Introduction

The purpose of this book is to provide relevant material for each subject in O-level education here in Tanzania. The first edition contains civics, history, geography, biology, chemistry and physics. The content is ordered by syllabus topic and contains relevant definitions and solved problems as they have appeared on NECTA examinations. Though it is impossible to predict NECTA topics and questions, I feel that a student who knows all of the information provided here can get a B in the subject if they are also able to understand English and have competency in the subject material. This is not meant to be a primary resource, but rather it is intended to help guide students and teachers towards relevant topics and questions for study and discussion. This book is for students taking form 4 examinations. Some form 1 and 2 topics are not covered, since they have not appeared on the examinations.

The expectation of this book is that it will provide a base of knowledge that each student will have by the time they come to take their national examinations. In class and in further study, topics and questions can be expanded upon to provide the student with the competency he requires to be successful on his national examinations. Students are encouraged to look at future topics before they are taught in class, so that the teacher can spend class time explaining difficult material, rather than writing definitions or notes on the board.

This work could not have been done without the help of my fellow teachers and staff here at Abbey Secondary School. I am grateful for their contributions to this project. I hope that each year we can update and improve these study guides so that our school can continue to grow academically.

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Biology

Form 1

1.2.3 Waste disposal

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- 1.3.1 Concepts of health and immunity
- 1.3.3 Infections and diseases
- 1.3.4 HIV/AIDS and STDs
- 1.3.5 Care and support for PWLHA

1.4.0 Cell structure and organization

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- 2.1.2.1 Division bryophyta
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4.2.3.3 Non-mendelian inheritance	4.4.3.2 Darwinism
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4.2.7 Application of genetics	4.5.2 Management and control of HIV/AIDS and STIs
4.3.0 Classification of living things	4.5.3 Counseling and voluntary testing (CVT)

Form 1

1.2.3 Waste disposal

Pollutant - A substance present in a large enough quantity in the environment to be harmful to living things

Recycling - The reuse of waste paper, metal, glass or other raw materials to conserve raw materials and reduce pollution

Proper ways of disposing of waste - Recovery, recycling, reduction, safe disposal

- **Recovery -** Turning materials considered to be waste into something useful (ex. changing cow dung into biogas)
- **Recycling -** Bringing items to a secondary processing place where they are turned into other useful items
- **Reduction of Use -** Reducing waste production by buying more durable, less toxic materials which use less packaging
- **Safe Waste Disposal -** Disposal of waste in a safe area or a landfill which is designed to hold waste
- **Safe Disposal Site -** A site to dump waste which has been approved by the appropriate authorities in government

1.3.0 Health

1.3.1 Concepts of health and immunity

Immunity - The body's ability to prevent an infection by having antibodies which fight against pathogens. It is the ability of the body to resist diseases

- **Types of Immunity -** Naturally acquired, artificially acquired
  - **Naturally Acquired Immunity -** A type of immunity developed by an organism's body against a particular disease after exposure to the microorganism causing the disease
  - **Artificially Acquired Immunity -** A type of immunity in which an organism develops after being vaccinated against an infection

Diseases against which children are immunized - Polio, tuberculosis, diphtheria, measles, tetanus, pertusis (whooping cough), small pox, hepatitis B, mumps

1.3.2 Personal hygiene and good manners

(Not present in exams)

1.3.3 Infections and diseases

Disease - An abnormal condition affecting the body of an organism

Infection - Diseases caused by microorganisms

Endemic - Diseases which occur in one region only
Epidemic - Occurs when a diseases rapidly spreads through a large portion of a population
Pandemic - Occurs when an epidemic spreads across whole continents (ex AIDS)
Non-communicable Diseases - Diseases which are not infectious and are caused by factors like malnutrition, inheritance, environment or hormones
Examples of Non-communicable Diseases - Sickle-cell anemia, lung cancer, diabetes, marasmus, kwashiorkor, scurvy, rickets, night blindness, anemia
Causes, transmission and prevention of various diseases -
- **Meningitis -**
  - **Causes -** Microorganisms such as viruses, bacteria or fungi
  - **Transmission -** Direct contact with an affected individual or sharing of utensils
  - **Symptoms -** Swelling of the spinal and brain tissues
  - **Prevention -** Vaccination, avoiding contact with infected individuals, use of preventive antibiotics
- **Cholera -**
  - **Causes -** Bacteria called V. cholera found in water contaminated by feces from diseased carriers
  - **Transmission -** Through direct contamination of food or water by feces as a result of poor hygiene
  - **Symptoms -** Watery diarrhea, vomiting excessively, body weakness, fast pulse, loss of body weight, severe dehydration, tightening of muscles with cramps in hands and feet
  - **Prevention -** Provision of clean and safe drinking water, heating food to high temperatures, keeping food/drinks covered, washing hands before eating, wash fruits/vegetables in safe water, proper sewage treatment and sanitation, improve personal and public hygiene, proper use of toilets, treating carriers of the disease to break the cycle, vaccination
  - **Effects -** Severe diarrhea, damage to cell lining in intestine, delay in treatment can lead to death
- **Malaria -**
  - **Causes -** Four parasites of the genus plasmodium (*P malaria, P vivax, P ovale, P falciparum*)
  - **Transmission -** Mosquitoes carry the plasmodium and infect humans by biting them
  - **Symptoms -** High fever, dizziness, joint pain, sometimes vomiting
  - **Prevention -** Attack the source, interrupt transmission, protect the host
- **Bilharzias (Schistomiasis) -** Occurs in the abdomen or urinary tract
  - **Causes -** Caused by flatworms in the large and small intestine or urinary bladder
  - **Transmission -** The worm lives in a snail until it produces larva which swim in a body of water and infect a human who is swimming there. They enter the water when a person with the worm urinates in the water
  - **Symptoms -** Pain and blood during urination due to the ulceration of the bladder and urethra, nausea, loss of appetite, blood in feces
  - **Prevention -** Killing host snails, introduction of ducks to eat snails, destroy breeding places of snails, treat patients so the life cycle is broken, educating people on the importance of latrines and boiling water
- **Rickets -**
  - **Causes -** Lack of vitamin D, common in children without access to vitamin D
  - **Symptoms -** Bone tenderness, dental problems, skeletal deformity
  - **Prevention -** Dietary supplements or more exposure to sunlight
- **Shock -** Is a sudden loss of consciousness arising from the failure of blood to circulate properly to all body parts, especially the brain
  - **Causes -** Emotional stress, low blood pressure, illness (malaria or anemia), severe injury/blood loss
- **Syphilis -**
  - **Transmission -** Sexually transmitted disease
  - **Effects -** Death of an unborn baby if syphilis is transmitted to the baby, deafness of the baby, a person with syphilis can become blind or have heart disease
- **Typhoid -**
  - **Causes -** Ingestion of contaminated water or food by the feces of an infected person which contain the salmonella bacteria
  - **Symptoms -** High fever, sweating, diarrhea, inflammation of the GI tract
  - **Prevention -** Sanitation and hygiene to prevent people from eating or drinking contaminated food or water

Heart Burn - A burning sensation in the chest caused by the regurgitation of gastric acid
- **Prevention of hearth burn -** Use of medicine to stop the regurgitation of gastric acid

Ways of preventing malaria - Attacking the source, interrupting transmission, protecting the host
- **Attacking the source -** Drain unwanted ponds and pools, clear bushes and grass around a living environment, introduction of animals which eat mosquitoes, do not leave standing water

Interrupting Transmission - Sleep under mosquito nets, use mosquito repellents and insecticides, burn mosquito coils to expel mosquitoes

Protect the Host - Effective treatment when sick, malaria prophylaxis like chloroquine or mephaquine

Diseases caused by bacteria - Tuberculosis, pneumonia, cholera, gonorrhea, syphilis, throat infection, diphtheria, salmonella (food poisoning), tetanus (lockjaw), meningitis, leprosy, botulism, ringworm

Diseases caused by viruses - AIDS, measles, rubella, influenza (the flu), polio, smallpox, herpes, mumps

Diseases caused by parasites - Malaria, bilharzias, sleeping sickness, dysentery

Diseases caused by fungi - Ringworm, athlete's foot, thrush

Diseases transmitted by polluted water - Cholera, typhoid fever, schistosomiasis, amoebiasis (amoebic dysentery), bacterial dysentery

Diseases associated with uncooked food - All types of bacterial, viral and worm infections

Cause of fainting - Sudden drop of blood pressure

Anorexia Nervosa - An obsessive desire to lose weight by eating very little food

Emphysema - Thinning of the lung tissue leading to the rupture of alveoli. Caused by smoking

Hypothermia - The cooling of the body until it is well below the normal 37°C

Meningitis - Inflammatory condition

Pathology - The scientific study of the effects on the body of disease

Shock - Is a sudden loss of consciousness arising from the failure of blood to circulate properly to all body parts, especially the brain

Vaccine - A suspension of dead, inactivated or harmless germs which when introduced to the blood stream stimulates the production of antibodies and makes the body immune to attack from that disease

1.3.4 HIV/AIDS and STDs

HIV - The virus which causes AIDS. It is transmitted by unsafe sex with an infected person, blood transfusion, sharing of needles by drug users

AIDS (Acquired Immunodeficiency Syndrome) - A disease caused by a virus which damages the immune system so that humans are unable to fight disease

Ways to contract HIV - Unsafe sex, sharing of needles, breast milk, transmission by mother to baby at birth

Ways not to contract HIV - Hugging, touching, kissing, mosquitoes, swimming with an infected person

1.3.5 Care and support for PWLHA

How to care for those with HIV/AIDS - Clinical care, social care

Clinical Care - Preventative care with antibiotics, insecticide treated nets, improving quality of drinking water, good hygiene practices, nutritional counseling

Social Care - Avoiding segregation of HIV victims, provide counseling, family support groups, encouraging them not to spread HIV, encourage physical exercise

Ways to care for HIV/AIDS patients - Avoiding stigmatization, provide balanced diet, support them mentally/physically/socially/financially, love them, clean their living environment, send them to health centers for treatment and ARVs

1.4.0 Cell structure and organization

1.4.1 The concept of a cell

Main parts of a cell - Cell membrane, nucleus, cell wall, cytoplasm, chloroplasts, cell vacuole

Cell Membrane - Made of living material. Its function is to enclose and protect the inner parts of the cell by selectively allowing certain substances to pass through while preventing others making it selectively permeable

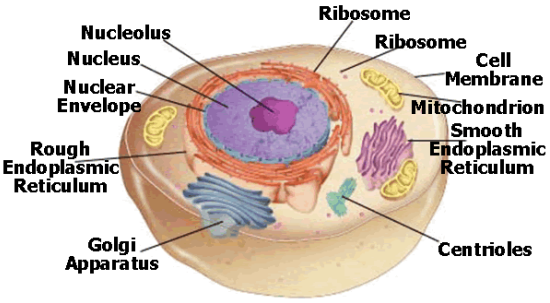
Nucleus - Is a spherical or oval body which is seen when cells are stained. It is composed of a fluid called nucleoplasm and is surrounded by a membrane called the nucleo-membrane. The nucleus controls the life processes of a of a cell such as growth, respiration and synthesis of materials. The nucleus also controls the hereditary characteristics of an organism

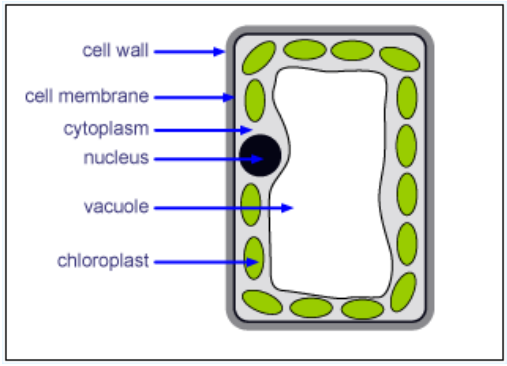
Cell Wall - Is made up of non living material called cellulose. The major function is to give shape and support to the cell. The cell wall is freely permeable to water and gases

Cytoplasm - Is composed of a mixture of chemicals and water whose role is to store food

Chloroplasts (Plants Only) - Small bodies within cytoplasm containing chlorophyll. It is the where photosynthesis occurs producing carbohydrates for the plant

Cell Vacuole - Cavity within cytoplasm filled with sap and enclosed by a membrane called vacuolar membrane. The accumulation of water in the vacuole creates pressure to exert on the cytoplasm and the cell wall to make plant cells firm and strong





Examples of cells in the human body -

The longest cell - Nerve cell (neuron)
A motile cell - Sperm
A cell with strong contractile ability - Muscle cell
A cell which moves and feeds like an amoeba - White blood cell

Cell - A unit of living matter consisting of a nucleus, cytoplasm and a cell membrane
Cell Membrane - The semi-permeable membrane which forms the outer surface of all cells
Cell Wall - Outer membrane surrounding a cell which is made of cellulose and controls the flow of particles in and out of the cell through osmosis
Cytoplasm - All of the contents of a cell except its nucleus
Internal Environment - The tissue fluid that bathes every cell of the body and supplies all of their food and oxygen requirements
Mitochondria - Rod-shaped organelles in the cytoplasm of cells which is concerned with respiration
Nucleus - Part of the cell which contains chromosomes and controls cell metabolism and division
Wall Pressure - A cell taking in water by osmosis inflates until its cellulose wall cannot be stretched further, this restraining force is called wall pressure
Cholesterol - A substance found mainly in animal fats which form part of the cell membranes. Excessive cholesterol in ones diet can lead to blocked arteries
Cilia - Small hair-like strands on the surface of certain cells i.e. paramecium. They flick back and forth allowing for movement in fluids
Differentiation - The process by which cells become specialized to perform a particular function
Semi-permeable Membrane - A membrane which allows certain substances to pass through but prevents others e.g. the cell membrane
Tissue - A collection of similar cells which work together to perform a particular function
Organ - Part of a living organism formed when different tissues work together to perform a general function
Characteristics of all living things - Nutrition, respiration, excretion, response, reproduction, growth, movement

1.5.0 Classification of living things

1.5.1 Concept of classification

Classification - The process of grouping animals by similar characteristics or heritage
Advantages of scientific name of organisms - Avoids repetition of names, makes it easier for scientists to study organisms based on features of organisms, universally agreed upon system
Reason that humans of all races are the same species (Homo Sapiens) - All have similar genetic constitution and morphology, can interbreed freely to give fertile offspring
Advantages of classification - Makes it easier to identify an organism, easier to describe organisms in a group, helps predict characteristics present in organisms, creates a standard system for classifying organisms, provides organized system, provides supporting evidence for evolution
Binomial Nomenclature - The process of giving living things two scientific names. The first name belongs to the genus and the second name belongs to the species in which an organism belongs
Pedigree - A record of ancestral history of an individual shown in the form of a chart, table or diagram
Differentiate between homologous and analogous structures -

Homologous Structures - Structures performing different functions but having the same or similar origin (e.g. limbs can be used for swimming, flying, running or grasping)

Analogous Structures - Structures performing the same function but having a different evolutionary history (e.g. bats and birds can fly with wings but they originated separately)

1.5.2 Classification systems

Types of classification systems - Artificial classification, natural classification

Artificial Classification - A method of grouping organisms by their physical characteristics together (ie all animals with wings)

Advantages - Stable system, easy to identify organisms, less expensive, doesn't consume time

Disadvantages - Unrelated organisms are grouped together, has no predictive value

Natural Classification - A method of grouping organisms by biological similarities showing the real relationship between organisms

Advantages - Has predictive value, more information about members in each group, evolutionally closely related organisms are placed together in the same group

Disadvantages - Expensive, requires more experiments, time consuming, difficult to identify organisms, only organisms with many features will be easily identified

1.5.3 Major groups of living things

1.5.3.1 Viruses

Characteristics of viruses - Require nutrients, reproduce (inside a living cell), grow by producing a new protein coat, lacks respiration and production of energy, no true cell structure, no evidence of sensitivity, does not feed/excrete/grow/respire

Differences between viruses and bacteria - Viruses have only DNA or RNA but not both, bacteria have both RNA and DNA, outer layer of a virus is covered in protein material called a capsid, the outermost surface of a bacterium is covered by a slime capsule, viruses have no cell walls, bacteria possess cell walls, viruses do not have chromosomes, bacteria possess chromosomes, viruses do not have structures for locomotion like flagella, viruses do not have food granules for food storage

Major basic structures of a virus - Core, endplate, capsid, envelope

Core (Head) - Contains genetic material (DNA/RNA)

Endplate - What the virus uses to attach to a cell

Capsid (Coat) - A protective coat of protein surrounding the core

Envelope - The additional layer of protein around the capsid found in viruses like HIV and influenza

1.5.3.2 Kingdom Monera

Characteristics of Monera - Single celled, have no nucleus, have a single circular chromosome

Functions of antibiotics - Kill microorganisms, prevent multiplication of microorganisms

Examples of antibiotics - Penicillin, streptomycin

Nitrifying Bacteria - Bacteria in the soil which convert the decaying remains of organisms into soil nitrate

Nitrogen Fixing Bacteria - Bacteria in the soil and root nodules which convert nitrogen in the air to soil nitrates

Prokaryote - A group of organisms lacking a cell nucleus (ex bacteria)

Economic importance of bacteria -

Positive - Decomposition of pollutants i.e. urea/carbon dioxide, decomposition of dead organic matter, nitrogen fixing in soils to be used by plants, increasing soil fertility, manufacture vinegar/lactic acid/citric acid, manufacturing certain kinds of medicine, production of cattle feed, creation of hormones

Negative - Causes diseases, spoils food/vegetables, denitrification

1.5.3.3 Kingdom Protoctista

Eukaryote - A group of organisms with a cell nucleus (ex plants, animals)

Characteristics of Protoctista - Mainly aquatic, single celled, one nucleus, move by pseudopodia, cilia or flagella, some parasitic

Examples of Protozoa - Amoeba, paramecium, plasmodium

Flagellum - A tail like projection that protrudes from a cell body whose function is locomotion

Importance of Protozoa -

Positive - Algae release oxygen for animals to breathe, carbon dioxide absorption is carried out by algae, form the base of food chains, seaweed can be used as fertilizer

Negative - Cause diseases like malaria, dysentery, and sleeping sickness

Form 2

2.1.0 Classification of living things

2.1.1 Kingdom fungi

Hyphae - Fine hollow threads which make up the body of many fungi, their purpose is to digest and absorb nutrients by secreting enzymes outside of the cells and absorbing the products of this digestion

