**FORM THREE BIOLOGY NOTES**

# ECOLOGY

## Introduction

***Ecology*** is the study of the interrelationships of organisms to each other and to their environment (biotic and Abiotic factors).

***Autecology***; study of single species within a community and how it relates with both the biotic and Abiotic factors.

***Synecology.*** This is the study of many different species of organisms’ interacting among themselves within an ecosystem.

Ecology helps to address the following issues.

* Sustainable food production
* Pollution control
* Natural resources conservation
* Pest and disease control
* Population control
* Eco-tourism
* Prediction of adverse weather conditions

## Concepts of ecology

* **Biosphere/ecosphere.** This is the part of the earth and atmosphere inhabited by living organisms.
* **Habitat.** This is a specific locality with a particular set of conditions where an organism lives. Habitats can be terrestrial or aquatic.
* **Ecological niche.** This is the position occupied by an organism in a habitat. It includes the ***physical space*** where an organism is found and ***its role*** in the habitat.
* **Population.** This refers to all members of a given species in particular habitat.
* **Community.** This refers to all organisms belonging to different species interacting in the same habitat. Many populations make up a community.
* **Ecosystem.** This is a natural unit made of biotic and Abiotic factors whose interactions lead to a self sustaining system. E.g. a tropical rain forest, a small pond etc.
* **Biomass.** This is the total dry weight of living organisms at a particular Trophic (feeding) level or per unit area.
* **Carrying capacity.** This is the maximum number of organisms an area can comfortably support without depletion of the available resources. E.g. the maximum number of cows a pasture land can comfortably hold without overgrazing.

**Study Question 1**

**Factors in an Ecosystem**

#### They are divided into two:

1. Abiotic factors or the non living factors
2. Biotic or the living factors

## Abiotic Factors

* **Light.** This is required by plants and photosynthetic bacteria to manufacture food. The sun is the source of light energy. Light intensity and quality (wavelength) affects the rate of photosynthesis, flowering and germination in plants, while in animals it affects migration, hibernation and reproduction. Light intensity is measured using a **Photographic Light meter** while a **Seechi disc** measures light penetration in water.
* **Atmospheric pressure.** Variation in atmospheric pressure affects the availability of oxygen and carbon (IV) dioxide in the atmosphere. These two gases in turn affect the distribution of living organisms. Low atmospheric pressure increases the rate of transpiration. Barometer is used to measure it.
* **Humidity.** This is the amount of water vapour in the atmosphere. It affects the rate of water loss from plants and animals surfaces through transpiration and sweating respectively. The higher the humidity the lower the rate of loss and vice versa. It is measured using the **hygrometer.**
* **Salinity.** This refers to the salt concentration of the water. This divides the aquatic environment into ***marine, estuarine and fresh water***. Only organisms with adaptable osmoregulatory features can comfortably occupy such habitats. In estuaries, there are fluctuations of salt concentrations at different times. When the sea tide is low, the salt concentrations are low due to the greater diluting effect of the fresh water being discharged. High tide raises the salt level. Estuarine organisms must therefore be adapted to cope with such wide salt variations.
* **Wind.** This is moving air. It increases the rate of water loss from organisms affecting their distribution. It also influences rain formation. It helps in formation of sand dunes in deserts which become habitats for the growth of deserts plants. Its an agent of seed and fruit dispersal
* **Temperature.** This affects the distribution of organisms in any habitat. Very low temperature may inactivate enzymes while very high temperatures denature them. Temperature varies due to seasons, altitude, and latitude and diurnally in hot deserts.
* **pH (hydrogen ion concentration.)**

This is the measure of acidity or alkalinity of water in aquatic habitats or soil solution. This influences the distribution of plants and animals in soil and aquatic habitats. Different organisms have different pH requirements. pH is determined using the pH meter.

**Study Question 2**

**Practical Activity 1**

**Study Question 3**

**Biotic Inter-Relationships**

**Competition**

Living organisms compete for resources such as nutrients, space, light and mates. There are two types of competition.

* 1. **Inter-specific competition.** This is the competition between individuals of different species for the same resources. For example. An experiment6 was carried out on two closely related species of paramecia- *Paramecium* *caudatum and Paramecium aurelia.* It was observed that when each species is grown separately in controlled cultures with constant food supply, they show normal population growth. When they are grown together in the same culture, thre is competition and *Paramecium* *caudatum* is eliminated. See graphs.

*Paramecium aurelia*

*Paramecium caudatum.*

*Paramecium aurelia*

*Paramecium caudatum.*

However, closely related species can live together without competition. For example, when *Paramecium caudatum and Paramecium bursoria* are grown in the same culture, there is no competition because each species occupies a different part of the culture. Similarly, browsers and grazers can occupy same habitat without competition because they feed at different levels of the same plants. For example, the zebras eat the softer shoots, followed by the wild beasts, and the gazelles which eat the fibrous left over of the same grass.

**Study Question 4**

* 1. **Intra-specific competition.** This is the competition between members of the same species for the same resources.

When there is competition the best adapted organisms survive while the less adapted ones may die or be forced to migrate.

* **Predation**

This is the relationship where one organism kills another for food and feed on it either as a whole or a part of it. The **predator** is the one which kills while the **prey** is the one being killed for food.

Predators have various adaptations to enable them to be efficient in capturing the prey. These include;

* Sharp eyesight as in eagles, kites and hawk
* Fast flight,
* Modified beaks
* Strong jaws with carnassial’s teeth as in leopards and lions.
* Large claws on strong forelimbs.
* Colour camouflage such as the spotted pattern of the leopard blends well with the background colour of the bushes and trees.
* Moving against the wind while stalking the prey. Preys also have structural and behavioural adaptations. These include:
* Swift movement e.g. the antelope and gazelle
* Camouflage e.g. in gazelles and stripes of the zebra.
* Large eyes on the sides of the head to giving them a wide field of view
* Confrontational display in porcupine

*NB/. When the number of the prey increases that of the predators also increases. An increase in the number of predators leads to a decrease in the population of the prey. This decrease in prey population leads to a fall in predator population which in turn gives space for the increase in the population of the prey. This is the basis of biological control. See the graph below.*

# Prey

# Predator

**Prey and predator population.**

**Time**

* **Parasitism**
* This is the relationship where an organism **[parasite**] obtains nutrients from another live organism **[host]** without killing it. The parasite obtains food and shelter from the host causing some harmful effects. Parasites may weaken the host and also transmit diseases which may kill their host thus reducing their number an d distribution. There are two types of parasites;
* **Ecto-parasites**
* **Endo-parasites**

**Study Question 5**

* **Symbiosis**

This is an association between two of different species in which both benefit. For example the association of colon bacteria with humans and other animals, especially plant-eating animals, the ox-pecker bird and the ox etc.

The ***Rhizobium*** bacteria help the leguminous plants to fix nitrogen while the bacteria obtain shelter and carbohydrates from the plants.

Diagram

* **Saprophytism**

This is where organisms obtain nutrients from dead organisms causing decomposition hence releasing nutrients into the ecosystem. Saprophytes include the bacteria and fungi.

**The Nitrogen Cycle**

This refers to the cycling of nitrogen and its compounds in the natural environment.

* Although nitrogen is abundant in the atmosphere as nitrogen gas, it cannot be utilised by plants. It has to be converted into a form that can be absorbed by plants through a process called **nitrogen fixation.**
* Nitrogen fixation is done in two ways;
* **Biological fixation**. This can occur in two forms
  1. **Nitrogen fixation by symbiotic bacteria** such as ***Rhizobium spp*.** They are found in the root nodules of legumes. They convert nitrogen gas into ammonia which is then converted into nitrates for plant utilisation.
  2. **Nitrogen fixation by free living bacteria e.g. *Clostridium, Azotobacter,* and** some algae such as ***Anabaena, chlorella and Nostoc.***
* **Non-Biological nitrogen fixation**. This is done by lightning. During thunderstorms, lightning energy combines atmospheric nitrogen gas with oxygen to form nitrous and nitric acid. These are then converted into nitrates.
* Plants absorb nitrates and convert them into plant proteins. Animals feed on these plants and obtain the proteins. They are then digested into amino acids and become assimilated into animal proteins.
* When living organisms die, saprophytic bacteria and fungi break down the proteins in their bodies into ammonia. Nitrifying bacteria convert this ammonia into nitrates thorough a process called **nitrification. *Nitrosomonas and Nitrococcus*** convert ammonia into nitrites and ***Nitrobacter***convert nitrites into Nitrates.
* Some soil micro organisms such as ***Pseudomonas denitrificans & Thiobacillus denitrificans***utilise the oxygen in the nitrates reducing it to nitrites, ammonia and eventually into nitrogen gas. This is called **de-nitrification.**
* This reduces the amount of nitrogen available to plants but it frees the nitrogen so that it becomes available for the cycle to continue.

**Diagram**

**Practical activity 2**

**Study question 6**

**Energy Flow in an Ecosystem**

The sun is the natural source of energy. This energy is transferred to the following feeding levels;

* Producers
* Primary consumers
* Secondary consumers
* Tertiary consumers
* Quaternary consumers
* These feeding levels are called **Trophic levels**

**Decomposers**

They break down organic materials into simple substances which are made available for re-use by other organisms. Decomposers are mainly fungi and bacteria.

**Food Chains**

This is the representation of energy flow from a producer to other organisms linearly. Green plants are eaten by herbivores which are eaten by carnivores.

Producers’ Primary consumers Secondary consumers Tertiary consumers Quaternary consumers

Some energy is lost as it is moved from one trophic level to the next. This is through respiration, defecation, excretion and in form of heat.

**Fig. 2.7**

**Examples**

When the decomposers are included in a food chain, they are placed at the end.

**Study Question 7**

**Food Webs**

These are several interconnected food chains. Simple food chains rarely exist since in any ecosystem, many populations interact.

**Examples**

**Study Question 8**

**Ecological Pyramids**

These give a simplified representation of feeding relationships and energy flow in an ecosystem. They are of three types.

* **Pyramid of numbers**
* **Pyramid of biomass**
* **Pyramid of energy**

**Pyramid of Numbers**

There is a progress decrease in the number of organisms as one move from the producers all the way to the quaternary consumers. Producers have the greatest number followed in a decreasing order by primary, secondary, tertiary and quaternary consumers.

1

Tertiary consumers

Secondary consumers

Primary consumers

Producers

Quaternary consumers.

