

## 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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## Legal Statement

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# Biology

## Form 1

- 1.2.3 Waste disposal
  - 1.3.0 Health
    - 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
  - 1.5.0 Classification of living things
    - 1.5.1 Concept of classification
    - 1.5.2 Classification systems
    - 1.5.3 Major groups of living things
      - 1.5.3.1 Viruses
      - 1.5.3.2 Kingdom monera
      - 1.5.3.3 Kingdom protocista
- ## Form 2
- 2.1.0 Classification of living things
    - 2.1.1 Kingdom fungi
    - 2.1.2 Kingdom plantae
      - 2.1.2.1 Division bryophyta
      - 2.1.2.2 Division filicinophyta (pteridophyta)
  - 2.2.0 Nutrition
    - 2.2.1 Concepts of nutrition and food nutrients
    - 2.2.2 Nutrition in animals
      - 2.2.2.1 Human nutrition
        - 2.2.2.2 Digestive system in humans
      - 2.2.3.1 Nutrition requirements in plants
      - 2.2.3.2 Photosynthesis
    - 2.2.4 Properties of food substances
    - 2.2.5 Food processing, preservation and storage
  - 2.3.0 Balance of nature
    - 2.3.1 Natural environment
    - 2.3.2 Interaction of organisms in the environment
    - 2.3.3 Food chain and food webs
  - 2.4.0 Transport of materials in living things
    - 2.4.2 Diffusion, osmosis and mass-flow
    - 2.4.3 Transport of materials in mammals
      - 2.4.3.1 Structure of the heart
      - 2.4.3.2 The blood
      - 2.4.3.3 Blood groups and blood transfusion
      - 2.4.3.4 Blood circulation
      - 2.4.3.5 The lymphatic system
    - 2.4.4 Transport of materials in plants
  - 2.5.0 Gaseous exchange and respiration
    - 2.5.1 Concept of gaseous exchange
    - 2.5.2 Gaseous exchange in mammals
    - 2.5.3 Gaseous exchange in plants
    - 2.5.4 Respiration
      - 2.5.4.1 Aerobic respiration

- 2.5.4.2 Anaerobic respiration
- 2.5.4.3 Infections and diseases of the respiratory system
- 2.5.4.4 Disorders of the respiratory system

## Form 3

- 3.1.0 Classification of living things
  - 3.1.1 Kingdom plantae
    - 3.1.1.1 Division coniferophyta (conifers)
    - 3.1.1.2 Division angiospermophyta (angiosperms)
- 3.2.0 Movement
  - 3.2.1 Concepts of movement and locomotion
  - 3.2.2 Movement of the human body
    - 3.2.2.1 The human skeletal system
    - 3.2.2.2 Muscles and movement
  - 3.2.3 Movement in plants
- 3.3.0 Coordination
  - 3.3.1 Concept of coordination
  - 3.3.2 Nervous coordination in humans
    - 3.3.2.1 Neurons
    - 3.3.2.2 Central nervous system
    - 3.3.2.3 Peripheral nervous system
    - 3.3.2.4 Reflex action
    - 3.3.2.5 Sense organs
  - 3.3.3 Drug abuse
  - 3.3.4 Hormones and glands
  - 3.3.5 Coordination in plants
    - 3.3.5.1 Tropic and nastic responses
- 3.4.0 Excretion
  - 3.4.1 Concept of excretion
  - 3.4.2 Excretion in humans
  - 3.4.3 Complications and disorders of the excretory system
  - 3.4.4 Excretion in plants
- 3.5.0 Regulation
  - 3.5.1 Concept of regulation
  - 3.5.2 Temperature regulation in animals
  - 3.5.3 Osmoregulation
  - 3.5.4 Blood sugar regulation in mammals
- 3.6.0 Reproduction
  - 3.6.1 Concept of reproduction
  - 3.6.2 Meiosis and reproduction
  - 3.6.3 Reproduction in flowering plants
    - 3.6.3.1 The structure of a flower
    - 3.6.3.2 Pollination
    - 3.6.3.3 Fertilization
  - 3.6.4 Reproduction in mammals
    - 3.6.4.1 Gamete formation and fertilization
    - 3.6.4.2 Multiple pregnancy
  - 3.6.5 Disorders of the reproductive system
  - 3.6.6 Complications of the reproductive system
  - 3.6.7 Sexuality, sexual health and responsible sexual behaviour
  - 3.6.8 Family planning and contraception
  - 3.6.9 Maternal and child care

<b>Form 4</b>	
4.1.0 Growth 4.1.1 Concept of growth 4.1.2 Mitosis and growth 4.1.3 Growth and developmental stages in humans 4.1.4 Growth in flowering plants  4.2.0 Genetics 4.2.1 Concept of genetics 4.2.2 Genetic materials 4.2.3.1 Concept of inheritance 4.2.3.2 Mendelian inheritance 4.2.3.3 Non-mendelian inheritance 4.2.4 Sex determination and inheritance 4.2.5 Variation among organisms 4.2.6 Genetic disorders 4.2.7 Application of genetics  4.3.0 Classification of living things	4.3.1 Kingdom animalia 4.3.1.1 Phylum platyhelminthes 4.3.1.2 Phylum aschelminthes (Nematoda) 4.3.1.3 Phylum annelida 4.3.1.4 Phylum arthropoda 4.3.1.5 Phylum chordate  4.4.0 Evolution 4.4.1 Concept of evolution 4.4.2 Theories of the origin of life 4.4.3 Theories of organic evolution 4.4.3.1 Lamarckism 4.4.3.2 Darwinism 4.4.4 Evidence of organic evolution  4.5.0 HIV/AIDS and STIs 4.5.1 Relationship between HIV/AIDS and STIs 4.5.2 Management and control of HIV/AIDS and STIs 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, pertussis (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 disease 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 (Schistosomiasis) -** 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 heart 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, gonorrhoea, 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

