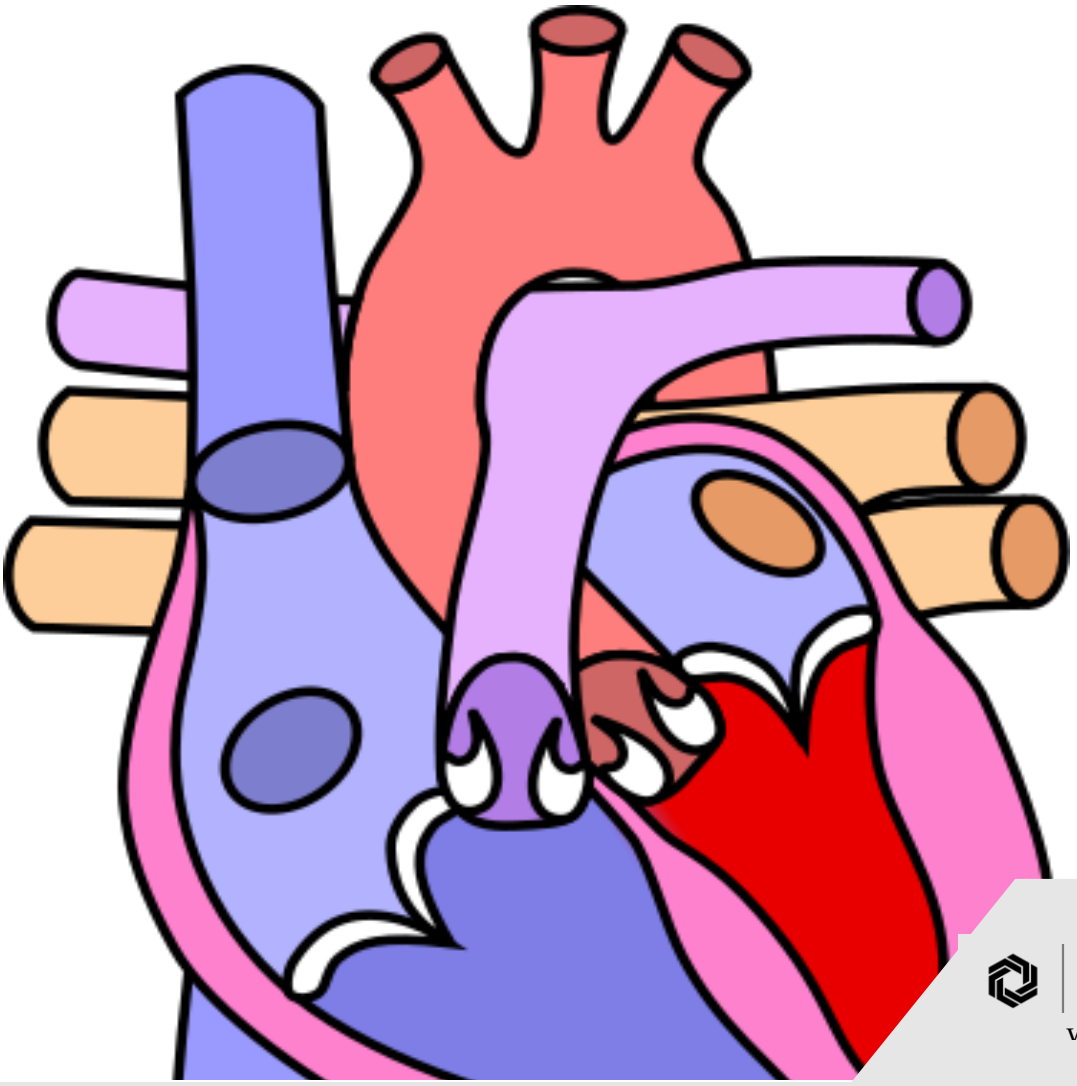
Based on the
National Curriculum

NEW
FOR 2024

Primary Six

Science



First Edition

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TEKART LEARNING

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Topic 1: classification of animals

Characteristics of living things

- **They feed**
  Nutrition is the taking in of food (materials) for energy, growth and development. Plants require sunlight, carbon dioxide and water. Animals need food and water.
- **They grow**
  Growth is a permanent increase in size and dry mass by an increase in cell number, cell size or both. Even bacteria and single-celled organisms show an increase in size. Multicellular organisms like humans increase the number of cells in their bodies, become more complicated and change their shape as well as increasing in size.
- **They reproduce**
  Reproduction is the process by which organisms produce young ones similar to themselves. Single-celled organisms and bacteria may simply keep dividing into two (Binary fission). Multicellular plants and animals may reproduce sexually or asexually.
- **They respond to stimuli**
  Sensitivity is the ability to detect or sense stimuli in the internal or external environment and to make appropriate responses.
- **They move**
  Movement is an action by an organism or part of an organism causing a change of position or place. Most single-celled creatures and animals move about as a whole. Fungi and plants may make movements with parts of their bodies.
- **They excrete**
  Excretion is the removal of waste products from organisms. Toxic materials and substances in excess have to be removed from the body. Excretion prevents damage of body organs due to accumulation of wastes.
- **They respire**
  Respiration describes the chemical reactions in cells that break down glucose and release energy for body processes. Most organisms need oxygen for this.

Living things are divided into five kingdoms namely;

- Animal Kingdom
- Plant Kingdom
- Prokaryote (Bacteria Kingdom)
- Protoctista (single celled organisms)
- Fungi Kingdom

Animal Kingdom

Animals are multicellular organisms whose cells have no cell walls or chloroplasts. Most animals ingest solid food and digest it internally.
Animals are classified into two groups

- Vertebrates
- Invertebrates

Vertebrates

Vertebrates are animals with a back bone /vertebral column (spine)

Groups of vertebrates

Vertebrates are classified into five classes;

- **M**ammals
- **B**irds
- **R**eptiles
- **F**ish
- **A**mphibians

For remembering (**A**ll **M**y **B**est **F**riends **R**epresent Vertebrates!).
Vertebrates are grouped into two major groups;

i. Warm blooded (homoeothermic)
ii. Cold blooded (poikilothermic)

Warm blooded

These are animals that can maintain a constant body temperature.

i) Mammals
ii) Birds

Cold blooded

These are animals that cannot maintain a constant body temperature.

i) Fish
ii) Reptiles
iii) Amphibians

Mammals

Mammals are vertebrates which have mammary glands. All female mammals have mammary glands, which secrete milk to nourish their young ones. Mammalian teeth are differentiated into incisors, canines, premolars, and molars and the middle ear contains three sound-conducting ear ossicles.

Characteristics of mammals

- Mammals are warm blooded.
- They have fur on their bodies.
- Most of them give birth to living young ones.
- They feed their young ones on breast milk.
- They breathe through the lungs.

- Their hearts are divided into four chambers. The four-chambered heart enables complete separation of oxygenated and deoxygenated blood.

Groups of mammals

- Primates (most advanced /fingered mammals)
- Ungulates (hoofed mammals)
- Carnivorous mammals (flesh eaters)
- Rodents (gnawing mammals)
- Insectivorous (insect eaters)
- Pouched mammals (marsupials)
- Flying mammals (chiropteran)
- Egg laying mammals (monotremes)
- Sea mammals (cetaceans)
- Lagomorpha

Primates

These are the most advanced group of mammals. Their brain, particularly the cerebrum, is relatively large and well developed, accounting for the intelligence and quick reactions of these mammals.

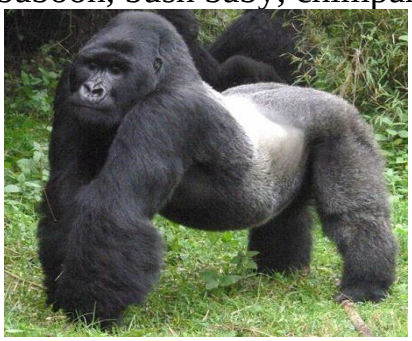
Characteristics of primates

- They have well developed brain.
- They use front limbs for holding and hind limbs for walking.
- They have five fingers on each hand and five toes on each foot.
- They are omnivorous i.e. they feed on both flesh and vegetables.
- They have well developed set of all the four types of teeth i.e. incisors, canines, premolars and molars (32 teeth)

Examples of primates

Humans, monkeys, gorillas, baboon, bush baby, chimpanzee, orangutan.

Humans



Gorilla

Bush baby

Baboon

Chimpanzee

Orangutan

Monkeys

Lemur

Tarsier

Ungulates (hoofed mammals)

These are herbivorous mammals with hoofed feet. All mammals in this group are herbivorous i.e. they feed on vegetation.

Ungulates are divided into two sub-groups

i) Even toed ungulates
ii) Odd toed ungulates

Even toed Odd toed

Even toed ungulates

These have hooves arranged in even form and have the third and fourth digits equally developed and bear the weight of the body. They include; Deer, pigs, cattle, giraffe, sheep, antelopes, hippopotamus.

Even toed ungulates are subdivided into two;

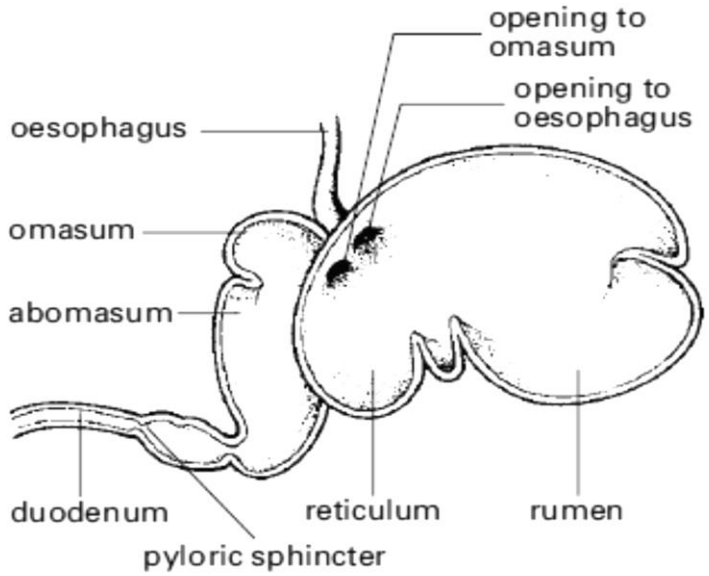
i) Ruminants

ii) Non-ruminants

Ruminants

These are ungulates with four stomach chambers and chew cuds. Swallowed food passes from the first chamber, the **reticulum**, to the **rumen**, where food is digested by ***cellulase*** and other enzymes that live in the rumen. Some products of digestion are absorbed in the rumen; the remaining partly digested food is regurgitated (to bring back what has been swallowed) and chewed to a pulp – the process known as 'chewing the cud'. This food mass is then swallowed and passes from the reticulum to the third chamber, the **omasum**, where water and some nutrients are absorbed; and finally, to the **abomasum**, in which further digestion takes place.

Stomach of a ruminant



Examples of ruminants

- Cattle
- Goats
- Sheep
- Camel
- Antelope

Cow

Goat

Sheep

Non-ruminants

- These are ungulates which do not chew cud but have a complete dentition.
- They have well developed canines which they use for protection

Examples of non-ruminants
Pigs, hippopotamus, warthog


Pig


Hippo


Warthog

Odd toed ungulates
The number of toes is always odd e.g. one in horse, donkey, zebra and three in elephant and rhino.


Rhino


Elephant


Donkey

Carnivorous mammals

A group of mainly flesh-eating mammals. Carnivores typically have very keen sight, smell, and hearing. The hinge joint between the lower jaw and skull is very tight, allowing no lateral movement of the lower jaw. This – together with the arrangement of jaw muscles – enables a very powerful bite. The teeth are specialized for stabbing and tearing flesh: canines are large and pointed.

Characteristics of carnivorous animals.

- They are strong mammals
- They have well developed canine teeth for tearing flesh of their prey.
- They have sharp claws for holding, killing and tearing their prey.
- They have a very good speed, good sense of smell, keen eye sight and good hearing.
- This is why they even hunt at night.

- Their feet have soft pads therefore thus can ran after their prey without making noise.

Carnivorous mammals are divided into two groups;

a) Scavengers (Dog family)

A scavenger is an animal that feeds on dead flesh (carrion/carcass)

Examples of scavenging mammals

Hyena, jackal, fox and wolf

Hyena

Fox

Jackal

b) Predators (Cat family)

A predator is an animal that hunts and kills others for food.

The animal hunted for food is called a ***prey***.

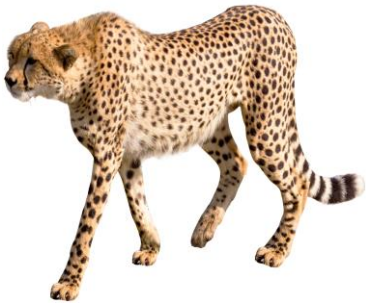
Examples of predatory mammals

Lion, leopard, tiger, cheetah, mongoose, jaguar, panther, domestic cat.

Lion

Mongoose

Tiger



Cheetah

Domestic cat

Leopard

Jaguar

Black panther

Gnawing mammals (Rodents)

A group of mammals characterized by a single pair of long curved incisors in each jaw. These teeth are specialized for gnawing: they continue growing throughout life and have enamel only on the front so that they wear to a chisel-shaped cutting edge. Rodents often breed throughout the year and produce large numbers of quickly maturing young ones.

- They don't have canines.
- Rodents are herbivores (vegetarians)

Examples of rodents

Rats, squirrels, porcupines, guinea pigs, beavers and mice.

Squirrel

Porcupine

Beaver

Insect eating mammals (insectivores)

A group of small, mainly nocturnal, mammals. They have long snouts covered with stiff tactile hairs and their teeth are specialized for seizing and crushing insects and other small prey.

- They have a sensitive snout and strong claws for digging.
- They are nocturnal i.e.; they hunt at night and sleep during day.

Examples of insectivores

Hedgehog, elephant shrew, Aardvark.

- A hedgehog is an animal with spines on its body. When threatened, it rolls itself up into a ball.

Hedgehog

Elephant shrew

Aardvark

Flying mammals (chiroptera)

A group of flying mammals comprising the bats. Their membranous wings are supported by very elongated forelimbs and digits and stretch along the sides of the body to the hind limbs and tail. Whenever bats rest they allow their body temperature to fall, hibernating in winter when food is scarce. Most bats are nocturnal; their ears are enlarged and specialized for ***echolocation***, which they use to hunt prey and avoid obstacles. Bats feed on insects, fruit, nectar, or blood.

- Bats are the only true flying mammals.

There are three main types of bats;

a) Insect eating bats: These are helpful to man because they eat many harmful insects like mosquitoes.
b) Fruit eating bats:
c) Blood sucking bats (vampires) they suck blood from large animals like horses, cows, buffaloes etc.
Bats are called nocturnal because they hunt and sleep during day.