Sun

**Construction of Pyramid of Numbers**

1. Use data provided or collected.
2. From the data, identify and draw the most suitable food chain.
3. Indicate the numbers at each trophic level in the food chain.
4. Choose a suitable scale for the data.
5. Using the chosen scale draw a horizontal rectangular bar to represent the number of the producers as the base of the pyramid.
6. Progressively draw horizontal bars of the other trophic levels in their ascending order.
   * *Ensure that the width of the bars is uniform.*

**Study Question 9**

**Interpretation of Pyramid of Numbers**

* Generally the body size of organisms increases at each trophic level from the base to the apex of the pyramid as their number decreases.
* At each trophic level much energy is lost through respiration, excretion, sweating, defecation etc. therefore less energy is transmitted to the succeeding trophic level. Fewer organisms can therefore be supported.
* Inverted pyramid of numbers also exist. For example where one mango tree supports several monkeys each being fed on by several fleas.

Fleas

Monkeys

Mango tree

**Pyramid of Biomass**

Biomass of an organism is its constant dry weight. In an ecosystem, the producers have the highest biomass followed in decreasing order by primary, secondary, tertiary and quaternary consumers.

20 Consumer

Primary Consumer

Producer

**Study Question 10**

**Practical activity 3**

**Study Question 11**

**Population**

Populations change in size, structure and organisation.

**Characteristics of a population.**

* **Density.** This is the number of individuals per unit area. E.g. 50 gazelles per Km2.
* **Dispersion.** This is the distribution or spread of organisms in a habitat.
* **Population growth.** This refers to the rate of increase in numbers.

**Population Estimation Methods**

Usually a representative sample is used to estimate the population of organism in a big habitat. A sample is a small number of individuals taken from the habitat that is a representative of the whole population. The following methods are used when sampling.

* Quadrat method.
* Line transect.
* Belt transect.
* Capture-recapture method.

**Adaptations of plants to various Habitats**

An adaptation is a **change to suit environment:** the development of physical, physiological or behavioural characteristics that allow organisms to survive and reproduce in their habitats. There are four main groups of plants namely;

* Xerophytes.
* Mesophytes.
* Hydrophytes.
* Halophytes.

**Xerophytes**

These are plants adapted to survive in the dry habitats. These habitats have the following characteristics.

1. Unpredictable and poorly distributed rainfall between 250-350mm per year.
2. Very high day temperatures and very low night temperatures hence high diurnal temperature range.
3. They are very windy.
4. Low humidity.

**Adaptations of Xerophytes**

1. Shedding of leaves during the dry season to reduce the surface exposed to transpiration.
2. Reduced leaves in size such as in pine or modified into spines as in cactus. This reduces the surface area over which transpiration occurs.
3. Leaves have a thick waxy cuticle to reduce the rate of transpiration.
4. Some store water in large parenchyma cells contained in succulent stems and leaves.
5. Some have reversed stomatal rhythm.
6. Sunken stomata
7. Folded leaves reduced the surface area.
8. Reduced number of stomata
9. Some have deep roots to absorb water from deep in the soil. Others have superficial roots growing horizontally close to the surface to absorb water after a light

**Mesophytes**

These are plants growing in well watered areas. Such habitats have the following general characteristics.

* Adequate rainfall; 950-1800mm that is well distributed throughout the year.
* Relatively high humidity
* Thick clouds
* Moderate to high temperatures
* Shallow water table
* Less windy

**Adaptations of Mesophytes**

They show various adaptations depending on where they grow. Some of these adaptations are for reduction of water loss, others for increased water, loss and some are also adapted to light conditions.

***Forest Ecosystem***

1. Vegetation grows fast to compete for light.
2. Trees grow very tall to compete for light.
3. Some develop buttress roots or prop roots for extra support such as the ***Ficus natalensis.***
4. Climbers such as lianas support themselves on stems of tall trees to reach light.
5. Epiphytes support themselves on the branches of tall trees.
6. Others are adapted to carry out photosynthesis under low light intensity by having many chloroplasts that are sensitive to low light intensity.
7. They show leaf mosaic pattern to minimise overlapping enhancing trapping of light for photosynthesis.

* *Those**in areas with a lot of water have broad leaves, thin cuticle and many stomata on both surfaces to encourage high rate of transpiration.*
* *Those in dry areas have waxy and shiny cuticle to reflect light. Others are deep rooted to obtain water from deep in the soil.*

**Hydrophytes**

These are plants growing in fresh water either partially or wholly. Such habitats have the following general characteristics.

* Low concentration of dissolved gases such as oxygen
* Presence of waves and currents
* Inadequate light in water

**Adaptations of hydrophytes**

1. Broad leaves with maximum number of stomata on upper leaf surface providing a large surface are for transpiration.
2. They have a large air filled tissue called ***aerenchyma*** tissue. The air reduces the density hence creating buoyancy to the plants and also aids in gaseous exchange.
3. Submerged ones have dissected leaves to offer large surface area for light absorption required during photosynthesis.
4. They have chloroplasts sensitive to low light intensity.
5. They have poorly developed leaves and lack the root hairs to reduce water absorption
6. Flowers are raised above the water to allow for pollination.

**Diagrams**

**Halophytes**

These are plants which are able to tolerate very salty conditions in soil and marine water. Such habitats have the following general characteristics.

* High concentration of mineral salts
* Low concentration of dissolved gases
* Low light intensity in marine water
* Presence of waves and currents in marine water

**Adaptations of Halophytes**

1. They root cells which concentrate a lot of salts to enable them to absorb water by osmosis.
2. Some have salt glands that secrete excess salts.
3. Many have water storage tissues.
4. Some like the mangroves have breathing roots called ***pneumatophores.*** These rise above the water surface to obtain oxygen from the atmosphere.
5. Mangroves growing on mud flats have buttress roots for support.
6. Submerged halophytes are adapted to photosynthesise under low light intensity.
7. Their fruits are adapted for dispersal by having ***aerenchymatous*** tissue for air storage to make them buoyant.

**CLASSIFICATION II**

Classification, in biology is the identification, naming, and grouping of organisms into a formal system based on similarities such as internal and external anatomy, physiological functions, genetic makeup, or evolutionary history.

**Study Question 1**

**General Principles of Classification**

Organisms that have similar and common features are grouped together while those that have different features are grouped separately.

**Taxonomy** is the study of grouping of organisms according to their relationship. There are seven major taxonomic units (taxa).

* Kingdom
* Phylum (phyla) or Division in plants
* Class
* Order
* Family
* Genus
* Species

As you move from the kingdom to the species the differences decrease as the similarities increases.

**Species** is a group of organisms that can freely interbreed to give rise to viable/fertile offsprings.

Sometime members of different species may interbreed to give an offspring which is *sterile*. E.g. a donkey and a horse can interbreed to give rise to a mule which is infertile.

**Binomial Nomenclature**

This is the *double naming* system of organisms where organisms are assigned two names i.e. the *generic* name and the *specific* name.

**Examples**

In binomial nomenclature the following rules are observed.

1. Generic name is written first followed by the specific name.
2. First letter in the generic name is in capital and the rest are in small letters.
3. Specific name is written in small letters.
4. The two names are underlined separately when handwritten or italicised when printed.

**Study Question 2**

**The Five Kingdoms of Classification**

***Carolus Linnaeus*** initially introduced the two kingdom system of classification. However many new life forms have been discovered which are neither animals nor plants. This has led to a more accepted classification system that adopts five kingdoms. These are;

* Monera
* Protoctista
* Fungi
* Plantae
* Animalia.

**Fig. 1.2**

**1. Kingdom Monera**

The kingdom is made up of mainly the bacteria e.g. *nitrobacter, azotobacter. Vibrio cholerae* etc.

**General characteristics**

1. They are unicellular and microscopic. Some are single cells while others are in colonies. They have different body shapes.

Fig. 1.4

1. Most are heterotrophic, feeding either saprophytically or parasitically. Some are autotrophic.
2. They are prokaryotic i.e. their nuclear material is not enclosed by a nuclear membrane.
3. They have few organelles which are not membrane bound. They don’t have mitochondria.
4. They have a cell wall though not made of cellulose.
5. They reproduce asexually mainly through binary fission.
6. Most of them respire an-aerobically but some respire aerobically.
7. Most of them move by use of flagella.

**Diagrams**

**Study question 3**

**2. Kingdom Protoctista**

Examples include paramecium, amoeba, plasmodium, chlamydomonas, euglena, spirogyra, and trypanosome.

**General characteristics**

1. They are eukaryotic whereby their nuclei is bound by a nuclear membrane.
2. Some are heterotrophic while others are autotrophic.
3. They have may organelles including mitochondria all of which are membrane bound.
4. They have different body forms; some are unicellular or colonial while others are multicellular.
5. Reproduction is mainly asexual by fission, fragmentation or sporulation. Some reproduce sexually by conjugation.
6. They are mobile and move by means of cilia, flagella or pseudopodia.
7. Some may have specialised structures that perform specific functions such as contractile vacuole for osmoregulation.

# Diagrams

# Practical Activities 1 and 2

**3. Kingdom Fungi**

**Examples**

Saprophytic ones include mushrooms, toadstools, bread moulds, penicilia, yeast etc.

Parasitic ones cause plant diseases such as wheat rust, potato and tomato blight and animal diseases such as athlete’s foot and ringworm.

# Practical Activities 3

**General characteristics**

1. They are eukaryotic.
2. Most have cell walls made of chitin but a few have cellulose cell walls.
3. They store food particles in their cytoplasm in the form of glycogen or oil droplets but not starch.
4. The basic unit is the ***hyphae***. Hyphae are thin filaments and many of them make up structures called ***mycelium***.
5. Fungi have neither the chloroplasts nor the chlorophyll. They feed on already manufactured food. Hyphae act as the roots and are sent into the food material to obtain nutrients. In saprophytic fungi the hyphae are referred to as ***rhizoids*** and in parasitic ones as ***haustoria***.
6. They reproduce ***sexually*** (fusion of nuclei in hyphal branches) and ***asexually*** (spores and budding).

# Examples

# Study Question 4

# 4. Kingdom Plantae

**Study question 5**

**General Characteristics**

1. They are eukaryotic and multicellular.
2. In most their body is differentiated into leaves, stem and roots.
3. They reproduce both sexually and asexually.
4. Their cells have cellulose cell walls
5. They have photosynthetic pigment hence are autotrophic.
6. Majority have a transport system
7. They show alternation of generation.

The kingdom Plantae is divided into three main divisions.

* Bryophyta.
* Pteridophyta.
* Spermatophyta.

**A. Division Bryophyta**

These are the mosses and the liverworts.