Mycelium - A collection of hyphae

Rhizoids - Hair-like structures of mosses or fungi that absorb water and nutrients

Decomposers - Fungi and certain bacteria which breakdown (decompose) dead organisms into humus and minerals

Chitin - The main component of cell walls of fungi, exoskeletons of arthropods and insects

Saprotrophs - Organisms which feed on organic matter such as the dead remains of animals and plants by releasing enzymes that digest the food externally, reducing it to a liquid which is absorbed into the saprotroph's body (e.g. certain types of bacteria and fungi/mushrooms)

Economic importance of fermentation - Breweries manufacture alcoholic drinks like beer and wine, baking bread (leavening of bread by fermentation), fermentation of tobacco leaves to make cigarettes

Characteristics of Fungi - Mainly terrestrial, no chlorophyll, saprophytic, mycelium consisting of filaments called hyphae, cell wall of fungal cellulose, sexual reproduction

- **Examples of Fungi -** Rhizopus, mushroom, penicillium, mucor
- **Characteristics of Ascomycota (kingdom Fungi) -** Reproduces asexually
  - **Examples of Ascomycota -** Yeast
  - **Economic importance of yeast -** Alcohol production, bread production

Importance of Fungi -

- **Positive -** Yeast is used for fermentation, used to manufacture penicillin, production of citric acid, used in research
- **Negative -** Causes decomposition of natural materials like leather and wood, can spoil food, can cause disease

2.1.2 Kingdom plantae

Characteristics of kingdom plantae - Have cellulose in their walls, capable of photosynthesis, body is differentiated into tissues, organs and systems

- **Characteristics of Algae -** Aquatic, possess chlorophyll, body not differentiated into root, stem or leaf, sexual reproduction by swimming gametes
  - **Examples of Algae -** Green, red and brown seaweed, spirogyra

Epiphyte - A plant that grows upon another plant (ex. tree) non-parasitically

Hydrophytes (Aquatic Plants) - Plants that have adapted to living in or on aquatic environments

Mesophytes - Terrestrial plants which are adapted for neither dry nor wet environments

Xerophytes - Plants that can survive in an environment with little available water (e.g. cacti)

2.1.2.1 Division bryophyta (Mosses)

Bryophyta - A plant body not differentiated into root, stem and leaves such as mosses

- **Characteristics of Bryophyta -** Terrestrial, may have stem and leaf like structures, well defined sexual reproduction, has chlorophyll, plant body not differentiated into root, stem and leaves, no vascular tissues, live in damp shady places
  - **Examples of Bryophyta -** Mosses
- **Characteristics of Hepatica (Liverworts) -** Rhizoids are unicellular, simple sporophyte with no chlorophyll
  - **Examples of Liverworts -** Pellia

2.1.2.2 Division Filicinophyta (Pteridophyta) (Ferns)

Characteristics of Pteridophyta - Terrestrial, highly differentiated with body and stem, leaf and root structures, high degree of internal tissue differentiation, possess chlorophyll, well defined sexual reproduction, found in water, arid country or as epiphytes in trees

- **Examples of Pteridophyta -** Ferns

2.2.0 Nutrition

2.2.1 Concepts of nutrition and food nutrients

Autotrophs - An organism that produces its own food by photosynthesis (ex plants, producers)

Heterotrophs - An organism that gets its nutrition from other animals or plants or from the environment (ex animals, fungi, bacteria)

Balanced Diet - A diet which contains all types of food nutrients at the right proportions for a healthy human

Constituents of a balanced diet - Carbohydrates, proteins, fats and oils, vitamins (A, B, C, D, K), mineral salts, water, roughage (fiber)

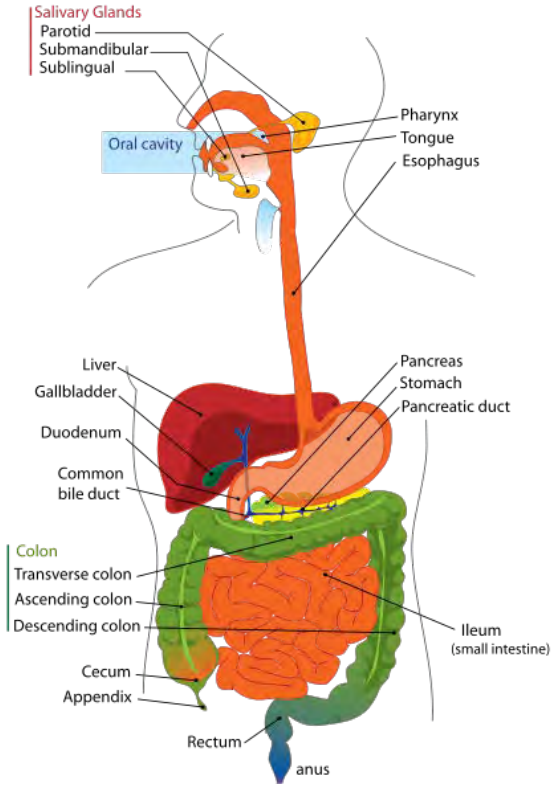
Carbohydrates - Energy source for living things (ex glucose, sucrose)
Sources of carbohydrates - Wheat, maize, cassava
Proteins - Used as building blocks of tissue and muscle in the body. All proteins contain nitrogen, carbon, hydrogen and oxygen
Sources of proteins - Beans, meat
Fats and Oils - Provides energy to the body and insulates it from heat loss
Sources of fats and oils - Peanuts, cashews, coconuts
Vitamins - Essential for normal health in a variety of roles
Vitamin A - Necessary for normal growth in children and for proper functioning of eyesight
Vitamin B - Strengthens the muscles of the body
Vitamin C (Ascorbic Acid) - Strengthens the gums and is involved in fighting disease
Vitamin D - Helps strengthen bones
Vitamin K - Essential for the process of blood clotting
Mineral Salts - Used in the development and maintenance of bones (iodine, calcium, iron, sodium, phosphorus, magnesium)
Water - The main solvent in the body
Roughage (Fiber) - Encourages peristaltic movement

Malnutrition - Deficiency disease caused by overfeeding or underfeeding as a result of an unbalanced diet
Causes of malnutrition - Poverty, ignorance, diseases, war, religious beliefs or taboos, crop failure, early weaning, lack of access to different types of foods
Diseases caused by malnutrition - Kwashiorkor, marasmus, obesity
Kwashiorkor - Caused by a lack of proteins
Symptoms - Retarded growth, swelling of limbs due to excess body fluids, loss of appetite, loss of weight, anemia, change in the colour of hair from black to light brown
Treatment - Providing a child with a balanced diet containing protein
Marasmus - Caused by a lack of carbohydrates providing energy
Symptoms - Crying often, wrinkled skin, loss of weight, good appetite present
Treatment - Provide a balanced diet with carbohydrates
Obesity - Occurs when a person eats too many carbohydrates
Symptoms - Person becomes overweight or obese due to body fat depositions in their body
Treatment - Exercise more, eat less carbohydrate rich foods, maintaining a balanced diet
Vitamin E is produced by humans
Effects of mineral deficiency -
Iodine - Goiter
Calcium - Weak bones and teeth
Iron - Anemia
Sodium - Muscle cramps

2.2.2.2 Digestive system in humans
Why a person can swallow something while standing on their head - Once food enters the esophagus a series of wave-like muscular contractions in the walls of the esophagus (peristalsis) start and the food is pushed towards the stomach and other parts of the alimentary canal
Metabolism - All of the chemical and physical processes necessary for life
Anabolism - The chemical reactions of metabolism that build up complex substances from simple materials, they require energy which comes from catabolism
Catabolism - A chemical reaction of metabolism which breaks down complex substances into simple ones and release energy
Biological importance of saliva - Contains the digestive enzyme salivary amylase which digests starch to maltose, lubricates food for easier swallowing
Importance of bile - Salts in bile break down fats through emulsification, reacts with fat soluble vitamins (A,D,E,K) to make them water soluble, salts in bile neutralize HCl
Autolysis - Refers to the destruction of a cell through the action of its own enzymes i.e. self digestion
Lipase - An enzyme which digests fats and oils
Catalysts - Substances that increase the speed of a chemical reaction and are used up in the reaction i.e. enzymes
Deanimation - The breakdown of unwanted amino acids in the liver by removal of nitrogen containing part of the nucleus
Distase - An enzyme which digests stored starch in seeds
Emulsification - Breakdown of fats into droplets
Protease - An enzyme which digests protein
Trypsin - An enzyme produced by the pancreas which digests proteins converting them to amino acids

Enzymes which digest protein cannot digest starch because <u>different enzymes can only break down specific types of substrates</u>

Absorption - The movement of digested (soluble) food through the walls of the alimentary canal into the blood stream
Amylase - A type of enzyme which digests carbohydrates,
Alimentary Canal (Gut) - A tube running from the mouth to the anus inside which digestion and absorption take place
Assimilation - Utilization of digested food to build cells in the body
Bile - A greenish-yellow liquid made in the liver which is passed into the duodenum where its function is to aid in the digestion of fats
Cecum - A part of the intestine at the junction between the ileum and colon, serves no function in man but is used for digestion of cellulose in herbivores
Chyme - The semi-fluid mass of partly digested food expelled by the stomach into the duodenum
Cilium - An organelle found in eukaryotic cells which help to move nutrients or other cells along in the organism
Colon - Part of the large intestine, its function is to absorb water and mineral salts from feces
Digestion - The process by which food is made soluble by the action of digestive juices (enzymes)
Dormancy - A resting, inactive condition in which metabolism almost stops



Duodenum - The part of the alimentary canal between the stomach and the ileum
Esophagus - The tube through which food passes from the mouth to the stomach
Fatty Acids - Chemical components released when fats are broken down during digestion
Fermentation - The breakdown of sugar by organisms such as yeast and bacteria which takes place under anaerobic condition
Gastrointestinal Tract - Refers to the stomach and intestines
Gall Bladder - A small bladder inside the liver where bile is stored
Glycogen - A carbohydrate similar to starch. It is stored in the liver and muscles of mammals and then is converted into glucose as the body requires energy for metabolism
Hepatic Portal Vein - Vessel in which blood containing absorbed food is carried from the intestine to the liver
Lacteal - Part of the lymphatic system which extends through the centre of the villus. Its purpose is to absorb digested fat from the ileum
Larynx - The voice box
Mucus - A sticky fluid produced by goblets cells
Pepsin - An enzyme produced by the stomach which begins the digestion of proteins
Peristalsis - A wave-like contraction of the tubular organs such as the alimentary canal (gut) which propels the contents of the tube in one direction
Pharynx - An area at the back of the mouth immediately above the trachea and esophagus
Rectum - The last part of the alimentary canal
Saliva - Fluids produced and released into the mouth by three pairs of salivary glands in response to food. Contains the enzyme salivary amylase, mucin and minerals. Saliva is alkaline so the pH will be lowered
Sphincter - A ring of muscle found in the walls of tubular organs such as the alimentary canal whose contraction slows or stops movements of substances through the tube
Stomach - A bag like organ at the end of the esophagus
Trachea - The wind pipe
Villi - Minute finger-like structures on the inner surfaces of the duodenum and ileum. These occur in the millions greatly increasing the surface area available for absorption
Liver - Detoxifies poisonous substances in the body such as alcohol, performs deamination to break down amino acids and form urea

Functions of the liver - Helps regulate blood sugar levels, stores fat to prevent starvation, deamination, storing vitamin A and D, stores iron from broken down erythrocytes (red blood cells)

Ileum - The region of the alimentary canal between the duodenum and colon where digestion is completed and absorption takes place, small intestine. It also secretes intestinal juice

Intestinal Juice (Succus Entericus) - Juice containing proteins which help to break down food substance as it passed through the ileum

Contents and roles of intestinal juice - Mucus, mineral salts, enzymes

Mucus - Helps to lubricate the intestinal wall and prevents autolysis

Mineral Salts - Produced in order to neutralize the acid chyme from the stomach and to provide a more suitable pH for the action of enzymes in the intestine

Enzymes - Protease, enterokinase, nucleotidase, carbohydrase

Protease - Convert peptides into smaller peptides and amino acids and hydrolyses dipeptides into amino acids

Enterokinase - A non-digestive enzyme which activates the trypsinogen produced by the pancreas

Nucleotidase - Converts nucleotides into sugars, organic bases and phosphoric acid

Carbohydrases - Amylase, maltase, lactase, sucrase

Amylase - Completes the hydrolysis of starch to maltose

Maltase - Hydrolyses maltose into glucose

Lactase - Hydrolyses lactose (the sugar in milk) into glucose and galactose

Sucrase - Hydrolyses sucrose into glucose and fructose

Factors affecting the absorption of digested food in the ileum - Being well supplied with blood capillaries to ensure digested food substances are absorbed into the blood, must have a thin epithelial lining which is permeable to molecules like glucose which will increase the rate of diffusion of the digested food substances, the epithelial cells must be rich in mitochondria to provide energy for their activities since the absorption of some nutrients must be forced since absorption is taken against their concentration gradient, must possess a large surface area for absorption

Efficient absorption in the ileum through a large surface area is achieved in the following ways - It is long (almost 6m in humans), its walls are folded to provide large internal projections, the folds themselves have numerous villi, the epithelial cells lining the villi are covered with minute projections called microvilli

2.2.3.1 Nutrition requirements in plants

Tubers - Various types of plants with modified structures that are enlarged to store nutrients

Root Tubers - A modified root whose purpose is as a storage organ (ex. cassava, sweet potatoes)

Stem Tubers - A plant with a modified stem whose purpose is as a storage organ (ex. Irish potatoes)

Uses of elements in plants - Phosphorus, nitrogen, calcium, iron

Phosphorus -

Source - Phosphate (PO_4^{3-})

Role - Synthesis of proteins, nucleic acid and ATP

Deficiency - Stunted growth, particularly of roots

Nitrogen -

Source - Nitrates (NO_3^-) and ammonium (NH_4^+)

Role - Protein synthesis, nucleic acid and chlorophyll synthesis

Deficiency - Stunted growth, chlorosis

Calcium -

Source - Calcium (Ca^{2+})

Role - Formation of middle lamella of cell walls

Deficiency - Stunted growth

Iron -

Source - Intermediate in chlorophyll synthesis

Role - Chlorophyll synthesis

Deficiency - Strong chlorosis particularly in young leaves

Trace Elements - Minerals which are essential for the healthy growth of plants but which are required only in minute quantities e.g. boron

Carbohydrates - Compounds containing carbon, hydrogen and oxygen which are the main source of energy for metabolism, i.e. starch/sugar

Vitamins - Chemicals required in small amounts to maintain health

Proteins - Compounds used in the building and repair of muscles and tissues as well as the creation of catalysts

Enzymes - Protein substances which act as catalysts and control the rate of chemical reactions in cells, speeding them up

Hydrolysis - A chemical reaction where molecules of water are split into hydrogen cations (H^+) and hydroxide anions (OH^-)

2.2.3.2 Photosynthesis

Photosynthesis - The process by which plants use light energy trapped by chlorophyll to form sugar out of carbon dioxide and water

Necessary conditions for photosynthesis - Presence of chlorophyll and sunlight

Raw materials of photosynthesis - Water (H_2O), carbon dioxide (CO_2)

Products of photosynthesis - Glucose ($C_6H_{12}O_6$), oxygen

Equation of photosynthesis - $6CO_2 + 12H_2O \xrightarrow{sunlight, chlorophyll} C_6H_{12}O_6 + 6H_2O + 6O_2$

Roles of photosynthesis - Produces food used by plants and animals, produces oxygen used for respiration in animals, reduces carbon dioxide concentration in the atmosphere

Chloroplasts - Small bodies within cytoplasm containing chlorophyll. It is the where photosynthesis occurs producing carbohydrates for the plant

Chlorophyll - Green substance in plants which absorbs light energy for use in photosynthesis

Importance of chlorophyll - To trap sunlight energy and keep it available in leaves as chemical energy

Compensation Point - The point at which photosynthesis and respiration in a plant are exactly balanced, and one process uses up the products of the other

Variegated Leaves - Is the appearance of different coloured zones on leaves, such as white on the outer rim and green in the middle. This is because the green parts of the leaf contain chlorophyll for producing energy and the white parts do not contain chlorophyll (so they do not provide energy)

Requirements for the formation of carbohydrates in plants - Sunlight, carbon dioxide, water, chlorophyll

2.2.4 Properties of food substances

(Food test practicals)

2.2.5 Food processing, preservation and storage

Methods of Food Preservation - Cold (refrigeration), drying (dehydration), heat, control of pH, salting (osmolarity), canning, irradiation, chemical preservatives, smoking

Refrigeration - Inactivates microbes by freezing the water used in cell activity and prevents their enzymes from being active

Drying Food - Removal of moisture from foods which inhibits microbial activities by blowing hot air over food or by drying food over a fire or smoking

Heat - Cooking or sterilization by heat kills microbes by destroying their cell walls and other proteins

Canning - After heat has killed all microbes, the food is placed in a can which prevents new microbes from entering

Pasteurization - Food or milk is heated up to about 60°C and abruptly cooled too kill microbes

pH - Microbes grow in acidic conditions, so vinegar or lactic acid can be used to prevent growth

Osmolarity (Salting) - Salted foods lose water so microbes cannot grow, sugar can be used

Irradiation - Use of radiation to kill microbes, commonly used for medical supplies or drugs

Chemicals - Chemicals are used to kill microbes

Advantages of local food preserving methods - No chemicals are added to foods, less expensive, does not require much knowledge, keeps a variety of foods for future use, excess food can be stored, allows for transportation and storage of food

2.3.0 Balance of nature

2.3.1 Natural environment

Environment - Is a natural unit consisting of living (biotic) components and non-living (abiotic) that interact with each other

Ecosystem - All the interaction between the members of a community and its environment

Habitat - A region of an environment containing its own particular community of organisms

Ecology - The study of interrelationships between living things and nonliving things in an environment

Community - A group of independent organisms which share a common environment

Colonization - The movement of animals and plants into a newly formed habitat

Niche - The place filled by an organism in an environment based on how it eats, lives or mates

Population - The number of organisms of a certain species living in an area at a time

Succession - The process by which one set of organisms gives way to another within a community