Bats resting

A bat flying

Pouched mammals (marsupials)

A group of mammals with a pouch. The female bears an abdominal pouch (**marsupium**) into which the newly born young, which are in a very immature state, move to complete their development. They obtain nourishment from the mother's mammary teats. Modern marsupials are restricted to Australasia (where they include the kangaroos, koala bears, phalangers and bandicoots) and America (the opossums).

Examples of marsupials

Kangaroo, Koala bear and Wallabies

Kangaroo

Koala bear

Wallabies

Egg laying mammals (monotremes)

A group of mammals that lay large yolky eggs. It contains only the duckbilled platypus and the spiny anteater. After hatching, the young feed on milk from simple mammary glands inside a maternal abdominal pouch. In the anteater the eggs are also incubated in this pouch, while the platypus builds an underground nest. Adult monotremes have no true teeth. Their skeleton resembles that of a reptile, and although they are warm-blooded the body temperature is somewhat variable.

They are the most primitive in the class of mammals because;

- They resemble birds and reptiles in that they lay eggs and also have beaks similar to those of birds.
- They have characteristics of birds, mammals and reptiles.
- Monotremes are regarded as mammals because they feed their young ones on milk from the mammary glands and for the care they give to their young ones after hatching.

Examples of monotremes

- Duckbilled platypus
- Spiny anteater (echidna) of Australia.

Duck billed platypus

Spiny anteater

Sea mammals (Cetaceans)

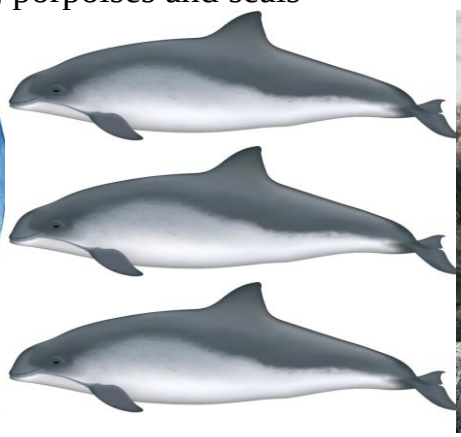
A group of marine mammals comprising the porpoise, dolphins and blue whale which is probably the largest known animal – over 30 m long and over 150 tonnes in weight. The forelimbs of whales are modified as short stabilizing flippers and the skin is very thin and almost hairless. A thick layer of ***blubber*** insulates the body against heat loss and is an important food store.

- They don't have gills but they breathe by means of lungs.
- They have a layer of fats under the skin called blubber to keep them warm.
- They have a high level of intelligence next to primates.
- They have mammary glands.
- They give birth to living young ones and suckle them on milk from the mammary glands.
- Most sea mammals have fur.

Examples of cetaceans

Blue whale, Sperm whale, porpoises and seals

Blue whale



Porpoises

Seals

Lagomorpha

A group of placental mammals that includes pikas, rabbits and hares. Gnawing, herbivores differing from rodents, because of having two pairs of incisors in the upper jaw, the second pair being small and functionless.

Rabbit

Pika

Hare

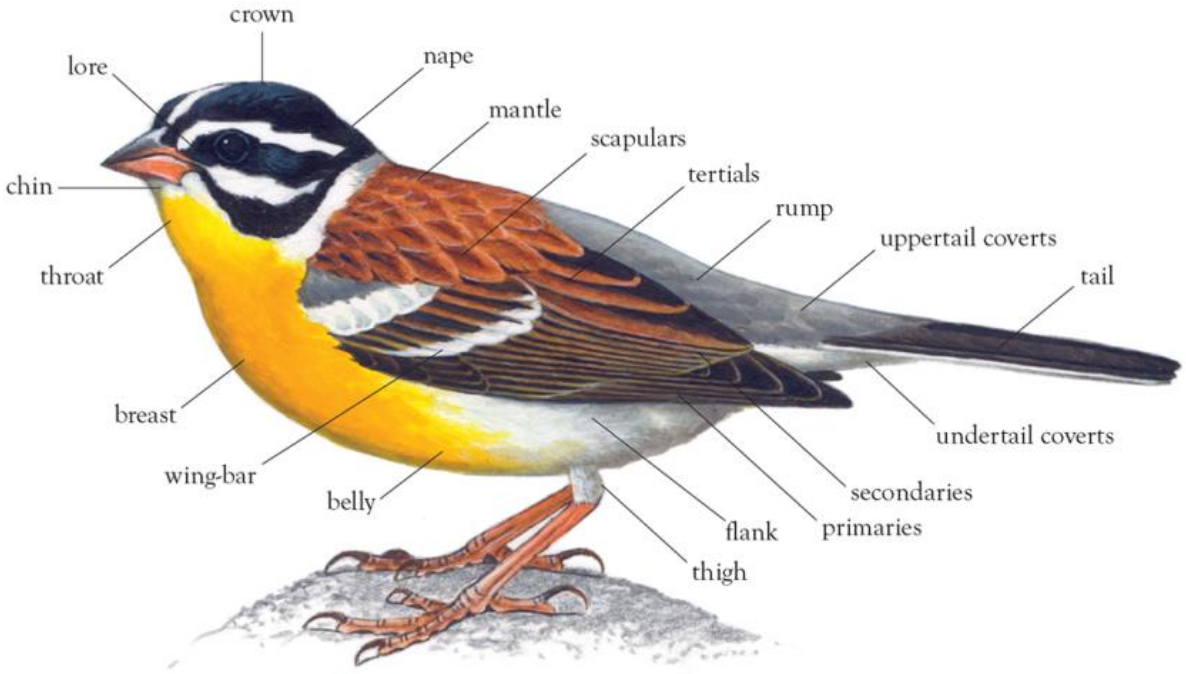
Birds

Also called aves is a class of feathered vertebrates with wings, and a beak. Birds have scaly legs, like reptiles. Birds are warm-blooded. The skin is dry and loose and has no sweat glands, so cooling is carried out by panting. They have lungs and four chambered hearts. The breastbone bears a keel for the attachment of flight muscles. The skeleton is very light; many of the bones are hollow (tubular), having internal struts to provide strength and air sacs to reduce weight and provide extra oxygen in flight. Their feathers are vital for flight, streamlining the body, and insulation against heat loss. Many birds show a high degree of social behaviour in forming large flocks and pair bonding for nesting, egg incubation, and rearing young ones. Fertilization is internal and the female lays hard-shelled eggs.

Characteristics of birds

- Their body is streamlined i.e. pointed at the front and back.
- Their bodies are covered with feathers which they molt every year.
- Their bones are hollow i.e. do not have bone marrow.
- They have scales on their legs.
- They are warm blooded.
- They breathe by means of lungs.
- Their front limbs are modified as wings.
- They have no teeth but have horny beaks.
- Their eyes have three lids the lower, upper and nictitating membrane.
- They lay shelled eggs which are fertilized internally.
- They care for their young ones.
- Many of them can fly.

External features of a bird



Classification of birds

This refers to the grouping of birds according to their characteristics. E.g. the type of beak and feet (claws) they have, the type of food they eat, the nature of environment they live in.

Groups of birds

- Birds of prey
- Perching birds
- Scratching birds
- Swimming birds
- Wading birds
- Flightless (walking) birds
- Climbing birds
- Scavenger birds

Birds of prey

- They are carnivorous birds.
- They eat rats, fish, mice, lizard, chicken etc.
- They have strong eye sight to spot their even when they are flying.
- They have strong sharp, hooked beaks for tearing the prey.
- They have strong sharp curved talons (claws) for gripping and killing the prey.

Examples of birds of prey

Hawks, eagles, secretary birds, owls, kites

Eagle

Hawk

Owl

Secretary bird

Osprey

Kite

Falcon

Structure of the beak and claws

	
Foot	Beak

Perching birds

- Split feet and walking legs.
- Backwardly pointing toe suitable for holding a perch.
- They have one toe pointing backward and three toes pointing forward.

Types of perching birds

i) **Seed eaters**

These have short strong conical beaks suitable for breaking up seeds e.g. pigeon, doves, weaver birds, finches.

Pigeon

Dove

Weaver bird

Finch

Structure of the foot

Structure of the beak

ii) Insect eaters

They have stoat narrow beaks for picking up the insect from the back of trees.

Examples

Sparrows, robins, swallows and swift.

Swallows and swifts have short and wide-open beaks which help them to catch insects even when flying.

Sparrow

Swift

Swallow

Robin

iii) Nectar suckers

These have long thin/slender curved beaks for sucking nectar.

Examples

Sunbird and humming birds

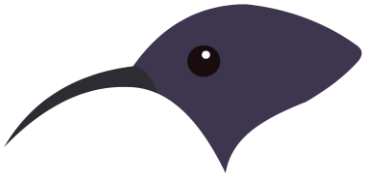
Sunbirds

Humming bird

Structure of the beaks of nectar suckers

A

B



Scratching birds

- These birds feed on seeds and insects which they find by scratching the earth.
- They have short, strong, firm pointed beaks for picking up things from the ground.
- They have strong feet with thick toes and blunt nails.
- They can walk easily.
- Their body is heavy and wings are weak.

Examples

Chicken, turkey, guinea fowl.

Turkey

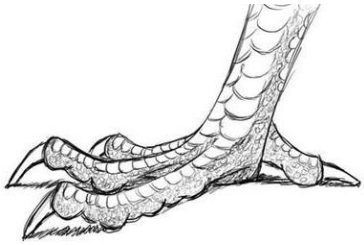
Guinea fowl

Cock

Structure of the beak and foot

Beak

Foot



Swimming birds

- They have webbed feed which act like paddles.
- They have broad breast bone.

- Their skin has many oil glands which produce oil to protect their body against water.
- They have beaks broad curved beaks which help them to sieve food from the mud.

Examples of swimming birds

Ducks, swans, geese, penguins, seagulls, pelicans

Duck

Penguin

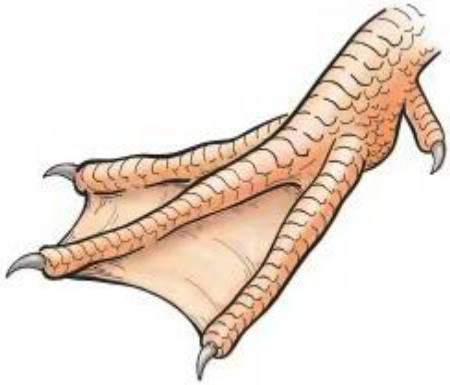
Pelican

Goose

Swan

Sea gull

Structure of the food and beak



Wading birds

These wade in mud using their long slender legs with short webs.
The nature of beaks they have depends on the food they eat.

Examples of wading birds

Crested crane, heron, ibis

Heron

Flamingo

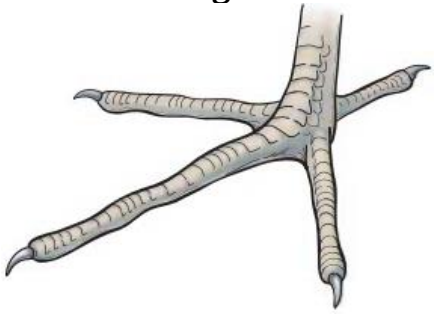
Shoebill

Crested crane

Ibis

Egret

Foot of a wading bird

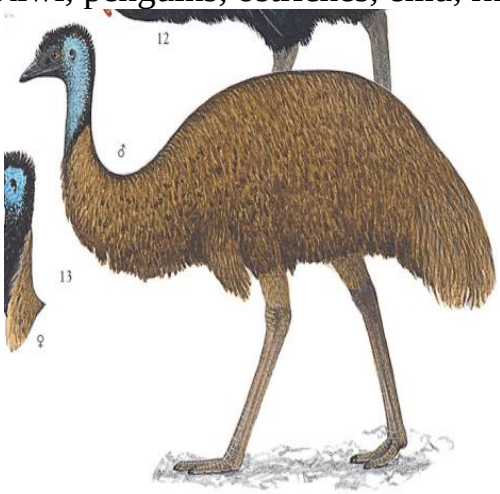


Flightless birds

- These are birds which are unable to fly but can run very fast.
- They have weak and small wings compared to the body size.
- They have bone marrow which increases the density of their bones.
- An ostrich is the largest and fastest flightless bird.

Examples of flightless birds

Kiwi, penguins, ostriches, emu, rhea, and cassowary.



Emu

Kiwi

Ostrich

Rhea

Cassowary

Feet of flightless birds

Climbing birds

- They have two toes pointed forward and other two backwards.

- This arrangement helps them in climbing to look for seeds and insects.
- They live in trees and run about on branches of trees.

Examples of climbing birds

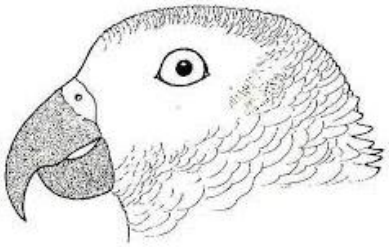
A parrot, a wood pecker and a cuckoo.

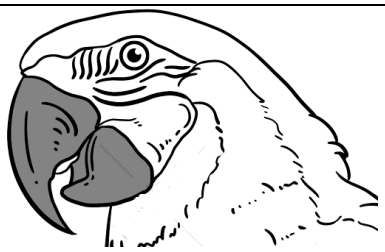
Cuckoo

Wood pecker

Parrots

The structure of the foot of climbing birds	**The structure of the beak of a woodpecker**
	
Beaks of parrots	





Scavenger birds

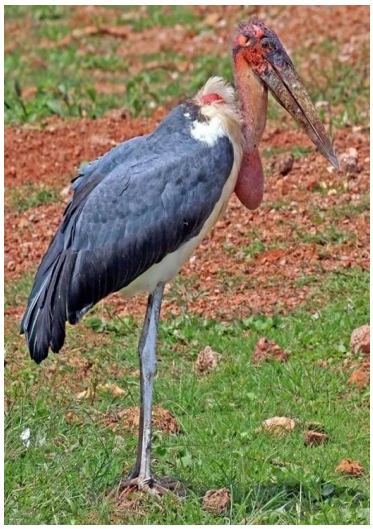
- These birds feed on flesh killed by other animals, rotten meat and fish.
- They usually have beaks similar to those of birds of prey.
- They are useful because they clear most of the dead decaying flesh which may otherwise be a source of many diseases.

Examples of scavenger birds

Vulture, crows, and marabou storks, raven

Vulture

Crow



Marabou stork

Raven

Ways in which birds are adapted for flying

- They are streamlined to reduce friction so that they can move through air easily.

- They have hollow bones which reduce weight and their back bones are fused (joined) to give them rigidity.
- They have strong attachment of their powerful and strong front muscles which are used for moving wings.
- Their fore limbs are modified into wings.
- They have no pinna to obstruct the flow of air.
- They have good eye sight to see well from long distances and judge the distance accurately.
- They have a nictitating membrane which cover the eye and protect them against moving air during flight.
- Their bodies are covered with flight feathers.