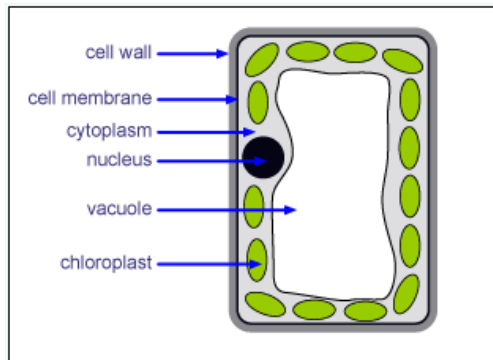
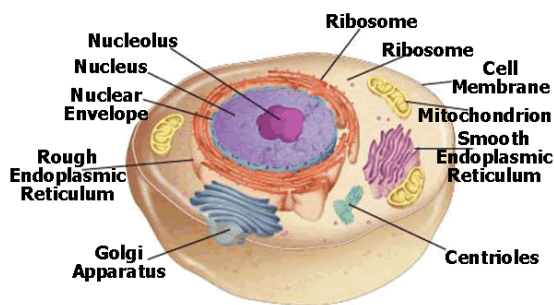
**Nucleus** - Is a spherical or oval body which is seen when cells are stained. It is composed of a fluid called nucleoplasm and is surrounded by a membrane called the nucleo-membrane. The nucleus controls the life processes of a of a cell such as growth, respiration and synthesis of materials. The nucleus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

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

**Characteristics of Protocista** - 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

**Deamination** - 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 different enzymes can only break down specific types of substrates

**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

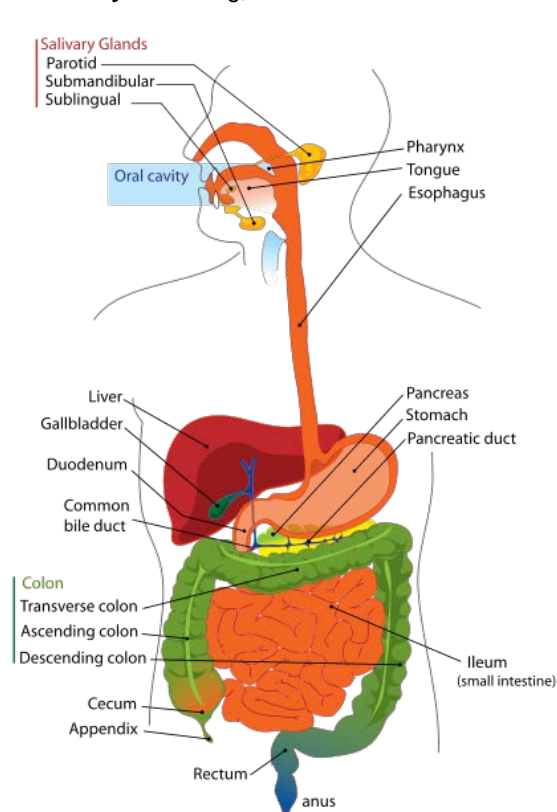
**Chyme** - The semi-fluid mass of partly digested food expelled by the stomach into the duodenum

**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 ( $\text{PO}_4^{3-}$ )

**Role** - Synthesis of proteins, nucleic acid and ATP

**Deficiency** - Stunted growth, particularly of roots

**Nitrogen** -

**Source** - Nitrates ( $\text{NO}_3^-$ ) and ammonium ( $\text{NH}_4^+$ )

**Role** - Protein synthesis, nucleic acid and chlorophyll synthesis

**Deficiency** - Stunted growth, chlorosis

**Calcium** -

**Source** - Calcium ( $\text{Ca}^{2+}$ )

**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<sup>+</sup>) and hydroxide anions (OH<sup>-</sup>)

### **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<sub>2</sub>O), carbon dioxide (CO<sub>2</sub>)

**Products of photosynthesis** - Glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>), oxygen

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

**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 plants

**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

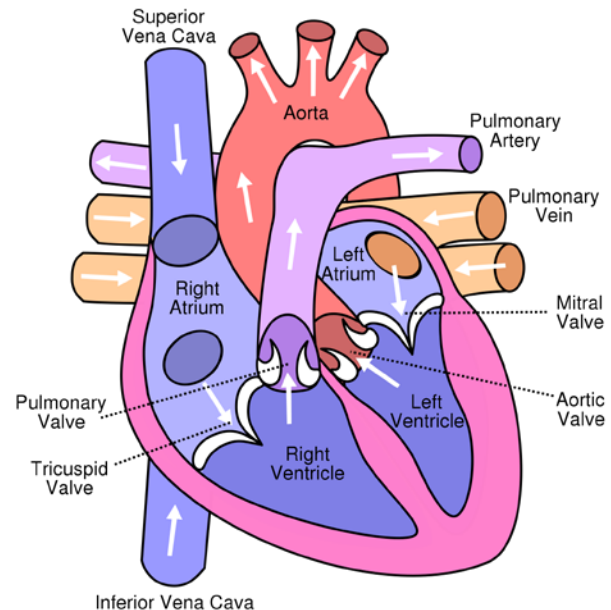
**Left Atrium** - Receives oxygenated blood from the pulmonary veins and pumps it into the left ventricle

