

Classification II

Classification is the placing of living organisms in a series of specialised group based on their similarities and difference that indicate a common biological relationship.

The study of grouping of organisms according to their relationship is called **Taxonomy**.

Major taxonomic units

- *Kingdom*
- *Phylum/Division*
- *Class*
- *Order*
- *Family*
- *Genus*
- *Species*

Species- is a group of organisms that can freely interbreed to give rise to a fertile offspring.

-Within a species we can also find various breeds (in animals) or varieties (in plants)

Binomial Nomenclature

-Is the scientific rule of double naming system where an organism is given two names ie genus name and specific name.

-It was pioneered by Carolus Linnaeus – a Swedish scientist.

Principles that guide binomial nomenclature.

1. Generic name is written first followed by specific name.
2. The first letter in the generic name must be a capital letter and the rest small letters. The specific name is written in small letters.
3. The two names are underlined when typed or handwritten but italicised when printed.
4. Scientists to give latinised name to newly discovered species.

The five kingdom of classification:

-Monera

- Protocista

-Fungi

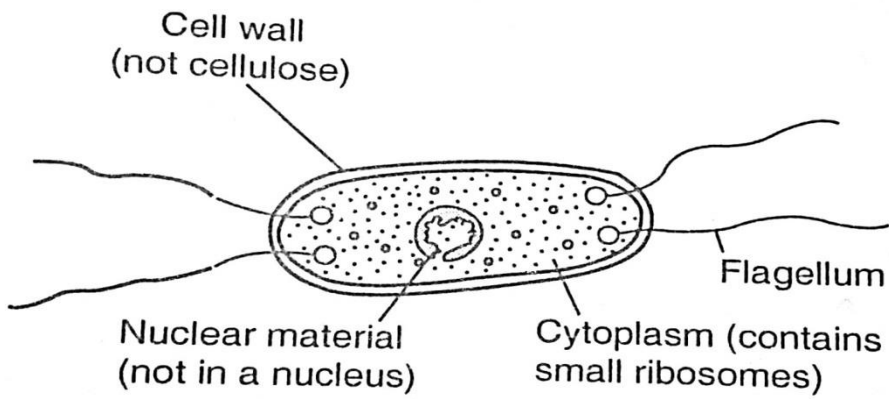
-Plantae

-Animalia

1.Kingdom: Monera

Comprises the **bacteria**.

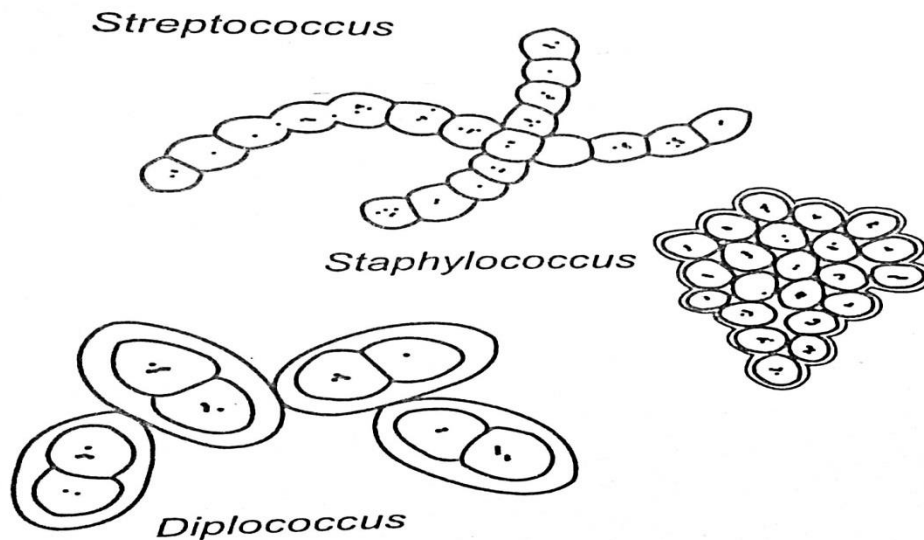
Below is a diagram of a generalised bacterium



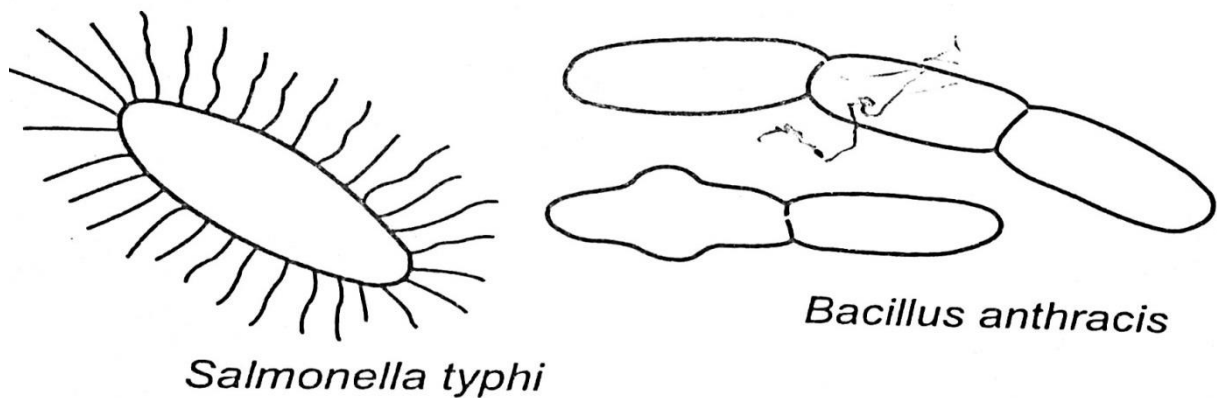
Bacteria are of three major categories:

i. Cocci – Sphere shaped bacteria

eg Staphylococcus, Diplococcus and Streptococcus



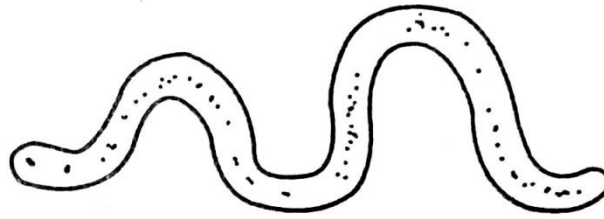
ii. Bacilli-Rod-shaped bacteria eg *Salmonella typhi* and *Bacillus anthracis*



iii. Spirilla-Spiral-shaped bacteria eg *Vibrio cholerae* and *Treponema*



Vibrio cholerae



Treponema

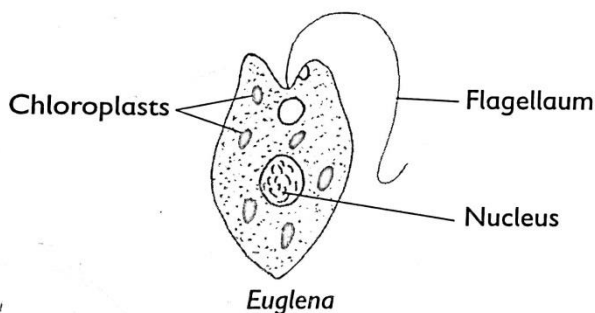
General characteristics.