Note: Some domestic fowls are unable to fly high because they have bone marrow which make them heavy.

Advantages of birds

- They are sources of food
- The feathers are used for decorations like on hats, suits and hand bags.
- Bones are used for making glue.
- Some birds kept for customary purpose like making sacrifices and paying dowry.
- They are source of income to farmers.
- They attract tourists (bird watching).
- Some birds pollinate flowers like the sunbirds, they pollinate when collecting nectar.
- Some help to clean our environment like the vultures, craws and marabou storks by feeding on dead flesh.

Disadvantages of birds

- Many birds damage our crops by eating seeds, like millet, rice, maize, sorghum etc. many birds are pests.
- Some birds cause accident on runways at the airport.
- They make a lot of noise like the weaver birds.

Reptiles

A class of vertebrates which can live in dry habitats as their skin is covered by a layer of horny scales, preventing water loss. They breathe atmospheric oxygen by means of lungs assisted by respiratory movements of the ribs (there is no diaphragm). Reptiles are coldblooded. Fertilization is internal and the majority of reptiles lay eggs on land. These eggs have a porous shell to allow gas exchange. In some reptiles the eggs are retained within the body of the mother until the young

are ready to hatch, thereby greatly reducing attacks from predators. Reptiles are crawling animals.

Characteristics of reptiles

- They are cold-blooded animals.
- They breathe by mean of lungs.
- Their skin is covered with dry scales.
- They have a three-chambered heart i.e., two atria and one ventricle.
- With exception of snakes, they have four limbs with claws.
- They have external ears. The tympanic membrane (ear drum) is usually situated below the surface of the body.
- They lay eggs which are fertilized internally. The shells of eggs are either leathery or quite hard made of calcium carbonate.
- They usually don't look after their young ones.

Classification of reptiles

Reptiles are divided into the following groups

i) Snakes
ii) Lizards
iii) Turtles, tortoises and terrapins.
iv) Crocodiles and Alligators.

Snakes

- They have no limbs.
- They are carnivorous animals.
- Their eyes are without eye lids but each eye is protected by an immovable transparent membrane.
- They have a forked tongue which acts as a sense organ for smell and taste.
- They have a large number of ribs.
- They shed (moult) their skin after a certain period.
- Their backward pointed teeth prevent the prey from escaping from the mouth.
- Some snakes have venom fangs which have a deep canal through which poison passes.
- The ribs and large scales on the underside of their body also help them to move.
- They hide or move away when disturbed.

Classification of snake

Snakes are grouped into three main groups namely;

- Venomous snakes
- Constrictors
- Non-venomous snakes

Venomous snakes

They have two long teeth called fangs near the front of the mouth to inject venom.

Example of poisonous snakes

- Cobra
- Mamba
- Puff adder /night adder
- Viper

Cobra

Viper

Puff adder

Non-venomous snakes

- These do not have fangs and venom.
- They have solid uniform teeth.
- They kill their prey by crashing and suffocating using their strong muscles.
- The lick the prey to make them smooth and slippery and swallow them whole.

Examples of constrictors

- Python
- Anaconda
- Boa constrictor

Anaconda

Python

First aid for the snake bite

- Apply black stone on the injured part to suck the poison after making cuts.
- Stay quiet and rest the bitten part so that the venom does not spread.
- Tie a bandage /tourniquet above the bite to limit the flow of poisoned blood to the heart.

- Cut between the fang marks and suck out the venom if you do not have wounds in the mouth.
- Take the victim to the nearest health unit to receive anti venom injection.

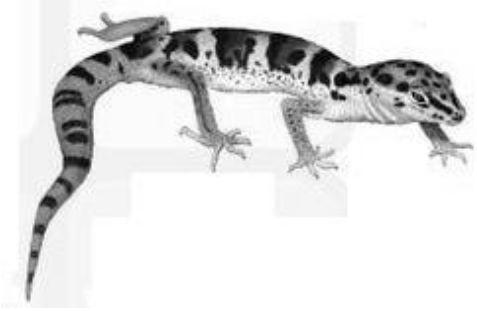
How to tell that a person has been bitten by poisonous snake.
It leaves two fang marks on the bitten area through which some blood dozes

Lizards

They have four limbs and tails which can grow when its cut.

Examples of lizards

- Geckos
- Chameleons
- Monitor lizards
- Iguana lizards



Gecko

Chameleon

Monitor lizard

Komodo dragon

Note:

- Chameleons are slow moving reptiles which protect themselves by changing colour. (camouflaging)
- They use their long sticky tongues to capture their prey.
- They hatch their eggs inside the body and lay young ones.

Tortoises and turtles

- These are reptiles that have hard shells on their backs.
- Turtles have their feet modified into flippers for swimming in water.
- Tortoises move by walking using their strong legs.
- They all lay their eggs in sand on the bank of water.

Diagram showing tortoise and a turtle

Note: tortoise have raised shells while turtles have flat shells,

Tortoise

Turtle

Differences between the feet of a tortoise and a turtle

Tortoise

Turtle

Crocodiles and alligators

- They are the largest of reptiles.
- They live in water and come out to sleep in the sand on the banks.
- They have strong tails for swimming and attacking their enemies /prey.
- They have rows of teeth in their long jaws for gripping their prey.
- They reproduce by laying eggs which are buried in sand at the bank of lakes or rivers.

Crocodile

Alligator

Importance of reptiles to man

- They have good skins which are used for making drums, belts, and shoes.
- Their skins can be sold to get income/money.
- They are sources of food to man.
- Some reptiles like geckos and lizards help to eat disease vectors like mosquitoes in the house.
- They are used for study and research.
- Reptiles like crocodiles act as tourist attraction.

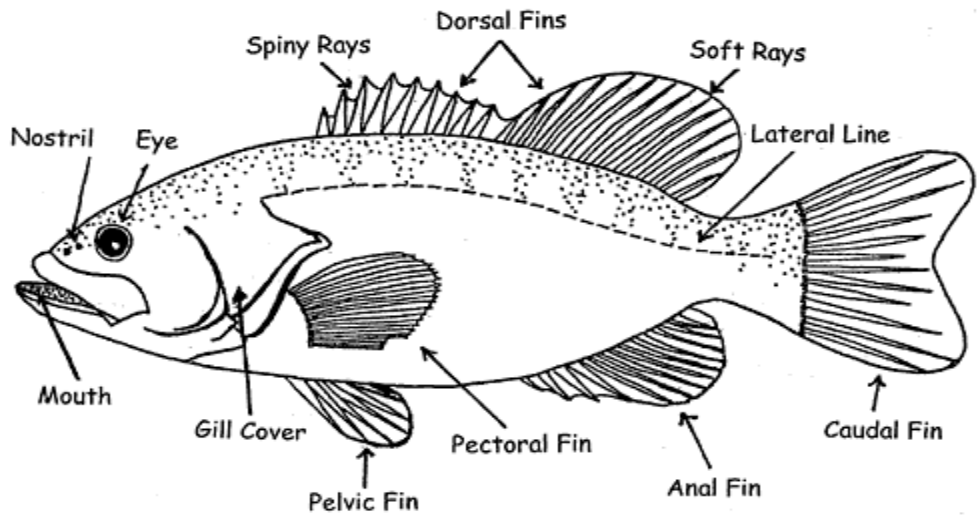
Fish

Fish are poikilothermic (cold blooded) vertebrates. Many of them have a smooth, streamlined shape which offers minimal resistance to the water through which they move. Their bodies are covered with overlapping scales and they have fins which play a part in movement. Fish breathe by means of gills which are protected by a bony plate, the operculum. Fish reproduce sexually but fertilization usually takes place externally; the female lays eggs and the male sheds sperms on them after they have been laid.

Characteristics of fish

- They live in water (aquatic).
- They breathe through gills which are enclosed in the operculum.
- They lay eggs which hatch into fries.
- Their eggs are fertilized by the male from outside the female's body. In water (external fertilization).
- Most have overlapping scales on their body except cattle fish.
- They have fins for swimming and protection.
- They are cold blooded vertebrates.
- They feed on plants and animals in water.
- They have hearts with two chambers.
- They have a lateral line for detecting sound waves.

The external parts of a fish



Functions of parts of a fish

1. **Fins:**
    - **Dorsal Fin:** Helps stabilize the fish and prevent it from rolling.
    - **Ventral Fin:** Assists in maintaining balance and stabilizing the fish.
    - **Pectoral Fins:** Aid in steering and controlling the fish's direction.
    - **Pelvic Fins:** Contribute to stability and help control the fish's pitch.
2. **Caudal (Tail) Fin:**
    - **Propels the Fish:** The main fin responsible for forward propulsion. The shape of the caudal fin can vary among species, influencing the fish's swimming speed and agility.
3. **Scales:**
    - **Protection:** Scales cover the fish's skin, providing a protective layer against predators and environmental hazards.
4. **Lateral Line:**
    - **Sensory Organ:** The lateral line is a series of sense organs along the sides of the fish that detects changes in water pressure and vibrations. It helps the fish sense its surroundings and detect prey or predators.
5. **Gills:**
    - **Respiration:** Gills extract oxygen from water and release carbon dioxide. They are crucial for the fish's respiratory process.
6. **Mouth and Teeth:**
    - **Feeding:** The mouth is adapted to the fish's feeding habits, and teeth (if present) aid in capturing, holding, and processing food.
7. **Eyes:**
    - **Vision:** Eyes are important for detecting prey, avoiding predators, and navigating in the water.
8. **Operculum:**
    - **Protection of Gills:** The bony covering over the gills protects them from damage and helps regulate water flow.
9. **Swim Bladder:**
    - **Buoyancy:** This gas-filled organ helps the fish control its buoyancy and maintain its position in the water column.

Types of fish

There are three types of fish

- Bonny fish
- Cartilaginous fish
- Lung fish

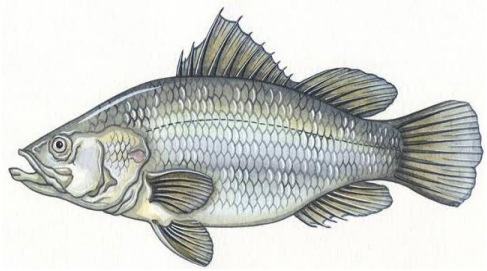
Bony fish

- They have no eye lids.
- They have swim bladder which helps to keep them floating or to prevent sinking.

- Their gills are protected by gill cover or operculum
- Their bodies are covered by overlapping scales.

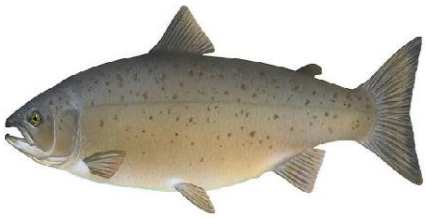
Examples of bony fish

Nile perch, Tilapia, herrings, trout, salmons.

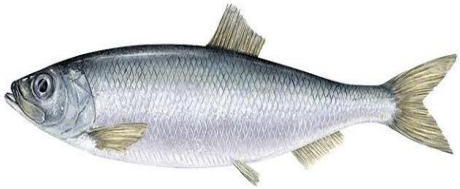


Nile perch

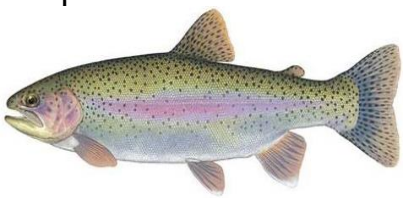
Tilapia



Salmon



Herrings



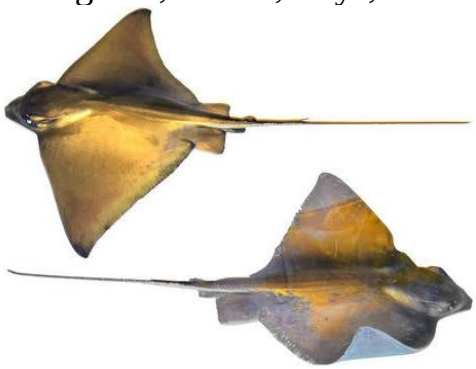
Trout

Cartilaginous fish

- Their skin is tough and shiny.
- They have gills slits instead of gill cover.
- They have mostly cartilage instead of bones in their skeletons.
- They do not have swim bladder.

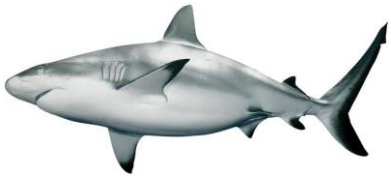
Examples of cartilaginous fish

Dog fish, Skates, Rays, sharks.



Rays

Skates



Shark

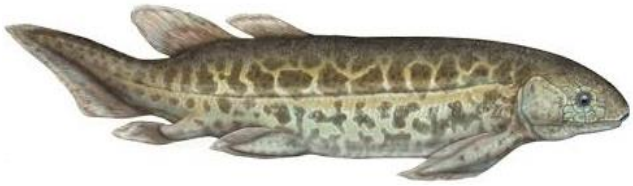
Dogfish

Lung fish

- They breathe through gills in water and by swim bladder when gills cannot supply enough oxygen.
- They live in dirty pools, swamps or rivers.
- They have long and thin pelvic and pectoral fins.
- They hibernate in dry seasons.

Examples of lung fish

- African lung fish/mamba
- Diponi



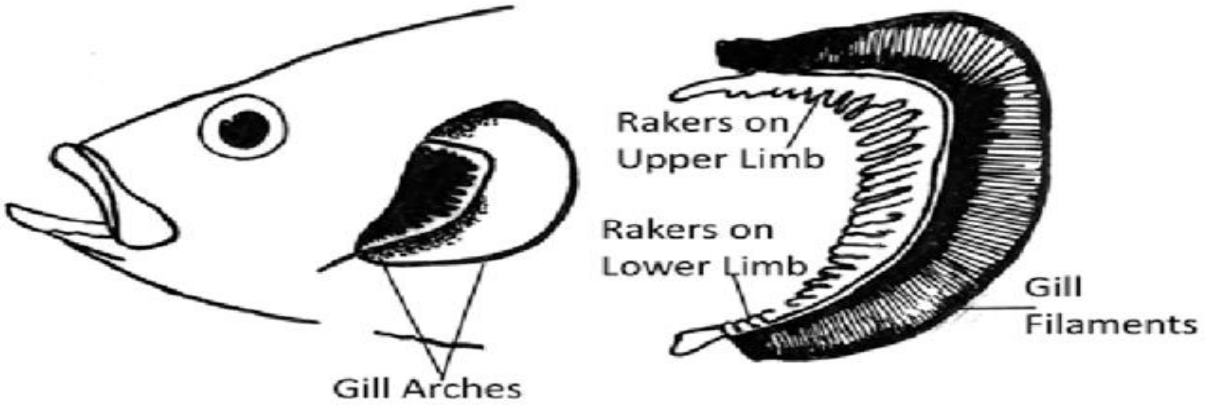
Diponi

African lung fish

Breathing in fish

- Fish breathe in dissolved oxygen in water.
- Water containing oxygen moves through the mouth and passes out over the gills which absorb the oxygen in the water.
- Gill rakers trap solid particles or dirt to prevent damage to the gills.
- The gill bars are spread out the gills to prevent interlocking.
- Gill filaments are many in order to give large surface area to absorb a lot of oxygen dissolved in water for respiration.