Balance of Nature - A situation where losses in the ecosystem are equal to replacements and the materials present are reused again and again

Water Cycle - Circulation of water between water vapour in the air and the water on and under the ground
Nitrogen Cycle - The circulation of nitrogen from the atmosphere to soil bacteria, soil nitrates, plants, animals and back to the atmosphere
Carbon Cycle - The continuous circulation of carbon atoms between atmospheric carbon dioxide and the bodies of living organisms

2.3.2 Interaction of organisms in the environment
Carnivore - A flesh (meat) eating animal (ex. lion, tiger)
Consumers - Organisms in a food chain which live by consuming (eating) other organisms
Detritus - The decaying remains of dead animals and plans
Herbivore - An animal that eats only plants i.e. horse, sheep
Host - An organism in or on which a parasite lives i.e. a lion or human being
Parasite - An organism which feeds on the nutrients of another organism, generally feeding on their blood (ex fleas, lice, ticks)
Omnivore - An animal that eats both animals and plants e.g. man
Species - A group of organisms which can mate together and produce fertile offspring
Symbiosis - A close association between two different organisms in which both benefit
What would happen if…
- **All predators were removed from an ecosystem -** The system would collapse because it would result in a huge increase in the numbers of prey. Since prey primarily eat vegetation, they would end up eating all of the vegetation leading to massive starvation from the lack of food
- **All bacteria were removed from an ecosystem -** The system would collapse because the important processes of recycling nutrient elements by decomposition would not be done which would end the cycling of nutrients through the ecosystem

Types of relationships between organisms - Commensalism, mutualism, competition, parasitism
- **Commensalism -** A relationship between two organisms in which one organism benefits, but the other is unaffected
- **Mutualism -** The way two organisms biologically interact benefits both organisms
- **Competition -** An interaction where the fitness of one organism is lowered in the presence of another by limiting the access of a particular resource by one organism
- **Parasitism -** A type of symbiotic relationship between organisms of different species where the parasite benefits at the expense of the host

Differentiate between parasite and vector -
- **Parasite -** A living thing which obtains food from a living body of another organism called the host
- **Vector (Carrier) -** It is an organism which carries a parasite to its primary host

Factors affecting the population of a species - Disease, predators, limitations of the food supply

2.3.3 Food chain and food webs
(Draw examples of food chains and webs, showing trophic levels)
Food Chain - A sequence of organisms through which energy is transferred. The first organisms are producers (usually green plants) and the succeeding links are the consumers
Food Web - A number of interconnected food chains
Trophic Levels - The position that a certain organism occupies in a food chain
Trophic levels in an ecosystem - Producers, primary consumers, secondary consumers, tertiary consumers, quaternary consumers
- **Quaternary Consumers -** Humans
- **Tertiary Consumers -** Large fishes
- **Secondary Consumers -** Small fishes
- **Primary Consumers -** Zooplankton
- **Producers -** Organisms like green plants that produce food; starting point of food chains

General food chain structure -
- **Trophic level 4 -** Tertiary consumer (top carnivore, ex hawk) - ***Top***
- **Trophic level 3 -** Secondary consumers (carnivores, ex small birds)
- **Trophic level 2 -** Primary consumers (herbivores, ex snails and earthworms)
- **Trophic level 1 -** Producers (plants) - ***Bottom***

Differentiate between food chain and food web -
- **Food chains** show a single path of animals consuming each other, from the producers at the bottom to the highest consumers at the top
- **Food webs** show how animals and plants are connected through different paths showing how life in an ecosystem is connected

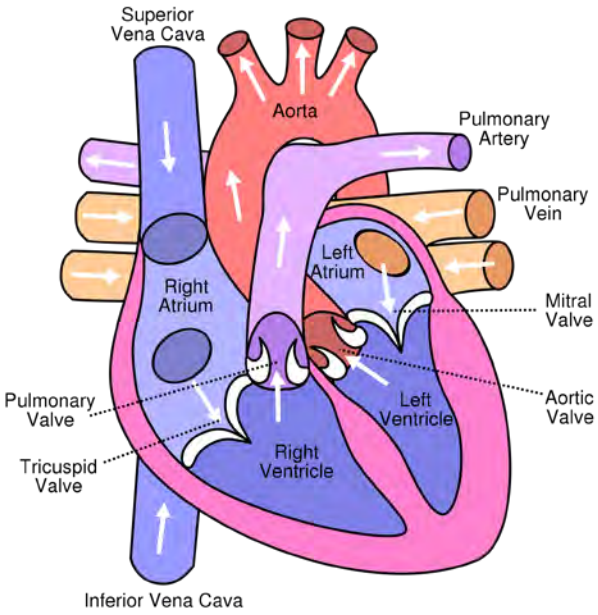
Green plants are known as producers because they make food from simple substances

2.4.0 Transport of materials in living things

2.4.1 Concept of transport of materials
(Not found in any exams)

2.4.2 Diffusion, osmosis and mass-flow
Osmosis - Passage of molecules through a semi-permeable membrane from a weak to a strong solution
Diffusion - The movement of molecules of liquids or gases in regions where they are highly concentrated until they are equally distributed
Osmotic Potential - The pressure which molecules could diffuse from a solution if it were separated from another solution by a semi-permeable membrane
Concentration Gradient - Represents the difference in concentration of a substance between two places
Plasmolysis - The shrinking of a cells cytoplasm due to the loss of water by osmosis
Mass Flow - The movement of fluids through a vessel or tube without passing through a membrane
Difference between osmosis and diffusion - Osmosis involves the movement of water molecules from a low concentration to a highly concentrated region, whereas diffusion is the movement of molecules of from a highly concentrated region to a lowly concentrated one
Hypertonic Solution - A solution which has more solute in concentration and less water molecules
Effects on a cell - It will lose water by osmosis and as a result will undergo flaccidity
Hypotonic Solution - A solution which has more concentration of water molecules and less solute
Effects on a cell - The solution is more diluted, so it will absorb water from its surrounding resulting in the cell undergoing turgidity

2.4.3 Transport of materials in mammals
2.4.3.1 Structure of the mammalian heart
Aorta - The largest artery in the body which originates from the left ventricle and extends down the abdomen distributing oxygenated blood to all parts of the body
Coronary Artery - Maintain blood flow in the heart muscle
Diastolic Blood Pressure - Causes blood from contracting auricles to flow into ventricles
Inferior (Posterior) Vena Cava - A large vein which carries deoxygenated blood from the posterior half of the body to the right atrium of the heart
Pulmonary Artery - Arteries which carry blood from the heart to the lungs
Pulmonary Vein - A large blood vessel which carries blood from the lungs to the left atrium of the heart
Semi-lunar Valve - Pocket like valves in the main arteries at the point where they leave the heart whose purpose is to stop blood from flowing back into the ventricles
Superior Vena Cava - The vein which carries deoxygenated blood from the upper half of the body to the right atrium of the heart
Systolic Blood Pressure - Causes blood from contracting ventricles to flow into pulmonary arteries and the aorta
Vena Cava - The main vein of the body
Ventricle - One of the large thick walled lower chambers of the heart that pumps blood into arteries
Four chambers of the heart - Left atrium, right atrium, left ventricle, right ventricle
Right Atrium - Receives deoxygenated blood from the superior and inferior vena cava and pumps it into the right ventricle through the tricuspid valve



Left Atrium - Receives oxygenated blood from the pulmonary veins and pumps it into the left ventricle
Left Ventricle - Receives oxygenated blood from the left atrium vial the bicuspid (mitral) valve and pumps it into the aorta via the aortic valve
Right Ventricle - Receives deoxygenated blood from the right atrium via the tricuspid valve and pumps it into the pulmonary artery via the pulmonary valve
Types of heart valves - Atrioventricular (AV) valves, semilunar (SL) valves
Atrioventricular Valves - Valves between the atria and the ventricles

Types of Atrioventricular Valves - Bicuspid (mitral), tricuspid
Tricuspid Valve - A valve on the right side of the heart between the right atrium and right ventricle
Bicuspid (Mitral) Valve - A dual-flap valve in the heart which lies between the left atrium and the left ventricle
Semi-lunar (Heart) Valve - Allows blood to flow through in one direction leaving the heart
Types of Semi-lunar Valves - Aortic valve, pulmonary valve
Aortic Valve - The valve which lies between the left ventricle and the aorta
Pulmonary Valve - The valve which lies between the right ventricle and the pulmonary artery
Heart Attack - A sudden stoppage of the heart beat which is commonly caused by a blockage of a coronary artery due to thrombosis

2.4.3.2 The blood
Mammalian blood consists of - Plasma, cells
Plasma - The liquid part of the blood
Contains - Water, proteins, minerals, end products of digestion, hormones
Functions of plasma - Transports carbon dioxide, waste matter, hormones, digested food, heat, ions and water, white blood cells and platelets
Blood Cells - Red, white, platelets
Red Blood Cells (Erythrocytes) - Disc shaped cells containing hemoglobin which transport oxygen from the lungs to the body tissue
White Blood Cells (Leucocytes) - The name for a number of colourless cells in blood e.g. phagocytes and lymphocytes, they attack and engulf bacteria and produce antibodies
Platelets (Thrombocytes) - Particles in the blood which are used in the formation of blood clots to stop bleeding of wounds
Differentiate between arteries and veins -

Arteries	Veins
• Transports blood away from the heart • Composed of elastic and smooth muscle tissue • No semi-lunar valves (except when leaving the heart) • Pressure of the blood is high and has a pulse • Blood flow is rapid • Lower blood volume • Carries oxygenated blood (except in the pulmonary artery)	• Transports blood towards the heart • Only slightly muscular with a few elastic fibres • Semi-lunar valves at intervals along the length to prevent the backflow of blood • Pressure of the blood is low and no pulse is detectable • Blood flow is slow • Higher blood volume than arteries or capillaries • Carries deoxygenated blood (except in the pulmonary vein)

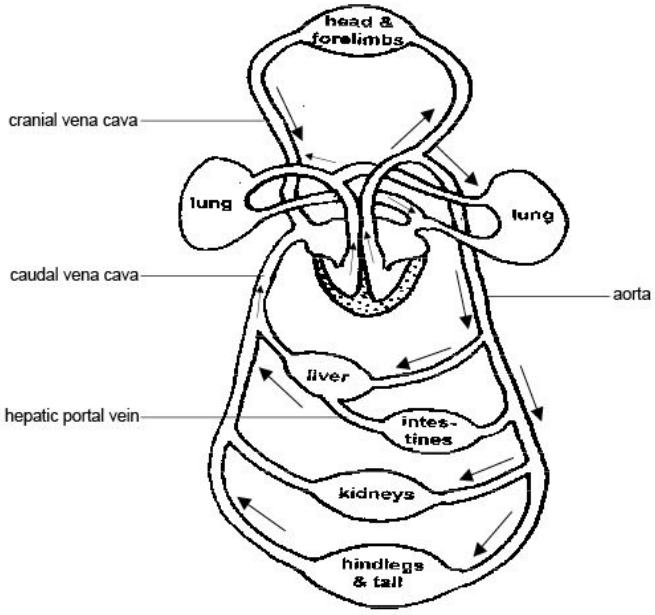
Functions of blood - Transports oxygen, continuous circulation of blood lowers body temperature, distributes food from intestines throughout the body, waste products such as carbon dioxide/mineral salts and urea are transported to organs responsible for their excretion, hormones are distributed, white blood cells defend against bacteria, maintains water levels in the body, formation of cloths over injured parts to prevent excessive blood loss
Blood Proteins - Albumins, immunoglobulins, fibrinogens
Albumins - Create pressure in the blood and transports other molecules
Immunoglobulins - Participate in the immune system
Fibrinogens - Are essential for blood coagulation (clotting)
Blood protects against diseases in the following ways - Blood clotting by platelets and fibrinogen to prevent excessive blood loss and entry of pathogens into the body, immunity by antibodies and lymphocytes, engulfing of bacteria present in the blood performed by white blood cells
Factors affecting blood pressure - Resistance to blood flow by blood vessels (peripheral resistance) due to fat deposition in blood vessels, diseases such as diabetes, stress or emotional distress, strength of the heart heat, stroke volume, eating salted food, infections, emotions
Hemoglobin - A red substance in a red blood cell whose purpose is to combine with oxygen to transport it to tissues
Importance of hemoglobin - Transportation of gases from lungs to body tissues and back to the lungs
Tissue Fluid - A fluid which is forced through capillary walls and moves between all cells of the body, providing them with food and oxygen and removing their waste products
Fibrinogen - A protein in blood which is transformed into fibres of fibrin which block damaged blood vessels and forms a blood clot

Capillaries - Small blood vessels which form a connection between arteries and veins
Capillary Narrow - A thin walled blood vessel which sends blood from arteries to veins. Exchanges of gaseous or dissolved substances between the blood and body cells takes place through capillary walls
Oxyhemoglobin - Hemoglobin which has combined with oxygen in the red blood cells
Pulmonary Circulation - The system of vessels that transport blood from the right ventricle to the lungs and back to the left atrium
Thrombosis - The formation of blood clots which may block an artery and stop the blood flow to vital organs
Vascular System (of mammals) - The heart and blood vessels
Hemophilia - An inherited blood disorder where blood from wounds clots very slowly or not at all

2.4.3.3 Blood groups and blood transfusion
Donor - A person who donates blood voluntarily
Universal Recipient - A person with blood type AB can receive blood from all other groups without being killed (except if there is a rhesus factor problem)
Universal Donor - A person with blood type O which can be given to all other groups without killing them
Agglutination - The clumping together of red blood cells which block small blood vessels leading to death. This is determined by the plasma and red blood cells of the recipient and donor during a blood transfusion

Blood Group	Antigen on RBC	Antibody in plasma
O	No antigen	Antibody A and B
A	Antigen A	Antibody B
B	Antigen B	Antibody A
AB	Antigen AB	No antibodies

How blood donation is determined - If the blood of the donor possesses the antigen of the antibody of the recipient, it will result in agglutination and death. For example, if a recipient of blood group A gets blood from a donor with blood group B, the antibody will attack the antigen, causing the agglutination
Rhesus Factor Positive (Rh+) - Refers to people who possess the rhesus antigen
Rhesus Factor Negative (Rh-) - Refers to people who do not possess the rhesus antigen
Why a person of blood group AB is not always considered a universal recipient - The presence of rhesus factors can still lead to an antigen-antibody reaction causing blood agglutination. For example if a patient is given Rh+ blood, he will survive the first transfusion, but the second transfusion results in an antigen-antibody reaction and agglutination because antibodies were made after the first transfusion in response to the presence of the rhesus antigen



Precautions taken during blood transfer - The blood group of the donor must be compatible with that of the recipient, the rhesus factor of the donor and recipient should be considered to determine if they are a match or not, the donor's blood should be safe from infections disease such as HIV

2.4.3.4 Blood circulation
Two-circuit circulatory systems (in animals) - Pulmonary circulation, systemic circulation
Pulmonary Circulation - Circulation of blood between the heart and lungs
Systemic Circulation - Circulation of blood in the rest of the body (excluding the lungs)
Types of circulatory systems - Open, closed
Open Circulatory System - The flow of blood from the heart to the body's tissues and back to the heart without passing through the blood vessels. Blood moves through a series of spaces
Closed Circulatory System - The flow of blood coming from the heart passes through different parts of the body through vessels and passes back to the heart
Spleen - An organ immediately below the stomach which produces white blood cells and destroys old worn out red blood cells

Systemic Circulation - The series of vessels which carry blood from the left ventricle around the body and back to the heart at the right atrium
Hepatic Portal Vein - The abdominal cavity that drains blood from the gastrointestinal tract to the spleen and liver
Hepatic Artery - Blood vessel that supplies oxygenated blood to the liver duodenum and pancreas

2.4.3.5 The lymphatic system
Antibodies - Chemicals made by the body in response to parasites or antigens that destroy them
Antigens - Bacteria, viruses or foreign substances in the body which stimulate the production of antibodies
Toxin - A poisonous substance
Antitoxin - A type of antibody which neutralizes poisonous substances, particularly those produced by parasites
Lymph - A liquid derived from tissue fluid after it has passed between the cells of the body and drained into the lymphatic system
Lymphatic System - A system of vessels that transport lymph from the tissues to the circulatory system
Lymph Node - A part of the lymphatic system which contains phagocytes which remove germs and dead cells from the lymph
Lymphocytes - White blood cells produced in the lymphatic system which make antibodies to destroy antigens
Phagocytes - White blood cells that engulf and digest germs
Ways the body prevents infection of diseases - First line of defense, second line of defense
First Line of Defense -
The Skin - Acts as a barrier against pathogens and produces sweat as a mild antiseptic
Acid and digestive enzymes in the stomach - HCl is secreted to kill most pathogens in food and water which was ingested, beyond the stomach digestive enzymes in the gut kill them
Respiratory System - Surfaces contain mucus to trap pathogens and cilia to sweep them away
Second Line of Defense -
White Blood Cells (Leucocytes) - Pathogens can be killed by WBCs by phagocytosis
Antibodies - Chemical substances which protect the body by destroying the pathogens and by neutralizing their toxins
Factors affecting the formation and flow of lymph - High blood pressure, decrease in plasma proteins, blockage of lymph vessels
Ways the body can remove or destroy bacterium - In the eye - Tears, **on the hands -** By washing, **in the bronchus -** By sneezing, **in the stomach -** By producing hydrochloric acid

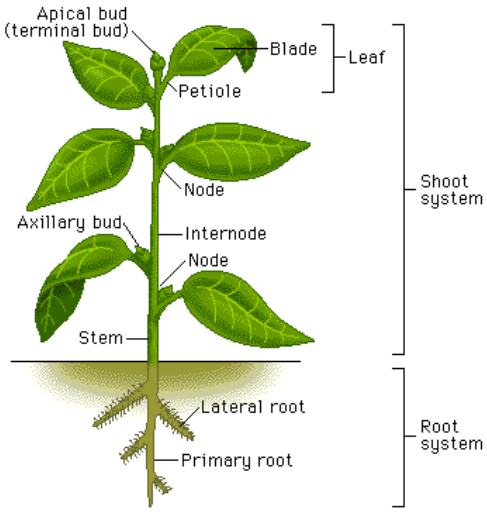
Differences between lymphocytes and phagocytes -