**Left Ventricle** - Receives oxygenated blood from the left atrium via 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 -**

<b>Arteries</b>	<b>Veins</b>
<ul style="list-style-type: none"> <li>• Transports blood away from the heart</li> <li>• Composed of elastic and smooth muscle tissue</li> <li>• No semi-lunar valves (except when leaving the heart)</li> <li>• Pressure of the blood is high and has a pulse</li> <li>• Blood flow is rapid</li> <li>• Lower blood volume</li> <li>• Carries oxygenated blood (except in the pulmonary artery)</li> </ul>	<ul style="list-style-type: none"> <li>• Transports blood towards the heart</li> <li>• Only slightly muscular with a few elastic fibres</li> <li>• Semi-lunar valves at intervals along the length to prevent the backflow of blood</li> <li>• Pressure of the blood is low and no pulse is detectable</li> <li>• Blood flow is slow</li> <li>• Higher blood volume than arteries or capillaries</li> <li>• Carries deoxygenated blood (except in the pulmonary vein)</li> </ul>

**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

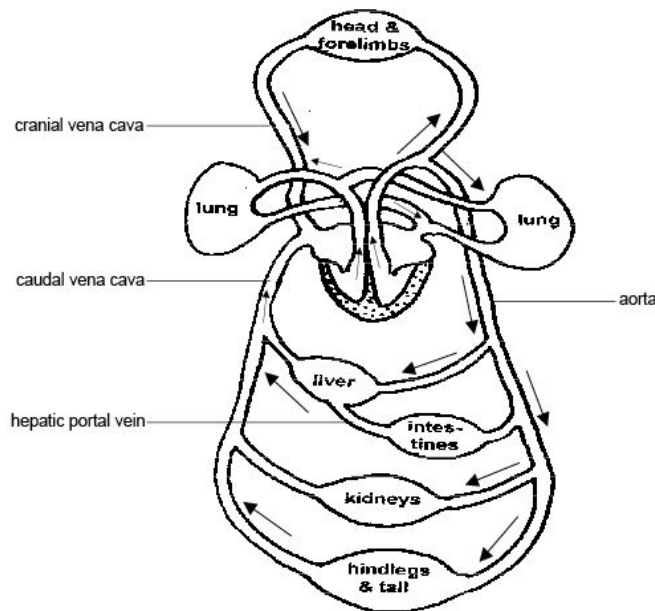
Blood Group	Antigen on RBC	Antibody in plasma
O	No antigen	Antibody A and B
A	Antigen A	Antibody B
B	Antigen B	Antibody A
AB	Antigen AB	No antibodies

**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 -**

<b>Lymphocytes</b>	<b>Phagocytes</b>
<ul style="list-style-type: none"> <li>• Secrete antibodies which fight germs</li> <li>• Secrete anti-toxins</li> <li>• Made in the lymphatic system</li> <li>• Have large oval shaped nuclei and no granules in their cytoplasm</li> </ul>	<ul style="list-style-type: none"> <li>• Destroy germs by engulfing microbes</li> <li>• Do not secrete antitoxins. Instead they gather at wounds to destroy bacteria before they can enter the body</li> <li>• Made in the bone marrow</li> <li>• Have a bi-lobbed (divided) nuclei and have granular cytoplasm</li> </ul>

**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

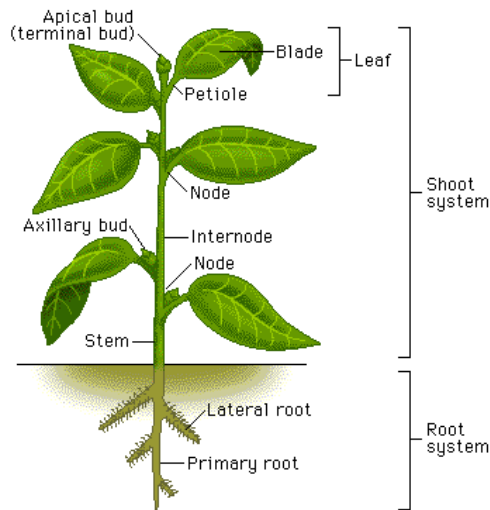
**Root Nodules** - A swelling on the roots of certain leguminous plants (e.g. peas/clover) which contain nitrogen fixing bacteria

**Root Pressure** - Pressure causing water to pass up the xylem from the living cells of the root

**Petiole** - A leaf 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 long 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

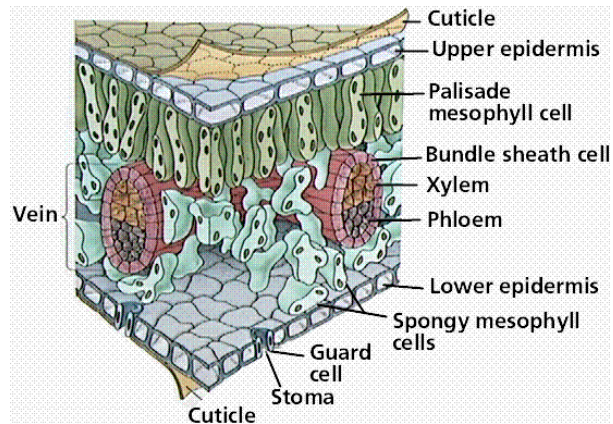
**Turgor Pressure** - The pressure within plant cells which results from the absorption of water by osmosis