Diagram showing gills.



How fish are adapted to living in water

- They have streamlined bodies which help to reduce friction in water.
- Fish have fins.
  Fins and tails allow fish to move through water. The tail propels the fish while fins guide their movement in water by controlling their direction and balance.
- They have gills for breathing in water.

Fish use gills to breathe under water. Most fish have to swim constantly. This enables water to pass through the gills to allow gaseous exchange.

- Fish have a lateral line to detect sound waves.
  The lateral line allows fish to detect vibrations in water, alerting them of predators.
- Their scales and colour provide protection.
- They have slippery scales to protect them from predators.

Uses of fish to man

- They are kept as pets in aquarium for decoration.
- Their bones are used to make glue.
- They are sources of employment e.g. fish mongers.
- They can be used for research and learning.

Amphibians

The name, amphibian, means 'double life' and refers to the fact that the organism spends part of its life in water and part on the land.
The class of vertebrates that contains the frogs, toads, newts, and salamanders. All adult amphibians have a passage linking the roof of the mouth with the nostrils so they may breathe air and keep the mouth closed. The moist scaleless skin is used to supplement the lungs in gas exchange. They have no diaphragm, and therefore the muscles of the mouth and pharynx provide the pumping action for breathing. Fertilization is usually external and the eggs are soft and prone to destruction, therefore reproduction commonly occurs in water. Amphibian larvae are aquatic, having gills for respiration; they undergo metamorphosis to the adult form.

Characteristics of amphibians

- They are cold blooded vertebrates.
- They reproduce by laying eggs.
- Amphibians are carnivores.
- They undergo external fertilization i.e., the male sheds sperms on the eggs outside the female's body as they are being laid in water.
- Their eggs are usually laid in egg spawns.
- Frogs have moist skins with a good supply of capillaries which can exchange oxygen and carbon dioxide with the air or water.
- They have scaleless skin.
- Their heart is three chambered.

Examples of amphibians

Frogs, toads, Newts, salamanders.

Frog

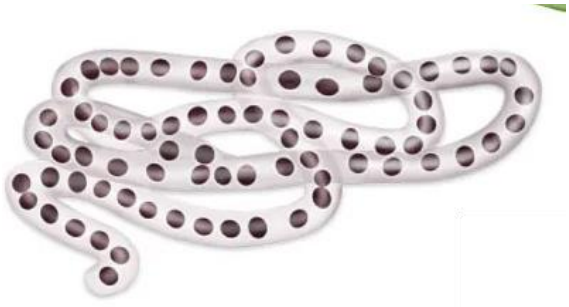
Toad

Newt

Salamander

Differences between a frog and a toad

- Frogs mostly live-in water while toads mostly live on land.
- Frogs have smooth slippery skins while toads have warty rough skins.
- Toads lay eggs in long ribbon spawns while toads lay eggs in mass spawns.
- Frogs have fully webbed hind feet while toads have partly webbed feet.
- Frogs can breathe through their lungs and moist skin while toads breathe through their lungs.
- Tadpoles of frogs are brown while of toads are black.



Toad

Frog

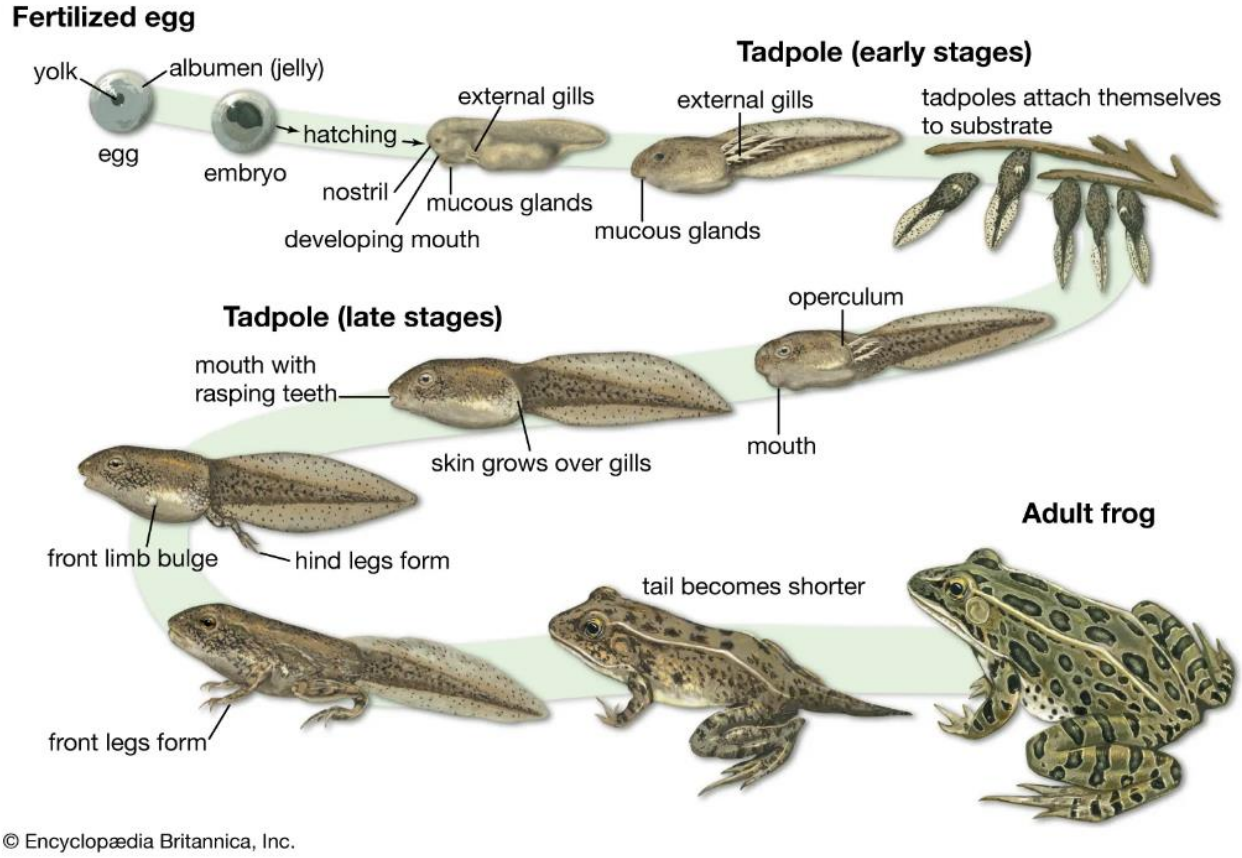
Feeding in frogs

- They feed on small insects and worms
- They use their long sticky tongues to trap their prey.

Reproduction in amphibians

- The male and female mate.
- The female lays eggs and the male sheds sperms over them to fertilize them (external fertilization).
- The eggs develop and after about two weeks hatch into tadpoles.
- The tadpoles undergo several changes to fully develop into an adult.
- This takes about three months.

Diagram to show life cycle of an amphibian



Invertebrates

These are animals without a back bone.
They are multicellular animals.

Classes of invertebrates

- Coelenterates
- Echinoderms
- Sponges
- Worms
- Mollusks
- Arthropods

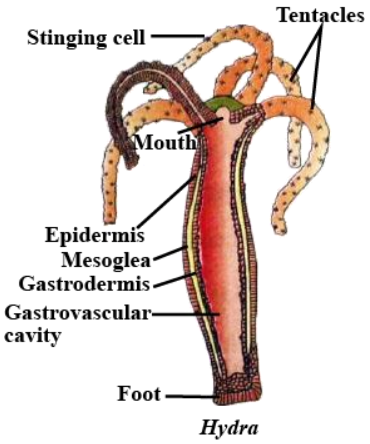
Coelenterates

- They have cylindrical bodies with only one opening which acts as the mouth and the anus.
- They have stinging cells on the tentacles surrounding the openings.
- They live in water.
- Reproduction is sexual and asexual.

Examples of coelenterates

- Corals
- Jelly fish
- Hydra
- Sea anemone.

Jelly fish



Hydra

Sea anemone

Echinoderms

The have spiny skins and tube feet.
They pump liquid into their feet to make them expand.

Examples of Echinoderms

- Star fish
- Sea urchins
- Sea lilies
- Sea cucumbers

Sponges

- Sponges are a collection of individual cells organized into one body on the sea floor.
- They cannot move about but remain stuck on the sea floor.
- They suck in sea water and filter out tiny pieces of food.
- They breathe and feed through the holes in their bodies.

Molluscs

- **Molluscs**, are soft-bodied invertebrates usually wholly or partly enclosed in a calcium carbonate shell secreted by a soft mantle covering the body.

- **Molluscs** is the second-largest group of invertebrate animals after the Arthropoda.
- Molluscs reproduce by laying eggs.
- Molluscs undergo external fertilization.
- Molluscs have a hydrostatic skeleton.

Examples of molluscs

- Octopus
- Squids
- Snails
- Slugs
- Oysters
- Cuttle fish
- Clams
- Mussel

Snails live on land and water
They feed on plants, while others are carnivorous
Slugs are similar to snails but do not have shells.

Octopus

Squid

Snail

Clam

Mussels

Cuttlefish

Worms

- These are tube-like, long and soft bodied invertebrates
- Have cylindrical bodies.
- Some live in soil or water while others are parasites living inside other animals.
- They breathe through their moist skins.
- They reproduce by laying eggs.

Types of worms

They are divided into three groups namely;

- Segmented worms (annelids)
- Round worms (nematodes)
- Flat worms (Platyhelminthes)

Segmented worms

These worms are known as **segmented worms** because their bodies are segmented, or separated into repeating units. Besides the earthworm, the other segmented worms also include leeches and some marine worms. Most segmented worms like the earthworm, feed on dead organic matter. **Leeches** however, can live in fresh water and suck blood from their animal host. You may have noticed many earthworms in soil. Earthworms help in aerating soil and decomposing organic matter in soil.

Characteristics of segmented worms

- They mostly live in moist soil and water.
- Each segment has the same set of organs.
- They reproduce asexually by dividing segments into two and laying eggs.
- They undergo external fertilization.
- Segmented worms have a well-developed body cavity filled with fluid. This fluid-filled cavity serves as a **hydro skeleton**, a supportive structure that helps move the worm's muscles.
- Earthworms have a complete digestive tract with two openings, as well as an esophagus and intestines.
- The circulatory system consists of paired hearts and blood vessels. Actually, there are five pairs of hearts that pump blood along the two main vessels.
- Segmented worms have a digestive system, nervous system, and circulatory system.

Examples of segmented worms

- Leeches
- Bristle worms
- Rag worms
- Earth worms

Earthworms

- They live in soil and eat decayed vegetation (organic matter).
- They are hermaphrodites i.e., has both male and female productive organs.
- They undergo external fertilization.
- They move by muscular contractions.

- They help to aerate the soil by making tunnels which also help to improve soil drainage.
- They help in the formation of humus in the soil by decomposing organic matter.

Diagram showing common segmented worms

Earthworm

Leeches

Bristle worm

Flat worms

- They have flattened and unsegmented bodies.
- Flatworms have an incomplete digestive system. This means that the digestive tract has only one opening.
- Flatworms do not have a respiratory system. Instead, they have pores that allow oxygen to enter through their body. Oxygen enters the pores by diffusion.
- There are no blood vessels in the flatworms.
- Many types of flatworms are parasitic. That means they live inside another organism, called a host, in order to get the food and energy they need.
- Some species of flatworms are free-living organisms that feed on small organisms and rotting matter.

Examples of flat worms

- Tape worms
- Schistosome worms (blood flukes)
- Pond flat worms
- Liver flukes

Note

- Tape worms have no mouth or gut but feed by absorbing digested food through their moist skins.
- Liver flukes suck blood from animals.

Diagram showing common flat worms

Tapeworm

Liver fluke

Blood fluke

Roundworms

Worms with round, non-segmented bodies are known as nematodes or **roundworms**

Nematodes are slender bilaterally symmetrical worms, typically less than 2.5 mm long. The smallest nematodes are microscopic, while free-living species can reach as much as 5 cm.

The head is covered with sensory bristles

Some are parasites in man and other animals and plants while others live in water.

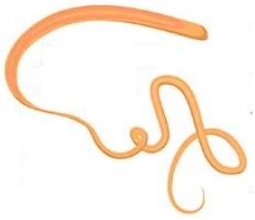
Roundworms have a complete digestive system, which includes both a mouth and an anus. This is a significant difference from the incomplete digestive system of flatworms.

Common examples of round worms

- Hookworms
- Eel worms
- Pinworms
- Heartworms
- Whip worms (Thread worms)
- Ascaris
- Filarial worms

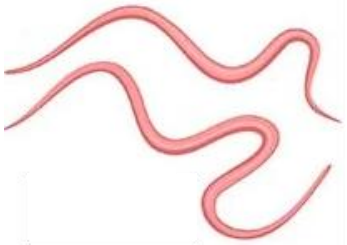
Note

- Hookworms enter our bodies by penetrating through the skin of bare feet and bathing water which is contaminated with hook worms.
- They feed by sucking blood from intestines and the stomach.



Round worm

Whipworm



Hookworms

Arthropods

How often do you think you see an arthropod? Well, have you ever looked up close at an ant? A spider? A fly? A moth? With over a million described species in the group containing arthropods, chances are, you encounter one of these organisms every day, without even leaving your house. Arthropods are a very diverse group of animals. In fact, they are the biggest group of animals on the planet, with up to around 5 million distinct species.

Arthropods are invertebrates with segmented bodies and jointed legs.

Characteristics of arthropods

- They have jointed legs
- They have hard external skeleton called exoskeleton (cuticle) which gives them physical protection and prevents them from drying out. In order to grow, arthropods shed this outer covering in a process called **moulting**.
- They have a segmented body with a head, a thorax, and abdomen segments
- They have compound eyes.
- They reproduce by laying eggs except the scorpions.
- They have a complete digestive system with a mouth and an anus.
- Aquatic arthropods use gills to exchange gases. These gills have a large surface area in contact with the water, so they can absorb more oxygen.