Lymphocytes	Phagocytes
• Secrete antibodies which fight germs • Secrete anti-toxins • Made in the lymphatic system • Have large oval shaped nuclei and no granules in their cytoplasm	• Destroy germs by engulfing microbes • Do not secrete antitoxins. Instead they gather at wounds to destroy bacteria before they can enter the body • Made in the bone marrow • Have a bi-lobbed (divided) nuclei and have granular cytoplasm

2.4.4 Transport of materials in plants
Lignin - A hard rigid substance which forms in the walls of cells which make up the xylem tissue
Vascular Bundle - Strands of xylem and phloem tissues running from the roots into the leaves which transports food and water throughout the plant and supports softer tissues
Vascular System (of plants) - Xylem and phloem tissues
Vein (of plants) - A strand of xylem and phloem tissue

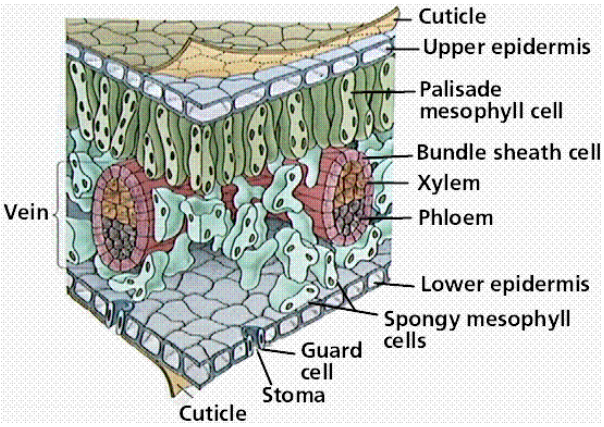
Structure of a plant - Leaves, roots, stems, buds, nodes, xylem, phloem
Xylem - A plant tissue which transports water and dissolved minerals from the soil to the leaves and also supports the softer plant tissues. It consists of the xylem vessels and fibres
Translocation - The movement of substances within a plant such as sugar moving through phloem
Transpiration - The evaporation of water from plant cells and out of their stomata, cooling effect
Root Hair Cells - Their function is to absorb water and minerals from the soil
Root Hairs - Hair like outgrowth from single cells in the epidermis of a root in a zone near the root apex
Root Nodules - A swelling on the roots of certain leguminous plants (e.g. peas/clover) which contain nitrogen fixing bacteria
Root Pressure - Pressure causing water to pass up the xylem from the living cells of the root

Petiole - A leave stalk
Phloem - A plant tissue that transports the products of photosynthesis from the leaves to the growing points and food storage organs. It consists mainly of sieve-tubes and companion cells
Pedicel - A flower stalk



Pericycle - A cylinder of cells that lines inside the endodermis in plants
Importance of water for plants - Major component of protoplasm, solvent for organic compounds, transport fluid, basic raw material for photosynthesis, supports plants by keeping the shoots turgid (stiff), for cooling plants through evaporation from leaves
Significance of transpiration - Water transport, salt transport, temperature control
Problems resulting from transpiration - Under dry conditions the plant may lose too much water and begin to wilt or even die

Leaf Structure - Spongy/palisade mesophyll, chloroplasts, guard cells, stomata, vein, epidermis
Spongy Mesophyll - A layer of cells in a leaf immediately below the palisade which contains large intercellular air spaces
Palisade Mesophyll - A layer of cylindrical cells at right angles to the upper epidermis of leaves which contain more chlorophyll than other plant cells and are the main cells concerned with photosynthesis
Chloroplasts - Organelles in plant cells which contain chlorophyll
Guard Cells - Crescent-shaped cells in the epidermis of plants which control the opening and closing of the stoma. Contains chloroplasts and are able to photosynthesize carbohydrates
Stomata - Pores in the epidermis of plants through which air enters and leaves and water evaporates during transpiration, used for excretion of waste materials by plants
Epidermis - The outer layer of cells in an animal or plant (skin), its function is to protect inner tissues from physical damage. In plants they give rise to the development of root hair cells
Meristem - Tissue in plants consisting of undifferentiated cells found in zones where plant growth takes place (ex. cambium)
Cambium - A region of unspecialized cells between the xylem and phloem of vascular bundles. Cell division in the cambium produces new vascular tissue and increases the diameter of the stem
Cellulose - A carbohydrate made of ling fibers which forms the rigid cell wall surrounding all plants
Lamina - The flat part of a leaf on either side of the mid-rib
Mid-Rib - The rigid rib in the centre of a leaf which contains the xylem and phloem
Adsorption - A force which holds water in a thin film around the surface of soil particles
Capillarity - Force that draws water upwards through narrow spaces such as those between particles of soil



Turgidity - Is when a plant cell becomes full of water. This is necessary because it supports plants and causes the growing tissues to extend and grow
Vacuole - A fluid filled space in the cytoplasm of a plant cell containing sap which creates turgor pressure
Turgor Pressure - The pressure within plant cells which results from the absorption of water by osmosis
A tree can die if you remove a ring of bark because the phloem tissues are destroyed blocking translocation of food from leaves
Functions of Roots - Anchors plant to the soil, absorbs water and mineral salts and transports them up to the stem, can be a storage organ, used for support
Functions of Stems - Continuous conduction of water and mineral salts upwards to the leaves, supports leaves and holds them out to receive sunlight, supports flowers, can serve as a storage organ
Functions of Leaves - Absorbs carbon dioxide for photosynthesis, contains chlorophyll, stomata allow for transpiration

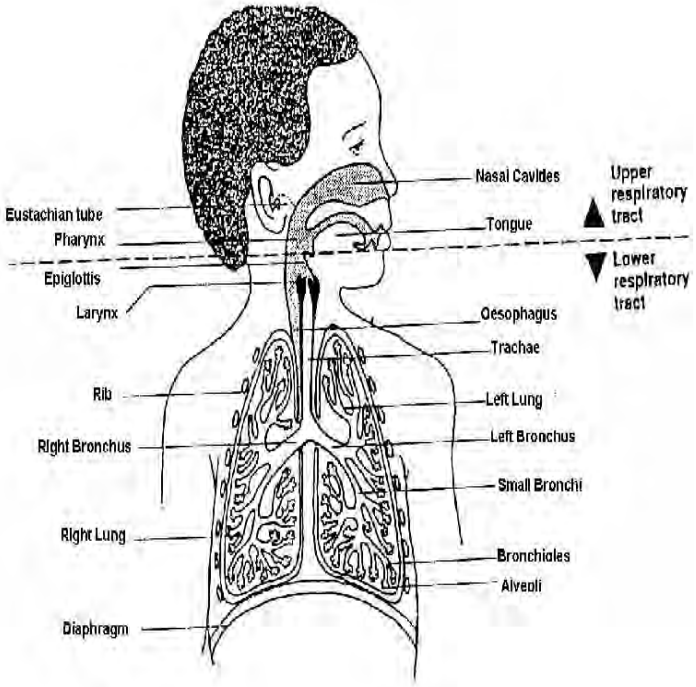
Functions of Flowers - Organ of reproduction, ovary forms the fruit which contains seeds
Differentiate between roots and stems -

Stems	Roots
• Have chlorophyll • Have nodes and internodes • Braches at nodes • Produce leaves, flowers and fruits • Are covered by a cuticle or bark • Have no stem cap • Have no root hairs	• Usually have no chlorophyll • Do not have nodes and internodes • Branches irregularly • Do not produce leaves, flowers or fruits • Do not have a cuticle • Have a root cap • Have root hairs

2.5.0 Gaseous exchange and respiration

2.5.1 Concept of gaseous exchange

Gas Exchange - The process by which an organism absorbs oxygen from the air in exchange for carbon dioxide, takes places in respiratory organs like lungs
Gaseous Exchange - Is the exchange of gases between the blood and respiratory surface or between the blood and respiring cells
Respiration - The exchange of carbon dioxide and oxygen in animals
Requirements for respiration in animals to occur - Medium for the gases (ex air or water), a large moist respiratory system which can dissolve the gases before they diffuse into our out of the cells, a transport system to move the dissolved gases around the body to all of the cells and to collect gases which need to be eliminated



2.5.2 Gaseous exchange in mammals

Structures concerned with gaseous exchange -
Mammal - Lungs
Young Tadpole - External gills
Insect - Tracheal system
Earthworm - Whole body through diffusion
Spider - Book lungs
Adaptations of lungs for gaseous exchange - Alveoli, moist, supplied by blood vessels, well ventilated
Large surface area - Alveoli increase the surface area for maximum contact with the air
Moist - The surfaces of alveoli are moist to enable easy diffusion of gases
Blood Supply - Blood supply ensures maximum absorption of oxygen
Ventilation - Well ventilated to receive a steady flow of new air

Differences between villi (digestion) and alveoli (respiration) -

Villi	Alveoli
• Found in the digestive system (alimentary canal) • Deal with absorption of food materials • Increase the surface area of the gut for the absorption of food materials	• Found in the respiratory system (lungs) • Deal with exchange of gases between the blood and environment • Increase the area of the lungs for gaseous exchange

Factors governing gaseous exchange at alveoli - Concentration of gases (oxygen & carbon dioxide) in the blood and alveoli, walls of capillaries and alveoli are very thin to allow for easy diffusion of gases, blood pressure in the blood capillaries surrounding the alveoli is high, alveoli surfaces are moist and aid in rapid diffusion of gases

Ventilation - The movement of air or water across a respiratory surface such as a lung or gill which enables gaseous exchange to take place
Breathing - Is the process whereby the air is exchanged between the environment and a multi-cellular organism

Order of respiratory components - Nasal Cavity → Pharynx → Trachea → Bronchi → Bronchioles → Alveoli
Alveoli - Bubble-like air pockets at the ends of the air passages in the lungs, they are surrounded by blood vessels and are concerned with gaseous exchange
Bronchi (Bronchus) - Major pathway of air entering the lungs from the trachea
Bronchioles - Smaller branches of the Bronchi that end with alveoli
Diaphragm - Dome shaped sheet of muscle at the base of the thorax, part of the mechanism that ventilates the lungs
Intercostal Muscles - The muscles between the ribs that raise the ribcage during inspiration (breathing in)
Pharynx - Part of the throat where both food and air pass through leading to either the stomach or lungs
Pleural Cavity - The fluid filled space between the outer surface of the lungs and the inner surface of the rib cage
Respiration - A sequence of chemical reactions which release energy from food
Trachea -The airway through which respiratory air passes in organisms
Thorax (of mammals) - The cavity in the chest which contains the lungs, heart and main blood vessels
Oxygen Debt - Occurs during strenuous aerobic exercise. It happens because there is not enough oxygen in the body to oxidize the excess lactic acid produced. This is resolved by increasing the rate of breathing during and after exercise to oxidize all of the lactic acid
The process by which carbon dioxide passes from the blood to the alveoli in the lung is diffusion

2.5.3 Gaseous exchange in plants
Lenticel - An airy aggregation of cells with structural surfaces of the stems, roots and other parts of vascular plants which functions as a pore for direct exchange of gases between internal tissues and the atmosphere
Why it is not healthy to sleep in a closed room with many potted plants - Plants are unable to produce oxygen without sunlight because photosynthesis requires sunlight, plants continue to respire which releases carbon dioxide into the environment, the room would lose all of its oxygen and only have carbon dioxide which will cause a person to suffocate

2.5.4 Respiration
2.5.4.1 Aerobic respiration
Aerobic Respiration - A type of respiration where oxygen is consumed (ex humans)
ATP (Adenosine Triphosphate) - A chemical that transfers energy released by respiration to other reactions in the body which absorb energy
Why metabolic activities use ATP instead of glucose as a source of energy - The high energy phosphorus bonds of ATP easily release the energy for a cell to use, but the energy stored in glucose requires more time and effort to process (it is a three step process). ATP stores chemical energy from glucose at a high rate of efficiency
Mitochondria - Rod-shaped organelles in the cytoplasm of cells which is concerned with respiration

2.5.4.2 Anaerobic respiration
Anaerobic Respiration - A type of respiration in which oxygen is not consumed (ex yeast)
Denitrifying Bacteria - Anaerobic bacteria in soil which break down nitrates into nitrogen and oxygen
Fermentation is an example of anaerobic respiration|
Differentiate between aerobic and anaerobic respiration -

	Anaerobic	**Aerobic**
Place it occurs	Cytoplasm	Mitochondria
Substrates	Glucose	Glucose and oxygen
Products	Alcohol and carbon dioxide in plants, lactic acid in animal cells	Carbon dioxide and water
Energy produced	2 molecules of ATP	38 molecules of ATP

2.5.4.3 Infections and diseases of the respiratory system
(Not found in exams)

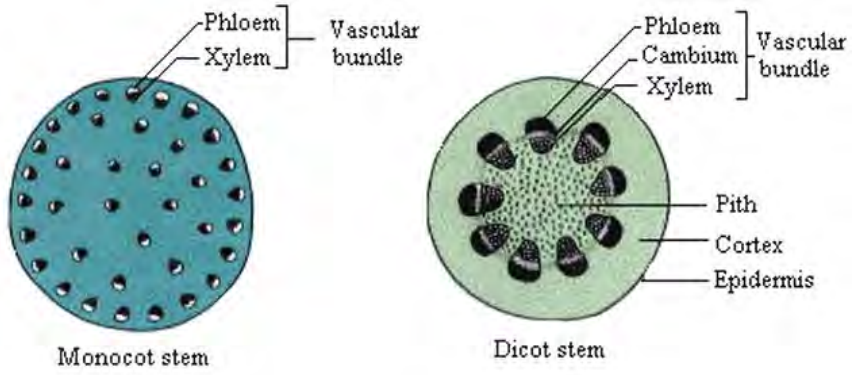
2.5.4.4 Disorders of the respiratory system
(Not found in exams)

Form 3

3.1.0 Classification of living things

3.1.1 Kingdom plantae
3.1.1.1 Division coniferophyta (conifers)
Characteristics of Gymnosperma (Conifers) - Trees and shrubs, flowers are cones, seeds are naked, evergreen, do not shed leaves regularly, soft wood
Examples of Gymnosperma - Redwood trees and other conifers
Advantages of conifers - Grow fast, used to produce softwood, used in building/paper/furniture, used as telephone poles
Disadvantages of conifers - Demands greater use of preservatives, prone to termites, plantations use a lot of land

3.1.1.2 Division angiospermophyta (angiosperms)
Characteristics of Angiosperma - Wide variety of forms including trees, shrubs and herbaceous plants, xylem acts as a vessel, flowers are common, hermaphrodite with seeds enclosed in a fruit, hardwoods, shed leaves regularly
Examples of Angiosperma - Maize, beans, oak trees, onions, grass
Uses of angiosperms - Timber (hardwood), medicine, paper, cotton, sisal fiber, crops
Groups of flowering plants - Monocot (monocotyledon), dicot (dicotyledons)
Monocot (Monocotyledon) - A group of flowering plants (angiosperms) whose seed has one embryonic leaf (one cotyledon). (ex. grains, rice, maize, wheat, sugar cane etc)
Dicot (Dicotyledons) - A group of flowering plants (angiosperms) whose seed has two embryonic leaves called cotyledons (ex. roses, magnolias etc)



Differentiate between dicots and monocots -

Monocots	Dicots
• Has one embryonic leaf • Tap roots • Vascular bundles spread around the middle • Floral parts are arranged in three parts of multiples of threes • Leaves are long and ribbon-like with veins arranged in a pattern parallel to the long axis of the leaf	• Has two embryonic leaves • Fibrous roots • Vascular bundles in a ring • floral parts are arranged in fours or fives or multiples of fours or fives • Leaves are different shapes and veins are arranged in a net pattern

3.2.0 Movement

3.2.1 Concepts of movement and locomotion
Locomotion - The ability of the whole body of an organism to move from one place to another
Types of locomotion - Amoeboid, ciliary, flagellar, muscular
Amoeboid - Movement is caused by extending cytoplasm in a certain direction

Ciliary - The surface of organisms is covered by thousands of small hair like cilia which are coordinated to beat backward and forward causing the organism to move

Flagellar - Movement is caused by whipping a large cilia like tail in water, causing the organism to rotate and move forward

Muscular - Movement is caused by the force generated by the contraction of muscles

Movement - The action of changing positions whereby a part of the body or the whole body of an organism moves from one place to another

Pseudopodia (Fake Feet) - Projections from the cytoplasm of certain cells like amoeba that are used for locomotion and feeding

Importance of movement to living organisms - It enables living things to obtain necessary things like food, shelter or mates for their survival from the environment around them

Types of movement used by the following organisms -

Amoeba - Amoeboid movement

Euglena - Flagellar movement

Paramecium - Ciliary movement

Birds - Muscular movement

3.2.2.1 The human skeletal system

Types of joints - Hinge, ball and socket, pivot, gliding, fixed

Hinge - A joint which can be lifted up or down similar to a door opening and closing (ex. knee and elbow joints)

Ball and Socket Joints - Characterized by allowing movement in many directions including rotation (ex. shoulder and hip joints)

Pivot - A joint which allows a pivot to turn in a socket (ex. joint between axis and atlas vertebrae)

Gliding - found where two bone surfaces move over each other (ex. joints between vertebrae and wrist joints)

Fixed - A type of joint formed by the fusing of bones which does not allow for movement (ex. skull)

Hydrostatic Skeleton - A structure found in many cold blooded organisms and soft bodied animals consisting of a fluid filled cavity (coelom), surrounded by muscles which allow the organism to change shape and produce movement (ex. jellyfish, earthworms, nematodes)

Humerus - A long bone in the arm that runs from the shoulder to the elbow

Articular Cartilage - Prevents surfaces or articulating bones from being worn out by function. Its cells actively divide miotically to make the bone grow

Endoskeleton - A skeleton which forms inside the body of an organism

Exoskeleton - A skeleton which forms on the outside of an organism

Hydrostatic Skeleton - Support which comes from water in the cells of an organism

Synovial Fluid - Minimizes friction in a joint when bones move due to bending or straightening of the limbs

Synovial Joint - Any freely moveable joint in the skeleton e.g. elbow

Synovial Membrane - Is the soft tissue that lines the non-cartilaginous surfaces with joints and cavities (synovial joints)

