

o **CLASSIFICATION**

- ✓ It's the process of placing and arranging organisms into groups according to their similarities and differences.
- ✓ General principles of classification
- ✓ Organisms are placed in seven major taxonomic units (taxa) i.e.
- ✓ Kingdom
- ✓ Phylum or Division
- ✓ Class
- ✓ Order
- ✓ Family
- ✓ Genus
- ✓ Species
- ✓ Kingdom is the 1st and the largest rank and species is the last and smallest.
- ✓ A species is a group of organisms that can freely and naturally interbreed to give rise to a fertile (viable) offspring,

- ✓ All human beings belong to the same species and interbreed to give rise to a fertile offspring.
- ✓ The difference in skin colour or facial structures places human beings in different races. In animals (except human beings the term breed is used while in plants the term variety is used.

o **Binomial nomenclature**

- ✓ Binomial comes from the word binomen which means two names while nomenclature means system of naming
- ✓ In this system individual species bear both generic (genus) and specific (species) names.

Procedures followed in

Binomial nomenclature

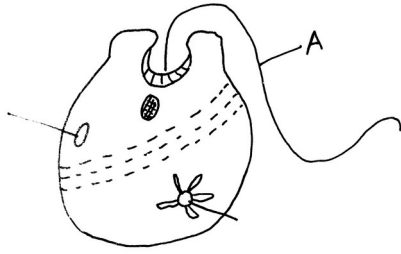
- ✓ Examples of scientific names
- ✓ The 5 kingdoms of classification
- ✓ These are
- ✓ **Kingdom; Monera**
- ✓ Comprises of bacteriaeg
Salmonella typhi,
Vibrio cholera,
Azotobacter
 - o **General characteristics**
- ✓ They are prokaryotic(nucleus is not enclosed in a nuclear membrane)
- ✓ They have a cell wall but not made of cellulose
- ✓ Have few organelles
- ✓ They are not membrane bound
- ✓ Mitochondria absent
- ✓ Most of them are heterotrophic, saprophytic or

parasitic. A few are autotrophic

- ✓ Reproduction is mostly asexual through binary fission and occasionally by conjugation.
- ✓ Most of them are anaerobes but some respire aerobically
- ✓ Most of them move by use of flagella
- ✓ They are unicellular and microscopic

Economic importance of bacteria

- ✓ **Kingdom; Protocista**
- ✓ They include;
amoeba,
paramecium,
euglena,
Plasmodium,
spirogyra,
Chlamydomonas,
Volvox,
Trypanosoma.



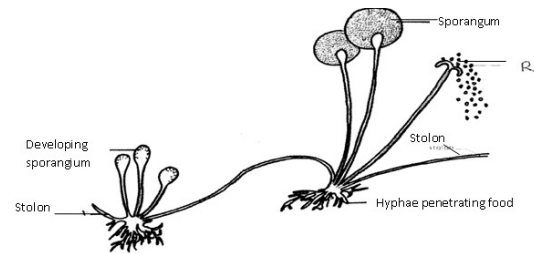
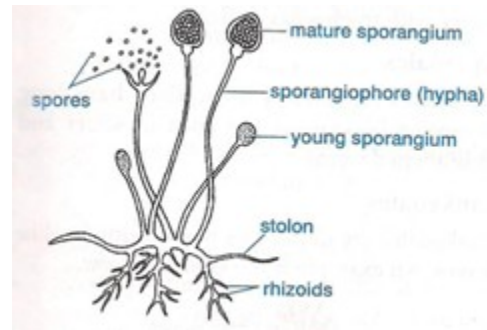
✓ **General characteristics**