**General Characteristics**

1. The lack the vascular system
2. Contain chlorophyll and are therefore photosynthetic.
3. They have rhizoids for anchorage and water and mineral salts absorption.
4. They show alternation of generations.
5. Fertilisation depends of availability of water. Male gametes are produced by the ***antheridia*** and female gametes by the ***archegonia.***
6. They grow on damp substratum such as walls, rocks and marshes.
7. They are ***thalloid*** as in liverworts or differentiated into simple leaf like and stem like structures as in mosses.

**Diagrams**.

**B. Division Pteridophyta**

This includes ferns and horsetails.

They are more advanced compared to the bryophytes.

**General Characteristics**

1. They have leaves, stems and roots but no flowers.
2. They are photosynthetic.
3. They have a clearly defined vascular system made of xylem and phloem.
4. They have compound leaves with leaflets called ***pinna.***
5. On the lower side of mature leaves are the spores bearing structures (sporangia) which occur in groups called ***sori*** (***sorus-singular***). see diagram.
6. They show alternation of generations where the sporophyte (fern plant) is the dominant one while the gametophyte is a heart shaped structure called ***Prothallus***. See diagram.
7. They have sexual reproduction which is dependent of water.

# Study Question 6

# Practical Activity 4

# Study Question 7

# Practical Activity 5

**C. Division Spermatophyta**

This comprises of all the seed bearing plants.

**General Characteristics**

1. They contain chloroplasts hence are photosynthetic.
2. The plant body is differentiated into roots, stems, leaves and seed bearing structures.
3. Vascular system is highly developed with xylem tissue consisting of both xylem vessels and tracheids.
4. Sexual reproduction is well defined.
5. Seeds are produced after fertilisation.
6. They show alternation of generation.

The division Spermatophyta is made up of two main subdivisions i.e.

* + **Gymnospermaphyta**
  + **Angiospermaphyta**

**Gymnospermaphyta**

**General Characteristics**

* They bear male and female cones.
* After fertilisation seeds are borne on the female cones and they are naked i.e. they are not enclosed in a fruit wall.
* They show xerophytic characteristics such as needle like leaves, rolled leaves, thick waxy cuticle and sunken stomata.
* Phloem doesn’t contain companion cells and xylem mainly consists of tracheids.

This subdivision has three main classes.

* Coniferales
* Cycadales
* Ginkgoales

**i) Class Coniferales**

* These include all the common gymnosperms.
* They are found in areas of little water.
* They have small needle-shaped leaves with waxy cuticle.
* They have cones and most of them are ever green.
* ***Male cones*** are in form of clusters at the ***base of the terminal bud***.
* ***Female cones are on lateral buds*** of young shoots and they contain naked seeds.

**Diagrams.**

**ii) Class Cycadales**

* They resemble the palm trees by appearance.
* They have long compound leaves which are clustered at the apex of a thick short un-branched stem.
* They bear cones at the apex of the trunk.

**iii) Class Ginkgoales**

* Members here are very rare.
* They include the ***Ginkgo biloba*** of China.
* They are deciduous with fan like leaves.

**Angiospermaphyta**

**General characteristics**

* Are usually bisexual and flower bearing.
* Seeds are enclosed in an ovary which develops into a fruit.
* Xylem has tracheids and vessels while the phloem has companion cells.
* They have double fertilisation.

This subdivision is divided into two classes.

* **Monocotyledonae. – examples**
* **Dicotyledonae**. – **examples**

|  |  |
| --- | --- |
| **Class Monocotyledonae** | **Class Dicotyledonae.** |
| * They have seeds with one cotyledon. | * Have two cotyledons. |
| * They have narrow-long leaves with parallel venation. | * Broad leaves with reticulate venation. |
| * Most of their leaves have a modified petiole to form a leaf sheath. | * Leaves have distinct petioles. |
| * Their stems have scattered vascular bundle. | * Vascular bundles are arranged to form a concentric ring. |
| * Pith is usually absent. | * Pith is present. |
| * Vascular cambium is usually absent hence no secondary growth. | * Vascular cambium is present hence there is secondary growth. |
| * They have a fibrous root system | * They have a tap root system |
| * Floral parts are in threes or in multiples of three. | * Floral parts are in fours, fives or their multiples. |
| * In the root vascular bundles are arranged in a ring with phloem and xylem alternating. | * In roots, the xylem is centrally placed and star shaped with the phloem alternating with the arms of the xylem. |

**Study question 8**

**Practical activity 6**

1. **Kingdom Animalia**

**Study Question 9**

**General characteristics**

1. Most show locomotion but a few are sessile
2. Most reproduce sexually and a few asexually
3. They are eukaryotic and multicellular
4. All are heterotrophic
5. Their cells have no cell walls

Kingdom Animalia has nine phyla but only two will be discussed i.e. Arthropoda and chordata.

**Phylum Arthropoda**

**Practical Activity 7**

**General Characteristics**

1. They are segmented.
2. They are bilaterally symmetrical.
3. They have open circulatory system where blood flows in open cavities called haemocoel.
4. Head is well developed with eyes, sensory structures and a fairly developed brain.
5. Gaseous exchange is through the tracheal system which opens through the spiracles to the outside. Some aquatic ones use gills.
6. Reproduction is mostly sexual with internal fertilization. They have different sexes.
7. They have jointed appendages hence the name arthropoda.
8. They have a body covered with exoskeleton made of chitin. This provides a surface for muscle attachment. It is shed periodically to allow growth through a process called ***moulting***.
9. Most have their body divided into head, thorax and abdomen. In some, the head and the thorax are fused to form ***Cephalothorax***. The thorax and the abdomen are all segmented.

The phylum arthropoda is divided into five classes.

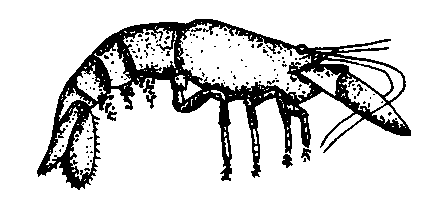
* Crustacea
* Chilopoda
* Diplopoda
* Arachnida.
* Insecta.

Different members of the phylum are placed to their respective classes based on;

* Number of limbs
* Presence and number of antennae
* Number of body parts.

**1. Class Crustacea**

Examples. Daphnia, crayfish. Crab and prawn.

****

**General Characteristics**

1. Head and thorax are fused to form cephalothorax.
2. They have two pairs of antennae.
3. They have between five and twenty pairs of limbs modified for different functions e.g. locomotion defence and feeding.
4. They have a pair of compound eyes.
5. Gaseous exchange is through the gills.
6. They have three pairs of mouth parts made of one pair of mandibles (lower) and two pairs of maxillae (upper).

**2. Class Chilopoda**

These are the centipedes.

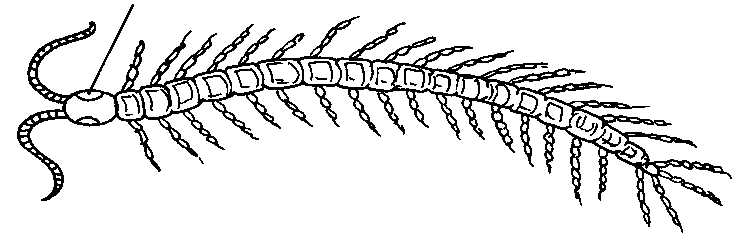
**Diagram**

**General Characteristics**

1. Body is divided into two parts, the head and the trunk.
2. The body is dorsa-ventrally flattened.
3. Body is made up of 15 or more segments.
4. Head has a pair of simple eyes.
5. Each segment has a pair of walking legs.
6. Head has a pair of antennae.
7. Have poison claws n the head and are therefore carnivorous.
8. Have a tracheal system for gaseous exchange.
9. Have separate sexes.

**3. Class Diplopoda**

These are the millipedes.

**Diagram**

**General Characteristics**

1. They have cylindrical body.
2. Have three body parts, head, and thorax and body trunk.
3. They have two clumps of many simple eyes.
4. They have no poison claws and are therefore herbivorous.
5. Heads has a pair of short antennae and mandibles.
6. Each body segment has a pair of spiracles for breathing.
7. Body has between 9-100 segments.
8. Each segment has two pairs of walking legs except the first thoracic segment.

**4. Class Arachnida**

These include the scorpions, spiders, ticks and mites.

**Diagrams**

**General Characteristics**

1. Body has two parts, cephalothorax and abdomen.
2. Cephalothorax has two chelicerae which produce poison to paralyse the prey.
3. Cephalothorax has four pairs of walking legs each having seven joints.
4. At the end of each leg are two toothed claws.
5. Cephalothorax has eight simple eyes.
6. Most have lung books for gaseous exchange, some use gill books or tracheal system.
7. They have no antennae but have a pair of pedipalps which are sensitive to touch.

**5. Class Insecta**

They include grasshoppers, bees, houseflies, butterflies, termites, beetles etc.

Insects form half the population of animals on earth. They occupy all habitats i.e. air, water, and land. Their food is varied such as plant tissues, animal fluids, dead animals and excretions of animals making them to be found almost everywhere on earth.

**General Characteristics**

1. Body is divided into three parts, head, thorax and abdomen.
2. Thorax is made up of three segments with three pairs of legs. Some have one or two pairs of wings on the thorax.
3. Head has one pair of antennae.
4. They undergo complete or incomplete metamorphosis.
5. Excretion is through the malpighian tubules which remove uric acid.
6. Gaseous exchange is through the tracheal system but they breathe through the spiracles.
7. The head a pair of compound eyes and several simple eyes.
8. Abdomen is made up of 11 or fewer segments. The terminal segments are modified for reproduction.
9. Mouth parts consist of the mandibles, maxillae and labium. The mouth parts are modified according to their feeding habits such as sucking, biting, chewing etc.

**Assignment**

**Discuss the economic importance of arthropods**.

**Study Question 10**

**Practical Activity**

**Phylum Chordata**

Chordate, common name for animals of the phylum Chordata, which includes vertebrates as well as some invertebrates that possess, at least for some time in their lives, a stiff rod called a notochord lying above the gut. About 43,700 living species are known, making the chordates the third largest animal phylum.

In animals such as the ***Amphioxus*** the notochord persists but in others it is replaced at later stages of development by the vertebral column.

Members in this phylum inhabit both aquatic (marine and fresh water) and terrestrial (burrowers and arboreal) environments.

**General Characteristics**

1. Members have a notochord at some stage of their development.
2. They are bilaterally symmetrical.
3. Heart is ventrally placed. Blood flows from the heart through the arteries and gets back to the heart through the veins.
4. They have a post anal tail although it is greatly reduced in some.
5. They have an endoskeleton.
6. They have a closed circulatory system.
7. They have visceral clefts where in fish they become the gills in higher chordates they are only present in the embryo.
8. They have a tubular dorsal nerve cord. It develops anteriorly into brain and posteriorly as the spinal cord. Spinal cord is enclosed by the vertebral column.
9. They have segmented muscle blocks called ***myotomes*** on either side of the body.