Classes of arthropods

- Myriapods
- Arachnids
- Crustaceans
- Insects

Myriapods

Myriapoda are mostly found in moist forests, where they help to break down decaying plant material. A few live in grasslands, semi-arid habitats, or even deserts. Most myriapods are decomposers, with the majority herbivores breaking down decaying plant material, but centipedes are nighttime predators. Centipedes roam around looking for small animals to bite and eat; their prey includes insects, spiders, and other small invertebrates. If the centipede is large enough, it will even attack small vertebrates, like lizards. Although not generally considered dangerous to humans, many from this group can cause temporary blistering and discoloration of the skin.

The group myriapods contains 13,000 species. They all live on land, which makes sense as all those legs are more adapted to land lifestyle, as opposed to an aquatic lifestyle.

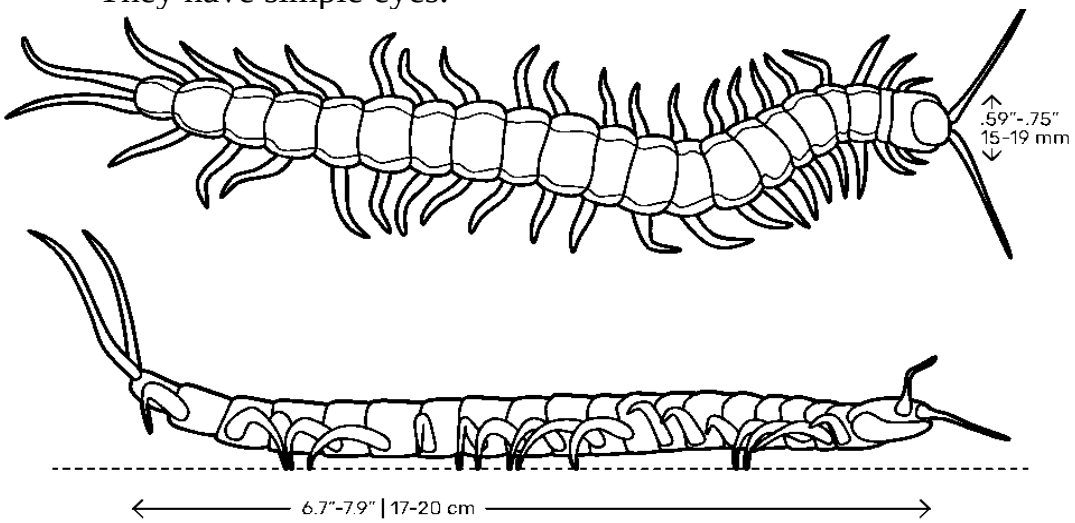
- Their body is divided into a large number of segments.
- Each segment has a pair of legs.
- A pair of antennae and a pair of eyes are present on the head.

Centipedes

Centipedes ("hundred feet") are fast, predatory carnivores, and venomous. There are around 3,300 described species, ranging from one tiny species (less than half an inch in length) to one giant species. These giant centipedes have been known to

attack, kill and eat much larger animals. Centipedes have one pair of legs per body segment, with the first pair of legs behind the head modified into a pair of fangs containing a poison gland. Many centipedes also guard their eggs and young by curling around them.

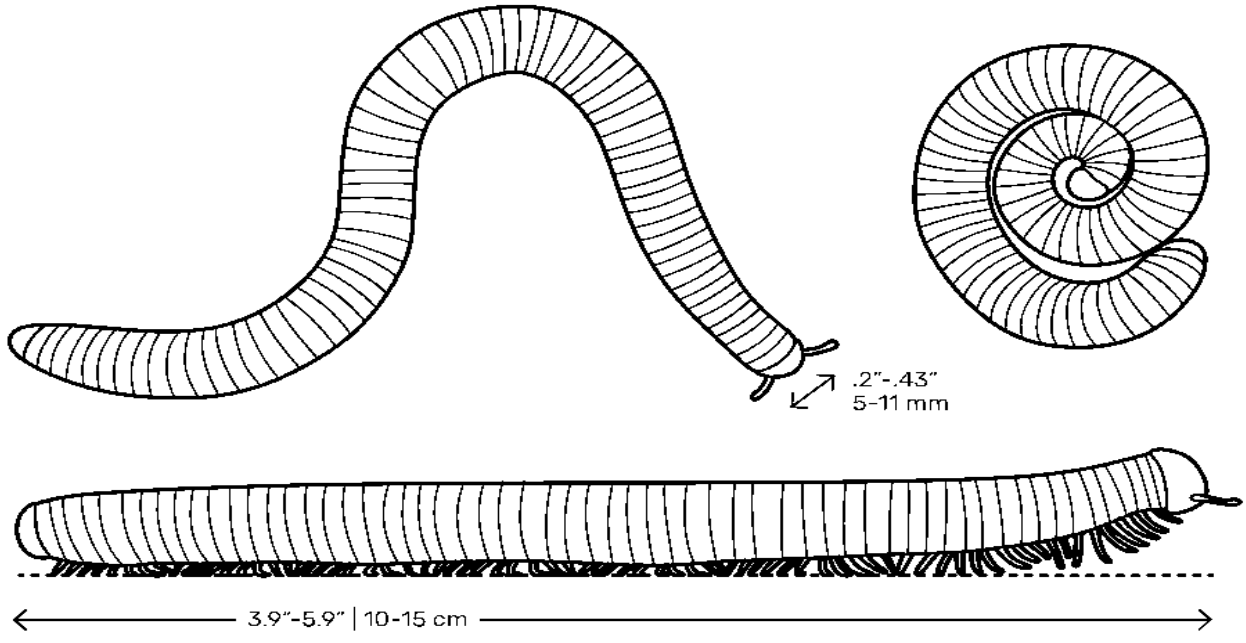
- They are carnivorous.
- They have simple eyes.



Millipedes

Most millipedes are slower than centipedes and feed on leaf litter and loose organic material. They can be distinguished from centipedes by looking at the number of legs per body segment. Millipedes have two pairs of legs per body segment, while centipedes have a single pair of legs per body segment. Millipedes protect their eggs from predators by using a nest of hard soil. Millipedes are not poisonous. They lack the pair of fangs containing a poison gland that centipedes have.

They curl or coil to protect themselves.



Crustaceans

Crustaceans are a large group of arthropods, consisting of almost 52,000 species. The majority of crustaceans are aquatic. Some live in the ocean, while others live in fresh water. A few groups have adapted to living on land, such as land crabs, hermit crabs, and woodlice Crustaceans are among the most successful animals, and can be considered the dominant aquatic animals. Though small, crustaceans are numerous enough to be the main source of energy for large ocean mammals. They are found as much in the oceans as insects are on land.

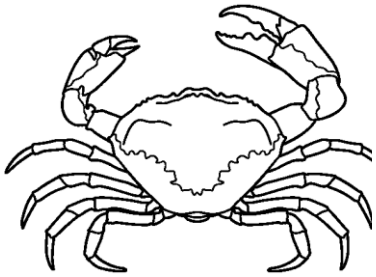
Characteristics of Crustaceans

Characteristics of crustaceans include:

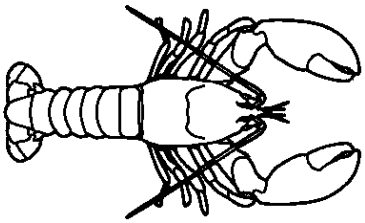
1. An exoskeleton that may be bound together, the thick back shield seen in many crustaceans often forms a protective space for the gills.
2. A main body cavity with an expanded circulatory system. Blood is pumped by a heart located near the back.
3. A digestive system consisting of a straight tube that has a **gastric mill** for grinding food and a pair of digestive glands that absorb food.
4. Structures that function like kidneys to remove wastes. These are located near the antennae.
5. Crustaceans periodically shed the outer skeleton, grow rapidly for a short time, and then form another hard skeleton. They cannot grow underneath their outer exoskeleton. They are very vulnerable during this time, as they lack their hard shell.
6. They have jointed legs and their bodies are divided into two main parts i.e., the cephalothorax and the abdomen.
7. The Head has two pairs of antennae and one pair of the mandibles (jaws).
8. They breathe through gills.

Examples crustaceans

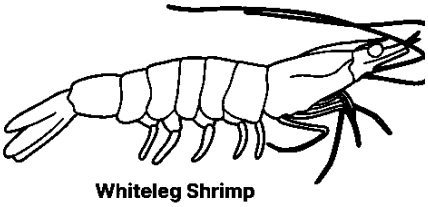
- Crabs
- Cray fish
- Lobsters
- Prawns
- Sand hoppers
- Shrimps
- Woodlice



Crab



Lobster



Shrimp

Uses of crustaceans

- They are eaten as food by man.
- Some are used as baits in fishing industry.

Arachnids

Arachnids are arthropods with four pairs of jointed legs and two main body parts. (Cephalothorax and abdomen). They live mainly on land but are also found in fresh water and in all marine environments, except for the open ocean. There are over 100,000 named species, including many species of spiders, scorpions, daddy-long-legs, ticks, and mites.

Characteristics of Arachnids

1. Four pairs of legs (eight total). You can tell the difference between an arachnid and an insect because insects have three pairs of legs (six total).
2. Arachnids do not have antennae or wings.
3. The arachnid body is organized into the **cephalothorax**, a fusion of the head and thorax, and the abdomen.
4. To adapt to living on land, arachnids have internal breathing systems, like a trachea or a book lung.
5. Arachnids are mostly carnivorous, feeding on the pre-digested bodies of insects and other small animals.
6. Several groups are venomous. They release the venom from specialized glands to kill prey or enemies.
7. Several mites are parasitic, and some of those are carriers of disease.

8. Arachnids usually lay eggs, which hatch into immature arachnids that are similar to adults. Scorpions, however, give birth to live young.

Examples of arachnids

Spiders, ticks, mites, harvestmen and scorpions.

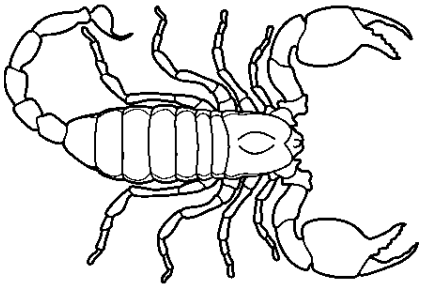
Spiders

- They have special organ at the end of their abdomen called spinnerets for spinning their webs.
- They breathe through book lungs.
- They use their webs for movement, building their nets, trapping their prey and finding their way back.
- They reproduce by laying eggs.

Ticks

- They live on the skin of animals.
- They feed on blood.
- They spread many diseases in domestic animals e.g., East coast fever, red water, heart water, typhus fever and relapsing fever in humans.

Scorpions



- They have a large tail with a poisonous sting.
- Their front legs are modified into pincers.
- They do not lay eggs but give birth to young ones.
- They feed on flesh.

Mites

Insects

This is the largest group of all the animal kingdom and the most varied and numerous of all arthropods. This is the reason that Insects are found everywhere. They may show social behaviour like ants or not like house flies.

Characteristics of Insects

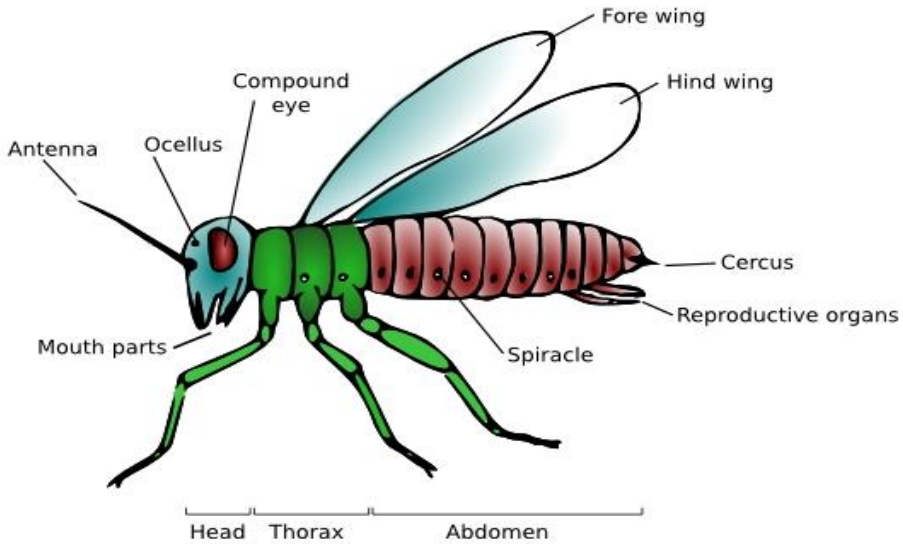
- Segmented bodies with an **exoskeleton**. The outer layer of the exoskeleton is called the **cuticle**. It is made up of two layers. The outer layer, or **exocuticle**, is thin, waxy, and water-resistant. The inner layer

is much thicker. The exocuticle is extremely thin in many soft-bodied insects, such as caterpillars

- They have three pairs of jointed legs. Insects use various types of movement. Insect movement can include flight, walking, and swimming. Insects are the only invertebrates that have the ability to fly. Many adult insects use six legs for walking, and they walk in alternate triangles touching the ground. This allows the insect to walk quickly while staying stable.
- They have a pair of feelers or antennae
- They have a pair of compound eyes.
- A closed digestive system, with one long enclosed coiled tube which runs lengthwise through the body, from the mouth to the anus.
- They reproduce by laying eggs
- Respiration through the **spiracles** i.e., openings on the sides of the abdomen.
- The segments of the body are organized into three distinct but joined units: a head, a thorax, and an abdomen. (Table below)

Structure	Description
Head	A pair of antennae, a pair of compound eyes, and three sets of appendages that form the mouthparts.
Thorax	Six segmented legs and two or four wings.
Abdomen	Contains most of the digestive, respiratory, excretory, and reproductive structures (ovipositors)

Diagram showing parts of an insect



Functions of parts of an insect

- **Mouth**
  i. Proboscis is a tube for sucking food in insects like mosquitoes, house flies, bees, tsetse flies etc.
  ii. Mandibles are used for chewing in insects like grasshoppers, locusts, cockroaches, beetles, etc.
- **Antennae/ feelers**
  These are used as sense organ for touch, smell detecting sound (hearing) and detecting changes in temperature, humidity and finding direction.
- **Wings** for flying
- **Compound eyes** for seeing
- **Halteres** in housefly for balancing during flight.
- **Spiracles** for breathing

Social life of insects

Some insects, such as termites, ants, and many bees and wasps are the most familiar social species. They live together in large, well-organized colonies. Only those insects which live in nests or colonies can home. **Homing** means that an insect can return to a single hole among many other apparently identical holes, even after a long trip or after a long time.

Groups of Insects

Insects are divided into two major groups:

1. Wingless: Consists of the bristle tails and the silverfish.
2. Winged insects: All other kinds of insects. They are named below.