Tendons - A strong band of fibres which attaches muscles to bones

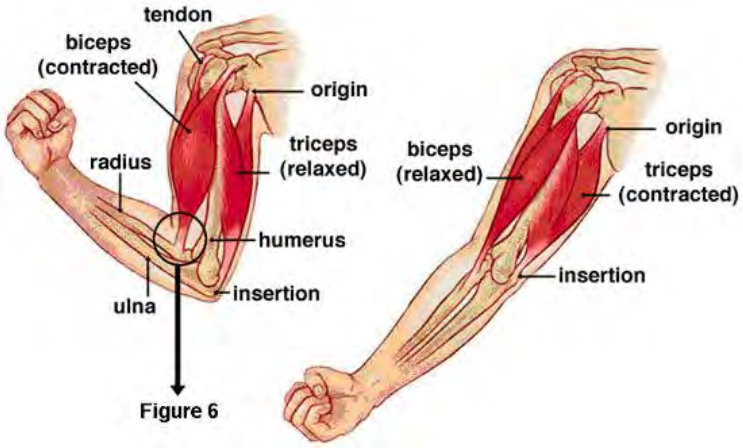


Figure 6

There are 7 vertebrae in the neck (cervical vertebrae)

Atlas - The first cervical vertebra of the spine, connects the skull to the spine

Axis - The second cervical vertebra of the spine, forms the pivot where the atlas rotates

3.2.2.2 Muscles and movement

Types of Muscle - Smooth, skeletal, cardiac

Skeletal Muscle - Is muscle which is attached to bone and is concerned with locomotion

Examples of Smooth Muscle - Small arteries, veins, lymphatic muscles, urinary bladder, uterus, male and female reproductive tracts, respiratory tract, gastrointestinal tract, ciliary muscle, iris

Cardiac Muscle - Is muscle found only in the heart

Smooth Muscle - Is found in the walls of organs in the body like the gut and bladder and is concerned with movement of materials through them

Antagonistic Muscle System - Two sets of muscles which oppose each other on either side of a joint one side flexes (bends) and the other extends (straightens)

Insertion (of a muscle) - The end of a muscle attached to the bone which moves when the muscle contracts

Motor Endplate - Part of a motor neuron which is embedded in a muscle

Motor Neuron - A neuron which sends an impulse from the central nervous system to a muscle or gland

Origin (of a muscle) - The anchorage point of a muscle i.e. the end which does not move during contraction

Oxygen Deprivation - Occurs in muscle tissue during strenuous exercise when oxygen is consumed faster than it can be supplied by the blood

Adaptations of motor neurons - Cell body is located at one end of the axon and is pointed towards the central nervous system to help carry the action potential from the central nervous system, has short dendrites to ensure that a fast response occurs, has a myelin sheath to ensure that the nerve impulse is traveling in only one direction without any interference, has a node of ranvier to help increase the speed of conduction of the nerve impulses (salutatory movement)

Difference between a ligament and tendon - A ligament is a tissue which connects *bone to bone* at the joint, whereas a tendon is a part of a muscle which attaches the *muscle to the bone*

Femur - Thigh bone which gives vertebrates the ability to walk or jump

Hyaline Cartilage - Its function is to reduce friction between bones during movement and to absorb shock

Joint - The junction point where two bones meet

Ligament - A band of fibres around a joint of a skeleton which holds the bones in place preventing dislocation, joins bone to bone at the joint

Vertebral Column - The backbone or spine. A chain of small bones called vertebrae that support the body, protects the spinal cord and permits bending movements

Biceps and triceps are antagonistic muscles in a mammal's arm, meaning when one contracts the other relaxes

Teeth

Dentine - A substance similar to bone which forms in the inner part of the tooth beneath the enamel

Diastema - The gap or space between teeth

Enamel - The extremely hard, white substance which forms the outer surface of a tooth

Incisor - Chisel-shaped teeth at the front of the jaws

Molars - Large teeth with four cusps, situated at the back of the jaw which are used to crush and grind food

3.2.3 Movement in plants

What is here? Syllabus is not clear.

3.3.0 Coordination

3.3.1 Concept of coordination

Coordination - The linking together of the activities of different organs so that they work at an appropriate time and rate required by the body

Components of coordination - Stimulus, receptor, coordinator, effector, response

Stimulus - Anything which produces a response in an organism (ex. a painful burn on the skin)

Receptor - A part of an animal's body which detects a change in the environment (ex. eyes, ears, nose, skin, tongue)

Coordinator - An organ which receives messages as sensory nerve impulses from receptors and then coordinates them to bring about a response

Effector - An organ which receives motor nerve impulses from the coordinator and brings about an appropriate response (ex. glands and muscles)

Response - An activity provoked by a stimulus (ex. pulling hand away from a hot object)

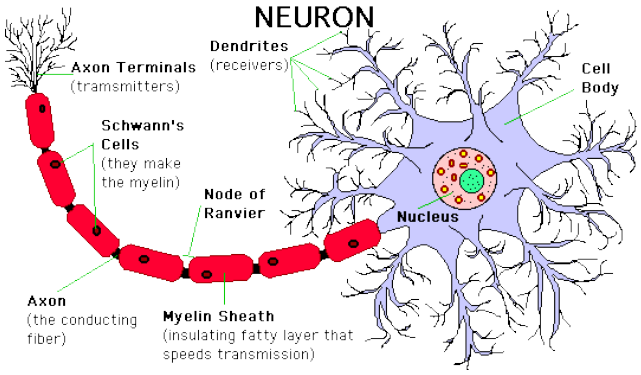
Condition - A behaviour which has to be learned

Effector Organ - A muscle or gland that contracts or secrets in response to nerve impulses

Pathway from a stimulus to a response - Stimulus inside a sense cell → nerve impulse by a sensory neuron → central nervous system → nerve impulse by a motor neuron → effector-gland or muscle → response

3.3.2.1 Neurons

Axon - The nerve fiber of a neuron which conducts nerve impulses away from the cell body
Chemoreceptor - A receptor which detects certain chemical stimuli in the environment



Dendrites - Short numerous fibres which receive impulses and conduct them towards the cell body
Ganglion - A biological tissue mass, most commonly as a mass of nerve cells
Proprioceptor - A sensory nerve ending which picks up stimuli originating inside the body e.g. a stretch receptor in a muscle
Myelin Sheath - A fatty material that insulates and protects the axon and speeds up the transmission of impulses
Neuron - A nerve cell consisting of a cell body and nerve fibres which conducts nerve impulses
Node of Ranvier - Gaps formed between myelin sheaths of different cells
Receptors - The regions of sensory nerve fibres where stimuli are received and converted into nerve impulses e.g. rods and cones of the eye
Synapse - Microscopic gap which the nerve impulses pass when moving from one nerve cell to the next
Synaptic vesicles - Contain the neurotransmitters which carry the impulses when one neuron is associated with another
Threshold - The level of stimulation at which nerve impulses begin to pass from a sense organ, or to cross over a synapse

Nerve Impulse -

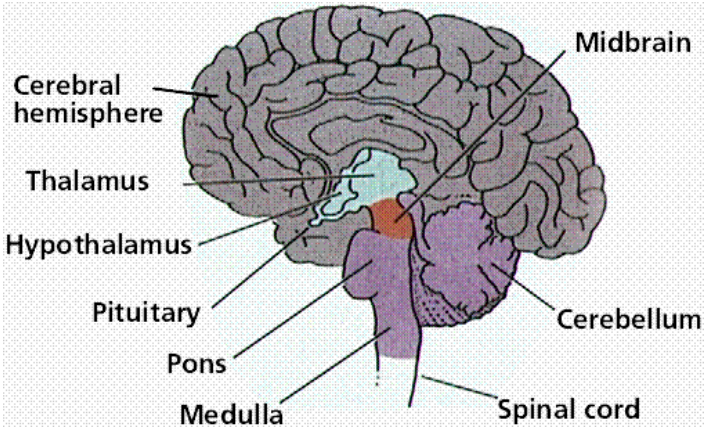
How a nerve impulse is propagated across a synapse - The arrival of nerve impulses in the presynaptic knob causes the synaptic vesicles to move and fuse with the presynaptic membrane. Then the vesicles burst to release chemical transmitters which diffuse across the gap to the post-synaptic membrane of the other neuron. Then they are received by the post-synaptic membrane causing the depolarization of the post-synaptic neuron and the nerve impulse proceeds to travel to the post-synaptic neuron until its destination

Characteristics of a nerve impulse - Have high conductivity and high excitability

Why the nerve impulse travels only in one direction - This is because the neurotransmitters are found only on the presynaptic knob meaning that impulses can only travel from the presynaptic neuron to the post-synaptic neuron

3.3.2.2 Central nervous system

Medulla Oblongata - The lower half of the brainstem which deals with breathing, heart rate and blood pressure



Pituitary (Master) Gland - An endocrine gland that secretes hormones regulating homeostasis. It is said to be the master gland because it secretes hormones which control the function of other glands
Central Nervous System - The brain and spinal cord
Cerebellum - The part of the brain which controls balance and muscular coordination
Cerebral Cortex - Gray matter which forms the outer layer of the cerebral hemispheres, controls voluntary movements and is concerned with memory, thinking and learning
Cerebrum - Responsible for thought, memory, intelligence and judgment
Cerebral Hemispheres - Two swellings in the front of the brain which form the largest region in the human brain and are concerned with consciousness, learning and memory
Gray Matter - Nervous tissue in the brain and spinal cords consisting mainly of neuron cells
Hypothalamus - The reflex centre concentrated with mechanisms like temperature control, water balance and carbon dioxide levels in the blood
Olfactory Lobes - Receives sensory impulses from the organ of smell and is connected to the cerebrum

Optic Lobes - Receives sensory neurons from the eye
Sensory Neuron - A neuron which conducts impulses from a receptor (e.g. sense organ) to the central nervous system
Spinal Cord - A long thin tubular bundle of nervous tissue and support cells from the brain which makes up the central nervous system
White Matter - Nervous tissue in the brain and spinal cord which consists of nerve fibers

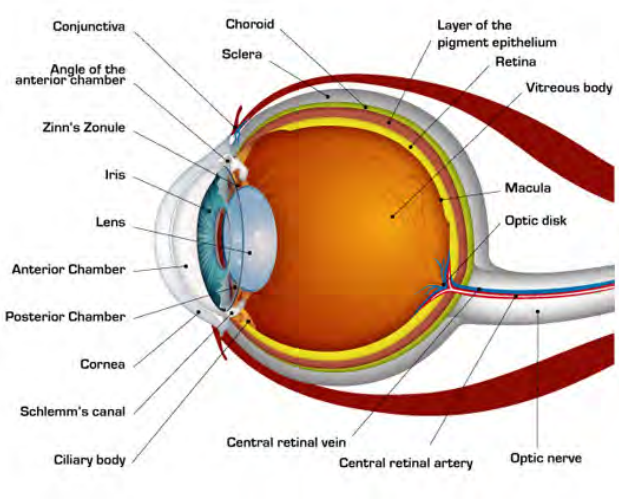
3.3.2.3 Peripheral nervous system
What is this? Syllabus is not clear.

3.3.2.4 Reflex action
Orientation Behaviour - The behaviour which allows animals to move in a particular direction depending on a received direction
Irritability - The ability of an organism to respond to stimuli
Reflex - A response that does not have to be learned and occurs very quickly without conscious thought e.g. withdrawing from a painful stimulus
Conditioned Reflex Action - The fast automatic response to a stimuli resulting from learning
Importance of conditioned reflex actions in living organisms - Helps change the animals behaviour so that it will behave in a way that allows them to survive, produces responses which are favorable (ex. a child responding to their parents voice), helps keep animals away from predators and to escape them
Types of Action - Reflex, voluntary
Reflex Action - A fast automatic response to a stimuli which is not controlled by will power
Voluntary Action - An action performed by an individual which is controlled by will power
Order of a simple reflex in the body - Receptor organ stimulated → Impulse travels in sensory fiber → Impulse crosses synapse → Impulse travels in motor fiber → Effector organ stimulated
Differences between a reflex action (animals) and tropism (plants) -

Reflex actions	Tropism
• Occurs quickly • Short term response • Conducted through nerve impulses through neurons	• Occurs slowly • Long term response • Conducted by hormones secreting to the point of cell elongation by diffusion

3.3.2.5 Sense organs
Receptors used in mammals for each type of stimulus -

Stimulus	Light	Sound	Chemical	Gravity	Temperature	Texture	Pressure
Receptors	Eyes	Ears	Nose and tongue	Ears	Skin	Skin	Skin



The Eye
The process of image formation - Light rays from an object enter the eye through the cornea, and then they pass through the aqueous humour to the pupil to the lens to the vitreous humour and finally reach the retina. As the light passes through the lens, cornea and aqueous humour, a partial refraction of the light occurs with the greatest amount of refraction occurring through the lens. The refraction directs light rays towards the centre of the eye which fall on the retina forming an image of the object. The image formed is real, inverted and smaller than the object. When the light rays fall on the retina, they stimulate photoreceptors which set up an action potential which is then sent to the brain through the optic nerve. The cerebrum interprets the impulses to create the real object in terms of orientation and size

Defects of a mammalian eye - Myopia, hypermetropia
Myopia (Short-sightedness) - A defect of the eye whereby a person cannot focus on distant objects properly, but can focus on nearby objects properly

Causes - It is caused by the extension of the eyeball which results in an increase in the distance between the lens and the retina
Correction - It is corrected by using a biconcave lens (glasses) to diverge the light rays so they can be focused on the retina

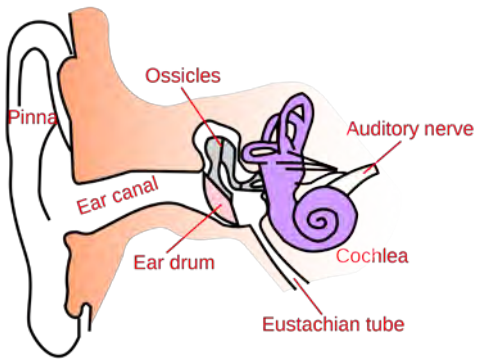
Hypermetropia (Long-sightedness) - A defect of the eye whereby a person cannot focus on nearby objects properly, but can focus on distant objects properly
Causes - It is caused by the compression of the eyeball, resulting in the shortening of the normal distance between the lens and the retina
Correction - It is corrected by using a biconvex lens (glasses) to focus light on the retina

Accommodation - Is the reflex mechanism by which light rays from an object are brought to focus on the retina. It is the ability of the eye to focus an image of near or distant objects
Blind Spot - The point at which the optic nerve leaves the retina of the eye. It is not sensitive to light
Ciliary Muscles - Muscles in the eye which change the shape of the lens during accommodation
Cones - Cone-shaped, light sensitive cells in the retina of the eye which work only in bright light and are sensitive to colour
Conjunctiva - The transparent skin which covers and protects the front of the eye
Cornea - Transparent, circular window at the front of the eye which focuses light
Fovea - Region of the retina immediately opposite the lens which consists of densely packed cones and provides the clearest vision
Iris - The coloured part of the eye which consists of the radial and circular muscles which alter the size of the pupil and control the amount of light entering the eye
Myopia - Shortsightedness which usually results from an abnormally elongated eyeball
Presbyopia - A condition resulting from old age in which the lens loses its ability to change shape during accommodation
Pupil - The hole in the iris of the eye through which light enters
Retina - A layer of light sensitive cells at the back of the eye on which images are formed
Rods - Rod shaped light sensitive cells found in the retina that work in dim light but do not respond to differences in colour
Suspensory Ligaments - Fibers which hold the lens in position within the eye
Vitreous Humor - The jelly-like substance that fills and supports the chamber of the eye
Sclerotic Membrane - The outer membrane of the eye

The Ear

Parts of the ossicles - Malleus (the hammer), incus (the anvil), stapes (the stirrup)
Malleus - Hammer shaped bone which is connected to the incus and the eardrum. Its function is to transmit vibrations from the eardrum to the incus
Incus - Anvil shaped bone which connects the malleus to the stapes transmitting vibrations
Stapes - Stirrup shaped bone which is attached to the incus and whose function is to transmit vibrations from the incus to the membrane of the inner ear

Functions of the ear - Used for hearing, used to balance the body, detects gravity and motion
Ossicles - Small bones in the middle ear which amplify sound waves
Auditory Canal (Ear Canal) - Is a tube running from the outer ear to the middle ear
Cochlea - Auditory portion of the inner ear, it is the sensory organ of hearing
Eardrum (Tympanic Membrane) - Thin membrane that separates the external ear from the middle ear, whose function is to transmit sound from the air to the ossicles inside the middle ear
Pinna (Auricle) - The visible part of the ear which is outside of the head



Eustachian Tube (Auditory Tube) - Is the tube that links the pharynx to the middle ear
Auditory Nerve (Cochlear Nerve) - The nerve that carries signals from the cochlea to the brain

The Skin

Functions of the skin - Prevention of water loss, prevention of damage of interior parts of the body, protection against radiation, vitamin D production, energy storage (fats), detects touch stimuli, detects pain stimuli

Adipose Tissue (Body Fat) - Loose connective tissue composed of fats whose purpose is to store fat, cushion and insulate the body
Sebaceous Gland - Microscopic glands of the skin which secrete an oil matter to lubricate the skin and hair of mammals
Dermis - The layer of skin beneath the epidermis consisting of connective tissue, blood vessels, nerves, hair roots and filled with fat
Malpighian Layer - A region of rapidly dividing cells beneath the epidermis of the skin which replaces cells worn away from the skin surface
Sebaceous Gland - A gland in the hair follicles of the skin which secretes sebum which is an oily substance that makes skin supple, waterproof and mildly antiseptic
Sweat Gland - A gland in the skin which produces water which evaporates into the air and cools the body

Nose
(Not found in exams)
Functions of the nose - Detects chemicals in the air (sense of smell is dependent upon the concentration of molecules in the air), is used with the tongue for tasting food

Tongue
(Not found in exams)
Functions of the tongue - Detects chemicals through four primary tastes (sweet, sour, salt and bitter)
Taste Bud - A collection of sensory nerve endings in the tongue which respond to certain chemicals in food producing the sensation of taste