The main classes of the phylum chordata are;

* Pisces
* Amphibia
* Reptilia.
* Aves.
* Mammalia

**Pisces**

**Diagram**

These are the fishes. They include those with a skeleton made of cartilage e.g. shark and those with a bony skeleton such as the tilapia, Nile perch, lung fish, dog fish, and cat fish etc.

**General Characteristics**

1. The move by fins
2. Bodies are covered with scales
3. Have gills for gaseous exchange in water.
4. They don’t have a middle or inner ear.
5. They have streamlined bodies.
6. They have a lateral line for sensitivity.
7. Their heart has two main chambers i.e. the auricle and the ventricle.
8. They are poikilothermic/ectothermic.
9. Eyes are covered by a nictating membrane.

* **Amphibia**

They include the toads, newts, salamanders and frogs.

The toad is the most advanced amphibian. Its skin is less moist and therefore uses the lungs more for gaseous exchange. They therefore stay mostly on land and only return to the ponds during reproduction.

**Diagrams**

**General Characteristics**

1. They have a double circulatory system.
2. They have a three chambered heart with two atria and one ventricle.
3. Fertilisation is external and they breed in water.
4. Gaseous exchange is through the skin, lungs and gills.
5. They have two eyes and an eardrum behind the eyes.
6. They are ectothermic.
7. They have 4 well developed limbs. The hind limbs are more muscular than the forelimbs.

* **Reptilia**

Examples include tortoise, turtles, snakes, crocodiles, lizards and chameleons.

**General Characteristics**

1. They are ectothermic.
2. They have a well developed lung for gaseous exchange.
3. They have double circulatory system with the heart having three chambers i.e. two atria and a partially divided ventricle. Crocodiles however have a four chambered heart.
4. The body is covered with a dry scaly skin reducing desiccation.
5. Some have four limbs while others don’t have any limbs such as the snakes.
6. Fertilisation is internal. They lay eggs with a leathery shell to avoid desiccation. Some species of chameleons give birth to young ones.

* **Aves**

Examples include doves, chicken, hawks, eagles and turkeys.

They are terrestrial and arboreal while some have been adapted for aquatic life.

**General Characteristics**

1. Bodies are covered with feathers for in insulation.
2. They have beaks.
3. They internal auditory canal/ meatus
4. Fertilisation is internal and they lay hard calcareous eggs.
5. They have lungs for gaseous exchange.
6. They have air sacs which store air in them reducing their body density for flight.
7. They are endothermic.
8. They have hollow bones.
9. They have scales on their hind limbs.
10. They have double circulatory system with a four chambered heart.
11. The sternum is enlarged to form keel for attachment of flight muscles.

* **Mammalia**

**Study Question 11**

* Some are arboreal such as the tree squirrels, and some monkeys.
* Some are terrestrial either on the surface of the earth or in tunnels.
* Some are aquatic such as the dolphins and whales.

**General Characteristics**

1. They have double circulatory system
2. They have mammary glands hence the name Mammalia.
3. Their body is usually covered with fur or hair.
4. They have two eternal ears (pinna)
5. They have sweat glands.
6. They have lungs for gaseous exchange.
7. They have four limbs.
8. They have a diaphragm which separates the body cavity into thoracic and abdominal cavities..
9. The brain is highly developed.
10. They have seven cervical vertebrae at their neck.
11. They are endothermic.
12. They have *heterodont* type of dentition where the teeth are differentiated into four types, incisors, canines, pre-molars and molars. The number varies in relation to feeding habits.

* **Although most mammals give birth to live young ones, some are egg laying such as the duck billed platypus. After hatching, the young ones are fed on milk.**
* **Practical Activity 9**
* **Practical Activity 10.**

**The Dichotomous Key**

The word dichotomous means separating into two. I.e. Separation of different or contradictory things: a separation into two divisions that differ widely from or contradict each other. As you move down the key you progress from general characteristics to more specific characteristics. The last single choice reveals the identity of the unknown organism.

**Rules Used in Constructing a Dichotomous Key**

1. Use morphological features as far as possible.
2. Start with the major characteristics and proceed to lesser variations that separate the organisms into smaller groups. E.g. in leaves start with type of leaf i.e. simple or compound.
3. Select a single characteristic at a time and identify it by a number such as.
   * Type of leaf
   * Type of venation
4. Use identical forms of words for the two contrasting statements e.g.

1. a) leaf simple.

b) Leaf compound

2. a) Leaf net veined.

b) Leaf parallel veined.

1. The statements should always be written in positive form. Where a negative statement cannot be avoided, the first statement must be in the positive form e.g.
   * + 1. Animal with wings
       2. Animal without wings
2. Avoid overlapping statements or generalisations such as

* Short plants
* Tall plants

Be very specific in your description such as

* Plant I metre tall and above.
* Plant 15cm to 60cm tall.

**Some common Features Used For Identification.**

* **In animals**
  1. Locomotory structures (legs, wings and fins)
  2. Antennae, presence and number
  3. Presence and type of eyes
  4. Number of body parts
  5. Body segmentation
  6. Type of skeleton present
  7. Feeding structures
  8. Presence of hair, fur, scales or feathers on the body
* **In plants**

|  |  |
| --- | --- |
| **Part of plant** | **Some characteristics.** |
| Leaf | * Phylotaxy * Leaf type * Leaf venation * Margin * Lamina * Colour |
| Flower | * Inflorescence * Flower shape * Number of floral |
| Stem | * Type of stem( woody, herbaceous or fleshy) * Shape (rectangular or cylindrical) * Texture of the stem (smooth or spiny/thorny) |
| Roots | * Root system (taproot or fibrous) * Storage roots. |
|  |  |

**Summary of the Five Kingdoms.**

**Practical Activities.**

**Revision Questions.**

**REPRODUCTION IN PLANTS AND ANIMALS**

* This is the process by which mature individuals produce offsprings.
* There are two types of reproduction.

1. **Sexual reproduction which involves male and female gametes**

Diagram

1. **Asexual reproduction where no gametes are involved.**

Diagram

**Importance of Reproduction**

1. **Procreation**

This ensures that a species does not become extinct.

1. **Quality improvement**

Reproduction allows for mixing of genetic materials bringing

about variations.

These variations are important tools in the refinement of quality of offsprings.

**Cell Division**

* Life in all living things start as a single cell as a spore or as a zygote.
* The cells have to divide further to give rise to make cells.
* Cell division starts with division of the nucleus (chromosome) and then the cytoplasm.

**Chromosomes**

* These are microscopic thread like structure within cells that carries the molecule deoxyribonucleic acid (DNA)—the hereditary material that influences the development and characteristics of each organism.
* Each chromosome is made up of two parallel strands called **chromatids.**
* Chromatids are joined together at one point by the **centromere**.

**Diagram**

* Each cell has a fixed number of chromosomes e.g. each human body cell has 46 chromosomes.
* Chromosomes occur in pairs in the nucleus. A member of each pair is called homologous chromosomes.
* Homologous chromosomes are similar in appearance, size, and shape but their genetic constitution may be different.
* Genes are found along the length of the chromosomes.
* Genes are very tiny and made up of a chemical substance called DNA (De oxy Ribonucleic Acid)
* DNA determines the characteristics of the offspring.
* **There are two types of cell division**

1. **Mitosis**
2. **Meiosis**

**Mitosis**

* In this type of cell division, each cell divides into two daughter cells each having the same number of chromosomes as the parent cell.
* Mitosis occurs in series of stages i.e.

1. **Interphase**
2. **Prophase**
3. **Metaphase.**
4. **Anaphase**
5. **Telophase**.

1)**Interphase**

During this stage the following activities take place within the cell in preparation of the division.

* Synthesis of new cell organelles such as ribosome’s, centrioles, mitochondria and Golgi apparatus.
* Multiplication of genetic material so that each daughter cell will have same number of chromosomes as the parent cell.
* Build up of enough energy stores in form of ATP (Adenosine Triphosphate) during respiration. This energy is important to see the cell through the process of division.
* At this stage the chromosomes are not clearly visible.

**Diagrams**

2)**Prophase**

The following events take place in this stage.

* Centrioles separate and move to opposite poles of the cells.
* Spindle fibres begin to form
* Nuclear membrane begins to break down and nucleolus disappears.
* Chromosomes thicken and shorten and they can be stained easily hence become visible.

**Diagram**

**3)Metaphase**

* Nuclear membrane disappears and chromosomes are free in the cytoplasm.
* Spindle fibres lengthen and attach to the centrioles at both poles.
* Chromosomes align themselves at the equator and are attached to the spindle fibres by their centromere.

**Diagram**

1. **Anaphase**

* Chromatids separate at the centromere and migrate to opposite poles. This is brought about by the shortening of the spindle fibres.
* Spindle fibres begin to disappear.
* In animal cells, cell membrane begins to constrict towards the end of anaphase.

**Diagram**

1. **Telophase**

* Chromatids collect together at the two opposite poles of the spindle.
* Nuclear membrane forms around each set of chromatids and are now referred to as chromosomes.
* Cytoplasm divides into two hence the formation of two daughter cells.
* Chromosomes become less distinct.

*In animal cells, division of cytoplasm is by constriction of cell membrane.*

*In plant cells, a cell plate forms within the cytoplasm and grows to separate the cell into two.*

**Diagrams**

Significance of Mitosis

1. Forms basis for asexual reproduction e.g. budding and spore formation.
2. Causes cell growth when the cells formed increase in number and size.
3. Ensures genetic constitution of the offspring is the same as the parents.
4. Replaces damaged and dead cells in the body.

**Meiosis**

* This involves two divisions of the parental cell resulting into four daughter cells.
* First meiotic cell division involves the separation of the homologous chromosomes. It is referred to as *Reduction division* because the numbers of chromosomes are reduced by half.
* In the second stage, the sister chromatids are separated and it is referred to *as Equatorial division*
* Each daughter cell has half the number of chromosomes (haploid n) as the parent cell.
* This takes place in the reproductive organs of animals (testis and ovary) and plants (anthers and ovary).
* Meiosis is divided into same series of stages as in mitosis.
* The phases are given names as in mitosis but each is followed by I or II.

**First Meiotic Division**

**Interphase I**

The cell prepares for division by the following.

* Replication of chromosomes.
* Synthesis of new cell organelles.
* Build up of energy.