Mayflies; dragonflies and damselflies; stoneflies; web spinners; angel insects; earwigs; grasshoppers, crickets, and katydids; stick insects; ice-crawlers and gladiators; cockroaches and termites; mantis; lice; thrips; true bugs, aphids, and cicadas; wasps, bees, and ants; beetles; twisted-winged parasites; snake flies; alderflies and dobsonflies; lacewings and ant lions; hanging flies (including fleas); true flies; caddis flies; and butterflies, moths, and skippers.

Life cycle of insects (metamorphosis)

The word metamorphosis means change in form.
There are two types of life cycle in insects

- Complete metamorphosis
- Incomplete metamorphosis

Complete metamorphosis

This is a life cycle of some insects which go through four stages of development namely;
Eggs – Larva – Pupa – Adult

Examples of insects which undergo complete metamorphosis

- Houseflies
- Mosquitoes
- Butterflies
- Beetles
- Ants
- Scorpion flies
- Bees
- Fleas
- Moth
- Wasps
- Tsetse fly

Life of a housefly

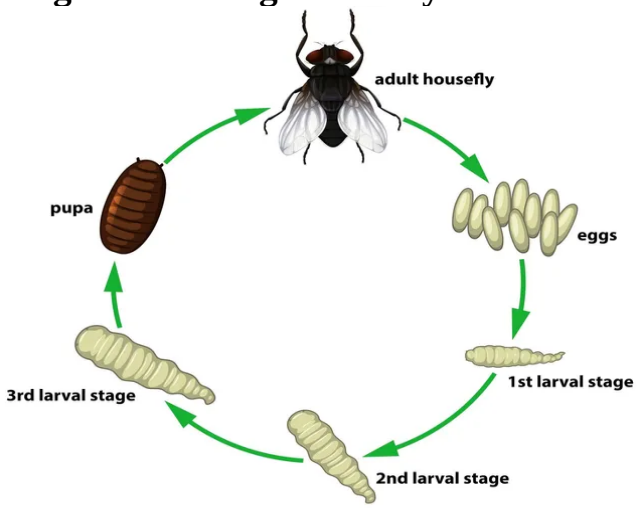
Adults lay eggs in batches of 100-150 eggs in manure heap, rotting bodies, exposed food or faeces.

The eggs hatch into larva called maggots after a day.

Note: Some flies such as blue bottle fly hatch the eggs from inside the body and lay maggots.

- Maggots feed on decaying matter, grow quickly and turn into pupa after 4-6 days.
- The pupa does not feed but grows from inside a case called Cocoon.
- The adult crawls out of the pupa after about 4-5 days.

Diagram showing the life cycle of a housefly



Dangers/economic importance of houseflies

- They carry germs on their body, saliva or mouth parts, which cause the following diseases; diarrhea, dysentery, cholera, typhoid, trachoma, red eyes.
- They help to reduce the volume of faeces in latrines which get filled up quickly.

MOSQUITOES

There are three main types of mosquitoes namely anopheles, mosquito, Culex mosquito, aedes/ tiger mosquito.

Anopheles mosquitoes

- Female anopheles mosquitoes spread a protozoan called plasmodia which causes malaria in humans.
- Culex mosquitoes spread worms called Filaria which causes elephantiasis/filariasis.
- Aedes/ tiger mosquitoes spread a virus causes dengue fever and yellow fever in human beings.

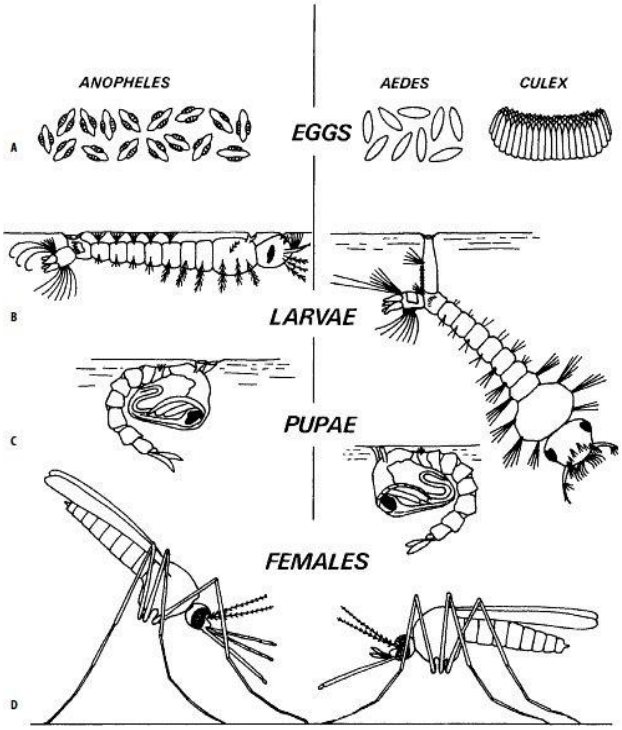
Life cycle of mosquitoes

Adult mosquitoes lay eggs in stagnant water.

After 2-3 days the eggs hatch into larva called Wrigglers which breathe through a spiracle on the tail end called Siphon/breathing trumpet.

After 2-3 weeks from eggs a fully grown adult comes out of the pupa.

Diagram showing life cycle of mosquitoes



Difference between anopheles and culex mosquitoes

Anopheles	**Culex**
Lays eggs with an air float	Lays eggs in crafts /clusters
The larva lies parallel to the water surface when breathing.	The larva lies at an angle to the water when breathing.
Adult lies in a sloppy position when at rest/.	Adult lies horizontally when at rest.

Ways of controlling mosquitoes

- Drain stagnant water around homes.
- Burry old fins, broken pots, or bottles where mosquitoes can breed.
- Clear all bushes around homes where mosquitoes can hide
- Spray adult mosquitoes with insecticides
- Sleep under insecticide treated nets.
- Keep fish in dams or reserves of water to eat mosquitoes, larva.
- Close doors and windows early in the evening
- Apply repellants on the body to drive away mosquitoes
- Plant trees /flowers that can repel mosquitoes in the compound.

Butterflies and moth

- They undergo complete metamorphosis
- Female lays eggs mainly on the underside of the leaves
- Eggs hatch into larva / caterpillars which feed on leaves
- The larva spins a cocoon around itself and changes into pupa/chrysalis which does not move or eat i.e., it is dormant.
- When the adult is full grown, it breaks the pupa case and comes out.

Advantages of butterflies and moths

- They help in pollinating flowers of farmer's crops.
- We get silk breads from the cocoons of some butterflies
- Caterpillars are eaten in some societies as food.

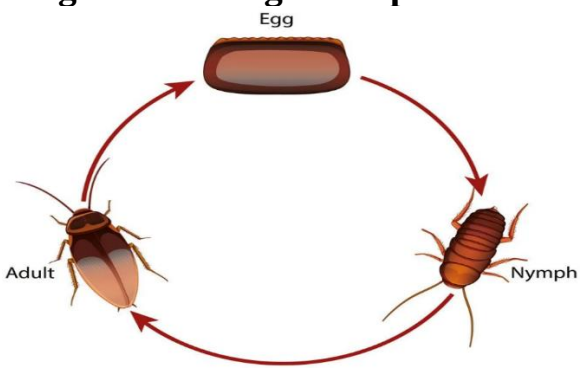
Disadvantages of butterflies and moths

- Their larva /caterpillars feed on leaves of crops / plants destroying them (crop pests)
- Caterpillars have bristle hairs which can burn and cause irritation itching or wounds on the skin.

Incomplete metamorphosis

This is a life cycle which involves three stages i.e.
Eggs – Nymph – Adult (imago)
The adult female lays eggs in the soil in an egg sac (pouch)
After a few days the eggs hatch into Nymphs
After several changes / moulting, the nymph develops wings and becomes a fully developed adult.

Diagram showing incomplete metamorphosis



Examples of insects which undergo incomplete metamorphosis

- Cockroaches
- Scale insect
- Whitefly
- Leafhoppers
- Grasshopper
- Crickets
- Dragon flies
- Damselflies
- Bed bugs
- Earwigs
- Termites
- Aphids
- Silverfish
- Praying mantis
- Walking sticks

Harmful and useful insects

Harmful Insects

Dangers in animals

Many types of mosquitoes, flies, fleas, lice, and bugs transmit diseases causing organisms to man and domestic animals. Some of these are:

- Mosquito: Female Anopheles mosquito transmits Plasmodium. Plasmodium causes malaria in man.
- Tsetse fly: It transmits Trypanosoma in humans. Trypanosoma causes sleeping sickness. Some species of Trypanosoma also cause nagana in cattle.
- Common house fly: It transmits disease-causing organisms to food. This contaminated food causes cholera, hepatitis, typhoid, diarrhoea, dysentery etc.

Dangers in Plants:

- A large number of insects lay eggs on fruits and other commercial crops like sugar-cane, maize (corn), cotton, and vegetables. The larvae of these animals damage fruits and crops. It causes economic losses to the farmers.
- The locust moves a large number from country to country. They damage the garden crops and other plants.

Useful insects

The following are ways insects are useful:

- The honey bee provides man honey and wax.
- Silkworm gives us silk.
- Some insects eat harmful insects.
- Some insects are scavengers. They eat dead animals and decayed vegetables.
- The larvae of insects are sources of food for fish.

Topic 2: Sound energy

Sound energy is a form of energy produced by vibrations of an object.
Sound is a form of energy that stimulates the sense of hearing (that enables us to hear)
Note: sound is measured in units called **decibels**.
TYPES

i. Loud sound
ii. Soft sound
iii. High sound
iv. Low sound.

Sources of sound
Natural sources

- Animals
- Wind
- Storm
- Volcanic eruption

Artificial sources
Musical instruments

How is sound produced?
Sound is produced by vibrations of an object. (when an object vibrates)

What is a vibration?
A vibration is a to and fro motion which is continuously repeated.
Ways living things produce sound

- Human beings produce sound by the vibration of their vocal cords. Vocal cords are found in the voice box. When air passes over them, they vibrate and produce sound.
- Crickets produce sound by rubbing their wings against the hind legs.
- Birds sing by the help of their rings of cartilage.
- Bees and mosquitoes produce sound by flapping their wings rapidly.

Transmission of sound
How does sound travel?
Sound travels in sound waves. It travels through the following media:

- Air
- Water
- Solid materials

N.B sound does not travel through vacuum.

- The speed of sound in air is 330m/sec
- The speed of sound in water is 1485m/s.
- The speed of sound in metals (solids) is 4800m/sec

Therefore

i. Sound travels fast in gasses
ii. Sound travels faster in liquids.
iii. Sound travels fastest in solids.

Factors affecting the speed of sound

The speed of sound in air is influenced by several factors

1. **Temperature:**
   - **Effect:** The speed of sound in air is directly proportional to the square root of the absolute temperature. In general, sound travels faster in warmer air.
   - **Explanation:** Warmer air molecules move more rapidly, increasing the speed at which sound waves can travel through them.
2. **Wind:**
   - **Effect:** Wind can affect the speed of sound, but its impact is generally small compared to other factors. If sound is traveling in the same direction as the wind, it can experience a slight increase in speed; if traveling against the wind, it may experience a slight decrease.
   - **Explanation:** Wind can either assist or impede the motion of sound waves, influencing their overall speed.
3. **Altitude:**
   - **Effect:** Sound travels faster at higher altitudes.
   - **Explanation:** At higher altitudes, the air density is lower. Since sound waves travel through air molecules, the reduced air density at higher altitudes allows sound waves to propagate more quickly.
4. **Heat:**
   - **Effect:** The heat in the environment can influence the speed of sound. However, it is often indirectly related to temperature.
   - **Explanation:** Heat can affect the temperature of the air, and as mentioned earlier, temperature is a significant factor in determining the speed of sound. Hotter environments generally lead to faster sound propagation.

Frequency

The frequency of sound refers to the number of vibrations per second produced by a sound wave.

It's measured in hertz (Hz), where one hertz equals one vibration cycle per second.

In simpler terms, frequency determines how high or low a sound is perceived to be. Higher frequencies create higher-pitched sounds, while lower frequencies create lower-pitched sounds.

Pitch
This is the highness or lowness of sound.
An experiment on pitch.

Title: Making Straw Panpipes

Materials:

1. Plastic drinking straws
2. Scissors
3. Ruler or measuring tape
4. Tape
5. Pencil or pen
6. Small container or cup
7. Water

Procedure:

1. **Cutting the Straws:**
    - Give each student several plastic drinking straws.
    - Instruct them to cut the straws into different lengths using scissors. They can experiment with various lengths, such as 10 cm, 15 cm, 20 cm, and so on.
2. **Arranging the Straws:**
    - Once the straws are cut, have the students arrange them in order from shortest to longest.
    - Tape the straws together side by side to create a panpipe-like structure. Make sure they are secured tightly.
3. **Creating a Water Container:**
    - Fill a small container or cup with water.
4. **Dipping the Straws:**
    - Instruct the students to dip the longer end of the panpipe (the end with the longer straws) into the water.
5. **Blowing Across the Tops:**
    - Have the students blow across the tops of the straws, not into them.
    - Ask them to observe and listen to the different pitches produced by the panpipe.

Observations and Questions:

- Ask the students to describe what happens when they blow across the straws.
- Encourage them to note any differences in pitch between the shorter and longer straws.
- Discuss why changing the length of the straws affects the pitch.

Explanation:

- The length of the straws determines the pitch of the sound produced. Shorter straws generally produce higher-pitched sounds, while longer straws produce lower-pitched sounds. This experiment introduces the concept that pitch is related to the frequency of vibrations, and changing the length of the vibrating column (in this case, the straw) alters the pitch.

What determines the pitch of sound?

1. **Size of a Vibrating Object:**
    - **Effect:** Larger objects tend to produce lower-pitched sounds, while smaller objects produce higher-pitched sounds.
    - **Explanation:** The size of the vibrating object influences the wavelength of the sound waves it produces. Larger objects have longer wavelengths and lower frequencies, resulting in lower pitch.
2. **Length of a Vibrating String:**
    - **Effect:** Longer vibrating strings produce lower-pitched sounds, and shorter strings produce higher-pitched sounds.
    - **Explanation:** The length of a vibrating string affects the fundamental frequency it produces. Longer strings vibrate more slowly, creating lower-pitched sounds, while shorter strings vibrate more quickly, producing higher-pitched sounds.
3. **Thickness of the Vibrating String:**
    - **Effect:** Thicker strings tend to produce lower-pitched sounds, while thinner strings produce higher-pitched sounds.
    - **Explanation:** The thickness of a vibrating string influences its mass and, consequently, its ability to vibrate. Thicker strings vibrate more slowly, resulting in lower pitch, while thinner strings vibrate more quickly, producing higher pitch.
4. **Tension:**
    - **Effect:** Higher tension in a vibrating object or string generally leads to higher-pitched sounds.
    - **Explanation:** Tension influences the stiffness of the vibrating object. Higher tension results in higher stiffness, causing the object or string to vibrate more quickly and produce higher-frequency sound waves.
5. **Frequency:**
    - **Effect:** Frequency directly determines the pitch of a sound. Higher frequencies correspond to higher pitch, and lower frequencies correspond to lower pitch.
    - **Explanation:** The frequency of a vibrating object refers to the number of vibrations or cycles per unit of time. Higher frequency means more vibrations per second, resulting in a higher-pitched sound.