- ✓ They are eukaryotic(nucleus is membrane - bound)
- ✓ They are mostly unicellular but a few are multicellular
- ✓ Some are microscopic(amoeba, paramecium) but some can be seen without use of microscope(spirogyra)
- ✓ Some exist as single cells(amoeba, Trypanosoma) others exist in groups called colonies(volvox)
- ✓ Some are composed of many cells arranged in the form of a filament(spirogyra)
- in others the many cells are arranged in a flat sheet-like structure(fucus)
- ✓ Some are autotrophic (spirogyra, euglena, Chlamydomonas and volvox.
- ✓ Some are heterotrophic and some like paramecium take in food substances through their gullets, others like amoeba engulf tiny food particles into their cytoplasm forming food vacuoles. This process is known as phagocytosis.
- ✓ They are mostly mobile, moving by cilia(paramecium), flagella(Trypanosoma) and pseudopodia(amoeba)
- ✓ Some have contractile vacuoles for

osmoregulation e.g.
amoeba.

o Economic importance of Protoctista

- ✓ Some cause animal diseases eg Trypanosoma cause nagana in cattle and sleeping sickness in man.
- ✓ Plasmodium causes malaria
- ✓ Spirogyra is food for the fish.
- ✓ **Kingdom; Fungi**
- ✓ Consists of ; toadstools, mushrooms, moulds, yeast, rust, smut and penicillium.
- ✓ **General characteristics**
- ✓ They are eukaryotic
- ✓ Some are unicellular(yeast) and aCandida albicans and others are multicellular(mould , toadstools and mushrooms)



- ✓ They are multicellular consisting of filamentous structures called hyphae. The whole structure is called mycelium.
- ✓ The hyphae is lined by a cell wall enclosing the cytoplasm.
- ✓ In most cases the cell wall is made of chitin and in a few cases its made of fungal cellulose
- ✓ Hyphae that lie on the surface are called stolons.
- ✓ Hyphae that anchor the mycelium to

- the substrate are called rhizoids. Their tips produce enzymes which digest organic materials in the substrate into soluble substances that are absorbed.
- ✓ Parasitic fungi have hyphae called haustoria which penetrate host cells to absorb nutrients.
 - ✓ Some hyphae called sporangiophores grow vertically and form reproductive structures called sporangia in which the spores are formed.
 - ✓ They store carbohydrates in the form of glycogen and lipid in the form of oil droplets.
 - ✓ They reproduce asexually by spores or budding and sexually by conjugation.
- ✓ **Economic importance of Fungi**
 - ✓ Saprophytic fungi help in decomposition of dead plants and animals.
 - ✓ Cause plant diseases e.g. phytophthora causes blight in potatoes and tomatoes.
 - ✓ Cause animal diseases e.g. ringworms, thrush, athletes' foot.
 - ✓ Some like aspergillus cause food spoilage and produce aflatoxins which cause cancer or death.
 - ✓ Yeast is used in brewing and bread baking industries.
 - ✓ Some like mushrooms are used as food.
 - ✓ Some like penicillium are used to make antibiotics.

- ✓ Dry rot fungi destroy timber.
- ✓ Fungi can be used by the military to prepare biological warfare.
- ✓ Some fungi form symbiotic relationships with the roots of certain forest trees. The complex so formed is called mycorrhiza. The fungus absorbs mineral salts some of which are absorbed by the tree. the fungus in turn get organic materials from the plant

✓ **Kingdom; Plantae**
 o **General characteristics**

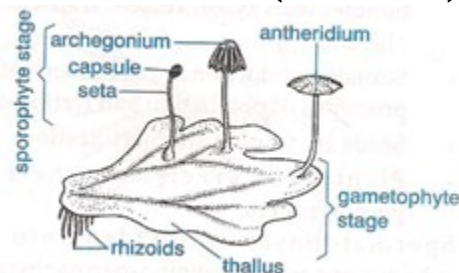
- ✓ Multicellular and eukaryotic.
- ✓ Most of them are differentiated into stems, leaves and roots.
- ✓ Have cellulose cell walls.