**Prophase I**

* Nucleolus disappears.
* Centrioles move to opposite poles.
* Chromosomes shorten and thicken becoming more visible.
* Homologous chromosomes lie side by side in the process of *synapsis* forming pairs called *bivalents.*
* Homologous chromosomes may become coiled around each other with their chromatids remaining in contact at points called *chiasmata.*

NB/. During chiasma formation homologous chromosomes may exchange genetic material during crossing over. These genetic exchanges are important because they bring about variations in offsprings.

**Metaphase.I**

* Nuclear membrane disappears.
* Homologous chromosomes as a bivalent move to the equator of the cell.
* Spindle fibres are fully formed and get attached to the chromosomes at the centromere.
* Homologous chromosomes orientate towards different poles.

**Diagram**

**Anaphase I**

* Homologous chromosomes separate and migrate to the opposite poles with their centromeres leading. This is brought about by the shortening of the spindle fibres.

**Diagram**

**Telophase I**

* Cell divides across the middle when the chromosomes reach the poles.
* At the end of meiosis I homologous chromosomes are separated.

**Diagram**

**Second Meiotic Division**.

In this stage the sister chromatids are separated from each other.

**Interphase II**

* Cells go into a short interphase.

**Prophase II**

* Chromosomes become shorter and thicker.
* New spindle fibres are formed.

**Metaphase.II**

* Chromosomes align at the equator of the cell.
* Spindle fibres attach to their centromeres.
* Chromosomes orientate themselves towards the opposite poles.

**Anaphase II**

* Sister chromatids separate from each other.
* Spindle fibres shorten pulling them to the opposite poles.

**Telophase II**

* Spindle fibres disappears
* Nucleolus reappears and nuclear membrane forms around each set of chromatids.
* Chromatids uncoil and become threadlike.
* Cytoplasm divides.
* Four cells are formed (tetrad).
* Each cell has haploid (n) number of chromosomes.

**Significance of Meiosis**

1. Gamete formation (sperms and ova) forming basis for sexual reproduction
2. Provides opportunities for genetic variations during crossing over

**Similarities between mitosis and meiosis**

1. Both take place in plants and animals.
2. Both involve division (multiplication) of cells.

**Differences between meiosis and mitosis**

|  |  |
| --- | --- |
| Meiosis | Mitosis. |
| 1. Homologous chromosomes associate with each other. | No association of homologous chromosomes |
| 1. Takes place in 2 nuclear divisions. | Takes place in one nuclear division. |
| 1. 4 daughter cells are produced each haploid (n) | 2 daughter cells are produced each diploid (2n) |
| 1. Occurs in reproductive organs leading to gamete formation. | Occurs in somatic (body) cells leading to growth. |
| 1. Chiasma formation takes place leading to crossing over hence variation | No chiasma formation therefore no crossing over hence no variation. |

**Asexual Reproduction**

* This is the production of offsprings from a single organism without fusion of gametes.
* This type of reproduction involves mitosis.

**Types of Asexual Reproduction**

1. **Binary fission in amoeba, plasmodium and bacteria**
2. **Sporulation in rhizopus**
3. **Budding in yeasts**
4. **Binary fission in amoeba**

* When there is enough food and favourable temperature and pH, a mature amoeba divides into two.
* During binary division, in amoeba, internal reorganization of molecules necessary for structural construction takes place.
* Nucleus first divides mitotically (Karyogamy) into two followed by the division of the cytoplasm (Cytogamy)

**Diagrams**

1. **Sporulation in Rhizopus**

* This is the formation of spores in substrates like the bread to form bread moulds
* A spore is a microscopic reproductive unit which contains a nucleus and a small amount of cytoplasm.
* Spores are produced by bacteria, most fungi, mosses and ferns.
* Rhizopus has a vegetative body called the mycelium.
* Mycelium is made up of many branched threads called ***hyphae***.
* Horizontal hyphae are called ***stolons***.
* Vertically growing ones are called ***sporangiophore***.
* Tips of sporangiophore swell up to form the ***sporangia (sporangium)***.
* Sporangia are the spore bearing structures. When fully mature, sporangium wall burst releasing the spores. If spores land on a suitable medium, they germinate and develop into other rhizopus.
* Rhizopus uses structures called ***rhizoids*** for anchorage and to obtain nutrients from the substrate.

**Diagrams**

**Budding in Yeast**

Under favourable conditions such as plenty of sugar, moisture, oxygen and optimum temperature, the yeast cell reproduces asexually by budding.

* A projection of bud forms on the parent cell.
* Nucleus divides into two.
* One nuclei moves into the new bud.
* Bud grows in size and forms new cell organelles. Later the bud separates off.

**Diagrams**

**Sexual Reproduction in Plants**

* In flowering plants the flower is the reproductive organ.

**Structure and Function of a Flower**

* A flower is made up of a flower stalk (pedicel) and a receptacle.
* Attached to the receptacle are four groups of floral structures i.e.

1. Calyx (sepals)
2. Corolla/petals
3. Androecium – male parts
4. Gynoecium – female parts
5. **Calyx (sepals)**

* Made up of the sepals which are usually green.
* If sepals are fused they form ***gamosepalous*** calyx.
* If they are free, they form ***polysepalous*** calyx.
* Calyx protects the inner parts of the flower especially during ***bud*** development.
* Some flowers have sepal like structures below the calyx called the ***epicalyx***.

1. **Corolla/petals**

* It’s made up of the petals which are brightly coloured, large and conspicuous especially in insect pollinated flowers.
* If fused – gamopetalous.
* If free – polypetalous

1. **Androecium – male parts**

* Made up of one or more stamens
* Satmen is made up of the filament and anthers.
* Another has four pollen sacs containing pollen grains.
* Pollen grains contain the male gametes.

**Diagrams**

1. **Gynoecium – female parts**

* It may contain one or more carpels
* A carpel consists of the ovary, the style and the stigma.
* Ovary contains the ovules.
* Ovaries are described as epigynous, hypogynous or perigynous depending on the place they occur in the flower.

1. **Epigynous (inferior) ovary**

* Ovary is located within the receptacle.
* All other floral parts occur above it such as in the apple flowers.

**Diagram**

1. **Hypogynous (superior) ovary**

* Ovary is above the receptacle and other floral parts such as in hibiscus.

**Diagram**

1. **Perigynous ovary**

* The receptacle surrounds the carpel.
* All other floral parts arise around the ovary such as in roses.

**Diagram**

The gynoecia can also be grouped into different types dependi.ng on the number of carpels present i.e. monocarpous or syncarpous.

**Monocarpous Gynoecium**

* It has only one carpel e.g. in beans.

**Diagram**

**Polycarpous Gynoecium**

* It has two or more carpels. It is divided into two.

1. **Apocarpous gynoecium**

* The carpels are free e.g in roses and bryophyllum.

**Diagrams**

1. **Syncarpous gynoecium**

* The carpels are fused together such as in hibiscus.

**Diagrams**

**Terms Used in Describing a Flower**

1. *Complete flower* – has all the four floral parts; calyx, corolla, androecium and gynoecium.
2. *Incomplete flower –* has one or two floral parts missing.
3. *Unisexual flower –* a flower with only one of the reproductive parts either male or female flower.
4. *Staminate flower –* male flower.
5. *Pistillate flower –* female flower.
6. *Monoecious plant –* bears both male and female parts of the flower.
7. *Dioecious plants -* the plant is either male or female e.g. in paw paw.
8. *Hermaphrodite or bisexual flower –* has both the male and female parts.
9. *Regular or actinomorphic flower –* a flower that can be divided into tow similar halves by any vertical section passing through the center i.e. radial symmetry such as in morning glory.
10. *Irregular or zygomorphic flower –* can be divided into two similar halves on one particular plane only i.e. bilateral symmetry e.g. in clotalaria.
11. *Pedicillate flower-* flower with a stalk.
12. *Solitary flower –* are flowers occurring singly.
13. *Inflorescence –* flowers that grow in clusters.
14. *Essential parts of the flower –* are the androecium and gynoecium.
15. *Non essential floral parts –* are the calyx and corolla.

**Pollination**

This is the transfer of pollen grains from the anther to the stigma.

**Types of Pollination**

1. ***Self pollination***. – Transfer of pollen grains from the anther to the stigma of the same flower.
2. ***Cross Pollination*** – transfer of pollen grains from the anther of one flower to the stigma of another flower but of the same species.