3.3.3 Drug abuse
Drugs - Are chemical substances that when taken will have psychological and physiological effects
Drug Abuse - Non medical use of a drug that interferes with health and productive life
Causes of drug abuse - Social pressure, experimentation, escaping problems, poverty, employment (selling drugs)
Types of psychoactive drugs - Stimulants, sedatives, hallucinogens, narcotics
- **Stimulants -** Drugs which stimulate or excite the nervous system, stimulating brain activity and body processes (ex. cocaine, nicotine)
- **Sedatives -** These are sleep-inducting drugs which slow down brain activities (Ex. alcohol, valium)
- **Hallucinogens -** Drugs which distort the way the brain interprets impulses from sensory organs producing hallucinations (Ex. LSD, mushrooms)
- **Narcotics -** Dull the senses and relieve pain by suppressing the cerebral cortex of the brain (ex. heroin, opium)

Differentiate between drug addiction and drug tolerance -
- **Drug Addiction -** The excessive use of drugs without consideration of their side effects and without the ability to stop using them
- **Drug Tolerance -** As a result of excessive use of a particular drug, a person requires large amounts of a drug in order to get the effects of a small dose

Measures used to control drug abuse - Avoid taking any drugs without a prescription from the doctor, avoid peer pressure to use drugs, avoid people who use drugs, inform the police if you see someone using drugs, engage in creative activities during leisure time, if you become addicted to drugs you should seek medical help
Ways to control drug addiction - Choose friends who make good decisions, commit to not using drugs, avoid areas where drugs are present, work hard and focus on education, drug treatment programs, control supply through illegalization of drugs, discuss drug abuse
Effects of drug abuse on society - Drug users resort to theft/prostitution/selling drugs, poor work performance, drug offenders crowd jails and the court system
Effects of drug abuse on individuals - Legal and illegal drugs can have harmful effects (e.g. alcohol can damage the liver), cocaine can cause high blood pressure, sharing needles can spread HIV/hepatitis, turning to crime to get money for drugs, malnutrition
Reasons drugs (inhibitory or antagonistic drugs) can temporarily stop pain after an injury - They inhibit synaptic transmission so that impulses are not processed in the brain, stimulate cholinesterase enzymes which distort neurotransmitters signals, they also bind to receptors blocking the sensation of pain
Socioeconomic hazards of drug abuse - Excessive spending on drugs means little is spent on basic necessities (i.e. food/clothing), violence in families or community, poor work performance, loss of employment, dangerous roads due to intoxication from alcohol or drugs

3.3.4 Hormones and glands

Enzymes used to break down proteins - Pepsin, Trypsin

Pepsin -

Site of Production - Gastric gland in the stomach

Substrate - Protein

Product - Peptide

Trypsin -

Site of Production - Pancreatic gland

Substrate - Protein

Product - Peptide

Properties of enzymes - They are proteins, specific to their functions, catalysts, activity is affected by pH /temperature/substrate concentration/enzyme concentration, they lower the activation energy of the reactions which they catalyze, possess active sites where the reaction takes place (sites have specific shapes), they are very efficient (a small amount of catalyst can bring about a big change to the substrate)

Enzymes found in the human gut which break down carbohydrates -

Enzyme	Site of production	Substrate	Product
Salivary Amylase	Salivary glands	Starch	Maltose
Pancreatic Amylase	Pancreas	Starch	Maltose

Secondary sexual characteristics of females - Enlargement of mammary glands (breasts), appearance of pubic hair under arm pits, experiencing monthly menstruation (bleeding), high pitched voice

Secondary sexual characteristics of females are controlled by estrogen

Differentiate between endocrine glands and exocrine glands -

Endocrine Glands - Ductless glands which release hormones directly into the blood stream by diffusion

Exocrine Glands - Glands with ducts which secrete their contents to the internal or external surface of the body (ex. sweat glands, pancreas)

Hormone - A chemical produced in small amount in one part of the body which helps to coordinate processes such as metabolism, growth and reproduction in other parts of the body

Properties of hormones (as a chemical messenger) - Travels in the blood, small soluble organic molecule, effective in low concentrations, affects a site different from where it was made (target site), fits precisely into a certain receptor like a key in a lock, specific to the target area

Functions of hormones - Assuring that growth occurs properly, ensuring that development and maturation occur properly and on time, ensuring that reproduction occurs at the best possible time

Changes brought about by sex hormones -

Women - Widening of the hip girdle

Men - Deepening of the voice

Examples of hormones - Follicle stimulating hormone (FSH), lutenizing hormone (LH), Adrenal corticotrophic hormone (ACTH), growth hormone

FSH - Stimulates the development of a graafian follicle in the ovary

LH - Causes ovulation in females

ACTH - Stimulates the adrenal cortex to release adrenocortical hormones which control ionic balance, especially of sodium and potassium ions

Growth Hormone - Stimulates the growth of tissues, especially muscles and the skeleton

Conditions associated with undersecretion or oversecretion of growth hormone - Dwarfism, gigantism, acromegaly

Dwarfism - Results from undersecretion of the growth hormone at a young age

Gigantism - Results from the oversecretion of the growth hormone at a young age

Acromegaly - Results from the oversecretion of growth hormone in adults

Similarities between nervous and endocrine control - Both systems provide a means of communication and coordination within the body, both involve the transmission of an impulse which is triggered by a stimulus which produces a response, target organs are similar to effector organs in that they give the response

Differentiate between nervous and endocrine control -

Nervous Control	Endocrine Control
• Messages travel faster and have a rapid effect • Usually a short lived response • Very localized as the impulse is transmitted to individual effector cells • Relatively few neurotransmitters (acetylcholine and adrenaline are most common)	• Messages and transported slower and take longer to take effect • Often a long lasting response • Effects are often widespread due to the hormone being carried through the body in the blood stream • Variety of hormones produced by different organs, each with a specific effect

• Linked through the nervous system and nerves • Effectors are muscles and glands • Stimulated through receptors, eyes, nose based on light, sound etc	• Linked through the blood and circulatory system • Effectors are organs and the whole body • Stimulated through internal or external receptors

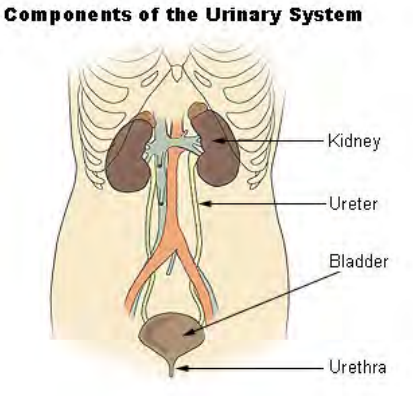
Adrenalin - A hormone secreted by the adrenal glands which prepares the body for instant action by increasing the heart rate, blood pressure and blood sugar levels
Endocrine System - A system of organs which produce hormones
Estrogen - The female sex hormone which controls conditions in the uterus before and during pregnancy which is secreted by the ovary
Gland - A group of cells which manufacture and release enzymes or hormones in the body
Insulin - A hormone produced by the pancreas which helps control the amount of sugar in the blood
Islets of Langerhans - Regions of the pancreas containing endocrine cells which produce the hormone insulin. A deficiency causes diabetes
Pancreas - An organ situated between the stomach and duodenum which produces insulin, trypsin, amylase and lipase
Secretion - The production by glands of substances such as enzymes which are useful to the body
Testosterone - The male sex hormone which controls the growth of pubic hair, muscular development, deepening of the voice. It is secreted in the testis of men
Thyroid - An endocrine gland in the neck which produces a hormone called thyroxin which effects physical and mental development. A deficiency causes dwarfism and mental retardation, overproduction causes increased metabolism
Diabetes is associated with under-secretion of insulin in the blood

3.3.5.1 Tropic and nastic responses
Auxin - A hormone produced by plants which controls the rate of cell growth in roots and shoots and is responsible for tropic responses
Hydrotropism - The growth movement in plants in response to water
Nastic Movements - Non-directional responses to stimuli (e.g. humidity, temperature)
Phototropism - Growth movement of a plant in response to the direction of light, plant moves towards the light source
Tropism (Tropic Responses) - A movement in plants where the direction of the root and show growth alters according to the direction of a stimulus
Geotropism - Growth movement of a plant in response to gravity, roots grow down and the stem grows up

3.4.0 Excretion

3.4.1 Concept of excretion
Excretion - Removal from the body of waste produced by metabolism and excess substances from the system
Faeces (Feces) - The indigestible material which remains in the colon after digestion has taken place

3.4.2 Excretion in humans
Urinary System
Urea - The main nitrogenous product excreted by a mammal
Ureter - A tube which carries urine from a kidney to a bladder
Urethra - A tube which carries urine out of the body as well as allowing the passage of sperm
Urine - Liquid containing waste materials removed from the blood by the kidneys which consists of water/urea/minerals



Nitrogenous waste products removal with water -
Ammonia, uric acid
Ammonia - Requires a large amount of water to excrete because it is toxic and soluble in water, commonly excreted by aquatic organisms due to the high availability of water
Uric Acid - Requires less water because it is less toxic and less soluble in water, commonly excreted by land organisms due to the low availability of water

The Kidney / Waste Removal

How the fluid in the proximal convolute tubule differs from that in the collecting duct in a nephron -

The proximal convolute tubule contains - Glucose (this is where glucose is mainly reabsorbed), nutrients from food, minerals, amino acids in greater amounts

The collecting duct contains - No glucose, no food nutrients and others in less amounts

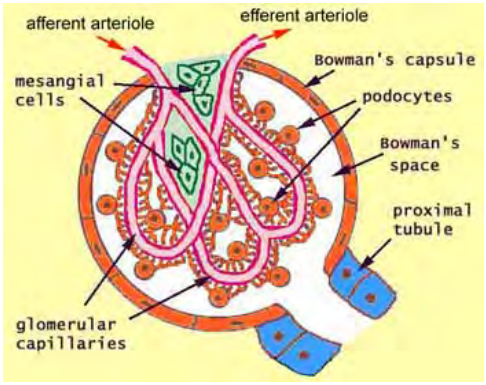
Effects of longer or shorter and the loops of Henle -

Longer - More water would be reabsorbed. This is an adaptation of many desert animals

Shorter - Less water would be reabsorbed

Why people do not urinate frequently on a hot day - Mammals have different ways of reducing the amount of excess water in the body like sweating, urination, breathing and defecation. Since it is hot the mammal will sweat meaning that there is less excess water in the body to urinate

Processes involved in urine formation - Ultra filtration at the glomerulus, reabsorption occurs at tubules, secretion occurs at the second coiled tubule



Bowman's Capsule - A cup-shaped structure in a kidney which contains a glomerulus and leads to a kidney tubule

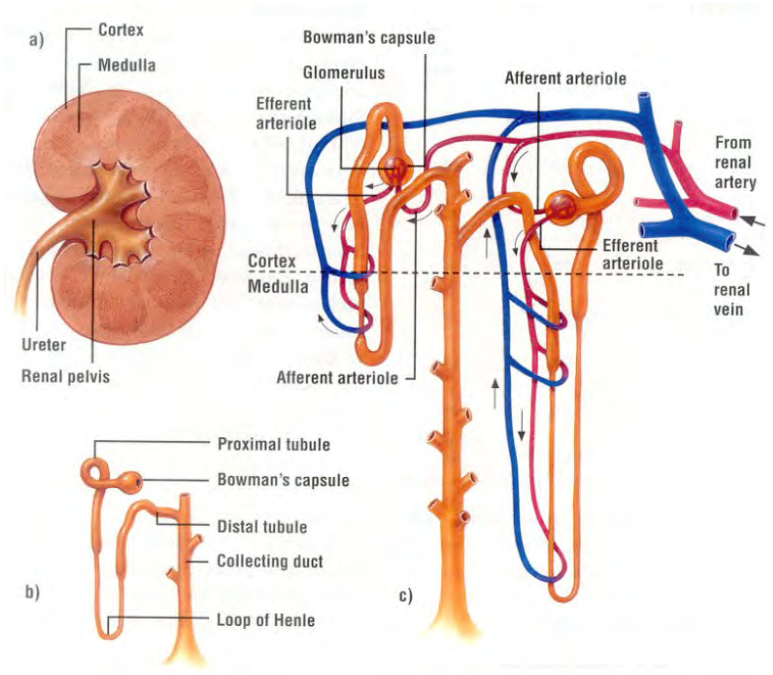
Proximal Convoluted Tubule - The coiled part of the tubule next to the Bowman's capsule and is located in the cortex

Distal Convoluted Tubule - Coiled part next to the open end of the tubule which joins with a collecting duct

Glomerular Filtrate - A fluid which results from the filtration of blood in Bowman's capsule. It consists of urine and many useful substances such as glucose. Proteins and blood cells do not diffuse into it

Glomerulus - A group of capillaries inside a Bowman's capsule in a kidney. Blood is filtered as it passes through the glomerulus and Bowman's capsule walls into the kidney tubule

Henle's Loop - Portion of the nephron that leads from the proximal straight tubule to the distal convoluted tubule



Kidney Tubule - A narrow tube leading form a Bowman's capsule in the kidney which reabsorbs water/glucose, Na^+/Cl^- and other useful substances from the glomerular filtrate

Nephron - The basic structural unit of the kidney whose function is to regulate the concentration of water and soluble substances by filtering the blood by reabsorbing what is useful and excreting waste as urine

Renal Artery - The artery that supplies blood to the kidney

Renal Vein - The vein that takes blood away from the kidney

3.4.3 Complications and disorders of the excretory system

Nephritis - An infection or inflammation of the kidneys due to the failure of glomeruli to allow protein to filter through into the tubules

Kidney Stones - Small stones that form in the pelvic region of the kidneys which can obstruct the flow of urine

Cystitis - An inflammation of the bladder caused by an infection which causes frequent painful urination

Kidney Failure - A condition where one or both kidneys no longer function and can be fatal if untreated

Dialysis - The use of semi-permeable membrane to separate large molecules from small ones, used in kidney dialysis machines to remove urea from blood

3.4.4 Excretion in plants

Transpiration - The process by which plants lose water in the form of vapour by evaporation

- **Importance of transpiration to plants -** Brings a cooling effect to the plant when environmental temperatures are high, water and minerals are drawn up from the soil solution up the plant in the transpiration stream which are then used for photosynthesis, regulates water levels in the plant
- **Harmful effects of transpiration -** Loss too much water due to transpiration can lead to wilting, serious desiccation, and eventually death
- **Factors affecting the rate of transpiration -** Environmental factors (temperature/wind/humidity/vapour pressure/light/air movement), leaf surface area and surface are to volume ratio, cuticles, stomata, number of stomata per unit of area

3.5.0 Regulation

3.5.1 Concept of regulation

Regulation - The processes in an organism which keep levels of required conditions at appropriate levels

Homeostasis - Maintenance of constant internal environment

Homoeothermic (Warm blooded) Organisms - Organisms which are able to maintain a constant body temperature

Poikilothermic (Cold blooded) Organisms - Organisms which cannot maintain a constant body temperature and vary according to the temperature of their surroundings

Hydrocele - An accumulation of fluid in the body

Mechanisms which affect the internal environment of a body - Breathing/gaseous exchange, temperature control, water and ionic control (excretion)

How water levels are kept constant in body fluids -

- **Too Low -** When water levels fall as a result of dehydration, the hypothalamus is stimulated which signals to the pituitary gland to secrete the hormone vasopressin to increase the permeability of distal convoluted tubules resulting in more water being reabsorbed in the blood stream and osmotic pressure is reduced to the optimal level
- **Too High -** When water levels are too high it causes a reduction in the secretion of vasopressin from the pituitary glad leading to a decrease in the permeability of the distal tubules resulting in less water being absorbed and large volumes of water being excreted as dilute urine

3.5.2 Temperature regulation in animals

Physiological activities which contribute to temperature regulation in mammals under -

- **Hot Conditions -** Vasodilation, reducing rate of metabolism, sweating, hairs lie flat to the skin surface
- **Cold Conditions -** Vasoconstriction, metabolism increased, hairs become erect, shivering occurs

Shivering - Shaking when an animal is cold. Its function is to generate heat when body temperature is low

Vasodilation - Refers to the widening of blood vessels resulting from the relaxation of smooth muscles in the vessel walls

Vasoconstriction - Refers to the constricting of blood vessels resulting from the tightening of smooth muscles in vessel walls

Poikilotherms - Animals which cannot control their internal temperature, so they must wait in the sun or shade to regulate their temperature (ex lizards)

Homoiotherms - Animals which control their temperature by the actions of the hypothalamus in the brain (ex humans)

Adaptations of Homoiotherms -

- **In cold environments -** Posses fat and fur, small ears and short noses to minimize surface area (to prevent heat loss), hide in burrows or nests, hibernation (metabolic processes are reduced to a minimum), migrating to warmer environments
- **In hot/dry environments -** Little fur or fat, large ears and long noses to maximize surface area, hide in nests during hot periods, aestivation (hibernation in hot, dry environmental conditions)

Methods used by mammals to lose heat - Production of sweat, evaporation of saliva leading to panting, immersing their body in water to cool down, hair is lowered making a thinner coat which allows heat to escape more easily, molting occurs, metabolism decreases so that less heat is produced

Methods used by mammals to gain heat - Decrease in production of sweat, jaws kept closed and breathing is slow through the nostrils to prevent evaporation of saliva, stays out of the water at night, thicker fur is grown, metabolism increases to produce more heat, shivering

A dog panting is an example of a <u>cooling effect in hot conditions</u>

3.5.3 Osmoregulation

Osmoregulation - The control of the movement of water in and out of the cells by osmosis

3.5.4 Blood sugar regulation in mammals

How glucose is kept at constant levels in body fluids - Glucose is regulated by two hormones: insulin and glucagon

Too Low - When the level of blood sugar falls, it stimulates the release of glucagons which convert glycogen into glucose, which increases blood sugar levels

Too High - When the amount of glucose rises, the receptor centers for glucose are stimulated the insulin is released to convert glucose into glycogen so that it can be stored in the liver

3.6.0 Reproduction

3.6.1 Concept of reproduction

Asexual Reproduction - Reproduction involving one parent, with the fusion of gametes

Sexual Reproduction - Reproduction involving two parents who produce gametes. These gametes fuse together making a zygote which develops through an embryo stage to become a new organism

Binary Fission - The process of a parent cell splitting to become an independent organism (done by ameba, paramecium and other bacteria)

Fertilization - The process of fusion between male and female gametes

Zygote - A fertilized Ovum which eventually develops into a new organism

Gametes - Male and female reproduction cells (eggs and sperm)

Hermaphrodite (Bisexual) - Occurs when an organism posses both male and female reproductive structures