- ✓ They have chlorophyll hence carry out photosynthesis.
- ✓ They reproduce asexually and sexually
- ✓ Its grouped into 3 main divisions i.e.

 o **Division; Bryophyta**

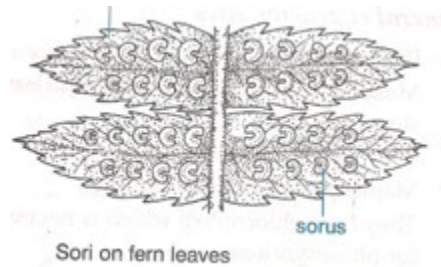
✓ **General characteristics**

- ✓ They are thalloid(liverworts) or differentiated into leaf-like or stem-like structures(Mosses)



- ✓ They have chlorophyll hence carry out photosynthesis.
- ✓ They have rhizoids for anchorage and feeding.
- ✓ They show alternation of generation where

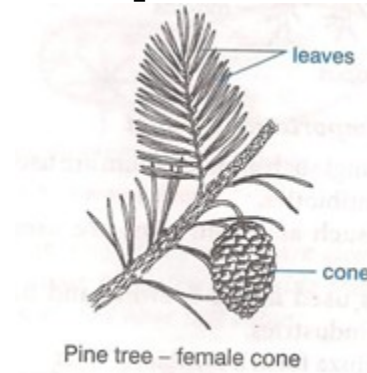
- the gametophyte (gamete production phase) is dominant over sporophyte (spore production phase)
- ✓ Male gametes are produced by antheridia and female gametes by archegonia.
 - ✓ They are terrestrial growing on damp substratum e.g. rocks, walls
 - ✓ No vascular transport system hence rely on diffusion for transport
 - ✓ Lack supportive tissues. This together with absence of vascular tissues means they cannot grow large
 - ✓ **Division; Pteridophyta**
 - ✓ They include ferns and horse tails.
 - ✓ **General characteristics**
 - ✓ Have large compound leaves (fronds), a leaf stalk called rachis with leaflets called pinna.
 - ✓ They show alternation of generation where the sporophyte is dominant while gametophyte is short-lived.
 - ✓ Well developed vascular bundles
 - ✓ They have chlorophyll hence carry out photosynthesis.
 - ✓ They have roots stems, and leaves but no flowers.
 - ✓ Mature leaves (fronds) bear sporangia (spore bearing structures) which exist in groups known as sori on the lower side.



- ✓ When the spores land on moist soil they germinate to form prothallus.
- ✓ Some ferns grow on trees as epiphytes i.e. a plant that grows upon another but is not a parasite on the host plant.
- o **Division; Spermatophyta**
- ✓ Comes from the word spermae which means seed hence are seed producing plants.
- ✓ **General characteristics**
- ✓ They are seed producing plants
- ✓ Well developed vascular bundles with xylem vessels, tracheids and phloem.
- ✓ They have roots, stems and leaves
- ✓ They reproduce asexually and sexually
- ✓ Its divided into two main sub-divisions i.e.
- ✓ **Sub-Division; Gymnospermaphyta/Gymnospermae**
- ✓ Gymno means 'naked' hence they are the plants that produce exposed seeds in structures called cones.
- ✓ **General characteristics**
- ✓ They do not flower.
- ✓ Found in high altitude areas thus show xerophytic characteristics e.g. needle-like leaves, thick waxy cuticle and sunken stomata to reduce rate of transpiration.eg pine, cedar, cypress, podo, junipers
- ✓ They bear naked seeds on male(small) and female (large)cones

- ✓ Xylem consists of tracheids and the phloem has no companion cells.
- ✓ Its divided into 3 main classes i.e.
- ✓ **Class; Coniferales**
- ✓ Coniferous trees are naturally found in areas of little water.
- ✓ They have small needle-like leaves with a thick waxy cuticle
- ✓ They have cones and most of them are evergreen.
- ✓ The top is conical for ice to slide off.
- ✓ In the pinus, the male cones are usually small and form clusters around the base of the terminal buds while the female cones appear on lateral buds on young shoots.
- ✓ Mature naked seeds occur at bases of the female

cones some months after pollination.