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
<ul style="list-style-type: none"> <li>• Have chlorophyll</li> <li>• Have nodes and internodes</li> <li>• Branches at nodes</li> <li>• Produce leaves, flowers and fruits</li> <li>• Are covered by a cuticle or bark</li> <li>• Have no stem cap</li> <li>• Have no root hairs</li> </ul>	<ul style="list-style-type: none"> <li>• Usually have no chlorophyll</li> <li>• Do not have nodes and internodes</li> <li>• Branches irregularly</li> <li>• Do not produce leaves, flowers or fruits</li> <li>• Do not have a cuticle</li> <li>• Have a root cap</li> <li>• Have root hairs</li> </ul>

## 2.5.0 Gaseous exchange and respiration

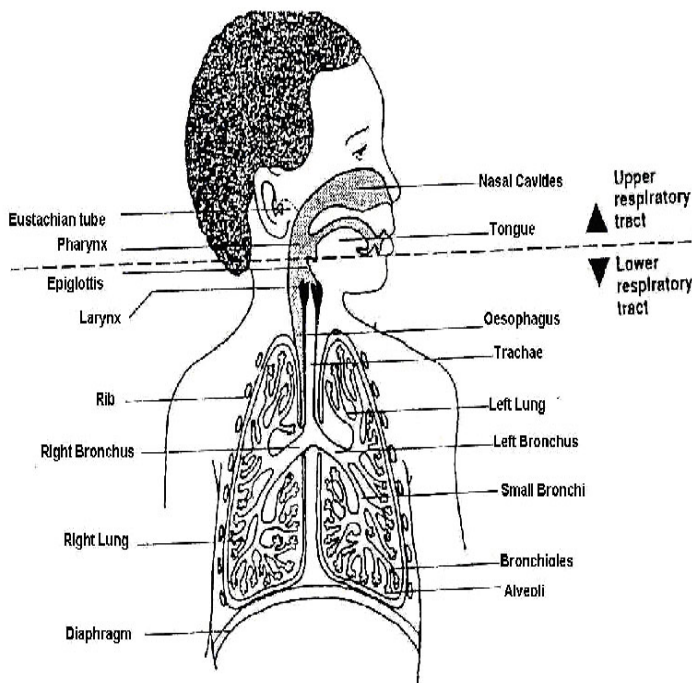
### 2.5.1 Concept of gaseous exchange

**Gas Exchange** - The process by which an organism absorbs oxygen from the air in exchange for carbon dioxide, takes place 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
<ul style="list-style-type: none"> <li>• Found in the digestive system (alimentary canal)</li> <li>• Deal with absorption of food materials</li> <li>• Increase the surface area of the gut for the absorption of food materials</li> </ul>	<ul style="list-style-type: none"> <li>• Found in the respiratory system (lungs)</li> <li>• Deal with exchange of gases between the blood and environment</li> <li>• Increase the area of the lungs for gaseous exchange</li> </ul>

**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 -**

	<b>Anaerobic</b>	<b>Aerobic</b>
<b>Place it occurs</b>	Cytoplasm	Mitochondria
<b>Substrates</b>	Glucose	Glucose and oxygen
<b>Products</b>	Alcohol and carbon dioxide in plants, lactic acid in animal cells	Carbon dioxide and water
<b>Energy produced</b>	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

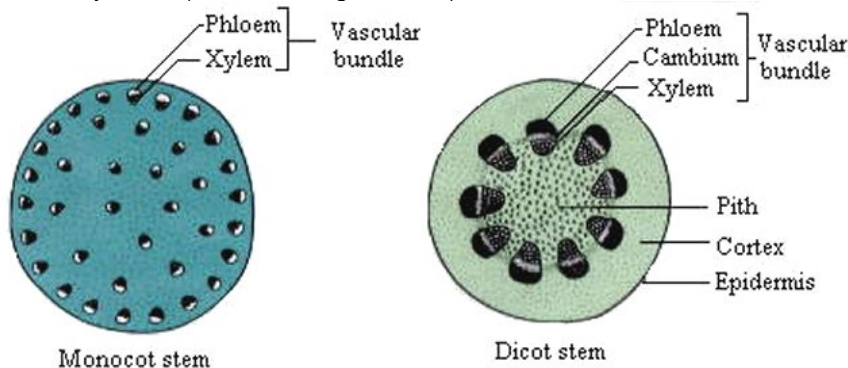
**Examples of Angiosperma** - Maize, beans, oak trees, onions, grass

**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 -**

<b>Monocots</b>	<b>Dicots</b>
<ul style="list-style-type: none"> <li>• Has one embryonic leaf</li> <li>• Tap roots</li> <li>• Vascular bundles spread around the middle</li> <li>• Floral parts are arranged in three parts of multiples of threes</li> <li>• Leaves are long and ribbon-like with veins arranged in a pattern parallel to the long axis of the leaf</li> </ul>	<ul style="list-style-type: none"> <li>• Has two embryonic leaves</li> <li>• Fibrous roots</li> <li>• Vascular bundles in a ring</li> <li>• floral parts are arranged in fours or fives or multiples of fours or fives</li> <li>• Leaves are different shapes and veins are arranged in a net pattern</li> </ul>