- a. They are unicellular and microscopic organisms.
- b. The nuclear material is not enclosed within a nuclear membrane hence they are said to be **prokaryotic**.
- c. They have cell wall but not made up of cellulose.
- d. They have few organelles which are not membrane bound. Mitochondria are absent.
- e. Most of them are heterotrophic, feeding saprophytically or parasitically, some are autotrophic.
- f. Reproduction is mostly asexual through binary fission.
- g. Most of them are anaerobic but some respire aerobically.
- h. Most of them move by use of flagella.

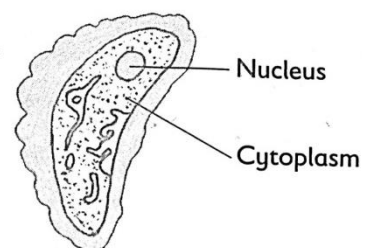
2. Kingdom: Protoctista

Examples of this kingdom include

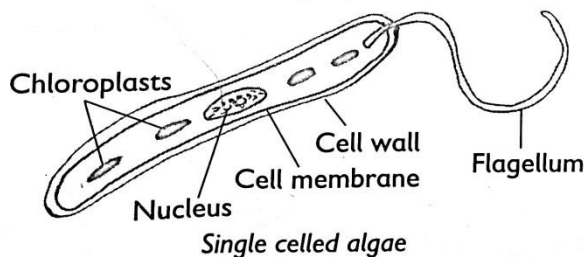
- amoeba
- paramecium
- plasmodium
- trypanosome
- chlamydomonas
- euglena
- spirogyra.
- volvox



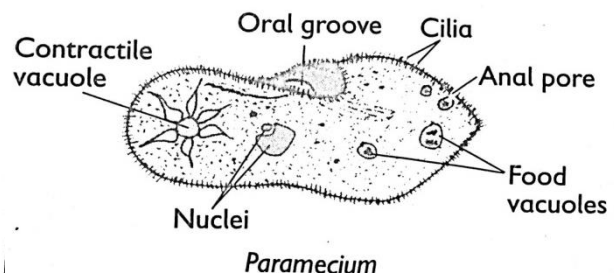
Euglena



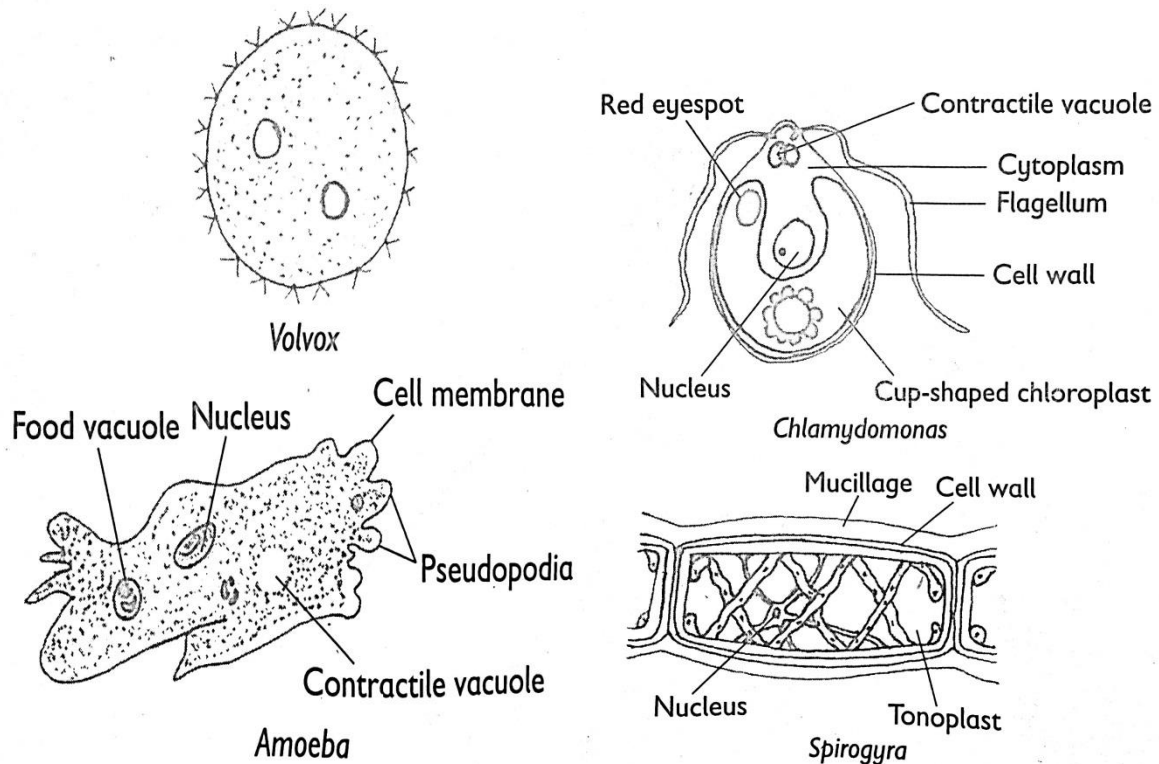
Plasmodium



Single celled algae



Paramecium

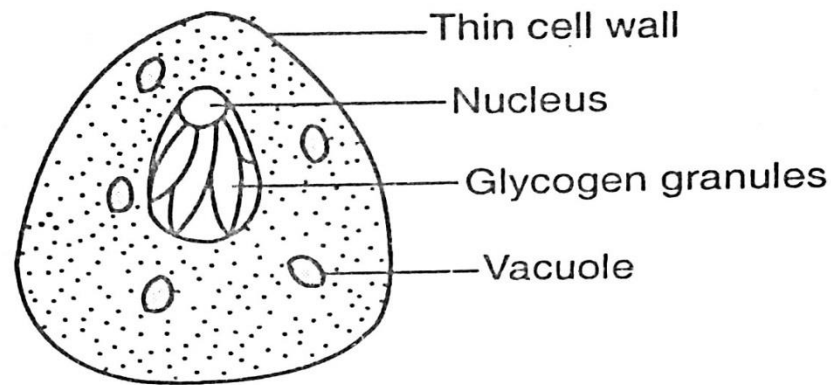


General characteristics.