✓

o (ii) Class; **Cycadales**

- ✓ Have long compound leaves at the apex of short and unbranched stems
- ✓ They have cones which are borne at the apex of the trunk among the leaves. They resemble palm
- ✓ **(iii) Class; Ginkgoales**
- ✓ They are rare
- ✓ They are deciduous with fan-like leaves e.g. Ginkgo biloba whose native land is china
- ✓ **Economic importance**

- ✓ Major source of soft wood timber used in construction of houses, making chipboard and making paper
- ✓ Source of turpentine for making paint thinner and removing paint from surfaces.

(ii) Sub-Division; Angiosperme/Angiospermaphyta

- ✓ Angio means enclosed

General characteristics

- ✓ Seeds are enclosed in an ovary which develops into a fruit
- ✓ Exhibit double fertilization
- ✓ They are flower bearing and usually bisexual

Dicotyledonae	Monocotyledonae
Have 2 cotyledons	Have one cotyledon

- ✓ Its divided into two main classes i.e.

✓ **Class; Monocotyledonae**

- ✓ They are mainly from the grass family e.g. wheat, maize, rice

✓ **(i) Class; Dicotyledonae**

- ✓ They include;
- ✓ Herbs - non-woody plants with small stems e.g. beans, tomatoes, cabbages
- ✓ Shrubs- have fairly thick stems e.g. coffee, tea, cocoa.
- ✓ Trees - have large stems e.g. mangoes, lemons, jacaranda

o Differences between Monocotyledonae **and** Dicotyledonae

in the seed	in the seed
Floral parts are in four's or in five's or in their multiples	Floral parts are in three's or in multiples of three
Have tap root system	Have fibrous root system
Have network of veins in the leaves/reticulate venation	Have parallel veins in the leaves
Vascular bundles in the stem are arranged in a ring	Vascular bundles in the stem are scattered
Have vascular cambium which bring about secondary growth	Have no vascular cambium hence no secondary growth
Leaves have a petiole	Leaves form a sheath around

	the stem
Leaves are generally broad	Leaves are generally narrow

✓

✓ **Kingdom;
Animalia**

✓ **General
characteristics**

- ✓ They are multicellular
- ✓ They are eukaryotic
- ✓ Their cells have no cell walls hence have irregular shapes.
- ✓ All animals are heterotrophic.
- ✓ Most of them show locomotion but a few are sessile
- ✓ They reproduce sexually although a few reproduce asexually
- ✓ This kingdom has nine phyla i.e.
- ✓ Phylum; Porifera e.g. sponges

(ii) Phylum;
Coelenterata e.g. Sea anemone, jelly fish

(ii) Phylum;
Platyhelminthes e.g. Tapeworms

(iv) Phylum;
Nematoda e.g. Roundworms

(v) Phylum;
Annelida e.g. Earthworm

(vi) Phylum;
Mollusca e.g. Octopus, snail

(vii) Phylum;
Echinodermata e.g. Star fish

(viii) Phylum;
Arthropoda e.g. Insects

(ix) Phylum;
Chordata e.g. man

**Phylum;
Arthropoda**

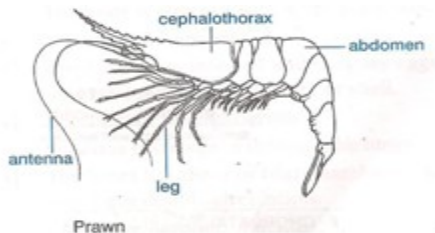
- ✓ It's the largest phylum in the animal kingdom.
- ✓ The animals in this group inhabit land, water and soil
- ✓ Some are ectoparasites living on other animals
- ✓ Some are useful e.g.
- ✓ Butterflies and bees act as pollinators of flowering plants
- ✓ Bees make honey
- ✓ Lobsters are used as food
- ✓ Some arthropods are harmful to other living organisms e.g.
- ✓ Ticks transmit diseases in animals
- ✓ Mosquitoes transmit malaria
- ✓ Tsetse flies transmit trypanosomiasis
- ✓ Aphids destroy crops
- ✓ **General characteristics**

