “sickle.” The sickle cells die early, which causes a constant shortage of red blood cells. This leads them to transport insufficient oxygen due to small surface area for transporting oxygen.  **Sickle cell trait (SCT)**  Sickle cell trait (SCT) is not a disease, but having it means that a person has inherited the sickle cell gene from one of his or her parents. People with SCT usually do not have any of the symptoms of sickle cell disease (SCD) and live a normal life.  **How Does Someone Get Sickle Cell Trait?**  People who have inherited one sickle cell gene and one normal gene have SCT. This means the person won’t have the disease, but will be a trait “carrier” and can pass it on to his or her children.  **Sickle Cell Trait**- Both types of cells, greater resistance to Malaria  **Sickle Cell Disease**  SCD is a genetic condition that is present at birth. In SCD, the red blood cells become hard and sticky and look like a C-shaped farm tool called a “sickle.” The sickle cells die early, which causes a constant shortage of red blood cells. Also, when they travel through small blood vessels, they get stuck and clog the blood flow. This can cause pain and other serious problems. It is inherited when a child receives two sickle cell genes—one from each parent. A person with SCD can pass the disease or SCT on to his or her children  **Sickle Cell Anemia**- Shortened Life span by approximately 50%  **What Are The Chances That A Baby Will Have Sickle Cell Trait**  If both parents have SCT, there is a 50% (or 1 in 2) chance •**•**that the child also will have SCT if the child inherits the sickle cell gene from one of the parents. Such children will not have symptoms of SCD, but they can pass SCT on to their children.  If both parents have SCT, there is a 25% (or 1 in 4) chance •**•**that the child will have SCD. There is the same 25% (or 1 in 4) chance that the child will not have SCD or SCT.  If one parent has SCT, there is a 50% (or 1 in 2) chance •**•**that the child will have SCT and an equal 50% chance that the child will not have SCT.  **Sickle Cell Disease**  **= Normal haemoglobin**  **= abnormal haemoglobin**    **Genotypic ratio = 1 : 2 :1**  **Phenotypic ratio = Normal: Sickle cell trait : Sickle cell anaemia**  **1 : 2 : 1**  **Sickle Cell Trait**- Both types of cells, greater resistance to Malaria  **Sickle Cell Anemia**- Shortened Life span by approximately 50%  **Sickle cell trait x normal** |
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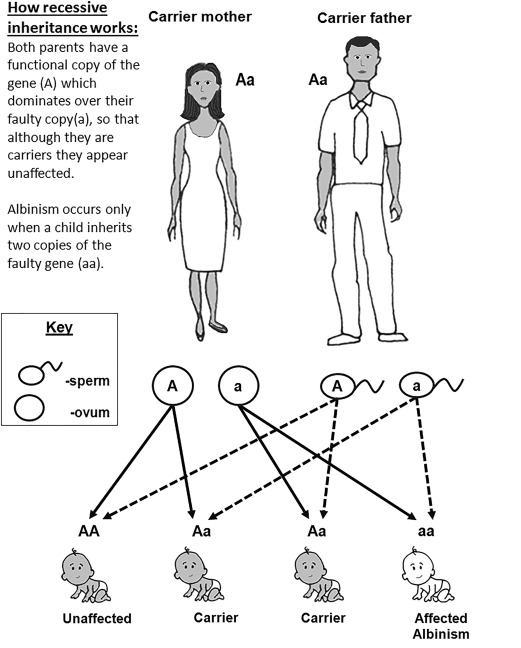