**Agents of Pollination**

* Insect
* Wind

**Adaptations of Insect Pollinated Flowers (Entomophilous)**

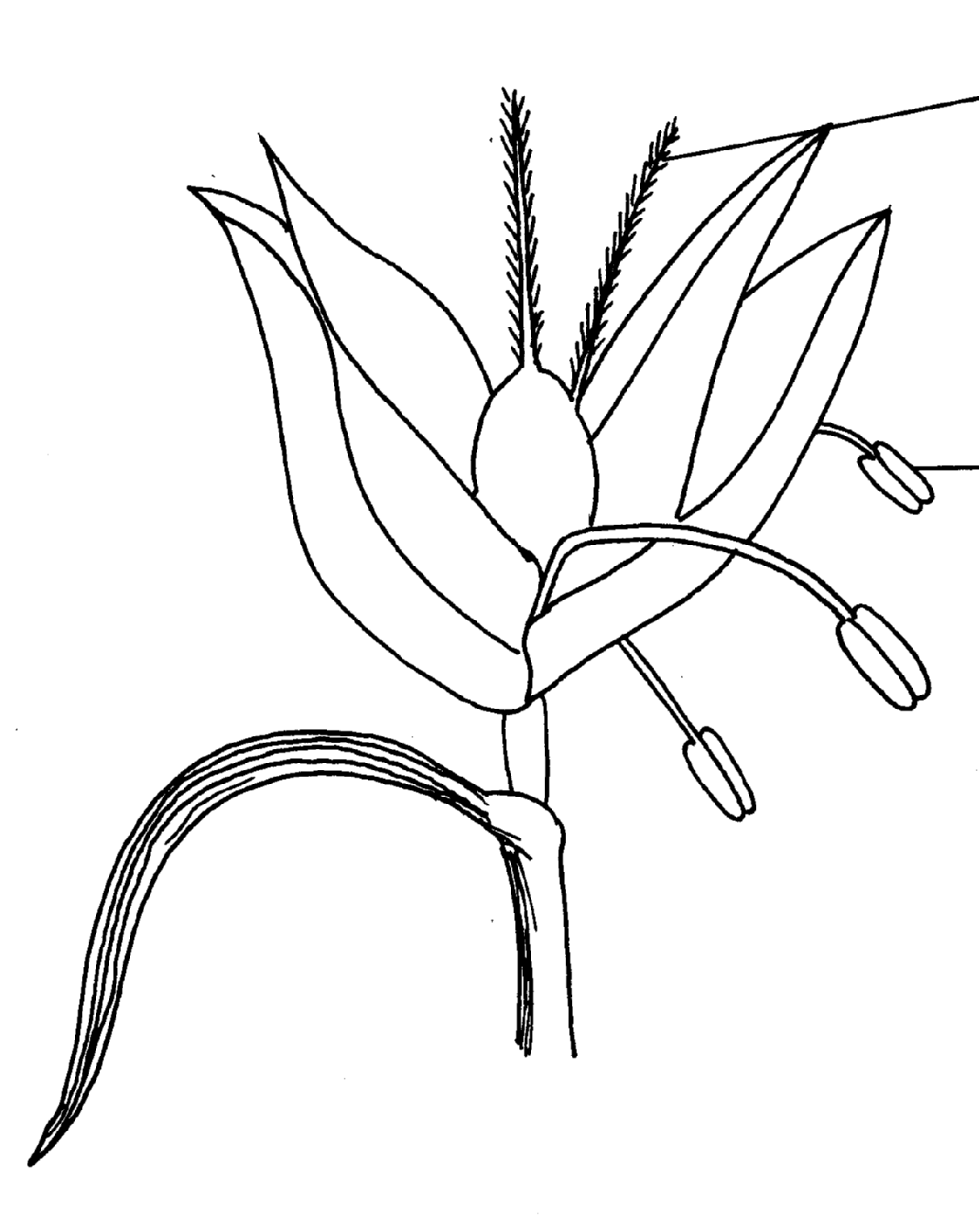
1. Flowers are large, conspicuous with brightly coloured petals and inflorescence to attract insects.
2. Flowers are scented and produce nectar to attract insects.
3. Pollen grains are relatively large, heavy, rough or sticky so as to stick on to the body of the sticks.
4. They have small and firmly attached anthers to a firm filament.
5. Stigmas are small, sticky and contained within the flower. This ensures that pollen grains from the body of an insect stick onto it.
6. Flowers have a tubular or funnel shaped corolla, landing platforms and honey guides.

**Adaptations of Wind Pollinated Flowers (Anemophilous)**

**e.g. maize and other grasses**

1. Small flowers with inconspicuous petals, bracts or inflorescence.
2. Flower structure is simple and flowers have no particular shape.
3. Stigmas are long, feathery and hang outside the flower to trap pollen grains.
4. Pollen grains are small, smooth and light to be easily carried by the wind.
5. Flowers are not scented and lack nectar.
6. Anthers are large and loosely attached to a flexible filament to be easily released when the wind blows.

**Diagram of a grass flower**



**Stigma**

**Anther**

Filament

**Features and Mechanisms Hindering Self Pollination and Self Fertilization**

1. Heterostyly – condition whre the stigma na d style have different arrangements e.g. coconut flowers have shorter stamens than pistils hence pollen grains from the anthers cannot reach the stigma.

***Diagram***

1. *Self sterility or incompatibility* – condition where pollen grains of a flower fail to germinate if they land on the stigma of the same flower.
2. *Protogyny and Protandry* – condition where either male parts of a flower mature before the female ones.

*Protandry* – stamen mature before the stigma e.g.in sunflower.

*Protogyny* – stigma matures before the anthers mature e.g. in maize.

1. *Dioecious plants and presence of features that promote cross pollination* such as brightly coloured petals which attract insects hence cross pollination.

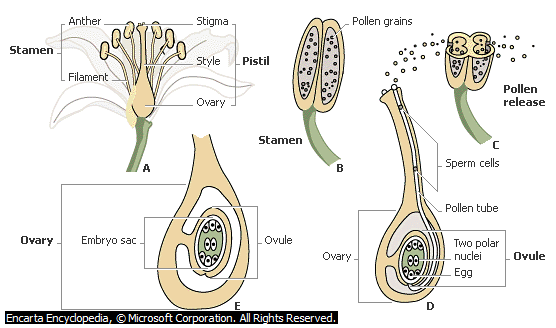
**Fertilization in Flowering Plants**

Fertilization in plants is the fusion of the male and female nuclei in the embryo sac.

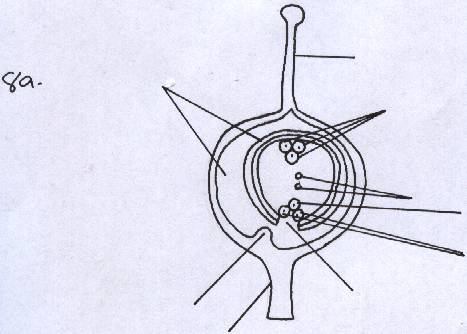
* Male gamete is contained in the pollen grain produced in the anther.

***Diagram***

Female gamete (egg cell) is found in ovules contained in the embryo sac.



**Process of Fertilization**



Embryo sac

Pedicel

Synegids

Egg cell

Polar nuclei

Antipodal cells

Ovary wall

Style

Micropyle

funicle

Integuments

* Pollen grains land stick to the stigma and germinates to form pollen tube, which grows through the tissue of the style towards the ovary
* The generative nucleus undergoes mitosis, forming 2 male nuclei
* The pollen tube gets into the embryo sac through the micropyle; pollen tube nucleus disintegrates, creating a passage for the male nuclei.
* The egg cell fuses with one of the two male nuclei to form a diploid zygote. The zygote undergoes mitosis to form an embryo
* The two polar nuclei fuse with the second male nucleus to form a triploid nucleus.
* The triploid nucleus forms the endosperm. The two con current fertilization incidents are collectively referred to as double fertilization

**Seed and Fruit Development**

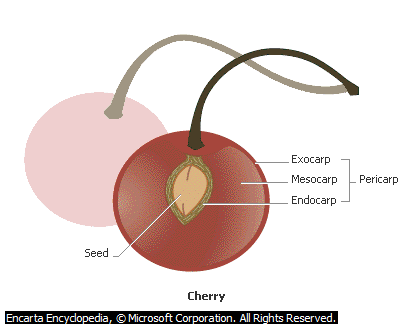
* Some changes occur to the ovary, ovule and the entire flower after fertilization.
* Calyx dries and falls off or may persist.
* Petals and stamens wither and fall off.

**Development of the Seed**

* Zygote undergoes mitotic division to become the embryo (plumule and radicle) and one or two cotyledons.
* Primary endosperm nucleus develops into the endosperm.
* Ovule forms the seeds.
* Ovary develops into a fruit.
* Integuments become the seed coat (testa).
* Testa has got a scar (hilum) which is the attachment point to the placenta.
* A seed a tiny opening called the micropyle which allows water into the seed during germination.
* Water is withdrawn from the seed from about 80% to 15% by mass making the seed dry and hard.

**Development of Fruits**

* A fruit is a fully grown fertilized ovary containing fully developed seeds.
* This is brought about by the hormones gibberellins and occurs after fertilization.
* As the ovules develop into seeds, the rest of the ovary develops into the fruit wall or the pericarp.
* Pericarp has two scars indicating the points of attachment to the style and to the receptacle.
* Pericarp has three layers; epicarp/exocarp (outer most), mesocarp (middle) and the endocarp (innermost).



* In some fruits such as pineapples and bananas fruit formation takes place without fertilization. This is called ***parthenocarpy***.
* False fruits are formed when other parts of the flower such as the receptacle enlarge and enclose the ovary e.g. in pineapples, apple, straw berry and cashew nut.

**Classification of Fruits**

**Succulent fruits**

They are divided into berry and drupe.

***Berry*** – has a succulent pericarp divided into epicarp, mesocarp and endocarp e.g. orange, tomato, passion fruit, melon, paw paw etc.

**Diagram**

***Drupe*** – they have a thin epicarp, fleshy or fibrous mesocarp and a very hard endocarp enclosing the seeds. In mango the fleshy edible part is the mesocarp while in coconut the mesocarp is a fibrous cover just before the hard endocarp.

**Diagram**

**Dry Fruits**

* They are divided into dehiscent and indehiscent.

**Dry Dehiscent fruit**

They dehisce to release their seeds. They are divided into;

1. Legume e.g beans

***Diagram***

1. Capsule e.g poppy

***Diagram***

1. Schizocarp e.g. castor.

***Diagram***

**Dry indehiscent fruits**

* These do not dehisce.
* They include;

1. **Caryopsis** - pericarp and seed coat are fused together to form a thin covering round the seed e.g. maize.

**Diagram**

1. **Cypsela** - it’s a one seeded e.g. the blackjack.

**Diagram**

1. **Nut** – the pericarp becomes hard and woody and it is separate from the seed coat e.g. macadamia.

**Diagram**

**Placentation**

* This is the arrangement of the ovules in an ovary. They include;

1. *Marginal Placentation*.

* Ovules are attached to the placenta in a row e.g. peas in a pod.

**Diagram**

1. *Basal placentation*

* Placenta is formed at the base of the ovary. Ovules are attached to it sunflower and sweet pepper.

**Diagram**

1. *Axile Placentation*

* The edges of the carpels fuse together to form a central placenta in the axile.
* Ovules are arranged on the placenta.
* The ovary is divided into a number of loculi by the walls of the carpel e.g. in orange

**Diagram**

1. *Parietal Placentation*

* Edges of the carpels fuse together and dividing walls disappear leaving a loculus.
* Placentas from each carpel appear as a ridge on the ovary wall and have numerous ovules on them e.g. in paw paw.

**Diagram**

1. *Free central placentation*

* Edges of carpels fuse together and the dividing walls disappear leaving one loculus.
* Placenta appears at the center and have numerous ovules on it e.g. in primrose

**Diagram**

**Adaptations of Fruits to Various Agents of Dispersal**

1. Water dispersal

* Such seeds and fruits enclose air in them to lower their density for buoyancy;
* They are fibrous/ spongy to lower the density for buoyancy;
* Have impermeable seed coat or epicarp to prevent water from entering during flotation so as to avoid rotting;
* The seeds can remain viable while in water and only germinate while on a suitable medium;

1. Wind dispersal

* They are light; and small; to be easily carried by wind currents due to lower density;
* Have developed extension (Parachute like structures and Wing like structures) which create a larger surface area; so as to be kept afloat in wind currents e.g. sonchus and jacaranda
* In some a Perforated capsule is usually loosely attached to a long stalk which is swayed away by wind scattering seeds;

1. Animal dispersal

* Brightly colored to attract animals
* Fleshy to attract animals; e.g. mangoes, passion fruits, oranges, tomatoes etc.
* aromatic /scented to attract animals;
* The seed coats are hard and resistant to digestive enzymes; the seeds are therefore dropped away in feaces/droppings e.g. passion fruit and tomatoes.
* Some have hook like structures to attach on animals fur e.g. blackjack

d) Self dispersal

* They have weak lines (sutures) on the fruit wall (pod), along which they burst open to release seeds, which get scattered away from the parent plant e.g. in legumes such as peas and beans.