- ✓ Arthros means jointed while poda means leg or foot hence they have jointed legs
- ✓ They have a tough coat made of chitin known as exoskeleton

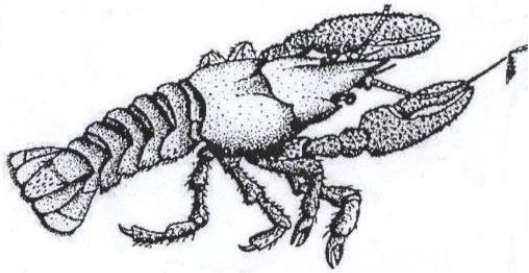
o **Functions of exoskeleton**

- ✓ Its waterproof hence prevents an animal from losing too much water.
- ✓ Protects internal organs against damage
- ✓ Internal muscles are attached to the exoskeleton
- ✓ Exoskeleton does not grow but its shed in a process called moulting/ecdysis to allow for growth
- ✓ They have bilateral symmetry i.e. they can be cut into two similar halves in only one way. Each half is a mirror image of the other

- ✓ Have an open circulatory system
- ✓ Gaseous exchange is through the tracheal system
- ✓ Reproduction is mainly sexual with internal fertilisation
- ✓ Its divided into 5 classes i.e.
- ✓ **Class; Crustacea**
- ✓ Crustacean is derived from "crusta" which means shiny coat
- ✓ They include; lobsters, crayfish, shrimps, crabs, water fleas
- ✓ **General characteristics**
- ✓ Body is divided into 2 parts i.e. cephalothorax(form ed by fusion of head and thorax) and abdomen
- ✓ Cephalothorax is covered by a shiny coat known as carapace
- ✓ Have appendages modified to form legs for walking, pincers for feeding and protection and for swimming.
- ✓ Have two pairs of antennae
- ✓ Have a pair of compound eyes at the end of stalks
- ✓ Have ten or more legs. Walking legs are usually located on the cephalothorax while swimming legs are located in the abdomen
- ✓ Gaseous exchange is through the gills
- ✓ Some are used as human food e.g. lobsters, crayfish, shrimps, crabs



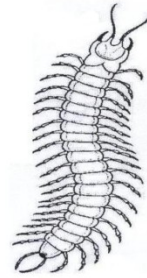
✓



✓ **(ii) Class;
Chilopoda**

- ✓ Its composed of centipedes
- ✓ **General characteristics**
 - ✓ Have flat bodies
 - ✓ Have a pair of legs in each segment
 - ✓ Body divided into a head and segmented trunk
 - ✓ Have up to 15 or more segments.
 - ✓ They are carnivorous and they use their poison claws to kill the prey
 - ✓ They may have compound eyes, simple eyes or no eyes
 - ✓ Gaseous exchange is through the tracheal system
 - ✓ Have a pair of antennae

- ✓ Centipedes are found under stones and logs where they feed on earthworms and insects

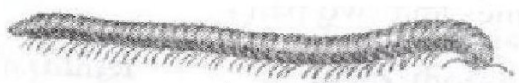


0

✓ **(iii) Class;
Diplopoda**

- ✓ Its composed of millipedes
- ✓ **General characteristics**
 - ✓ Have two pairs of legs in each segment except the first thoracic segments that have one pair of legs each
 - ✓ Have elongated, cylindrical bodies
 - ✓ Body divided into a head and segmented trunk
 - ✓ Have up to 25 -100 segments.
 - ✓ Have a pair of antennae