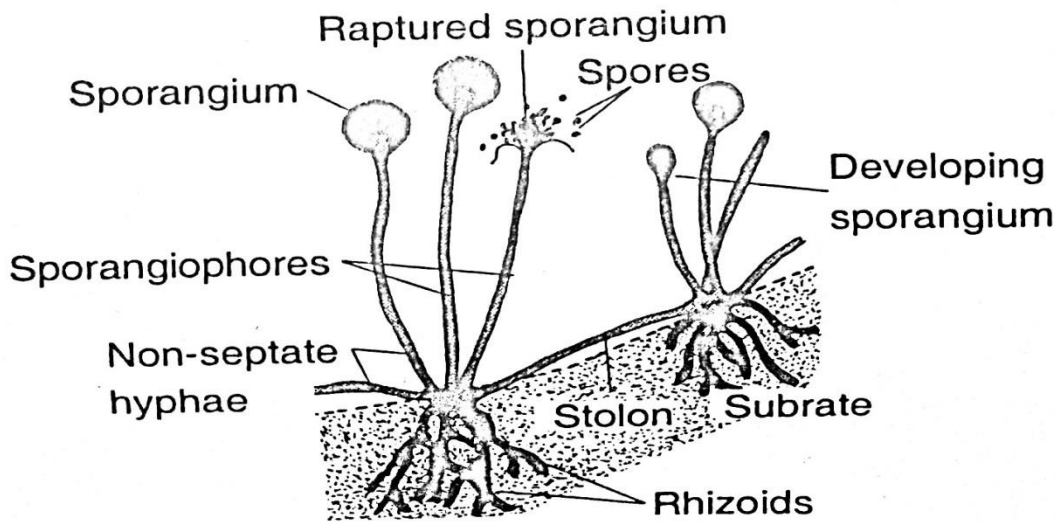
- These are organisms with varied body forms. Some are microscopic unicellular or colonial, while others are multicellular thaloid.
- Their nuclei are membrane bound, hence they are said to be eukaryotic.
- They have many organelles including mitochondria which are membrane bound.
- Some are heterotrophic while others are autotrophic.
- Reproduction is mainly asexual by fission, fragmentation or sporulation, under special conditions, some reproduce sexually by conjugation.
- Most protocista are mobile, moving by means of pseudopodia, ailia or flagella. Some are sessile.
- Some may have specialised structures that perform specific functions. For example contractile vacuoles for osmoregulation.

3.Kingdom Fungi

- Fungi includes well-known **saprophytes** like;
 - Yeasts
 - penicillia,
 - bread moulds,
 - toadstools
 - mushroom.
- The **parasitic** ones cause animals and plant diseases such as
 - ringworm,
 - athlete's foot,
 - wheat rust,
 - potato and tomato blight.



(a) Yeast



(b) *Rhizopus*

General characteristics.

- The fungi are **eukaryotic** organisms, the simplest are unicellular **yeast** while others are multicellular organisms like the **moulds, mushrooms and toadstools**.
- The basic unit is the **hypha** which consists of a cell wall enclosing cytoplasm containing numerous nuclei.
The hypha appear as filaments collectively the hypha make up a structure called **mycelium**.
- Most fungi have cell walls containing chitin while a few have their walls made of cellulose.
- Fungi lack chlorophyll. They are **heterotrophic**. They send hyphal threads into the food materials (called rhizoids in saprophytic types and haustoria in parasitic type.)
- The food particles stored in the cytoplasm may be glycogen or oil droplets but not starch.
- Fungi reproduce both asexually and sexually. Asexual reproduction is by spores or budding as in yeast whereas sexual reproduction involves fusion of nuclei in hyphal branches.

ECONOMIC IMPORTANCE OF FUNGI

- (i) Some are a source of antibiotics eg Penicillium
- (ii) Some are used in baking and fermentation process eg Yeast
- (iii) Some are a source of food eg Mushrooms
- (iv) some cause food poisoning eg Aspergillus which releases aflatoxins.
- (v) Some cause plant diseases as blight and animal diseases as ringworms and thrush.
- (vi) Saprophytic fungi are decomposers hence are involved in the recycling of nutrients.

4. Kingdom Plantae

General Characteristics

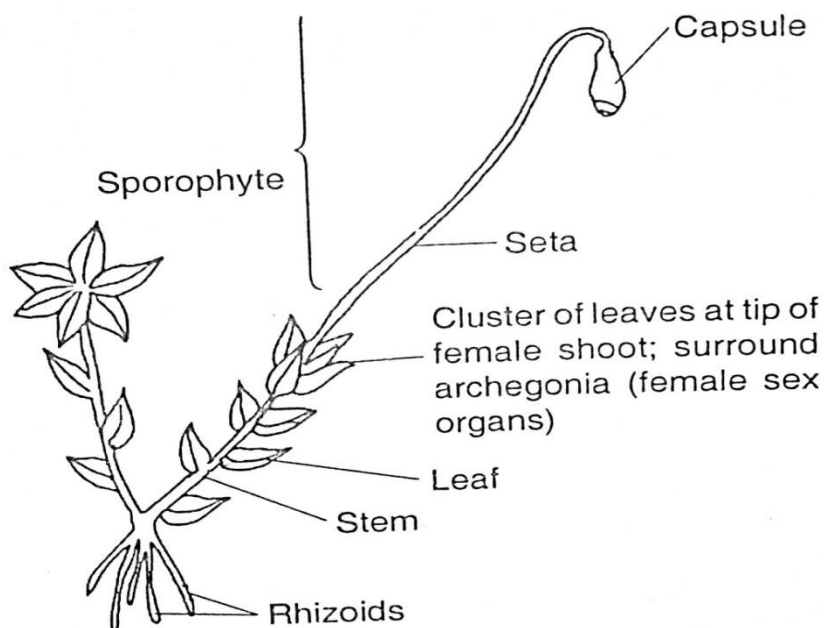
- I. They are eukaryotic and multicellular.
- II. In most of the body is differentiated into leaves, stem and roots.
- III. Their cells have cellulose cell walls.
- IV. Majority have a transport system.
- V. They have photosynthetic pigment hence are autotrophic.
- VI. Reproduction is both asexual and sexual.
- V. They show alternation of generations.

The kingdom plantae is divided into three main divisions namely:

- *Bryophyta*
- *Pteridophyta*
- *Spermatophyta*

1.DIVISION:- BRYOPHYTA

These include **mosses and liverworts**.