**SEXUAL REPRODUCTION IN ANIMALS**

* This involves gamete fusion.
* The male produces the male gamete (sperms) and the female produces the female gamete (ovum/ova).
* The gametes are produced in special organs called gonads i.e. the testes and ovaries.
* The sperm fuses with the ovum to form a zygote through a process called *fertilisation* the gametes are haploid and the zygote is diploid.
* Fertilisation may be internal or external.

**External Fertilisation in Amphibians**

* The female lays eggs and the male sheds sperms on them (to fertilise them). This is only possible in water.
* Many eggs are released to increase the chances of survival since bacteria and other organisms can eat fertilised eggs.
* Eggs are also in long strands of slippery jelly like substance, which offer the eggs protection.
* This substance separates the eggs from each other allowing for good aeration.
* It also attaches the eggs to water plants and makes them buoyant.

**Internal Fertilisation**

* This occurs in reptiles, birds and mammals where fertilisation occurs within the body of the female.
* Sperms are introduced into the female’s body.
* Few eggs are produced because there are high chances of fertilisation and the gametes/zygote receive further protection.
* In most mammals, some chameleons and some snakes the fertilised eggs develop into young ones within the body of the female. They give birth to young ones.

**Study Question 8**

**Reproduction in Mammals**

* Mammals have internal fertilization where eggs are laid or develop within the female’s body in the uterus.
* The egg laying mammals (monotremes) they are said to be *oviparous such as the platypus.*



**Platypus**

The duck-billed platypus, *Ornithorhynchus anatinus,* found only in eastern Australia, belongs to an unusual group of egg-laying mammals called monotremes. It lives in streams, rivers, and occasionally lakes. The duck-billed platypus feeds on bottom-dwelling aquatic insect larvae, which it finds by probing the streambed with its pliable, sensitive bill.

* In marsupials such as the kangaroo the zygote does not develop fully within the uterus but completes development in the pouch.



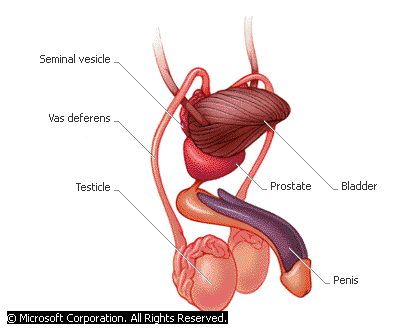
**Mother Kangaroo and Baby**

Kangaroos are a type of mammal called a marsupial. Baby marsupials are unable to survive on their own when they are born, so they must live in a pouch on their mother’s belly. A newborn kangaroo, called a joey, stays in its mother’s pouch for about six months, where it feeds on her milk.

* The ability to give birth to young ones as in placental mammals is called viviparity.
* Mammals have mammary glands, which produce milk on which the young ones are fed. Parental care is highly developed in mammals.

**Reproduction in Human beings**

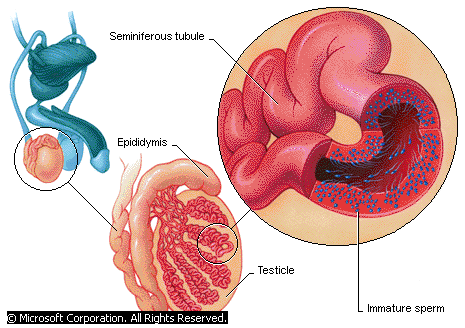
**Structure and Function of The male Reproductive System**



**Male Reproductive System**

The organs of the male reproductive system enable a man to have sexual intercourse and to fertilize female sex cells (eggs) with sperm. The gonads, called testicles, produce sperm. Sperm pass through a long duct called the vas deferens to the seminal vesicles, a pair of sacs that lies behind the bladder. These sacs produce seminal fluid, which mixes with sperm to produce semen. Semen leaves the seminal vesicles and travels through the prostate gland, which produces additional secretions that are added to semen. During male orgasm the penis ejaculates semen.

* Testes are found outside the abdominal cavity in the *scrotal sac.* This position provides a cooler environment for sperm production since sperms develop best at lower temperature than that of the body.
* Testis is made up of highly coiled tubes called **seminiferous tubules** whose inner lining has actively dividing cells which give rise to sperms.
* Between the seminiferous tubules are interstitial cells, which produce the male hormones (androgens).



**Internal View of Male Reproductive System**

The reproductive anatomy of the male human is largely external. Beginning at puberty, sperm are produced within seminiferous tubules of the testicles, a pair of glands that reside in a pouch called the scrotum. The external location of the scrotum keeps the temperature of sperm slightly below body temperature, which is necessary for their healthy development and survival. From each testicle, sperm migrate to a long, coiled tube known as the epididymis, where they are stored for one to three weeks until they mature. Also located outside the body is the penis, the erectile organ responsible for the excretion of urine and the transfer of sperm to the vagina of the female. Just before ejaculation during sexual arousal, mature sperm travel from the epididymis, a coiled tube behind each testicle, through a long duct called the vas deferens. Sperm leave the body in semen, a fluid produced by the seminal vesicles.

* Seminiferous tubules unite to form the **epididymis, which** is about 6m long and highly coiled. It stores the sperms.
* It’s connected to the **sperm duct/vas deferens.** Sperm duct connects the epididymis to the urethra, which is the ejaculatory duct.
* **Seminal vesicles** provide an alkaline fluid, which contains nutrients for the sperms.
* **Prostate gland** secretes an alkaline substance to neutralise the vaginal fluids. It also activates the sperms.
* **Cowper’s glands** secrete an alkaline fluid that neutralizes the acidity along the urethra.
* **All these fluids combine with the spermatozoa to form the semen.**
* Since the urethra serves both passage of urine and semen it is said to be urino-genital in function.
* The penis is erectile and made of spongy tissue, muscle and blood vessels.
* Once erect, the penis is able to penetrate the vagina in order to deposit sperms into the female’s reproductive tract.

# Study question 9 and Practical.

**Structure and Function of The Female Reproductive System**.

**Diagram**

* The internal sex organs of the female consist of the vagina, uterus, fallopian tubes (or oviducts), and ovaries.
* The *vagina* is a flexible tube-shaped organ that is the passageway between the uterus and the opening in the vulva. Because during birth the baby travels from the uterus through the vagina, the vagina is also known as the birth canal.
* The woman's menstrual flow comes out of the uterus and through the vagina.
* When a man and a woman engage in vaginal intercourse, the penis is inserted into the vagina.
* The *cervix* is located at the bottom of the uterus and includes the opening between the vagina and the uterus. It secretes a plug of mucus, which prevents entry of pathogens into the uterus during pregnancy.
* The *uterus* is a muscular organ that has an inner lining (endometrium) richly supplied with blood vessels and glands. During pregnancy, the uterus holds and nourishes the developing foetus.
* Although the uterus is normally about the size of a fist, during pregnancy it is capable of stretching to accommodate a fully developed foetus, which is typically about 50 cm (about 20 in) long and weighs about 3.5 kg (about 7.5 lbs).
* The uterine muscles also produce the strong contractions of labour.
* At the top of the uterus are the pair of *fallopian tubes (oviduct)* that lead to the ovaries.
* The two *ovaries* produce eggs, or ova (the female sex cells that can become fertilized), and female sex hormones, primarily oestrogen and progesterone.
* The fallopian tubes have finger like projections at the ends near the ovaries that sweep the egg into the fallopian tube after it is released from the ovaries.
* Movement of ovum is also aided by the smooth muscles of the oviduct.
* If sperm are present in the fallopian tube, fertilization (conception) may occur and the fertilized egg will be swept into the uterus by *cilia* (hair like projections inside the fallopian tube).

**Practical**

**The Human Sperm**

* Are formed in the seminiferous tubules of testes by meiosis.
* Final products of meiosis enter the sertoli cells where they are nourished and undergo maturation.
* Mature sperms leave for epididymis where they are stored.
* A mature sperm has an ovoid head, short neck, middle piece and a tail.

**Diagram**

* Head has a large nucleus carrying the genetic material, which is haploid (n).
* At the tip of the head there is the acrosome containing lytic enzymes. These enzymes digest the wall of ova.
* The short neck contains centrioles.
* Middle piece has a large number of mitochondria, which provide with the energy required for propulsion of the sperm to reach the ova.
* The tail propels the sperm forward by its side-to-side lashing action.

**Formation of The Ova**

* In females egg formation begins in the ovary of the foetus before birth unlike in males where production of sperms starts at puberty.
* At birth there are about **70,000 potential egg cells** in the ovaries of a baby girl.
* A layer of ovary cells called **primary follicles**, which provide them with nourishment, encloses them.
* Only about 500 of them develop into ova during puberty. During puberty the primary follicles grow to become **Graafian follicle**.
* At ovulation, the Graafian follicle bursts open to release a mature ovum surrounded by a layer of cells.

**Diagram**

* A mature ovum is spherical in shape with a diameter of about 0.2 mm.
* It has a large haploid nucleus surrounded by a nuclear membrane.
* Nucleus is within the cytoplasm enclosed by the **plasma membrane**. **Vitelline** membrane surrounds the plasma membrane.

**Study Question 11**

**Fertilisation**

* Process where the nucleus of a male gamete fuses with the nucleus of a female gamete to form a zygote.
* This takes place in the upper part of he oviduct after copulation. Sperms are drawn up by suction through the cervix into the uterus. They swim up to the oviduct using their tails.
* Very many sperms are released but only one is required to fertilise the ovum.
* The ovum releases chemical substances, which are neutralised by those released by the acrosome.
* When the ovum comes into contact with the egg the acrosome bursts releasing lytic enzymes, which dissolve the egg membranes.
* The acrosome turns inside out forming a filament, which is used to penetrate the eggs.

**Diagrams**

* The Vitelline membrane undergoes a change, which stops any other sperm from entering the ovum.
* Once inside the cytoplasm the head bursts to release the male nucleus, which then fuses with the female nucleus to form a diploid zygote.
* After ovulation the ovum can remain viable for 8-24 hours before it dies.
* The sperm can remain viable for 2-3 days in the female reproductive tract.