- ✓ They may have compound eyes, simple eyes or no eyes
- ✓ They breathe through spiracles
- ✓ Millipedes roll their bodies when disturbed. After coiling they produce a stinking substance from their stink glands. This is self-protective behavior against enemies and predators
- ✓ Millipedes are herbivorous as they feed on dead plant material
- ✓

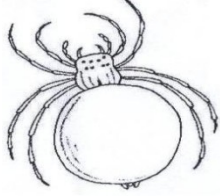


o (iv) Class; **Arachnida**

- ✓ Its composed of spiders, scorpions, ticks, mites
- ✓ **General characteristics**
- ✓ Body is divided into 2 parts i.e.

- cephalothorax and abdomen
- ✓ Have 4 pairs of jointed legs attached to the cephalothorax
- ✓ They may have 8 simple eyes on cephalothorax
- ✓ Have no antennae instead they have a pair of pedipalps which are short, jointed and look like legs
- ✓ In some arachnids pedipalps squeeze and chew food
- ✓ In mites tips of pedipalps become specialized container for the transfer of sperms
- ✓ The ventral side of cephalothorax has two chelicerae each having a claw-like structure which produces poison that paralyses the prey
- ✓ Gaseous exchange is through the lung books

- ✓ Members of arachnida are carnivorous



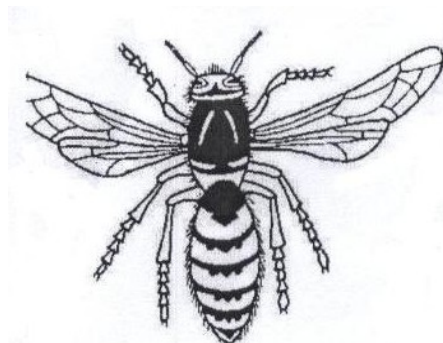
o

o (v) Class; **Insecta**

- ✓ Comes from the word incised which means 'cut'
- ✓ Insects form half the population of animals on earth .
- ✓ They occupy all habitats i.e. air, water and land in all the climatic regions of the earth
- ✓ **General characteristics**
- ✓ Body is divided into 3 parts i.e. Head, thorax and abdomen
- ✓ They may have a pair of large compound eyes and

several simple eyes

- ✓ Some have one or two pairs of wings attached to the thorax
- ✓ Gaseous exchange is through the tracheal system
- ✓ Mouth parts consist of mandibles, maxillae and labium
- ✓ Abdomen made up of 11 or fewer segments with the terminal parts modified for reproduction
- ✓ Excretion is through malpighian tubules which remove uric acid



Phylum; Chordata

- ✓ Chordate comes from the latin word "chorda" which means chord. Organisms in this phylum at one time in their life have a chord-like structure called notochord.

o Characteristics

- ✓ They have a vertebral column which forms part of the internal skeleton.
- ✓ Have a nervous system with a brain which is connected to a hollow nerve tube.
- ✓ They have a bilateral symmetry
- ✓ This phylum is divided into 5 classes i.e.
 - ✓ Pisces
 - ✓ Ampibia
 - ✓ Reptilia
 - ✓ Aves
 - ✓ Mammalia
- ✓ **Class; Pisces**
- ✓ Pisces is derived from the word Pisces which means fish.

- ✓ Some fishes have skeleton made up of cartilage (cartilaginous fish) e.g. sharks, rays, dogfish, skates
- ✓ Others have skeleton made up of bones (bony fish) e.g. tilapia.

o Characteristics

- ✓ Live in water habitats e.g. lakes, oceans, seas
- ✓ Skin covered with scales.
- ✓ Gaseous exchange is through the gills.
- ✓ Have fins for movement
- ✓ They are poikilothermic
- ✓ They exhibit internal fertilization where the eggs are laid by the females and the male sheds sperms over them.
- ✓ Have streamlined body.
- ✓ Heart consists of two main chambers i.e. auricle and ventricle
- ✓ X