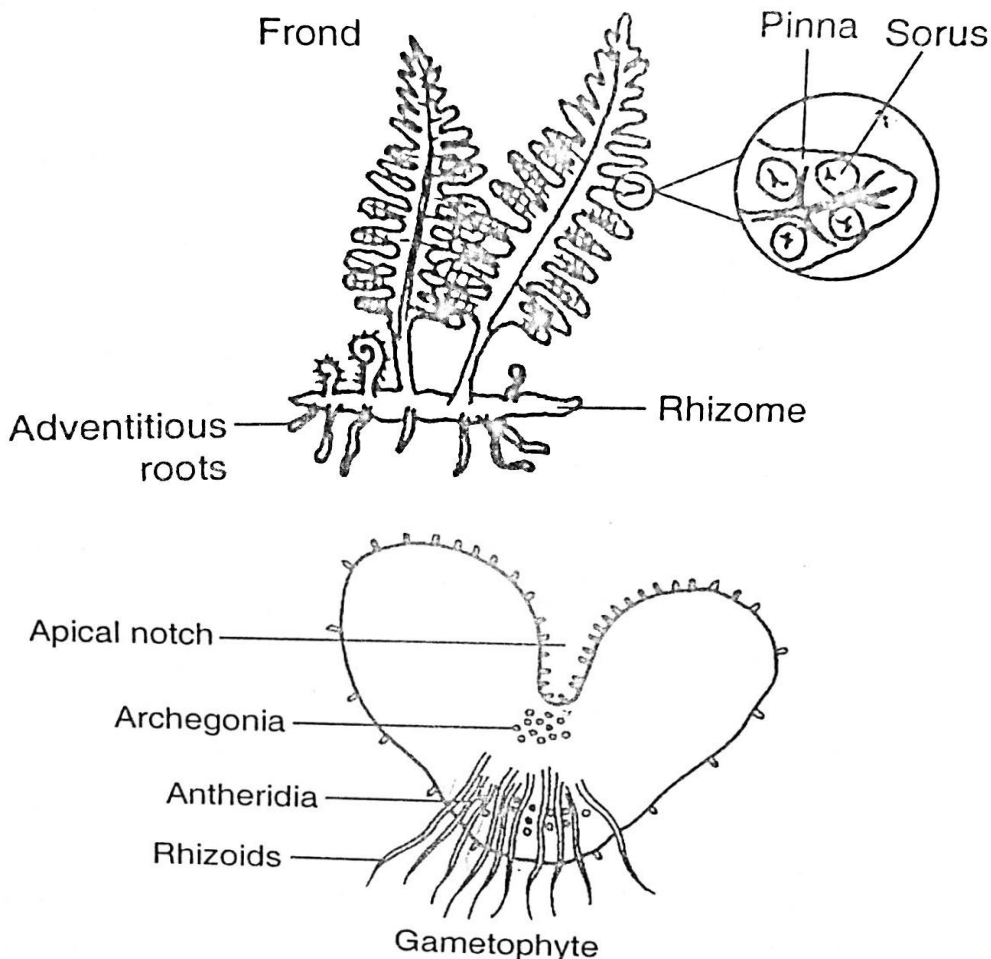
Moss (*Funaria*)

General Characteristics

- They are thalloid as in liverworts or differentiated into simple leaf like and stem like structures as in mosses.
- They lack a vascular transport system.
- They contain chlorophyll hence are photosynthetic.
- They have developed rhizoids for anchoring and absorbing water together with dissolved mineral salts.
- Show alternation of generations- the gametophyte is the persistent plant. The spore producing sporophyte is born on the gametophyte on which it depends on.
- Male gametes are produced by antheridia and female gametes by archegonia. Fertilization depends on availability of water.
- They are terrestrial growing on damp substratum e.g rocks, walls and marshes.

2.DIVISION:- PTERIDOPHYTA

- These include the **ferns and the horsetails**.



- The pteridophyta shows a wide variety from small types of giant tree ferns of more than ten meters tall.
- They show a greater ability to inhabit land than bryophyta.

General Characteristics

- a) They have roots, stem and leaves but no flowers.
- b) Leaves are compound with leaflets known as **pinna**.
- c) They possess clearly defined vascular system (having xylem and phloem).
- d) They possess chlorophyll and are photosynthetic.
- e) They show alternation of generations where the sporophyte normally referred to as the fern plant, is the dominant one while the gametophyte is a small heart shaped structure called **prothallus**.
- f) On the lower side of mature leaves are borne spore bearing structures (sporangia) which exist in groups known as **sori** (singular sorus)
- g) They show clearly defined sexual reproduction. Fertilization is independent of water.

3.DIVISION:- SPERMATOPHYTA.

- It comprises all the seed bearing plants. They are the familiar green plants when produce seeds through the flowers or cones.
- The following are the general characteristics seeds bearing plants.

General characteristic

- a) The plant body is differentiated into roots, stems, leaves and seed bearing structure.
 - b) The vascular tissue is highly developed with xylem tissue consisting of both vessels and tracheids.
 - c) Sexual reproduction is well defined, fertilization is preceded by growth of pollen tube and does not depend on water like in another groups.
 - d) Seeds are produced after fertilization.
 - e) They have alternation of generation whereby sporophyte is the dominant generation.
 - f) They contain chlorophyll hence are photosynthetic.
- *The division spermatophyta consist of two main sub-divisions*
 - - (i) *Gymnospermaphyta*
 - (ii) *Anglospermaphyta*

(A)Sub- division-Gymnospermaphyta

General characteristics

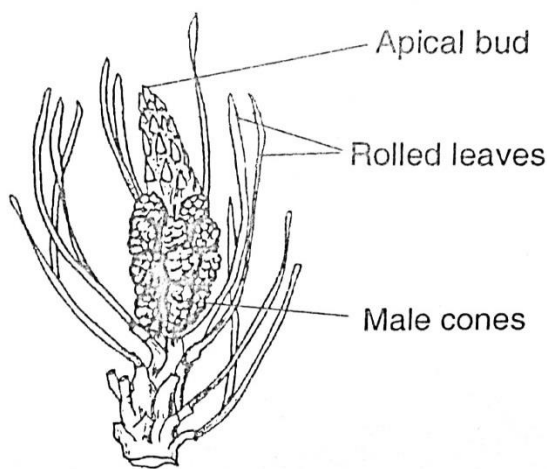
1. They bear cones of two types; male cones and female cones.
2. After fertilization, seeds are borne on the female cones and the seeds are not enclosed in a fruit wall (naked seeds).
3. They show some xerophytic characteristics such as rolled leaves, needle shaped leaves, sunken stomata and thick waxy cuticles.
4. Xylem consist of mainly tracheids while the phloem does not have companions cells.

- These sub- divisions has three main classes namely:
 - Coniferales
 - Cycadales
 - Ginkgoales

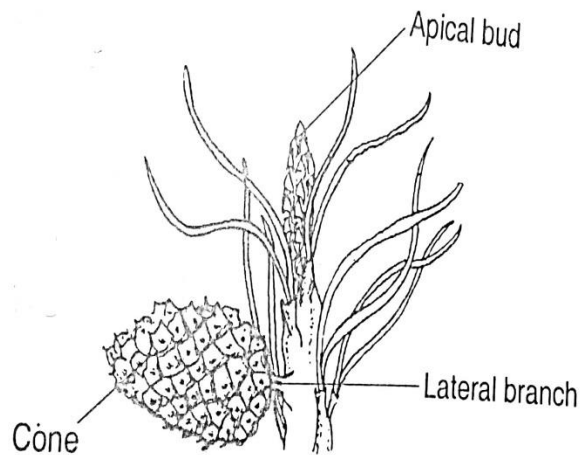
Class: Coniferales.

- This includes all the common gymnosperm coniferous trees naturally found in areas of little water. eg Pine and Casuarina.
- They have small needle-shaped leaves with a thick waxy cuticle.
- Conifers can be recognized by presence of cones and most of them are evergreen.

Male cone



female cone



(ii) Class Cycadales

- Example cycad
- Resemble palms superficially.
- Have long compound leaves with unbranched stems.

(iii) Class Ginkgoales

- Example *Ginkgo biloba*.
- Are rare- *Ginkgo* is the only surviving species.
- Native of China.
- Are deciduous.