**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 mitotically 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

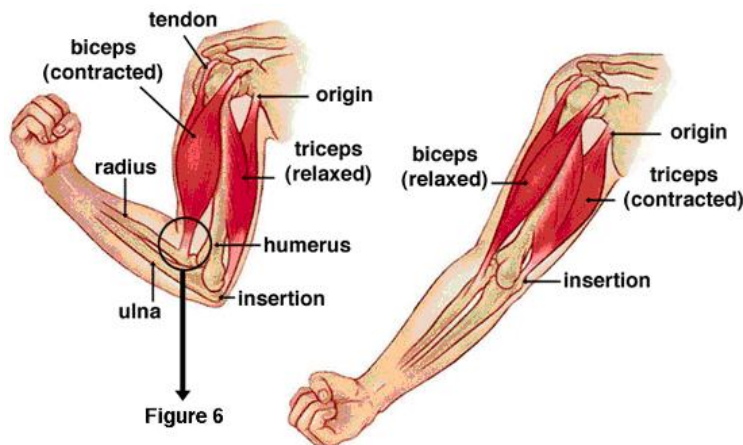


Figure 6

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

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

**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

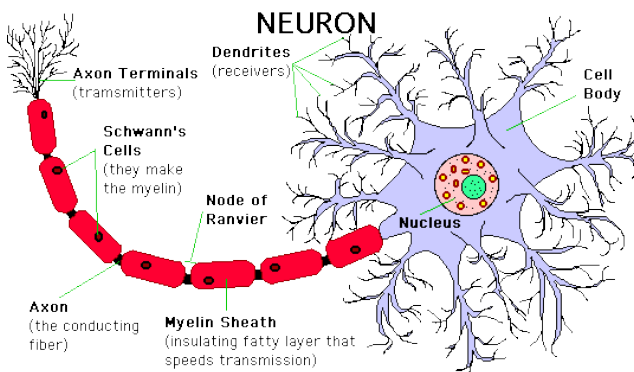
**Effector Organ** - A muscle or gland that contracts or secretes in response to nerve impulses

**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** -

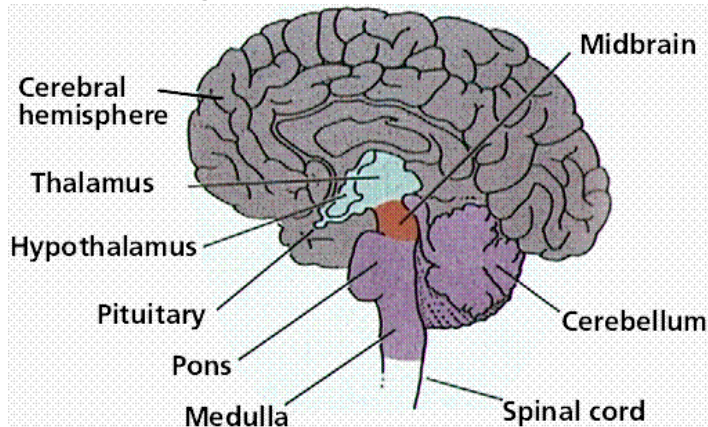
**How a nerve impulse is propagated across a synapse** - The arrival of nerve impulses in the presynaptic knob causes the synaptic vesicles to move and fuse with the presynaptic membrane. Then the vesicles burst to release chemical transmitters which diffuse across the gap to the post-synaptic membrane 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

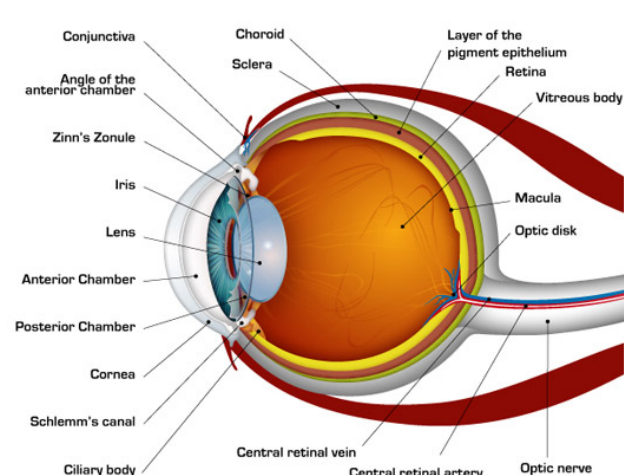
**Differences between a reflex action (animals) and tropism (plants) -**

Reflex actions	Tropism
<ul style="list-style-type: none"> <li>Occurs quickly</li> <li>Short term response</li> <li>Conducted through nerve impulses through neurons</li> </ul>	<ul style="list-style-type: none"> <li>Occurs slowly</li> <li>Long term response</li> <li>Conducted by hormones secreting to the point of cell elongation by diffusion</li> </ul>

**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

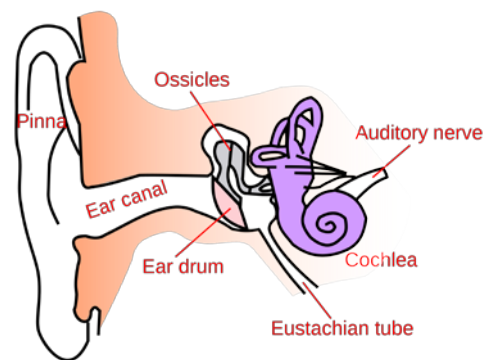
**Cochlea** - Auditory portion of the inner ear, it is the sensory organ of hearing