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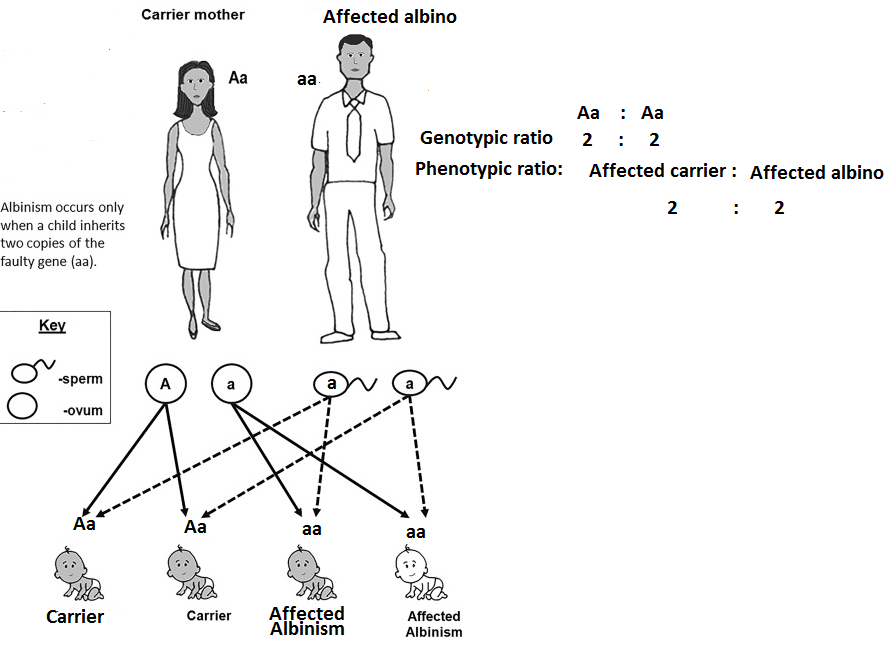
**INHERITANCE OF ALBINISM**

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| Albinism is a group of inherited disorders that results in little or no production of the pigment melanin, which determines the colour of the skin, hair and eye colour.  Albinism is caused by a recessive gene but do not show signs and symptoms of the condition. The albino colour is controlled by a recessive gene (a) and the normal skin is controlled by a dominant gene (A). |

Albinism in humans is caused by a recessive allele *a*. From marriages between people known to be carriers (*Aa*) and people with albinism (*aa*). If both husband and wife are known to be carriers of the allele for albinism, what is the chance of the following combinations in a family of four children?



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A researcher who has been studying albinism has identified a large group of families with four children in which at least one child shows albinism. None of the parents in this group of families shows albinism. Show by workings that a 3:1 phenotypic ratio would be expected on the basis of Mendel’s Principle of Segregation.

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| Genotypic ratio : AA : Aa : aa  1 : 2 : 1  Phenotypic ratio: Normal Brown skin : Albinism  3 : 1 |

**SEX LINKAGE (SEX LINKED TRAITS)**

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| **Sex Linkage(sex linked traits) -** The genes for these traits are found only on the X chromosome, There are **NO** genes for this trait on the Y chromosome  **Color-blindness** (C-Normal color vision c-color blindness)  **Females**-Has XX therefore 2 genes **Males**-Has XY therefore 1 gene (on  the X chromosome)  CC-Normal Color Vision CY-Normal Color Vision  Cc-Carrier(Normal color vision but has the Cannot be a carrier gene to pass on)  cc-Color-blind cY-Color-blind   |  |  |  |  | | --- | --- | --- | --- | | Gametes | C | c | **Mother** | | C | CC-Normal Color Vision | Cc-Carrier | Females | | Y | CY-Normal Color Vision | cY-Color-blind | Males | | |  | | --- | | Father | |  |  |  | |

**HAEMOPHILIA**

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| **Haemophilia**-A condition in which the blood doesn’t clot and continues to bleed caused by the body not synthesizing factor VIII(8)-a step in the process of blood clotting  H-Normal Clotting h-Hemophilia  **Female Male**  HH-Normal HY-Normal  Hh-Carrier  hh-Hemophilia hY-Hemophilia  There have been virtually no cases(but still some) of Hemophilia in a Female because it is a rare gene and most people die at an early age from it |

**GENETICS AND ENVIRONMENT**

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| 1)Green Color in Plants-(C-Chlorophyl production c-No chlorophyl production)  **CC- Green Cc- Green cc-White (dead)**  **2)Baldness in Humans-(B-Bald b-Hair)**  Female Genotype Male A minimal level of testosterone  Hair BB Bald is needed to activate the dominant  Hair Bb Bald gene for baldness in Humans  Hair bb Hair |