(B)Sub- division Angiospermaphyta

Includes:

- Grasses
- Shrub
- Herb
- Trees

General characteristics

1. They are flower bearing and are usually bisexual.
2. Seeds are enclosed in an ovary which develops into a fruit.
3. Xylem has tracheids and vessels while phloem has companion cells.
4. They exhibit double fertilization.
5. **(a)Class: Monocotyledonae**

- The seeds of these plants have an embryo with one cotyledon.
- They have relatively narrow long leaves with parallel veins.
- The cross- section of the stem reveals scattered vascular bundles.
- Vascular cambium is usually absent hence no secondary growth.
- They bear floral plants in three or multiple of three.
- The root system is fibrous system.
- In the roots, the vascular bundle are arranged in a ring with phloem and xylem alternating.

Examples are:

<i>Grass</i>	<i>Coconuts</i>	<i>Wheat</i>
<i>Bananas</i>	<i>Wheat</i>	<i>Maize</i>
<i>Sorghum</i>	<i>Sugarcane</i>	<i>Palms</i>






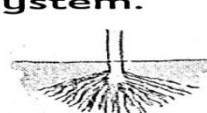
(b)Class: Dicotyledonae

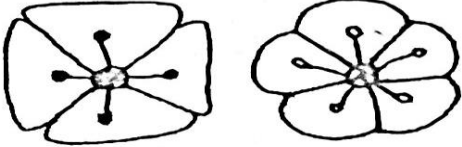
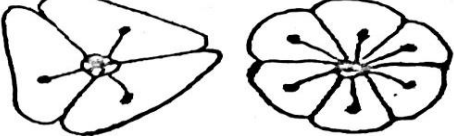
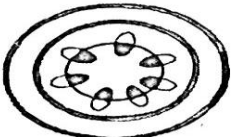
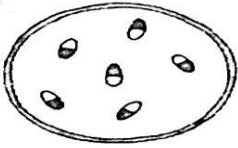
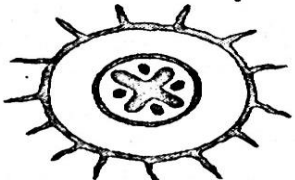
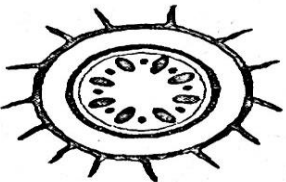
- These are plants whose embryo of the seeds has two cotyledons.
- The leaves of the plants are broad and have network veins.
- Vascular bundles arranged in a ring or rings with a pith and a narrow cortex.
- Vascular cambium is usually present in stems and roots resulting in secondary growth.
- They have a tap root system.
- The cross- section of the root reveals a centrally placed star- shaped xylem with phloem alternating with the arm of xylem.
- Their flowers have floral parts in fours/fives or their multiples.

Examples are:

- *Herbs* -*Shrubs* -*Trees*

Differences between monocotyledonous and dicotyledonous plants

Dicotyledons	Monocotyledons
<p>(i) Leaves are net veined.</p> 	<p>(i) Leaves are parallel veined.</p> 
<p>(ii) Seed embryo has two cotyledons (seed leaves).</p> 	<p>(ii) Seed embryo has one cotyledon (seed leaf).</p> 
<p>(iii) They have a tap root system.</p> 	<p>(iii) They have a fibrous root system.</p> 

<p>(iv) Floral parts arranged in fours, fives or their multiples.</p> 	<p>(iv) Floral parts arranged in threes or multiples of three.</p> 
<p>(v) In their stems, vascular bundles are arranged in a ring surrounding the pith with cambium ring in between.</p> 	<p>(v) Vascular bundles are scattered in the stem with no cambium ring.</p> 
<p>(vi) In their roots, the xylem vessels form a star at the middle with the phloem vessels in between the rays of the star. There is no pith.</p> 	<p>(vi) In their roots, the xylem and phloem alternate in a ring leaving the pith at the centre.</p> 

5.Kingdom:-Animalia

Include phylum - *Arthropoda*
- *Chordata*

General characteristics of kingdom animalia

- i. Eukaryotic and multicellular.
- ii. Their cells have no cell walls
- iii. All are heterotrophic.

- iv. Most reproduce sexually while a few asexually.
- v. Most show locomotion but a few are sessile.

C. Phylum-Arthropoda

Main Characteristics

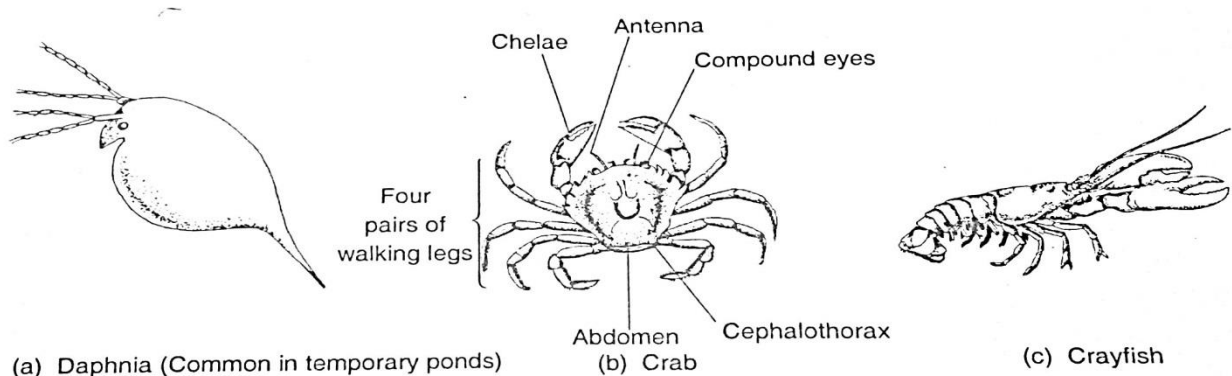
1. Members of phylum Arthropoda have jointed appendages hence the name Arthropoda.
2. The body is covered with a hardened exoskeleton made of chitin.
 - The exoskeleton provides surface area for muscles attachment. It is shed at interval to allow for increase in sizes.
3. The body of most of them is divided into head, thorax and abdomen.
4. Members of the phylum Arthropoda are bilaterally symmetrical.
5. They have an open circulatory system where blood flows in open cavities.
6. The head is well developed having eyes sensory structure and a fairly well developed brain.
7. Gaseous exchange is through the tracheal system which opens through spiracles to the outside. Some aquatic forms use gills for gaseous exchange.
8. Reproduction is mainly sexual with internal fertilization, the sexes are separate.

Classes of Phylum Arthropoda.

- (i) *Diplopoda*
- (ii) *Chilopoda*
- (iii) *Arachnida*
- (iv) *Crustacea*
- (v) *Insecta*

(i) Class Crustacea

Examples: crab, lobster, daphnia, crayfish and prawn

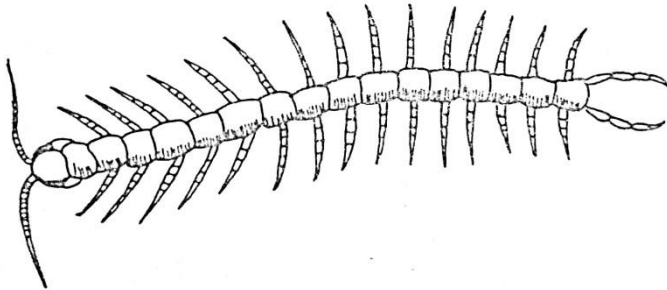


General characteristics.