**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-inducing 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
<ul style="list-style-type: none"> <li>• Messages travel faster and have a rapid effect</li> <li>• Usually a short lived response</li> <li>• Very localized as the impulse is transmitted to individual effector cells</li> <li>• Relatively few neurotransmitters (acetylcholine and adrenaline are most common)</li> </ul>	<ul style="list-style-type: none"> <li>• Messages and transported slower and take longer to take effect</li> <li>• Often a long lasting response</li> <li>• Effects are often widespread due to the hormone being carried through the body in the blood stream</li> <li>• Variety of hormones produced by different organs, each with a specific effect</li> </ul>

<ul style="list-style-type: none"> <li>• Linked through the nervous system and nerves</li> <li>• Effectors are muscles and glands</li> <li>• Stimulated through receptors, eyes, nose based on light, sound etc</li> </ul>	<ul style="list-style-type: none"> <li>• Linked through the blood and circulatory system</li> <li>• Effectors are organs and the whole body</li> <li>• Stimulated through internal or external receptors</li> </ul>
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**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 shoot 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

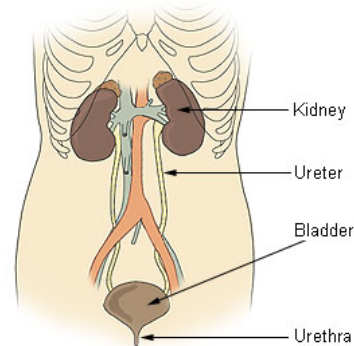
#### **Nitrogenous waste products removal with water -**

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

**Components of the Urinary System**



### 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

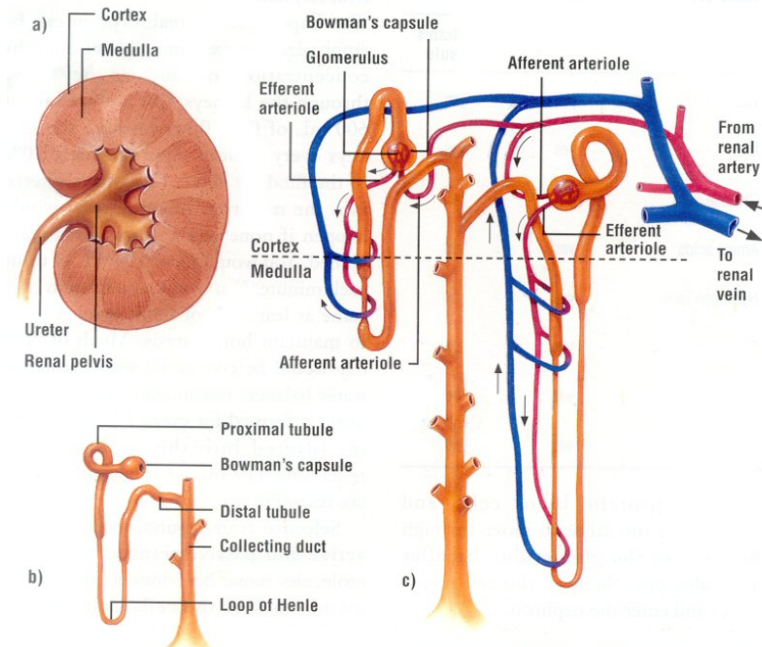
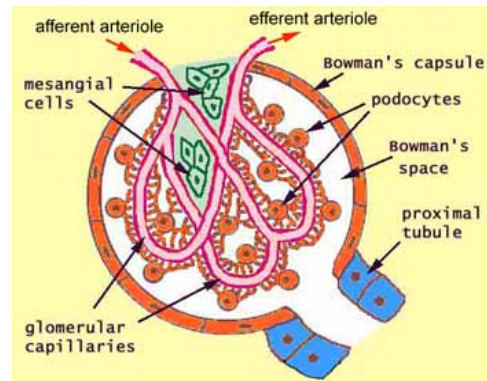
**Proximal Convoluted Tubule -** The coiled part of the tubule next to the Bowman's capsule and is located in the cortex

**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 from a Bowman's capsule in the kidney which reabsorbs water/glucose,  $\text{Na}^+/\text{Cl}^-$  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 area 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 gland 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 cooling effect in hot conditions

### **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 -**

<b>Asexual Reproduction</b>	<b>Sexual Reproduction</b>
<ul style="list-style-type: none"><li>• No genetic variation between offspring</li><li>• Requires one parent only</li><li>• No gametes are involved</li></ul>	<ul style="list-style-type: none"><li>• There is genetic variation between offspring</li><li>• Usually requires two parents</li><li>• Involves fusion of two gametes</li></ul>

### **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

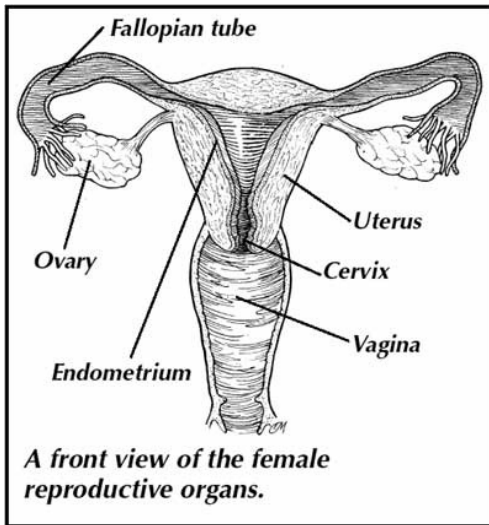
**Parthenocarpic** - Plants that can form a fruit without being fertilized (e.g. bananas)