Volume
It is the loudness or softness of sound.

Echo
An echo is a reflected sound (the bouncing back of sound waves)
Echo is formed when sound is reflected by an object.

Uses of echo in nature.

1. **Location and Navigation:**
    - Bats use echolocation, a form of biological sonar, to navigate and locate prey in complete darkness. They emit high-frequency sounds and use the returning echoes to determine the location, distance, size, shape, and even texture of objects around them.
2. **Communication in Birds:**
    - Some birds use echoes as a means of communication. For example, certain species of birds in dense forests may produce calls that bounce off the trees. This helps them communicate with distant members of their group or signal the presence of potential threats.
3. **Determination of Object Characteristics:**
    - Some animals, like dolphins, use echolocation not only for navigation but also to determine the size, shape, and texture of objects in their environment. This ability aids in hunting and social interactions.
4. **Orientation in Caves:**
    - Certain cave-dwelling animals, such as certain species of bats, use echoes to navigate through complex cave systems. The echoes help them avoid obstacles and locate suitable roosting spots.
5. **Location of Prey by Marine Mammals:**
    - Marine mammals like whales and dolphins use echolocation to locate prey in the vast ocean. By emitting sounds and listening to the returning echoes, they can identify the location and size of fish or other marine organisms.
6. **Communication in Insects:**
    - Some insects, such as crickets, use sound signals that can create echoes. These echoes may play a role in mating communication, helping the insects attract mates or establish territory.
7. **Survival in Nocturnal Animals:**
    - Nocturnal animals, like certain rodents and marsupials, may use echoes to navigate and locate food during the night when visibility is limited.
8. **Communication in Caves:**
    - In cave environments, where visibility is often low or absent, echoes may be used by certain animals for communication. This can include mating calls, warning signals, or territory marking.

Uses of echoes to people.

1. **Sonar Technology:**
    - Echoes are widely used in sonar technology for underwater navigation and detection. Submarines and ships use sonar systems to emit sound waves and listen for the returning echoes, allowing them to navigate and detect underwater obstacles.
2. **Medical Ultrasound Imaging:**
    - Ultrasound imaging in medicine relies on the use of echoes. High-frequency sound waves are directed into the body, and the echoes bouncing off internal structures are used to create detailed images of organs, tissues, and developing fetuses.
3. **Distance Measurement:**
    - Some distance measurement devices, such as rangefinders, utilize echoes to determine the distance to a target. For example, laser rangefinders emit a laser beam and measure the time it takes for the beam to return as an echo, providing distance information.
4. **Acoustic Design in Architecture:**
    - Architects and engineers use knowledge of echoes to design spaces with optimal acoustics. This includes designing concert halls, theaters, and auditoriums to minimize echoes and enhance sound quality.
5. **Sports and Outdoor Activities:**
    - In outdoor settings, people often use echoes for entertainment or communication. Shouting or producing a loud sound in a canyon or open space can result in echoes that can be enjoyed for recreational purposes or used for communication over long distances.
6. **Echo Location for the Blind:**
    - Some visually impaired individuals use echoes to navigate their surroundings. By making sounds and listening to the returning echoes, they can perceive the layout of the environment and identify obstacles.
7. **Search and Rescue Operations:**
    - In search and rescue missions, echoes can be utilized to locate individuals in remote or challenging terrain. Rescuers may use loudspeakers or signals, and the returning echoes help in determining the location of stranded individuals.
8. **Entertainment and Music:**
    - Musicians and sound engineers use echoes deliberately in music production for artistic effects. Echo effects are created using electronic devices, and they contribute to the overall sound quality and atmosphere of musical compositions.

Ways of preventing echoes.

Cinema halls. Theatres and confidence halls are covered with boards and thick carpets to reduce echo by absorbing sound.

MUSICAL INSTRUMENTS

They are classified into three:

- String instruments
- Wind instruments
- Percussion instruments

String instruments

String instruments are instruments that produce sound by vibration of their strings when plucked.

Examples

i. Guitar
ii. Tube fiddle
iii. Harp
iv. Lyre etc.

Guitar

Tube fiddle

Harp

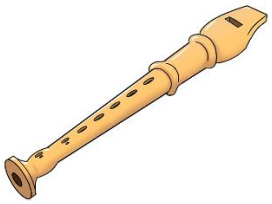
Other string instruments

Wind instruments

Wind instruments are instruments that produce sound by vibration of air blown inside them.

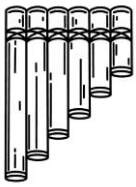
Examples

- Recorders
- Whistles
- Trumpet
- Panpipes
- Flute etc.



Recorder

Flute



Pan pipe

Percussion instruments

Percussion instruments are instruments that produce sound by vibration of their surfaces when hit.

Examples

- Drums
- Thumb piano
- Shakers
- Xylophone
- Rattles etc.

Drum

Long drum (Tom-tom)

Thumb piano

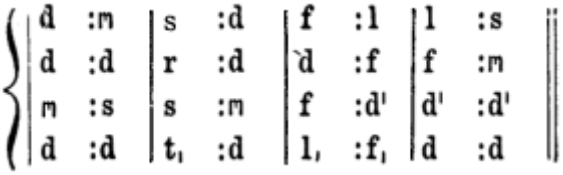
Xylophone

Triangle

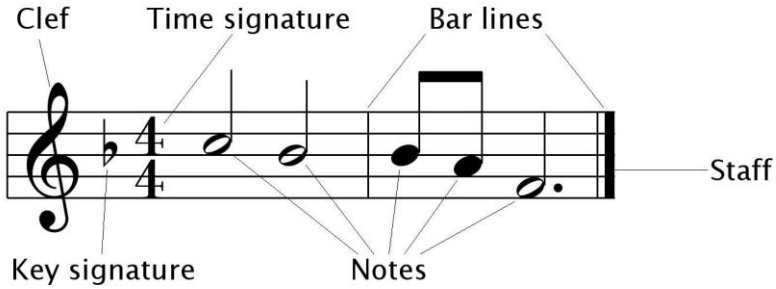
Shakers

Methods of storing sound

- Recording method
- Notation method
  i) Solfa notation
  ii) Staff notation



Solfa notation



Staff notation

Methods of reproducing sound

- Singing (human voice)
- Playing musical instruments

Devices used in storing sound.

- Compact discs (C.D)
- Flash discs
- Magnetic cassette tapes
- Memory cards
- Hard disks (hard drives) HDD
- Solid state drives (SSD)

Devices used to reproduce sound

- Use radio cassettes
- Using tape recorders
- Using video decks
- Using film projectors.
- Computer
- Laptops
- Smart phones
- DVD players

Video cassette tape

Audio cassette tape

Solid state drive

Memory card

Flash pen drive

Hard disk drive

Compact disc

DVD player

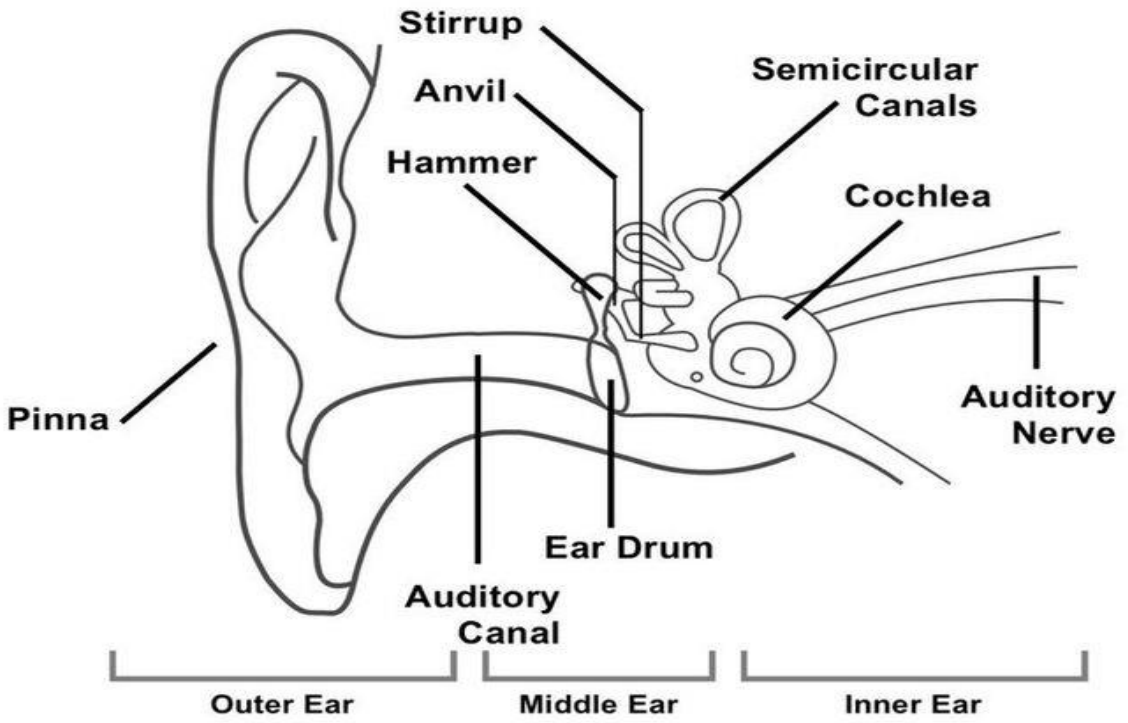
Video deck

THE MAMMALIAN EAR

The ear is a sense organ involved in hearing. It is found in almost all vertebrates. They are usually found in a pair, one on each side of the head. It is involved in hearing and maintaining of body balance and posture.

The ear is divided into three: The ear is usually divided into three sections surrounded by a bone. These are the **outer ear**, **middle ear** and **inner ear**.

Structure and functions of parts of the mammalian ear (human)



Functions of parts of the human ear

1. **Outer Ear:**
    - **Pinna (Auricle):** The visible, external part of the ear.
        - **Function:** Gathers sound waves and directs them into the ear canal.
    - **Ear Canal (Auditory Canal):**
        - **Function:** Conducts sound waves to the eardrum.
2. **Middle Ear:**
    - **Eardrum (Tympanic Membrane):**

        - **Function:** Receives sound waves from the ear canal and vibrates in response.
    - **Ossicles (Malleus, Incus, Stapes):**
        - **Function:** Transmit vibrations from the eardrum to the oval window of the inner ear.
    - **Eustachian Tube:**
        - **Function:** Equalizes air pressure between the middle ear and the atmosphere, helping to prevent the eardrum from being damaged.
3. **Inner Ear:**
    - **Cochlea:**
        - **Function:** Converts mechanical vibrations into electrical signals that are sent to the brain for interpretation. It plays a crucial role in the sense of hearing.
    - **Vestibular System:**
        - **Semicircular Canals and Vestibule:**
            - **Function:** Contribute to the sense of balance and spatial orientation by detecting changes in head position and movement.
4. **Auditory Nerve:**
    - **Function:** Carries electrical signals from the cochlea to the brain, where they are processed and interpreted as sound.
5. **Eustachian Tube:**
    - **Function:** Connects the middle ear to the back of the throat, allowing for the equalization of pressure on both sides of the eardrum. This is crucial for maintaining optimal hearing conditions.
6. **Round and Oval Windows:**
    - **Function:** Transmit vibrations from the middle ear to the fluid-filled cochlea in the inner ear.
7. **Hair Cells:**
    - **Function:** Located in the cochlea, these specialized cells are responsible for converting mechanical vibrations into electrical signals that are sent to the brain.

How the ear works

Vibrations of sound cause the sensation of hearing. These vibrations pass through air in the form of sound waves. On reaching the ear, the sound waves are directed by the pinna into the ear tube and then the eardrum. On reaching the eardrum, eardrum causes sound waves to vibrate. The vibration of the eardrum causes the ear ossicles, malleus in contact with it to vibrate. The malleus in turn causes the incus to vibrate which in turn causes the stapes to vibrate. As these vibrations pass through the ossicles, they are amplified. The last ossicle (the stapes) causes the oval window to vibrate. These vibrations are then transmitted to the round window. The vibrating oval window causes the fluid inside the

cochlea to vibrate accordingly. The sensory cells in the cochlea are stimulated by the vibrations reaching them. They start nerve impulses which are transmitted to the brain via the auditory nerve. On reaching the brain, the impulses are interpreted into sound. We are then able to learn the sound as it came from the source.

Common diseases of the ear

1. **Otitis Media:**
    - **Description:** Inflammation or infection of the middle ear.
    - **Symptoms:** Ear pain, fluid drainage, hearing loss, and sometimes fever.
    - **Causes:** Bacterial or viral infections, often following a respiratory infection.
2. **Otitis Externa (Swimmer's Ear):**
    - **Description:** Inflammation or infection of the outer ear canal.
    - **Symptoms:** Itching, pain, redness, and swelling of the ear canal; sometimes drainage.
    - **Causes:** Exposure to water, especially in humid environments, providing a favorable condition for bacterial or fungal growth.

N.B Disorder may be foreign bodies and any harm caused by an accident.

Disorders of the ear

1. **Hearing Loss (deafness):**
    - **Description:** Partial or permanent loss of the ability to hear sounds.
    - **Types:** Conductive (related to problems in the ear canal, eardrum, or middle ear) or sensorineural (related to damage in the inner ear or auditory nerve).
    - **Causes:** Aging, noise exposure, genetic factors, infections, trauma, or certain medications.
2. **Tinnitus:**
    - **Description:** Perception of noise, such as ringing or buzzing, in the ears without an external sound source.
    - **Symptoms:** Persistent noise in one or both ears.
    - **Causes:** Exposure to loud noise, age-related hearing loss, earwax blockage, or underlying medical conditions.
3. **Earwax Impaction:**
    - **Description:** Buildup of earwax that causes blockage in the ear canal.
    - **Symptoms:** Earache, hearing loss, tinnitus, dizziness.
    - **Causes:** Overproduction of earwax, use of cotton swabs that push wax deeper, or narrowing of the ear canal.
4. **Labyrinthitis:**
    - **Description:** Inflammation of the inner ear, often resulting from a viral or bacterial infection.
    - **Symptoms:** Vertigo, hearing loss, nausea, and vomiting.
    - **Causes:** Infections, respiratory illnesses, or viral infections affecting the inner ear.