**o (ii) Class;
Amphibia**

- ✓ Amphibia comes from the amphi which means dual or two hence they live on both land and in water e.g. newts, toads, frogs and salamanders.

o Characteristics

- ✓ Have 4 limbs where hind limbs are longer and more muscular than the forelimbs.
- ✓ They breed in water and fertilization is external.
- ✓ Have a 3- chambered heart with 2 atria and one ventricle.
- ✓ Gaseous exchange is through skin, gills and lungs.
- ✓ Have 2 eyes and an ear drum behind the eyes.
- ✓ They are poikilothermic

**o (iii) Class;
Reptilia**

- ✓ Reptilia comes from the latin word reptilis which means crawl,

hence organisms in this class move by creeping or crawling eg snakes, turtles, tortoises, crocodiles, lizards and chameleons.

o Characteristics

- ✓ They have a dry scaly skin. Some like tortoises have scales which have been hardened to form a shell.
- ✓ They are mostly terrestrial.
- ✓ Lay eggs covered with shells and have internal fertilisation
- ✓ **NB** Some snakes and chameleons give birth to live young ones.
- ✓ Most of them have two pairs of legs except snake.
- ✓ Use lungs for gaseous exchange.
- ✓ They are poikilothermic

o (iv) Class; Aves

- ✓ Aves comes from the latin word avis which means bird

o Characteristics

- ✓ Their bodies are covered with feathers for insulation.
- ✓ Their legs are covered with scales.
- ✓ Their front limbs are modified to form wings. The hind legs are used for walking, running, swimming etc.
- ✓ They have hollow bones that make them light for flight.
- ✓ They use beaks for feeding and have no teeth.
- ✓ They lay eggs with a hard shell made of calcium.
- ✓ They carry out internal fertilisation
- ✓ They are endothermic /homoeothermic and show parental care.

o (v) Class;

Mammalia

- ✓ Mammalia comes from the latin word mammalis which means mammal or mamma which means milk secreting organ of female animals.
- ✓ They occur various habitats e.g. some are arboreal e.g. tree squirrel and some monkeys, some are terrestrial where some live on the surface of the land and others live on tunnels, some are aquatic e.g. dolphins and whales.

o **Characteristics**

- ✓ All have mammary glands which produce milk hence care for their young ones.
- ✓ Their bodies are covered with fur, wool and hair.
- ✓ They give birth to young ones except the duck-billed platypus and spiny-eater which lays eggs.
- ✓ It's the only class of animals with external ear.
- ✓ They exhibit internal fertilisation and are endothermic /homoeothermic.

- ✓ The teeth have differentiated into 4 different types (heterodont)

- o **Dichotomous key**

- Dichotomous key**

- Dichotomous comes from the word dichotomy which means divided into 2 parts.
 - Dichotomous key is a biological tool for identifying unknown organisms up to some taxonomic level.

- Rules used in the construction of a dichotomous key**

- Use morphological characteristics as much as possible e.g. type of leaf (simple or compound)
 - Start with the major characteristics that divide the organisms into two large groups, and then proceed to lesser variations.
 - Select a **single characteristic** at a

time and identify it using a number

- Use similar forms of words for the two contrasting statements.
- The first statement should always be written in the positive form
- Avoid generalizations or overlapping variations, be specific e.g.
- Plant 1 metre and above
- Plant 15 cm to 60cm tall

- Some common features used for identification**

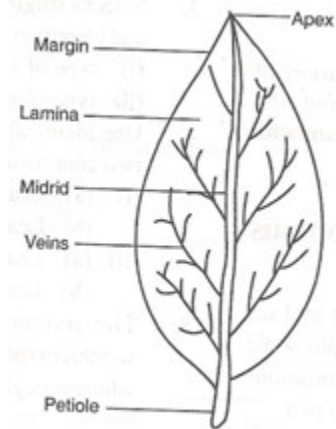
- Animals**

- Locomotory structures such as legs, wings and fins
 - Antennae (presence and number)
 - Presence of type of eyes
 - Number of body parts
 - Body segmentation
 - Body structures such as hair, fur or scales
 - Feeding structures