### **3.6.4 Reproduction in mammals**

**Human ovaries produce** - Ova, estrogen, progesterone

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





**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

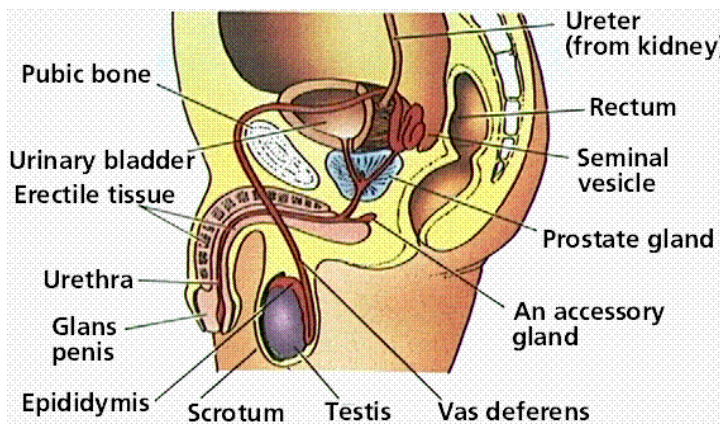
**Blastocyst** - The structure formed in the early stage of embryogenesis in mammals

**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)** - Gonorrhoea, 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 gonorrhoea

**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, heart 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

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

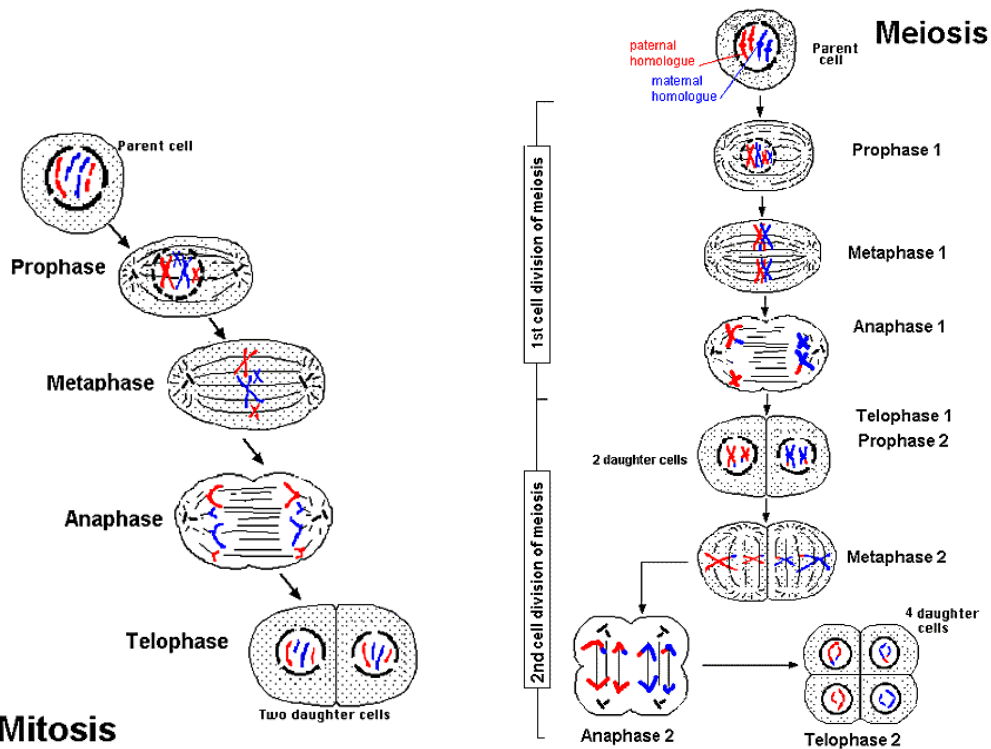
**Zygotene** - Stage of meiosis where chromosomes line up with each other in homologous pairs, occurs during prophase I

**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
<ul style="list-style-type: none"> <li>• One nuclear division</li> <li>• Homologous chromosomes pair but do not undergo crossing over</li> <li>• A single cell divides into two daughter cells</li> <li>• The daughter cells are genetically identical to each other and the parent cell</li> <li>• Daughter cells are diploid</li> </ul>	<ul style="list-style-type: none"> <li>• Two nuclear divisions</li> <li>• Homologous chromosomes pair and undergo crossing over during prophase I</li> <li>• A single cell divides into four daughter cells</li> <li>• The daughter cells are not genetically identical to each other or the parent cells</li> <li>• Daughter cells are haploid</li> </ul>

**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

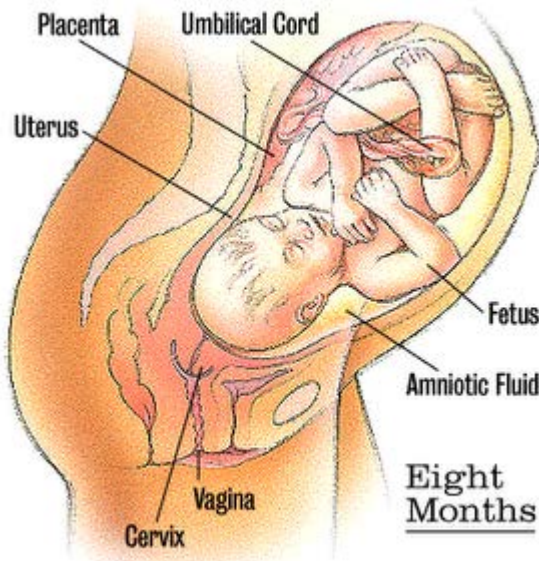
### Birth control methods which -

**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 mother's 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 main 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