Differentiate between sexual reproduction and asexual reproduction -

Asexual Reproduction	Sexual Reproduction
• No genetic variation between offspring • Requires one parent only • No gametes are involved	• There is genetic variation between offspring • Usually requires two parents • Involves fusion of two gametes

3.6.2 Meiosis and reproduction

**Found in 4.1.2 along with mitosis*

3.6.3 Reproduction in flowering plants

Anther - Terminal part of a stamen which produces and releases pollen

Stamens - The male reproductive organs of a flower. The anthers of stamens produce pollen grains, consists of anthers and filament

Stigma - The part of the carpel where pollen grains become attached during pollination

Style - Surrounds the pollen tube of a plant, between the stigma and the ovary

Spore - A microscopic reproductive cell released from an organism during asexual reproduction commonly found in fungi/mosses/ferns. For bacteria a spore is a resting or dormant stage of the life cycle usually formed when conditions are unfavorable

Pollen - Male gametes of flowering plants

Pollination - Transfer of pollen grains from stamens to stigmas

Endosperm - The tissue produced under the seeds of flowering plants around the time of fertilization to surround the embryo and provide nutrition

Germination - The transformation process of seeds turning into seedlings

Nectary - An organ in a flower that produces nectar and aids in pollination by attracting insects

Carpel - The female sex organ of a flower

Sepals - Leaf like structures at the outer region of a flower which protect the flower when it buds

Calyx - The collective name for the sepals of a flower

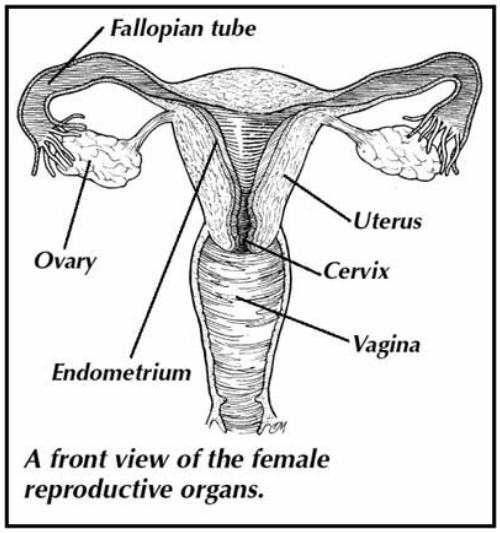
Coleoptile - Sheath-like protective covering over the first formed leaves of grasses and other cereals

Pathenocarpic - Plants that can form a fruit without being fertilized (e.g. bananas)

3.6.4 Reproduction in mammals

Human ovaries produce - Ova, estrogen, progesterone

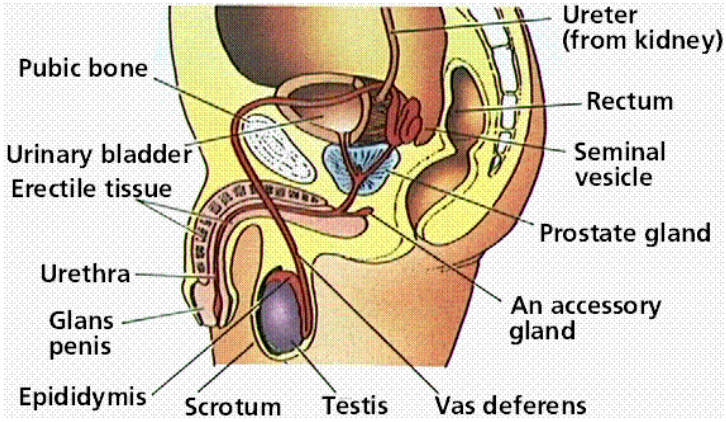
Female Reproductive System - Uterus, cervix, ovary, fallopian tube, vagina, endometrium



A front view of the female reproductive organs.

Uterus - A bag like organ of the female reproductive system which contains, protects and nourishes the developing embryo
Cervix - The lower, narrow portion of the uterus where it joins with the top end of the vagina. During menstruation it opens slightly to allow the endometrium to shed
Ovary - An organ which produces female gametes (ova or ovules)
Fallopian Tube - The tubes which connect the ovaries to the uterus
Vagina -
Endometrium - Inner membrane of the mammalian uterus. During menstruation it grows thick so that a blastocyst can implant in the uterus
Blastocyst - The structure formed in the early stage of embryogenesis in mammals
Graafian Follicle - A fluid filled space in mammalian ovaries containing a cell which develops into a female gamete (ovum)
Factors affecting pregnancy in females - Releasing of ova in a normal monthly cycle, blocking or twisting of fallopian tubes, implantation of an embryo in the uterus, antibodies which destroy sperm

Male Reproductive System - Prostate, vas deferens (sperm duct), epididymus, testes, scrotum, urethra



Prostate - An exocrine gland of the male reproductive system
Vas Deferens (Sperm Duct) - Transports sperm from the epididymis before ejaculations
Epididymus - Stores sperm and ejaculant
Testes - The male reproductive organ of animals which produce gametes called sperm and testosterone

3.6.4.1 Gamete formation and fertilization

Ways a zygote differs from other cells in the body - Has the ability to differentiate when it divides forming new cells that are specialized for different functions like tissues or organs. The division of a zygote leads to the formation of a complete organism which grows and develops to a stage where it is able to reproduce

Zygote - The cell which results from the fusion of a male and female gamete (a fertilized egg)
Ovum (Ova) - Female gametes of animals
Oviduct - A tube leading from a funnel-shaped opening near an ovary to the outside of the body
Ovulation - The release of an ovum (egg cell) from a ripe graafian follicle
Ovule - The part of a carpel containing the female gamete or egg nucleus. Ovules develop into seeds after fertilization
Menopause - The age at which women lose their ability to have children (infertility)
Menstruation - The breakdown and removal from the body of the lining of the uterus, which occurs if an ovum has not been fertilized
Gametes - Cells involved in sexual reproduction i.e. pollen grain, ova. Gametes fuse together at fertilization forming a zygote which develops into an embryo
Gametogenesis - Is a process by which diploid or haploid cells undergo cell division and differentiation to form mature haploid gametes creating eggs or sperm
Semen - Fluid produced by the testes of mammals which consists of sperm and chemicals which nourish them and stimulate their swimming movements
Sperm - The male gametes of animals
Gestation - A period of growth and development of a fetus in the uterus of a mammal
Embryo - The stage of development between the fertilized egg (zygote) and the newly formed organism

Factors affecting fertilization by males - Few sperm produced in one ejaculation, vas deferens may be blocked, a high proportion of sperm are abnormal

3.6.4.2 Multiple pregnancy
(Not found in exams)

3.6.5 Disorders of the reproductive system
Artificial Insemination - The process of introducing sperm at the time of ovulation which have been kept frozen by liquid nitrogen
Test Tube Baby - A baby produced from an ovum fertilized outside its mother's body then returned to her womb to develop
Vasectomy - A surgical operation in which men are made sterile by cutting or blocking the sperm ducts
Hermaphrodite - An organism which possesses both male and female reproductive organs
Fertility Drugs - Substances used to stimulate the development and release of ova from the ovaries of women who are infertile because ovulation has stopped
Conditions affecting the reproductive system - Cancer, cysts, fibroids, prostate gland infection, impotence

3.6.6 Complications of the reproductive system
Abortion - The termination of pregnancy by the removal or expulsion of a fetus or embryo from the uterus resulting in its death
Still Birth - Occurs when a fetus has died in the uterus and the mother gives birth to the dead fetus, generally happening after 20 weeks gestation
Miscarriage - Occurs when the embryo or fetus is incapable of surviving and dies, generally happening prior to 24 weeks gestation
Ectopic Pregnancy - Occurs when pregnancy occurs outside of the uterus (in the fallopian tube) causing internal bleeding of the mother and possibly her death
Non-communicable reproductive tract infections (RTIs) - Gonorrhea, syphilis
Non-communicable reproductive tract diseases (RTDs) - Urinary tract infection (UTI), candidiasis

3.6.7 Sexuality, sexual health and responsible sexual behaviour
Responsible Behaviours - Are actions which do not lead to health problems and require making good decisions
Risky Behaviours - Actions or practices which lead to the development of health problems i.e. HIV infection
Delaying Sex - An individual does not engage in sexual intercourse until they and their partner are ready
Advantages of abstaining from sex during adolescence - Eliminates risk of STDs, reduces risk of HIV infection, avoids pregnancy, gives time to finish school
Assertive Behaviour - When someone stands for their rights no matter what the circumstances are
Importance of assertive behaviour - Avoids unsafe sexual behaviour, to avoid contracting HIV, avoiding drug use, avoiding early pregnancy
Passive Behaviour - When someone is silent and takes no action for their rights
Venereal Disease (VD) - A disease passed from one person to another during sexual intercourse e.g. syphilis and gonorrhea
Ways to prevent infections of the reproductive system - Use of condoms, avoiding irresponsible sexual behaviour, abstinence, faithful to one partner
Consequences of STD infections - Death, deafness, blindness, hearth diseases, insanity, loss of economic productivity
Behaviours which lead to -
- **Risk of contracting STDs -** Drug/alcohol abuse, multiple sexual partners, prostitution, unprotected sex
- **Lead to drug abuse -** Peer pressure, choosing bad friends, laziness, stress or depression
- **Lead to unplanned pregnancies -** Premarital sex, unprotected sex, drug/alcohol use, prostitution, promiscuity, sexual abuse i.e. rape, social/cultural practices

3.6.8 Family planning and contraception
Family Planning - The planning of when to have children by using birth control, abstinence, fertility management, education
Types of birth control - Birth control pills, condoms, emergency contraceptive pill, sterilization, rhythm method, abstinence, abortion, use of spermicide

3.6.9 Maternal and child care
Prenatal Care - Care of a pregnant woman before delivery
Postnatal Care - Care of a woman after delivering a baby

Form 4

4.1.0 Growth

4.1.1 Concept of growth

Types of Growth - Localized, diffuse

Diffuse Growth - Growth occurs all over the body, found in kingdom animalia

Localized Growth - Growth occurs in a certain region only, found in kingdom plantae

Factors influencing growth - Access to food (carbohydrates, proteins, minerals, vitamins), water, light and temperature (plants), growth hormone, genetic factors, diseases, accumulation of toxins in the body

4.1.2 Mitosis and growth

Stages of cell division - Prophase, metaphase, anaphase, telophase, interphase

Prophase - Is a stage of mitosis where the chromatin condenses into a chromosome

Diplotene - Stage of meiosis where the exchange of genetic material takes place, occurs during prophase I

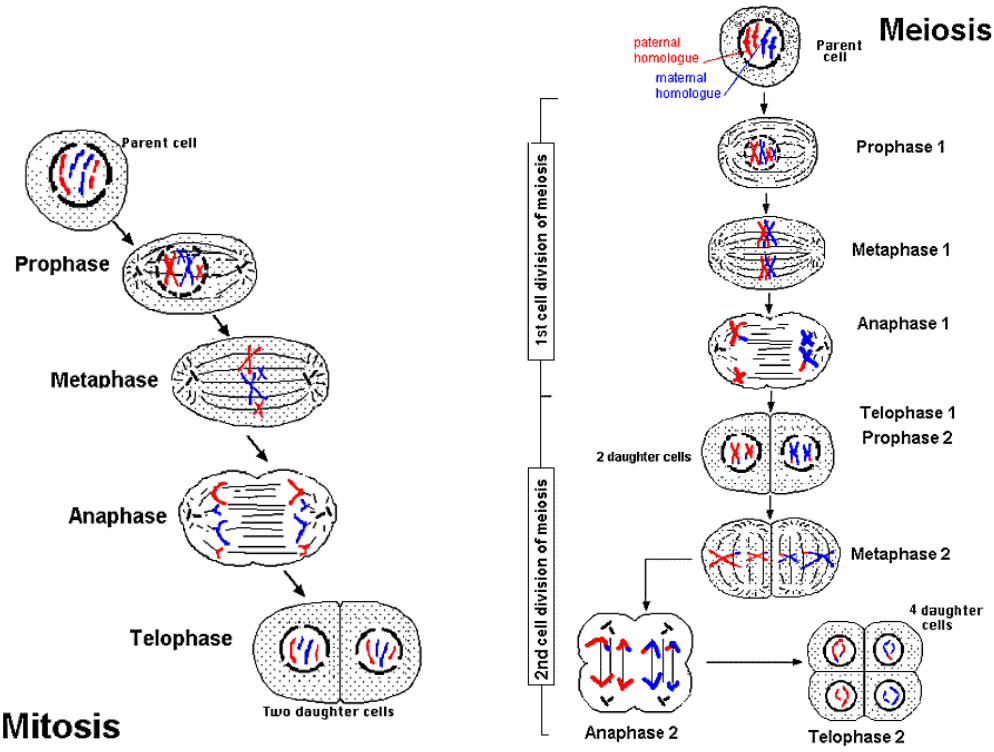
Zygotene - Stage of meiosis where chromosomes line up with each other in homologous pairs, occurs during prophase I

Metaphase - The stage of mitosis where chromosomes align in the middle of a cell before being separated into each of the daughter cells

Anaphase - The stage of mitosis when chromosomes separate. Each chromatid moves to the opposite ends of the cell at opposite ends of the mitotic spindle

Telophase - Is a stage of both meiosis and mitosis where two daughter nuclei form in the cell as the nuclear envelope forms around each pair of chromatids

Interphase - The phase a cell spends the majority of its time in. Most cell function is done during this phase as well as preparation for cell division



Importance of mitosis to organisms - Cell replacement, growth, regeneration, asexual reproduction, genetic stability

Reasons meiosis is needed in the life cycle of sexually reproducing organisms

1. Brings about a reduction in the number of chromosomes from diploid to haploid during the formation of gametes. This preserves chromosome numbers in the species, since gametes must fuse during fertilization forming diploid zygotes which will contain the species character number of chromosomes

2. Crossing over and independent assortment of chromosomes during this process brings about an exchange of chromosomal material between homologous chromosomes and also in the genetic makeup of the offspring. Both events lead to variations which natural selection acts upon

Significance of mitosis - Can occur in damaged parts of an organism to repair certain parts, dividing cells carry hereditary materials, growth occurs as a result of cells dividing producing more and more cells

Significance of meiosis - Helps bring about a reduction in the number of chromosomes from diploid to haploid which is necessary during fertilization when gametes must fuse, crossing over occurs during this process which brings about an exchange of chromosomes which introduces variations in the genetic makeup of the offspring. Natural selection acts upon these variations

Similarities between mitosis and meiosis - DNA replicates once, involves nuclear division, they follow through the same steps (interphase, metaphase, anaphase, telophase), paired homologues align at the metaphase

Differentiate between mitosis and meiosis -

Mitosis	Meiosis
• One nuclear division • Homologous chromosomes pair but do not undergo crossing over • A single cell divides into two daughter cells • The daughter cells are genetically identical to each other and the parent cell • Daughter cells are diploid	• Two nuclear divisions • Homologous chromosomes pair and undergo crossing over during prophase I • A single cell divides into four daughter cells • The daughter cells are not genetically identical to each other or the parent cells • Daughter cells are haploid

Analogous Chromosomes - Chromosomes with the same function but have different origins

Cancer - A disease in which fast growing abnormal cells invade and destroy healthy organs

Chromatid - One of the two identical strands of chromosomes, which separate during cell division and moves to the opposite ends of the cell

Chromatin - Is the combination of DNA and proteins that makes up chromosomes

Crossing Over - A process during which meiosis where chromosomes exchange material with one another. This increases the chances of variation within species

Diploid - A cell having the full number of chromosomes (e.g. organisms with paired chromosomes like humans)

Haploid - A cell having half of the number of chromosomes created through meiosis

Heterozygous - The state of an individual which has different alleles in corresponding loci on a pair of homologous chromosomes (i.e. Tt or Bb)

Homologous Chromosomes - The two chromosomes of each pair during meiosis which are identical in shape and size

Meiosis - Type of cell division that produces gametes and results in cells with half the number of chromosomes found in the parent cell

Mitosis - Type of cell division resulting in cells with the same number of chromosomes as the parent cell, type of division used when an organism grows or a colony of bacteria multiplies

Recessive Characteristic - One that does not appear in the phenotype when crossed with a dominant characteristic

Rapid mitotic cell division is seen in embryonic tissues

Chromosomes form pairs at the early stage of meiosis

4.1.3 Growth and developmental stages in humans

Cultural practices affecting reproductive health in Tanzania - Female genital mutilation, early marriage

Female Genital Mutilation - Surgical removal of the clitoris, labia minora, and labia majora from a female for religious or ritualistic purposes which is often done as a part of initiation rites

Early Marriage - Marriage of women under 18 which can lead to delivery complications from lack of physical development of the mother

Advantages of placental development for a developing fetus - Supplies food nutrients to fetus (e.g. glucose, amino acids, vitamins), supplies oxygen/water/mineral salts, removes waste from fetus, protects fetus against the mother's immune system and changes in mother's blood pressure, provides physical attachment of the fetus to the wall of the uterus

Functions of the umbilical cord - *Transports the following:* Food materials from the placenta to the embryo, oxygen from the placenta to the developing embryo, carbon dioxide from the embryo to the placenta (e.g. urea), wastes from the embryo to the placenta, mineral salts from the placenta to the embryo

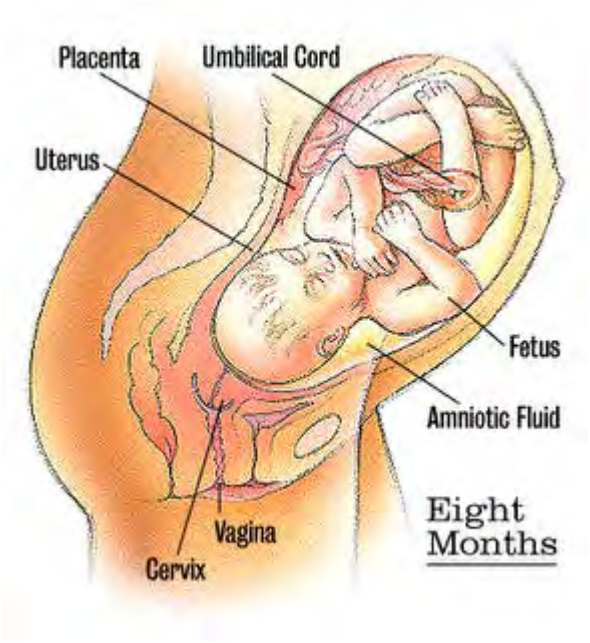
Substances which pass from the mother's blood to the blood of the fetus - Oxygen, food (e.g. glucose, amino acids), mineral salts, water