1. The head and thorax are fused to form cephalothorax which is often protected by a carapace.
2. They have two pairs of antennae.

3. They have between five and twenty pairs of limbs which are modified for different function e.g. locomotion, feeding and defense.
4. Have a pair of compound eyes.
5. Three pair of mouth part consisting of one pair of mandibles and two pairs of maxillae.
6. Gaseous exchange is through gills.

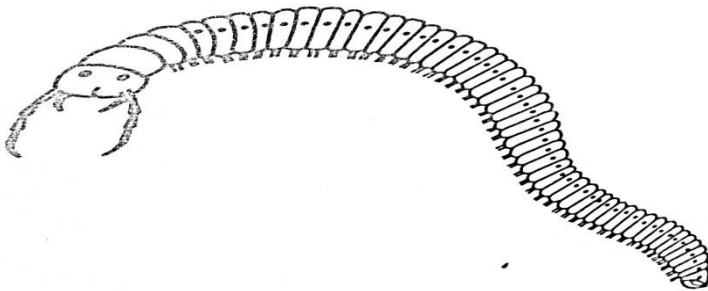
(II) Class Class Chilopoda- comprise the Centipede.



General characteristics

1. The body is dorsa- ventrally flattened.
2. The body is divided into two parts. The head and the trunk.
3. The body consists of up to 15 or more segments.
4. Each segment has a pair of walking legs.
5. The head has a pair of simple eyes.
6. The head has a pair of antennae.
7. They have poison claws on the head which secrete, a poisonous substances.
8. Gaseous exchange occurs through tracheal system.
9. The sexes are separate.

(III) Class -Diplopoda : compises the Millipede

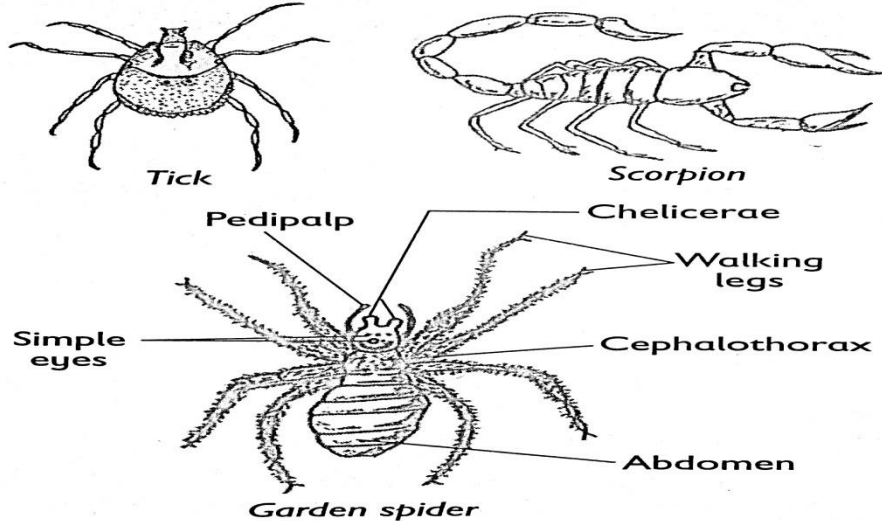


General characteristics.

1. Members of class diplopoda have a cylindrical body.
2. Diplopods have three body parts, the head, shirt thorax consisting of four segments and a body trunk.
3. The body has between 9- 100 segments.
4. Each segment has two pairs of walking legs except for the thoraic segments.

5. The head has a pair of short antennae and mandibles.
6. They have two clumps of many simple eyes.
7. Each body segment has a pair of spiracles for breathing.
8. Millipedes have no poison claws.

(IV) Class- Arachnida :Comprises *Ticks ,mites ,spiders and scorpions*



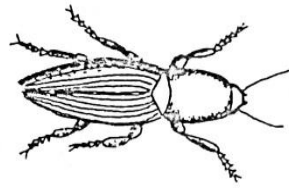
General characteristics.

1. The body has two parts, the cephalothorax and abdomen. The cephalothorax consists of fused head and thorax.
2. The ventral side of cephalothorax has two chelicerae each having seven joints.
3. The cephalothorax has four pairs of walking legs each having joints.
4. Arachnids have no antenna.
5. The cephalothorax commonly has eight simple eyes.
6. Most arachnids have lungs books for gaseous exchange. In some, gill books or tracheal system are used.
7. Each leg ends in two toothed claws.

(V) Class- Insecta

Examples:

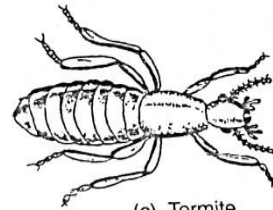
- *Tsetsefly* -*Beetle* -*Flea* -*Locust*
- *Butterfly* -*Housefly* -*Termite*
-



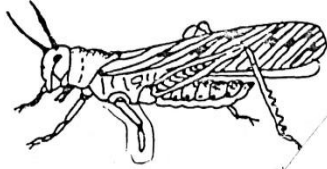
(a) Ground beetle



(b) Honey bee



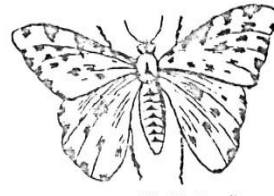
(c) Termite



(d) Shorthorned grasshopper



(e) House fly



(f) Butterfly

General characteristics.

1. The body is divided into 3 parts; head, thorax and abdomen.
2. The thorax is made up of 3 segments with 3 pairs of legs. Some insects have one or two pairs of wings on the thorax.
3. The head has one pair of antennae.
4. The head has a pair of compound eyes and several simple eyes.
5. The mouth part consists of mandibles, maxillae and labium.
6. The abdomen is made up of eleven or fewer segments with terminal part modified for reproduction.
7. They breathe through spiracles, gaseous exchange is through tracheal system.
8. The insects undergo complete or incomplete metamorphosis.
9. Excretion is through malpighian tubules in which removes uric acid.

NB: The science of dealing with the study of insects is called Entomology.

(2) Phylum Chordata

- These includes *fishes, amphibians, reptiles, birds and mammals.*
- The term chordata was derived from the term notochord.

General characteristics.

1. Members of phylum chordata have a notochord at least at some stages of their development.
2. They are bilaterally symmetrical.
3. Have single dorsal tubular nerve cord.
4. Have visceral clefts lie slits perforating the body walls of the pharynx.
5. The heart is ventrally located.
6. They have a closed circulatory system.
7. They have segment muscle blocks known as myotomes on either side of the body.