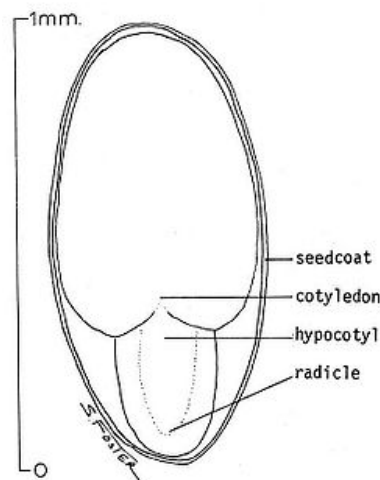
**Alleles** - One of a pair (or more) of alternative forms of a gene

**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 linked 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

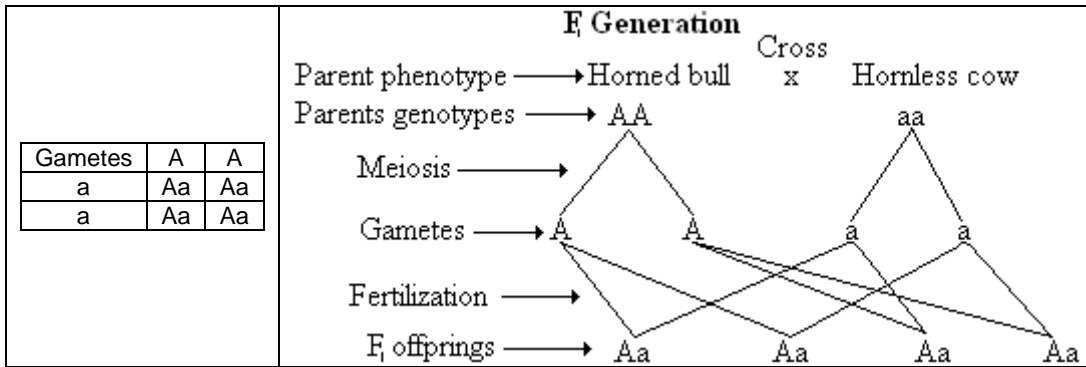
**P Generation** - The parental generation. This is where the original genes come from

**F<sub>1</sub> Generation** - The first filial generation. Organisms produced by crossing animals or plants which form the starting point of genetic expression

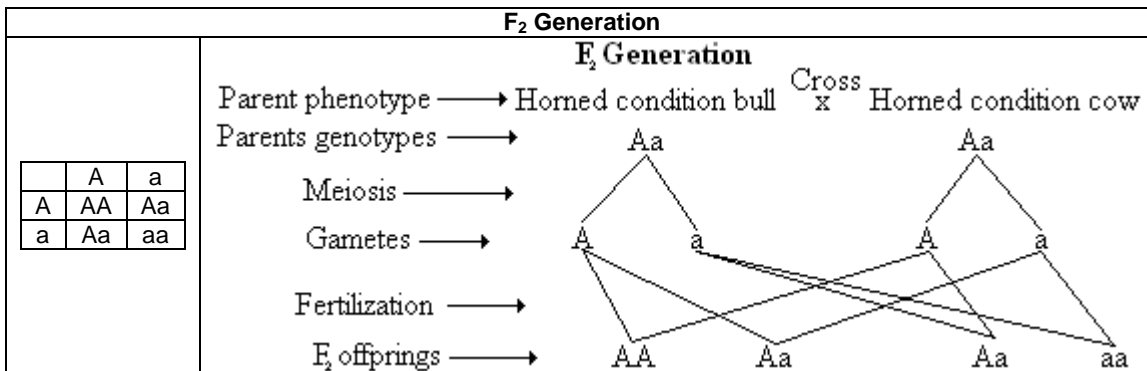
**F<sub>2</sub> Generation** - The second filial generation. Organisms produced by crossing or self crossing members of an F<sub>1</sub> generation

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<sub>1</sub> and F<sub>2</sub> generations?

<b>F<sub>1</sub> Generation</b>
---------------------------------



In the F<sub>1</sub> generation we can see that all offspring will be heterozygous horned condition Aa



In the F<sub>2</sub> 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 21<sup>st</sup> 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** - encylocostomiasis (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
<ul style="list-style-type: none"> <li>• Used as food</li> <li>• Tourism to view beautiful insects (colourful beetles)</li> <li>• Used in biological control of pests</li> <li>• Useful in recycling organic matter</li> <li>• Production of fibres</li> </ul>	<ul style="list-style-type: none"> <li>• Pests destroy crops</li> <li>• Destruct human property (timber/clothes/etc)</li> <li>• Vectors of diseases</li> </ul>

#### 4.3.1.5 Phylum chordata

**Characteristics of Chordata** - Notochord present in adults, tubular, dorsal, hollow 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, daggaa

**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 were passed on to offspring. This has been proven to be incorrect

**Weaknesses of Lamarckism** - Traits are not acquired during an animal's 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)*