**Study Question 12**

**Implantation**

* This is the attachment of the blastocyst to the walls of the uterus by the villi.
* After fertilisation, the zygote undergoes various mitotic divisions as it moves down the oviduct. Its movement is aided by cilia in the oviduct and by the contractions of the smooth muscles lining the oviduct.
* By the time it reaches the uterus it has formed a hollow structure of cells called blastocyst.
* Movement of the zygote from the oviduct to the time it is implanted takes about 7 days.

**Diagrams**

* Sometime the zygote may fail to move down to the uterus and gets implanted into the walls of the oviduct. This condition is referred to as **ectopic pregnancy**.

**Formation of Placenta**

* During implantation the blastocyst differentiates into three layers, **chorion, amnion** and **allantois.**

**Diagram**

* **Chorion** is the outermost and it has finger like projections called **chorionic villi**. These villi grow into the endometrium. During the early stages of embryo development, villi form the sites for material exchange between the embryo and maternal blood vessels.
* **Amnion** surrounds the embryo forming an amniotic cavity. Amniotic cavity contains the amniotic fluid, which suspends the foetus providing it with support. It also acts as a shock absorber hence protecting it against mechanical injury.
* **The chorionic villi, allantois and the endometrium form the placenta.**
* The embryo is attached to the placenta by a tube called the **umbilical cord**.
* When the placenta is fully formed, the embryo becomes the foetus at about three months of pregnancy.

**The Role of The Placenta**

* This is a temporary organ found only in placental mammals. It is the only organ in animals composed of cells derived from two different organisms; the foetus and the mother.
* It facilitates the transfer of nutrients and metabolic waste products between the mother and the foetus. It selectively allows some materials to pass through and not others.

Refer to the table below

* Drugs, alcohol and some chemicals from cigarette smoke pass through the placenta. Pregnant mothers should therefore not take alcohol or smoke excessively.
* There is no direct connection between the foetal blood system and that of the mother.
* If the two systems were directly connected, the delicate blood vessels of the foetus would burst due the higher pressure in the maternal circulatory system.
* Exchange of materials occurs across the sinus in the uterine wall and the capillary system of foetus across intercellular space by diffusion.

**Diagram**

**Study question 13**

* During pregnancy, placenta takes over the role of producing hormones oestrogen and progesterone.

***Major functions of oestrogen and progesterone during pregnancy***

|  |  |  |  |
| --- | --- | --- | --- |
| **Oestrogen** | | **Progesterone.** | |
| 1. Growth of mammary glands 2. Inhibits FSH release. 3. Inhibits prolactin release. 4. Prevent infection in uterus 5. Increase size of the uterine muscle cells. 6. Increase ATP and creatine phosphate formation. 7. Increases sensitivity of myometrium to oxytocin. | | 1. Growth of mammary glands. 2. Inhibits FSH release 3. Inhibits prolactin release. 4. Inhibits contraction of myometrium. | |
| **What is allowed to pass through the placenta** | | **What is not allowed to pass through the placenta** | |
| **From the mother to the foetus.**   1. Oxygen 2. Vitamins 3. Mineral salts 4. Hormones 5. Water 6. Antibodies and antigens. 7. Glucose, amino acids, fatty acids and glycerol.   **From the foetus to the mother**   1. Carbon (iv) oxide. 2. Nitrogenous wastes. | | 1. All blood cells. 2. Plasma proteins. 3. Most bacteria. | |

**Gestation Period**

* This is the period between conception and birth. This varies in different animals.
* E.g. mice 22 days
* Rabbits, 30 days
* Man, 9 months
* Elephants, 18 month
* When the human embryo is **two weeks** old, allantois, chorion and amnion have already formed. Embryo then differentiates into tissues and organs.
* By the end of the **third month**, the heart and blood vessels are fully developed. Spinal cord and the head region, which includes the eyes and the nose, are also well developed. Limbs show early signs of development.
* By the end of **6 months** the alveoli and nose are well developed. Foetal movement can as well be felt.
* By the end of the **nine months**, the foetus head is directly above the cervix.
* By now all the organs and systems are fully developed.
* If birth occurs before completion of 6 months, this is called **miscarriage** and the baby cannot survive.
* If the foetal development is interfered with either physically or chemically such that the foetus is released, this is called **abortion.**
* If birth occurs after 7 months but before term, this is called **premature birth**. Such babies are raised in incubators and they do survive.
* Pregnant mothers must have a balanced diet. Calcium, proteins, phosphates and iron should be abundant in her diet.
* Calcium and phosphorous are needed for bone formation while iron is for haemoglobin formation.
* Pregnant mother should visit antenatal clinic.

**Birth/Parturition**

* Maternal posterior pituitary gland releases hormone oxytocin. Progesterone level goes down. Oxytocin stimulates contraction of the myometrium.
* Oxytocin is released in waves during labour. This provides the force required to expel the foetus from the uterus.
* The cervix dilates, the amnion and chorion rupture releasing the amniotic fluid.
* The uterus starts contacting from the top downwards pushing the foetus downwards head first through the widened cervix and the birth canal.
* After birth, the umbilical cord is ligatured/cut to separate the baby from the placenta. Placenta is expelled later after birth.
* Then newborn baby takes in the first breath, lungs expand and become functional. The respiratory role of the placenta is taken over by the lungs.

**Diagrams**

**Caesarean delivery**

* This is the surgical incision of the abdominal and uterine walls for delivery to be achieved. This is done where there are complications ns such that the foetus cannot pass through the birth canal.

**Parental care**

* The newborn baby is given food and protection. Placental mammals feed their young ones on milk. Milk is produced by the mammary glands under the influence of lactogenic hormones e.g. prolactin.
* Mother’s milk is the best as it contains all the nutrients needed for the growth and development of the body.
* For the first 3 days, colostrum is produced which contain antibodies, which provide natural defence to the foetus against diseases.
* Milk is deficient of iron. The baby relies on iron stored in its liver during gestation.
* Milk let down is an example of a reflex action.
* The prevailing environment as shown below influences it either positively or negatively.

**Milk production in various environments**

|  |  |
| --- | --- |
| ***Positive Environment*** | ***Negative Environment*** |
| * Sucking at the breast, smell of the baby or crying of the baby trigger milk let down. * Hypothalamus relays impulses to pituitary gland which releases hormone oxytocin * Oxytocin reaches the breasts and causes alveoli to contract forcing milk into the ducts. * Ducts conduct milk into the reservoirs behind the areola * Baby sucks the milk from this reservoir. | * Milk let down may be inhibited or blocked if the breastfeeding mother experiences embarrassment, fatigue or anxiety. |

**Assignment**

**Child labour**

**Role of Hormones in Human Reproduction**

**Secondary sexual characteristics**

These are physiological, structural and mental changes associated with masculinity and femininity. They are controlled by oestrogen in females and androgens in males. They occur at puberty.

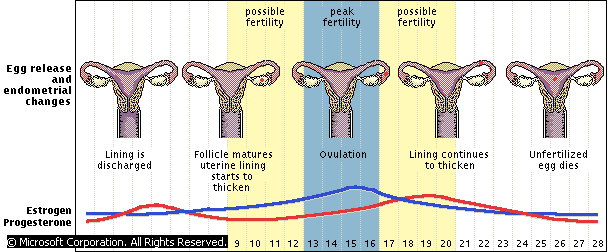
**Secondary sexual characteristics in males**

* Hypothalamus stimulates pituitary gland to release gonadotrophic hormones i.e. FSH and LH.
* FSH stimulates sperm synthesis.
* LH is also known as Interstitial Cell Stimulating Hormone (ICSH) and it stimulates interstitial cells to release Androgens mostly Testosterone. It stimulates the onset of secondary sexual characteristics mostly at the age of 14. These include;

1. Deepening of voice
2. Growth of hair in pubic parts and armpit region
3. Appearance of beards
4. Body becomes masculine
5. Testes enlarge and begin to produce sperms

**Secondary sexual characteristics in females**

* In females they start at early age 10-12 years. They include,
  1. Development of mammary glands
  2. Growth of hair in pubic parts and armpit region
  3. Enlargement of the pelvic girdle and widening of the hips
  4. Body becomes feminine.
  5. Ovaries mature and start releasing eggs under the influence of FSH and LH hence ovulation and menses.
* Unlike in males, the production of gonadotrophic hormones is not continuous. It is produced periodically in cycles.

**Menstrual Cycle**

**Menstruation**

* An average menstrual cycle begins with three to five days of menstruation, the shedding of the uterine lining, during which hormone levels are low.
* At the end of menstruation, pituitary gland secrets FSH which has two functions. It stimulates new Graafian follicles to develop in the ovary and stimulates the ovary to secrete the hormone oestrogen.
* Oestrogen brings about repair and healing of the endometrium, which is destroyed during menstruation.
* Oestrogen accumulates to levels, which stimulate the release of LH. LH stimulates the maturity of Graafian follicle. The mature Graafian follicle releases the ovum into the fallopian tube. This is called Ovulation and occurs on the 14th day.
* The empty Graafian follicle forms the corpus luteum, an endocrine body that secretes progesterone.
* LH stimulates corpus luteum to secrete hormone progesterone. This hormone stimulates thickening and increased blood supply to the endometrium preparing the endometrium for implantation.
* If fertilization takes place, the level of progesterone increases and thus inhibits FSH from stimulating the maturation of another Graafian follicle.
* If fertilization does not take place, the corpus luteum dies and progesterone hormone levels fall.
* Without hormonal support, the uterine lining disintegrates and discharges, beginning a new menstrual period and cycle.
* This cycle lasts for 28 days in human beings.

**Assignment**

**Sanitary Health**

* **Menopause**
* **STI**

**Advantages of Asexual reproduction**

1. Good qualities from the parents are retained since there is no variation.
2. There is faster maturation.
3. Its independent of processes such as pollination, fertilisation and fruit and seed dispersal
4. New offspring’s are able to obtain nourishment from their parents and are therefore able to survive under unsuitable conditions.
5. There is no wastage of a large number of offspring’s**.**

## Disadvantages

1. Reduction in strength and vigour in offsprings.
2. Undesired qualities are easily inherited.
3. Due to faster maturation there are chances of overcrowding and competition.
4. Offsprings may not withstand changing environmental conditions due to lack of variation.

**Advantages of sexual reproduction**

1. There is hybrid vigour due to mixing of genetic material.
2. There is high adaptability
3. Variation form basis for evolutionary changes.

**Disadvantages**

1. May produce individuals with undesirable qualities.
2. Method is dependent of union of gametes and therefore may not take place if the two organisms are isolated

**Revision Questions**