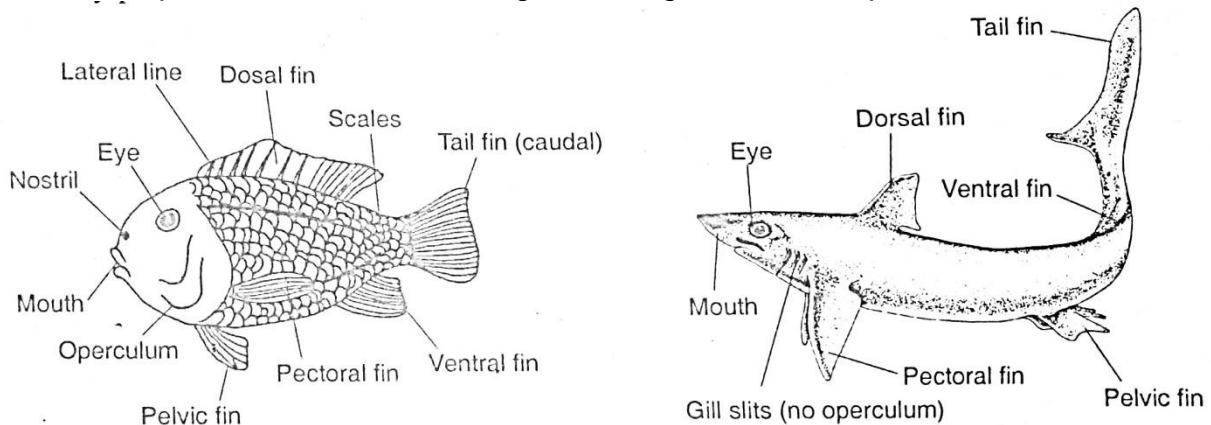
8. They possess an internal skeleton.

- **The main classes of phylum chordata are:**

- (a) *Pisces*
- (b) *Amphibia*
- (c) *Reptilia*
- (d) *Aves*
- (e) *Mammalia*

(a) **Class- Pisces.**

- These are the **fishes**.
- A number of fishes have skeleton made of cartilage eg shark.
- A number of fishes have skeleton made up of bones eg tilapia.
- Others examples include: Cat fish, Dog fish, Lung fish and Nile perch.

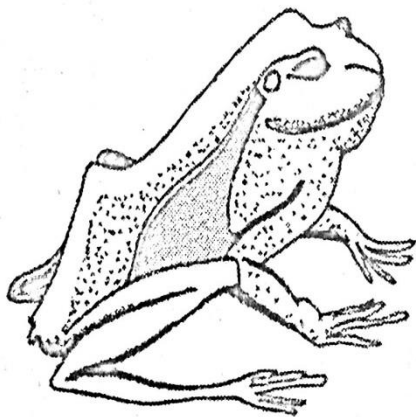


General characteristics.

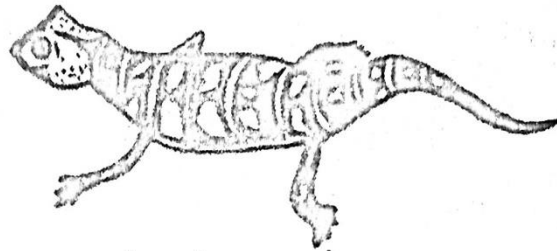
1. Have gills for gaseous exchange in water.
2. Movement is by means of fins.
3. Their body is covered with scales.
4. Have a streamlined body.
5. They possess a lateral line system for sensitivity.
6. They do not possess middle or external ear.
7. Their heart consists of two main chambers, the auricle and ventricle with single circulatory system.
8. Body temperature changes according to the temperature of the environment that is why they are ectothermic (poikilothermic).
9. Eyes covered by a nictating membrane.

(b) **Class-Amphibia**

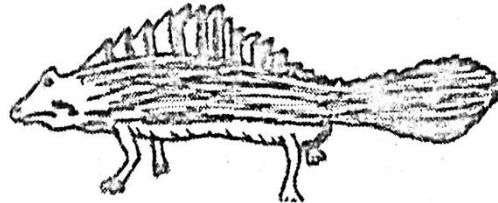
- This includes the ***newts, salamander, frogs and toads.***



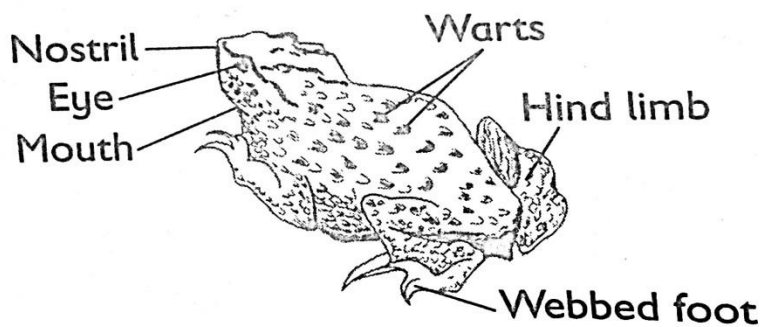
A tree frog



A salamander



A newt



A toad

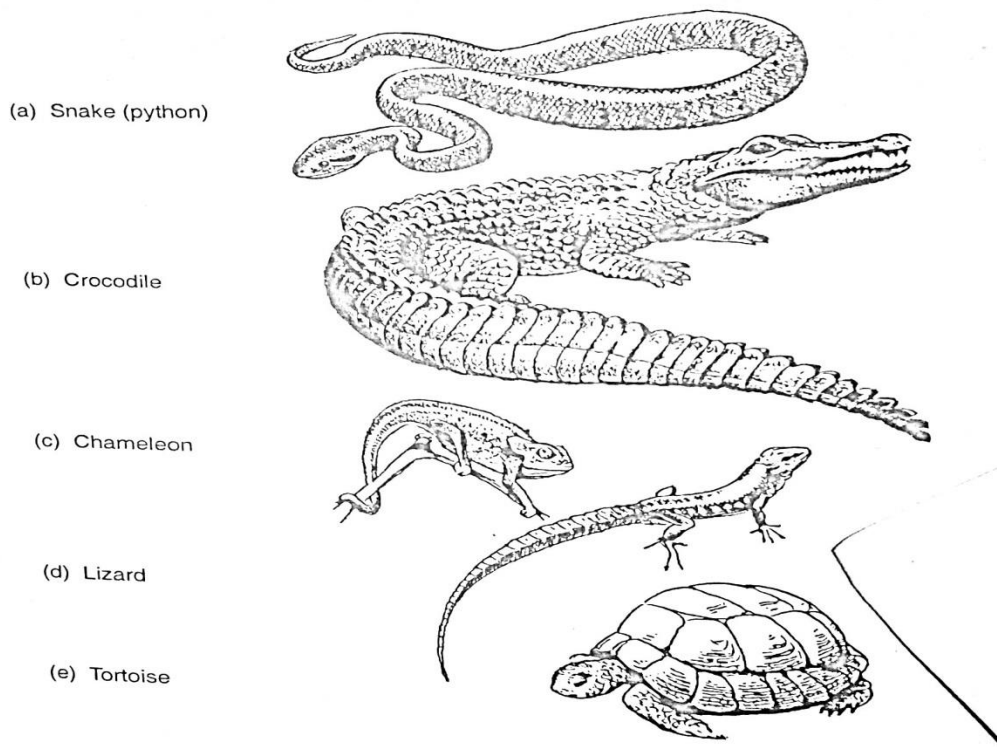
-They have partly aquatic and partly terrestrial.