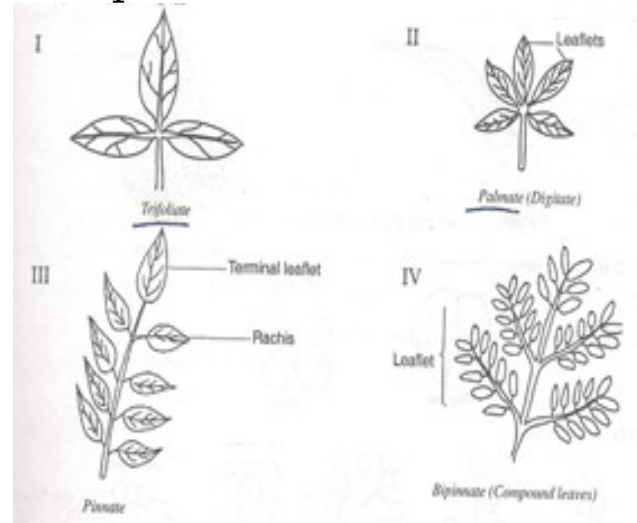
- Type of skeleton present
- Plants

Part of plant	Characteristics
Leaf	Phyllotaxy
	Leaf type
	Leaf venation
	Margin
	Lamina
	Colour
Flower	Inflorescence type
	Flower shape
	Number of floral types
Stem	Type of stem(woody, herbaceous or fleshy)
	Shape (Rectangular or cylindrical)
	Texture of stem(smooth or spiny/thorny)
Roots	Root system(tap root or fibrous)
	Storage roots

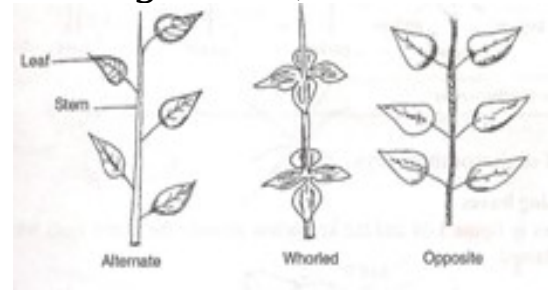
Simple leaf



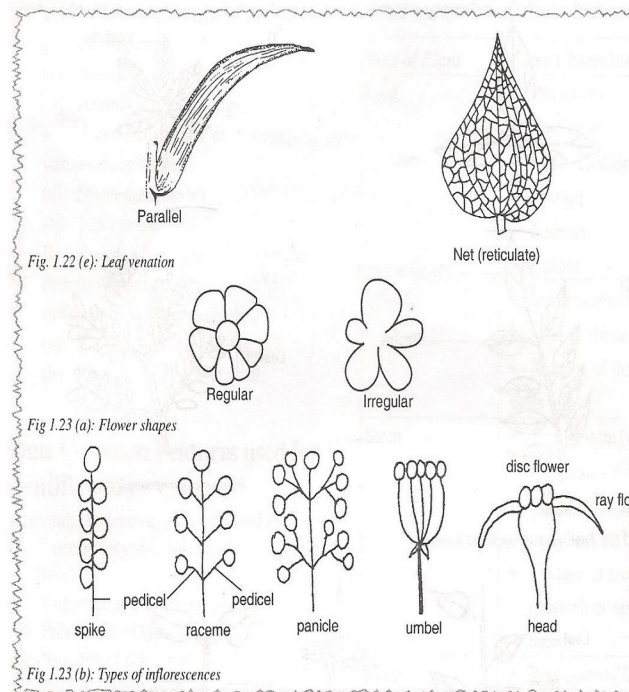
Compound leaves



Phyllotaxy (leaf arrangement)



Types of leaf margins



✓