Possible consequences of early pregnancy - Miscarriage, abortion, premature delivery, mother leaves school, financial and emotional stress

Birth control methods which -

Suppress the formation or release of gametes - Contraceptive pills (chemical method), sterilization
Prevent the implantation of a fertilized egg - Intrauterine devices
Prevent the union of gametes in fertilization - Rhythm method (use of menstrual cycle calendar), barrier method which involves the use of a condom, diaphragm or female condom, spermicides

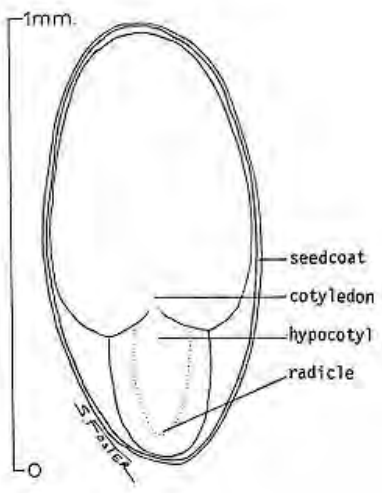
Puberty - The stage of development where men and women become sexually mature and are able to reproduce



Pregnancy - The period during which a female mammal carries a developing embryo in her uterus
Placenta - The organ through which the fetus of a mammal obtains food and oxygen from its mother's blood and passes waste into the mothers blood
Umbilical Cord - A tube containing blood vessels connecting a developing embryo with its placenta
Fetus - The embryo of a mammal at the stage of development in which the mean features are visible
Amniotic Fluid - Its function is to protect the developing embryo from physical damage as a kind of shock absorber
Amnion - The fluid-filled sac that surrounds and protects embryos of reptiles, birds and mammals

4.1.4 Growth in flowering plants

Factors which cause difference in height among plants - Light, water, soil fertility
Limiting factors for plant growth - Nutrients, light, carbon dioxide, water
Germination Types - Epigeal, hypogeal
Epigeal - Cotyledons are brought above the ground along with the shoot
Hypogeal - Cotyledons remain below the surface of the soil and the shoot grows outward
Purpose of starch stored in beans to a developing plant - It is used to release energy to the young plant when it undergoes anabolism which is used for cellular activities like cell division
Factors required for the formation of carbohydrates in plants - Sunlight, carbon dioxide, water, chlorophyll
Structure of a Seed - Cotyledon, hypocotyl, radicle, seed coat
Cotyledon - After germination the cotyledon becomes the embryonic first leaves of a seedling
Hypocotyl - Part of the germinating seedling of a seed, which grows up with embryonic leaves (cotyledons)
Radicle - Part of the seed which grows into the root system
Seed Coat (Testa) - Outer protective covering of a seed
Plumule - Consists of the first true leaves of a young plant
Coleorhiza - The cover on the radicle in a monocot seed
Coleoptile - The cover of a cotyledon in a monocot seed



4.2.0 Genetics

4.2.1 Concept of genetics

Alleles - One of a pair (or more) of alternative forms of a gene
Back Cross - The mating of a hybrid organism with one of its parents
Centromere - A part of a chromosome without genes which the chromosome uses to become attached to the spindle
Chromosomes - Rod-like structures visible in the nucleus of a cell during cell division which consist of genes and contain the hereditary information of the cell
Crossing Over - Is the exchange of genetic material between homologous chromosomes during prophase I of meiosis (diplotene)

Dominant Gene - One which appears in the phenotype when crossed with a contrasting recessive character
Gene - A part of a chromosome which controls the appearance of a set of hereditary characteristics
Genetics - The scientific study of genes
Genotype - The genetic makeup of an organism, the set of genes which it possesses
Heterozygous - Is when an organism has alleles (two genes) which control a characteristic and are opposite in nature, the two alleles are different
Homozygous - When the two alleles are the same
Inbreeding - Is the reproduction from the mating of two genetically related parents which increases the chances of the offspring being affected by recessive traits
Key - A sequence of statements about the characteristics of a group of organisms which can be used to identify an organism belonging to that group
Mutation - A sudden unpredictable change in a gene or chromosome which alters its characteristics
Phenotype - The visible hereditary characteristics of an organism as opposed to the genotype which is the genetic characteristics
Recessive - Refers to the trait or gene which cannot express itself due to the presence of a dominant trait or gene. It is only expressed when it exists alone
Recessive Gene - A gene which is not expressed when paired with a dominant gene, but can be expressed if paired with another recessive gene. This can lead to genetic diseases
Segregation - The separation of genes which are called alleles of each other at meiosis and their environment into separate gametes
Spindle - An arrangement of fibres between the poles of a cell which the chromatids (or chromosomes) move during mitosis or meiosis
Test Cross - Is a test used to determine if an individual exhibiting a dominant trait is homozygous or heterozygous for that trait
X Chromosome - A chromosome which when present in a zygote either along with another X chromosome cause the zygote to develop into a female organism
Y Chromosome - A chromosome which when present in a zygote results in that zygote developing into a male organism

4.2.2 Genetic materials
Amino Acids - Organic compounds that consist of chemical units liked together in long chains to form protein molecules, they separate from one another when the protein is digested
Differentiate between DNA and RNA -
DNA (Deoxyribonucleic Acid) - A chemical within chromosomes which contains the hereditary information of the cell
RNA (Ribonucleic Acid) - A molecules which assists in the building of proteins, is formed by a single helix, and is involved in the process of regulating which genes are expressed

4.2.3.1 Concept of inheritance
Inheritance - The passing on of traits to offspring from parents or ancestors

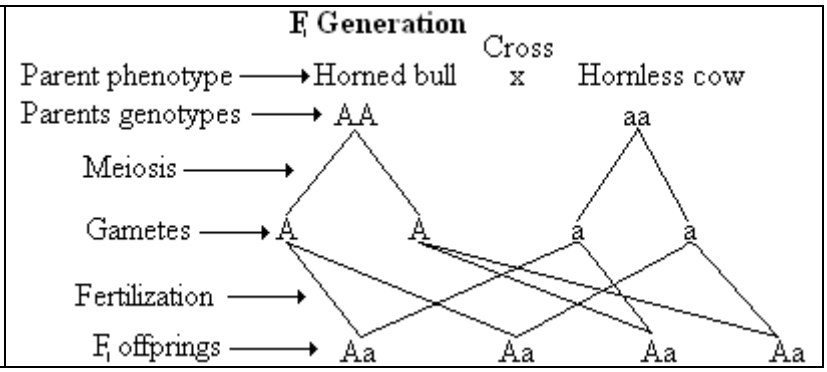
4.2.3.2 Mendelian inheritance
Mendel's First Law - Each of the two alleles of one gene may combine randomly with either of the alleles of another gene independently
Bb - Heterozygous
BB - Homozygous dominant
bb - Homozygous recessive

Selective Breeding - Choosing to mate animals with desired characteristics so that future generations will possess them (ex breeding cows for better milk or meat)
Monohybrid Cross - A cross between organisms which show contrast variations of only one characteristic
P Generation - The parental generation. This is where the original genes come from
F_1 Generation - The first filial generation. Organisms produced by crossing animals or plants which form the starting point of genetic expression
F_2 Generation - The second filial generation. Organisms produced by crossing or self crossing members of an F_1 generation

1. In cattle the hornless trait is dominant and the horned trait is recessive. If a pure horned bull is mated with a pure hornless cow, what kind of offspring are expected and it what ratio at the F_1 and F_2 generations?

F_1 Generation

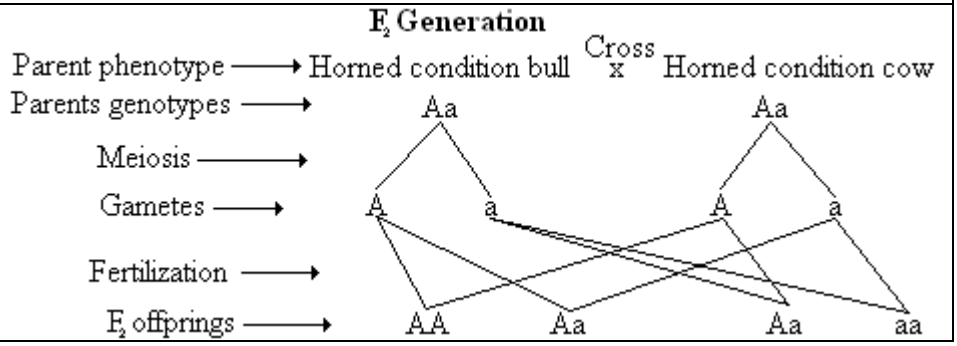
Gametes	A	A
a	Aa	Aa
a	Aa	Aa



In the F_1 generation we can see that all offspring will be heterozygous horned condition Aa

F_2 Generation

	A	a
A	AA	Aa
a	Aa	aa



In the F_2 generation, we can see that the genotypic ratio is 1:2:1 between AA:Aa:aa. This means that there will be 1 pure horned : 2 heterozygous horned : 1 hornless. The phenotypic ratio will be 3:1 meaning there will be 3 with the horned condition and 1 with the hornless condition

4.2.3.3 Non-mendelian inheritance

Complete Dominance - This is when a dominant gene is seen in the phenotype of an organism and the recessive gene is not

Incomplete Dominance - This is when one gene does not completely dominate the phenotype of an organism and a blending between the two traits occurs (ex a red flower gene and a white flower gene combine to create a pink flower)

4.2.4 Sex determination and inheritance

Sex Determination - Sex in humans is determined by chromosome pairs. XY is male, XX is female; fertilization is a matter of chance i.e. whether the outcome will be XX or XY

Sex Influenced Trait - Phenotype is caused when an allele is recessive in one sex but dominant in the other

Sex Limited Character - Is a character which is restricted to one sex only (ex. baldness in males, enlargement of breasts in women)

Sex-linked Characters - Characters carried in the X chromosome

Sex Linked Inheritance - Traits which are inherited together with the sex chromosome e.g. hemophilia and colour blindness

4.2.5 Variation among organisms

Variation - Is any difference which exists between members which belong to the same species

Continuous Variations - Do not have clear cut differences (ex. height in a population)

Discontinuous Variations - Clear distinctions are present (ex. males/females, blood type)

Causes of variation - Genes and their properties

4.2.6 Genetic disorders

Mutagens - Factors that cause genetic mutation (ex gamma rays, chemicals)

Genetic Disorders - Hemophilia, colour blindness, turner syndrome, down's syndrome, mongoloid

Hemophilia - Impairs the body's ability to control blood clotting (coagulation) to stop bleeding

Colour Blindness - The inability to see differences in colours that others are able to distinguish
Turner Syndrome - Occurs when all or part of one chromosome is absent causing physical abnormalities like being short, swelling of the body, having a board chest, low hairline, low ears
Down's Syndrome (Mongoloid) - Occurs when there is all or part of an extra 21st chromosome

4.2.7 Application of genetics

Biotechnology - The harnessing of biological processes to make useful substances, i.e. microbes that can be used to make food/fuel/medicine/hormones
Genetic Engineering - A technique for altering an organisms genetic makeup by inserting a gene from another organism into its chromosome

4.3.0 Classification of living things

4.3.1 Kingdom animalia

Characteristics of mammals (kingdom animalia) - Presence of mammary glands, typically covered with hair, have internal fertilization, have a four chambered heart functioning as a double pump, possess well developed senses of smell and hearing. In 20% of mammal species, hearing is more important than vision
Examples of mammals - Humans, bats, mice, lions, elephants
Characteristics of Invertebrates -
Characteristics of Molluscs - Unsegmented soft body often with a shell, large single muscular foot
Examples of Molluscs - Snails, slugs, mussels, octopi
Differentiate between homologous and analogous structures -
Homologous Structures - Structures performing different functions but having the same or similar origin (e.g. limbs can be used for swimming, flying, running or grasping)
Analogous Structures - Structures performing the same function but having a different evolutionary history (e.g. bats and birds can fly with wings but they originated separately)

4.3.1.1 Phylum platyhelminthes

Characteristics of Platyhelminthes - Flattened segmented worms, alimentary canal, but no mouth, body composed of three layers of cells, no body cavity
Examples of Platyhelminthes - Planarians, flukes, tapeworms
Characteristics of Cestoda (kingdom animalia) - Possess hooks used for attachment in the gut to prevent being washed away by undigested food materials, possess suckers for attachment to the gut wall, possess a cuticle with mucus to prevent digestion by the host's enzymes
Examples of Cestoda - Tapeworms
Diseases caused by tapeworms or flukes - Schistosomiasis (bilharzias), teniasis

4.3.1.2 Phylum aschelminthes (Nematoda)

Characteristics of Nematodes - Unsegmented worms, pointed at both ends, gut with mouth and anus, three layers of cells, many parasitic
Examples of Nematodes - Hookworms, roundworms, threadworms
Diseases caused by nematodes - encylcostomiasis (hookworm infection)

4.3.1.3 Phylum annelida

Characteristics of Annelids - Segmented worms, body composed of three layers of cells, but with mouth and anus
Examples of Annelids - Earthworms, lugworms, ragworms, leeches

4.3.1.4 Phylum arthropoda

Characteristics of Arthropoda - Segmented body with a hard exoskeleton, jointed limbs segmentally arranged, three layers of cells, true body cavity, bilaterally symmetrical
Examples of Arthropoda - Scorpions, spiders, millipedes, centipedes, cockroaches
Types of metamorphosis - Complete, incomplete
Complete Metamorphosis - A type of metamorphosis where an insect develops through four stages, *egg → larvae → pupa → adult*, e.g. butterfly
Incomplete Metamorphosis - A type of metamorphosis where an insect develops through three stages, *egg → nymph → adult*, e.g. cockroach
Antennae - Long, narrow sense organs on the heads of insects which contain receptors for touch, taste, smell, humidity and temperature
Larva - An early stage in the life cycle of certain organisms which bears little or no resemblance to the adult
Ecdysis - Shedding of the outer exoskeleton of an insect exposing the new soft exoskeleton e.g. cockroach

Ways which insects are harmful or beneficial to man -

Beneficial to Man	Harmful to Man
• Used as food • Tourism to view beautiful insects (colourful beetles) • Used in biological control of pests • Useful in recycling organic matter • Production of fibres	• Pests destroy crops • Destruct human property (timber/clothes/etc) • Vectors of diseases

4.3.1.5 Phylum chordata

Characteristics of Chordata - Notochord present in adults, tubular, dorsal, hallow nerve cord, closed blood system, post-anal tail

Characteristics of Pisces (Fish) - Paired fins, gills for gaseous exchange, external scales, lateral line system

Examples of Pisces - Tilapia, carp, dagaa

Characteristics of Amphibia - Paired limbs, gills present in tadpole stage, lungs in adult, soft skin, no scales, no outer ear

Examples of Amphibia - Frogs, lizards, toads

Characteristics of Aves (Birds) - Paired limbs, forelimbs are wings for flight, lungs for gaseous exchange, feathers on the body, eggs with a calcareous shell, no larval stage, warm blooded

Examples of Aves - Eagle, heron, stork

Characteristics of Mammalia - Paired limbs, lungs for gaseous exchange, sebaceous and sweat glands, hair, warm blooded, possess outer ear

Examples of Mammalia - Apes, humans, elephants, lions, mice, dogs, monkeys

4.4.0 Evolution

4.4.1 Concept of evolution

Evolution - The sequence of gradual changes over millions of years in which new species arise

4.4.2 Theories of the origin of life

Natural Selection - A theory which explains how evolutionary change occurred. It says that certain mutations of a living organism allow it to compete for resources better than those without the mutation, meaning that over a long period of time that characteristic will become dominant in the species and stay as a part of their phenotype

Survival of the Fittest - The statement that only organisms with the best characteristics will survive over a long period of time, those with weaker characteristics will become extinct. This is partially true because animals with weaker characteristics can still survive due to there being enough resources in the environment, a lack of predators in the ecosystem or by filling a specific niche in the ecosystem

4.4.3.1 Lamarckism

Lamarckism - The theory by Jean Baptiste de Lamarck which said that traits acquired by parents during their lifetime where passed on to offspring. This has been proven to be incorrect

Weaknesses of Lamarckism - Traits are not acquired during an animals lifetime, genetics has shown that genes determine the characteristics of offspring

4.4.3.2 Darwinism

Darwinism - Theory proposed by Charles Darwin which states that new species arise as the result of genetic changes over time which causes members of a species to no longer be capable of reproducing with one another, creating two separate but genetically related species (ex. humans and apes share the same common ancestor, however the ancestors split into two groups, one evolved into humans, the other evolved into apes over the course of millions of years, ***man did not evolve from apes***)

4.4.4 Evidence of organic evolution

Evidence of organic evolution - Anatomy, embryology, histology, biochemistry, genetics, paleontology, geography

Anatomy - Groups of living animals resemble each other based on common ancestry

Embryology - There is a great deal of similarity during the development of embryos among widely different animals (ex all vertebrates share common features during embryonic development even though in adult stages they are very different, like humans and birds)

Histology - Tissues and cells of related organisms are very similar

Biochemistry - The biochemical processes among all animals work the same as eukaryotic cells, showing that animals developed from eukaryotic cells (ex cell respiration and the use of ATP)

Genetics - Study of DNA clearly shows the genetic heritage which is shared by similar animals as well as broadly among classes, phylums and kingdoms (ex mice and humans are genetically similar even though they seem very different when you look at them. Their similar genotype means that we can use mice to study diseases found in humans)

Paleontology - The study of animals and plants from millions of years ago shows that they were very different than animals and plants today, yet they show a long term slow change in phenotype over time towards animals and plants we see today, or showing lineages which no longer exist

Geography - This causes plants and animals to develop differently given different geographic locations. For example marsupials and Australia carry their young in pouch, which is not done by similar animals on other continents because they developed separately from the other groups

4.5.0 HIV/AIDS and STIs

4.5.1 Relationship between HIV/AIDS and STIs

(Not found in exams)

4.5.2 Management and control of HIV/AIDS and STIs

(Not found in exams)

4.5.3 Counseling and voluntary testing (CVT)

(Not found in exams)