General characteristics.

1. They have four well developed limbs.
2. They have double circulatory system.
3. They have three chambered heart with two atria and one ventricle.
4. They breed in water and fertilization is external.
5. Gaseous exchange is through the skin, gills and lungs.
6. They have two eyes and an eardrum behind the eyes.
7. They are ectotherms.

c) Class-Reptilia

-They include the **turtles, tortoise, snakes, crocodile, lizards and chameleons.**

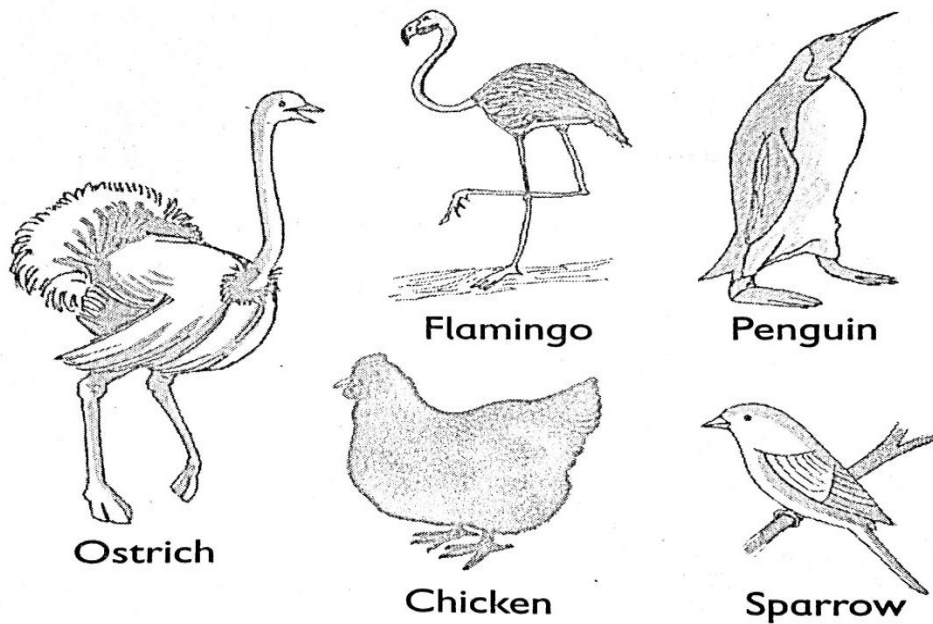


General characteristics.

1. Their bodies are covered with a dry skin which reduces desiccation.
2. Some have no limbs, like the snakes while others have four limbs e.g crocodile
3. Fertilization in reptiles is internal and they lay eggs which are covered with a leathery shell which reduces desiccation.
4. They have a double circulatory system. The heart has three chambers with two atria and a partially divided ventricle. However the crocodile has a four chambered heart.
5. They have well- developed lungs of gaseous exchange eliminating the needs to use the skin or the mouth for gaseous exchange.
6. They are ectothermic.

(d) Class Aves

- They comprise **the birds**.
- Common birds include: **Chicken, Dove, Weaver bird, hawk, Eagles and Turkeys.**



General characteristics.

1. Their bodies are covered with feathers for insulation and flight.
2. They have beaks.
3. They have hollow bones.
4. The sternum is enlarged to form a keel for attachment of flight muscles.
5. The hind limbs are for walking or swimming.
6. The hind limbs have scaly skin.
7. They have a double circulatory system with a four-chambered heart, which has two atria and two ventricles.
8. They have lungs for gaseous exchange.
9. They are endothermic.
10. Fertilization is internal.
11. They have an internal auditory meatus.

(e) Class Mammalia

- These are animals inhabiting various habitats.
- Some are arboreal (tree dwellers) e.g. monkeys while others are terrestrial.
- Some terrestrial ones live on the surface of land and others live in tunnels.
- There are also some mammals which are aquatic such as dolphin and whale.

General characteristics.

1. Have mammary glands hence the name mammalia.
2. Their body is covered with fur or hair.
3. Their teeth have been differentiated into four types in relation to feeding habits (heterodont dentition).
4. They have two pinnae (external ear).

5. They usually have sweat glands.
6. They have lungs for gaseous exchange.
7. They have double circulatory system with a four chambered heart.
8. They have four limbs. Have a diaphragm that separates the body cavity into thoracic and abdominal cavity.
9. Their brain is highly developed.
10. Have seven cervical bones at their neck.
11. They are endothermic.

IDENTIFICATION OF ORGANISMS

- **Identification**- is the recognition of characteristics of organisms and the application of a name to an organism with those particular characteristics.
- The most common identification key is the dichotomous key.

Construction of Dichotomous key

- **A dichotomous key** is a biological tool for identifying unknown organisms into some taxonomic level.
- The word dichotomous means separating or branching into two.
- The key is constructed as a series of couplets each consisting of two contrasting statements describing characteristics of a particular organism or group of organisms.
- A choice between two statements is made that best fits the organism in question.
- By reading the two statements of each couplet or pair, you progress through the key from typical broad characteristics to narrower and more specific characteristics until only a single choice remains.
- This last single choice gives the identity of the unknown organism.

Rules used in constructing a Dichotomous Key

1. Use morphological characteristics as far as possible e.g types of leaf, (simple or compound), type of venation.
2. Start with the major characteristics that will place the organisms into two large groups. Then proceed to lesser variations that would separate the organisms further into smaller groups e.g in leaves, start with type of leaf.
3. Select a single characteristic at a time and identify it by a number
eg- (i) Type of leaf
(ii) Type of venation
4. Use identical forms of words for the two constructing statements
eg (i). a) leaf simple
b) leaf compound

- (ii). a) leaf net veined
- b) leaf parallel veined

5. The statement should always be written in the positive form; However wherever a negative statement cannot be avoided, the first statement must be in a positive form

- a) animals with wing
- b) Animals without wings

6. Avoid generalisation or overlapping variations such as;

- a) short plant
- b) Tall plant

Some common features used for identification in animals,

- i) *Locomotory structure (legs, wings, and fins)*
- i) *Antennae presence and number*
- ii) *Presence and type of eyes*
- iii) *Number of body parts*
- iv) *Body pigmentation*
- v) *Structures on body surface such as fur hair, feathers or scales.*
- vi) *Feeding structures.*
- vii) *Types of skeleton presented.*

- In plants the features are listed below

Plant part	Some characteristics
leaf	<ul style="list-style-type: none"> - phylotaxy - Leaf type - Margin - Lamina - Colour
flower	<ul style="list-style-type: none"> - Inflorescence type - Number of floral part - Flower part
stem	<ul style="list-style-type: none"> - Type of stem (woody herbaceous or fleshy) - Shape(rectangular or cylindrical) -Texture of stem (smooth or thorny)
roots	<ul style="list-style-type: none"> - Root system (tap and fibrous) - Storage roots

The end