5. **Acoustic Neuroma:**
    - **Description:** A noncancerous tumor that develops on the vestibular nerve, which connects the ear to the brain.
    - **Symptoms:** Gradual hearing loss, ringing in the ear, and imbalance.
    - **Causes:** The exact cause is unknown, but it may be associated with genetic factors.

CARE FOR THE EAR.

1. **Keep Your Ears Dry:**
    - Dry your ears thoroughly after swimming or bathing. Tilt your head to each side to allow any trapped water to drain out.
2. **Earwax Management:**
    - **Don't insert objects:** Avoid using cotton swabs or any other objects to clean your ear canal. This can push earwax deeper and increase the risk of impaction.
    - **Seek professional help:** If you have excessive earwax or earwax impaction, consult a healthcare professional for safe removal.
3. **Protect Your Ears from Loud Noise:**
    - Use ear protection, such as earplugs or earmuffs, when exposed to loud noises for an extended period. This is crucial for preventing noise-induced hearing loss.
4. **Maintain Ear Hygiene:**
    - Clean the outer ear: ** Gently clean the outer part of your ears with a washcloth during your regular hygiene routine. Avoid inserting anything into the ear canal.
5. **Avoid Smoking:**
    - Smoking can contribute to earwax buildup and increase the risk of infections. Quitting smoking is beneficial for overall ear and health.
6. **Regular Hearing Checkups:**
    - Schedule regular checkups with an audiologist or healthcare professional for hearing assessments, especially if you have concerns about your hearing.
7. **Monitor and Manage Medical Conditions:**
    - Conditions like diabetes, cardiovascular disease, and high blood pressure can affect ear health. Manage these conditions with proper medical care.
8. **Stay Hydrated:**
    - Proper hydration is important for overall health, including the health of the delicate tissues in the ear.
9. **Protect Your Ears in Harsh Weather:**
    - During cold or windy weather, wear a hat or ear coverings to protect your ears from harsh conditions.

Topic 3: The circulatory system

The mammalian circulatory system consists of a **heart** which pumps blood to circulate through a well-defined network of vessels (arteries, veins and capillaries) throughout the body.
The type of circulatory system in humans is **double circulatory system** in which blood passes through the heart twice before completing a full circuit.

Functions of the human circulatory system

- Transport oxygen to blood cells.
- Transport digested food nutrients to the cells of the body.
- Transport carbon dioxide from cells to excretory organs.
- Transport hormones to the glands.

Parts of the circulatory system;

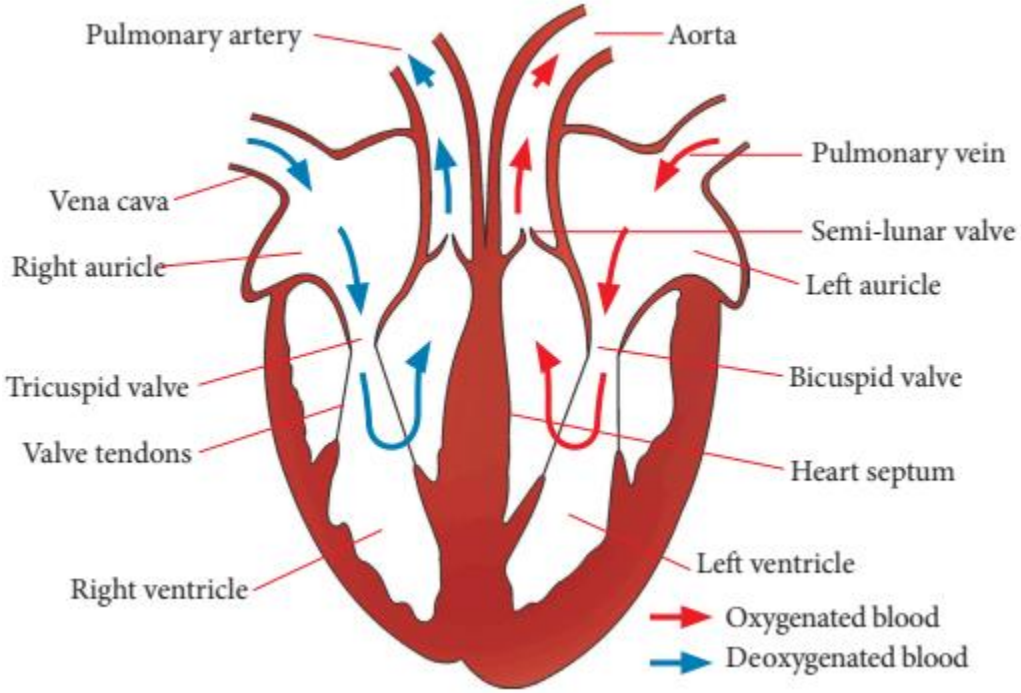
The circulatory system in human beings is made up of three main organs:

- **The heart** -This is a muscular organ that **pumps** blood to all parts of the body.
- **Blood vessels** -These are **tubes** that carry blood around the body. They are of different types depending on what they do.
- **Blood** - This is the red **fluid** that **transports** substances in the body.

The heart

The heart is a muscular organ about the size of the fist. It lies inside the chest cavity between the two lungs.
The heart is surrounded by a tough membrane called the **pericardium** which covers and protects it. The heart is also protected by the **ribcage** in the chest.
The heart is divided into two sides, the left and the right side which are completely separated by a wall called the **septum**.
The septum prevents blood on the right side from mixing with that on the left side. Each side consists of a small upper chamber called the **atrium** (plural atria) and a larger lower chamber called the **ventricle**. This makes the mammalian heart a four-chambered organ. The atria (also called auricles) are thin walled and receive blood into the heart which they pump to the ventricles. The ventricles are thick walled and pump blood out of the heart.
The heart is made of special muscle called **cardiac muscle**.
The heart receives food nutrients and oxygen via a vessel known as the **coronary artery** which branches from the aorta and spreads through the heart muscle.

The structure of the heart



The heart is divided into four chambers:
The upper chambers are called atria (atrium) and the lower chambers are called ventricles.

How the heart works

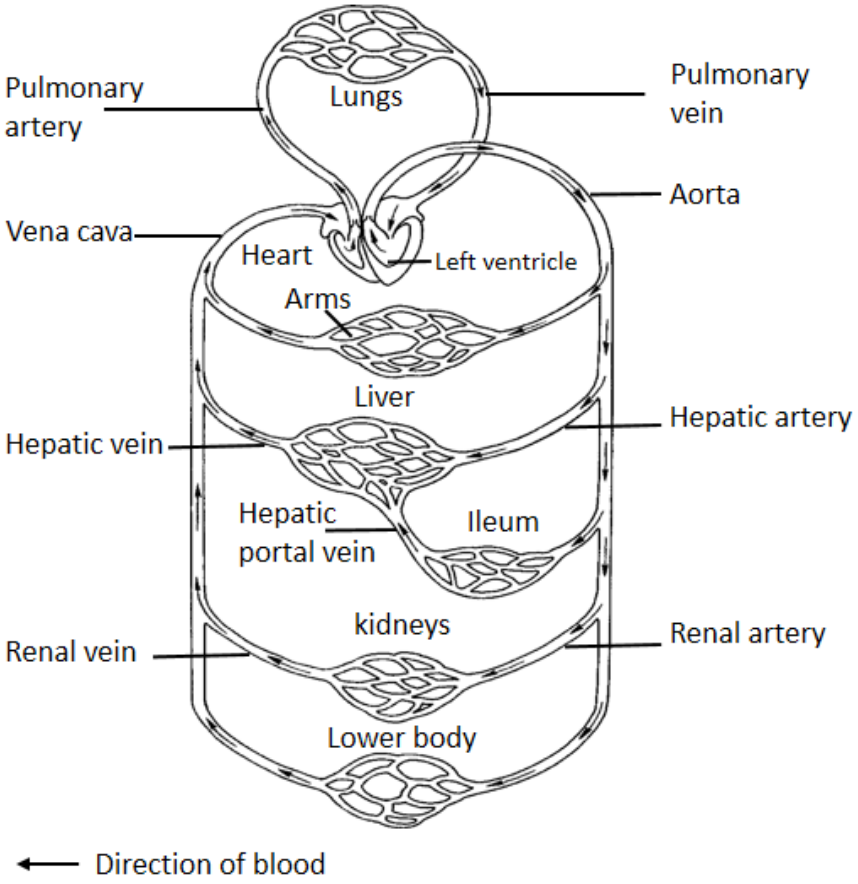
The function of the heart is to receive and pump blood. The heart receives blood when its muscles relax. It pumps blood when its muscles contract. These two processes take place in a repeated sequence or cycle known as the heart or **cardiac cycle**. The cardiac cycle has two alternating phases known as **systole** and **diastole**. During systole, the muscles of the heart chambers contract to pump out blood. During diastole, muscles of the heart chamber relax for them to receive blood.
The right atrium receives blood coming from the body tissues through the vena cava. This blood has very little oxygen dissolved in it because most of the oxygen has been taken up for respiration by the tissues. It is however rich in carbon dioxide and appears dull red in colour. This blood is described as **de-oxygenated blood.**
The right atrium then pumps the blood into the right ventricle via the tricuspid valve. When full, the right ventricle lets blood into the pulmonary artery. Semi-lunar valves at the opening of this artery prevent back flow into the right ventricle. At the same time, the tricuspid valve prevents any back flow of blood into the right atrium. The pulmonary artery carries blood to the lungs. In the lungs the blood picks up oxygen and gives up carbon dioxide. It is now said to be **oxygenated** and is bright red in colour. It goes to the left atrium of the heart via the pulmonary vein. The left atrium lets blood into the left ventricle via the bicuspid valve. The left ventricle pumps blood to all parts of the body, except the lungs. This blood leaves

the left ventricle through the **aorta**. Semi-lunar valves that open into the aorta prevent back flow of blood. The left ventricle walls are much thicker than the right ventricle walls in order to develop a high pressure to pump blood to all parts of the body.

Organs related to the circulation of blood.

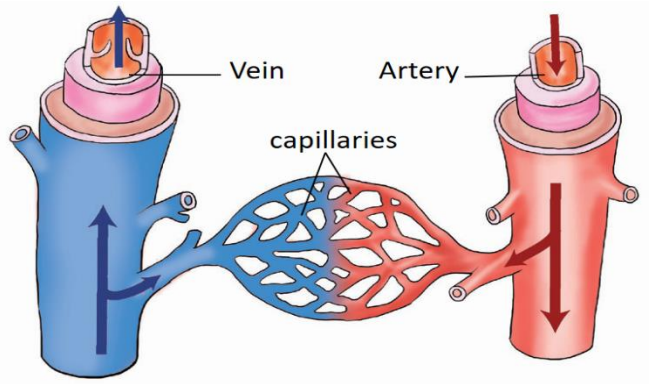
- The heart
- The lungs
- The kidneys
- Small intestines
- The liver

The diagram to show circulation of blood.



Blood vessels

Blood vessels are tube-like structures which form continuous channels through the body. They transport blood to and from the heart to the body tissues.
There are three major types of blood vessels: **arteries**, **veins** and **capillaries**.



Arteries

The heart pumps blood into vessels called arteries. Arteries carry blood away from the heart to various parts of the body. Due to the pumping action of the heart, blood from the heart enters the arteries at high pressure. Therefore, the structure of the arteries enables them to withstand the high pressure of blood flowing in them.

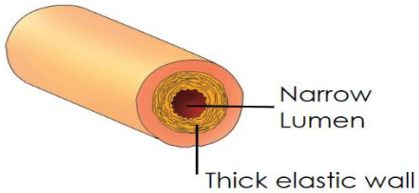
Characteristics of arteries

- They transport blood away from the heart to the body.
- Thick muscular walls to withstand and maintain higher pressure of blood.
- An outer fibrous coat for strength and protection.
- A thick layer of muscle and elastic fibres which contract and relax to adjust their diameter as blood flows through them.
- A narrow lumen to maintain the pressure of blood inside them.
- Arteries are located deep within our bodies.
- All arteries carry **oxygenated** blood except the pulmonary artery which carries deoxygenated blood.

Note

Pumping of the blood can be felt on an artery if pressure is put on it with a finger. This is known as the **pulse**. It is this pressure which makes blood in arteries to flow in only one direction i.e. it prevents backflow of blood.

Diagram showing the walls of the artery.



Capillaries

Capillaries are fine branching blood vessels that form a dense network between the arterioles and venules.

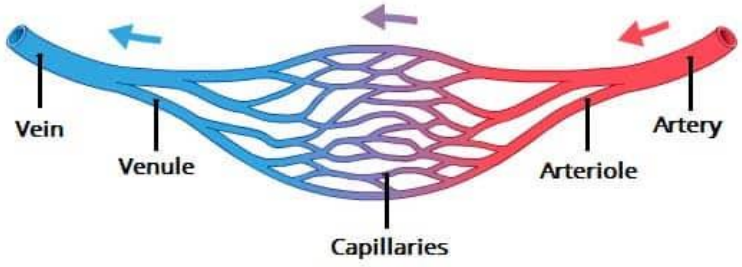
Characteristics of capillaries

- They have thin walls to allow rapid exchange of substances.
- They form a dense network which creates a large surface area over which the exchange of substances takes place.

- Their walls are narrow to allow high pressure build-up within them. This ensures faster movement of substances out of them.
- They have very thin walls made up of only one cell layer so they are the smallest blood vessels.

Capillaries join to form larger vessels known as **venules**. Venules link up to form **veins.**

The structure of a capillary



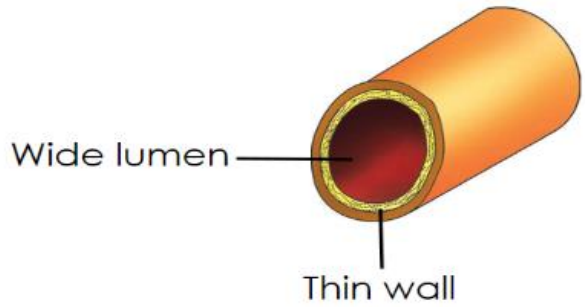
Veins

Veins carry blood from all parts of the body to the heart.
The main vein is the **vena cava**. Blood in the veins flows at much low pressure than in arteries this is because it is not directly being pumped by the heart.

Characteristics of veins

- Veins carry blood under low pressure from the tissues towards the heart.
- They have thin walls.
- Veins have a wide lumen which allows blood to flow at a low pressure.
- Veins have valves in their walls which prevents the back flow of blood thereby allow it to flow only in one direction towards the heart.
- They carry deoxygenated blood except the pulmonary vein which carries oxygenated blood.
- Portal veins have capillaries at both ends. They are unique veins that carry blood from one organ to another, for example, the hepatic portal vein which carries blood from the small intestine to the liver.

The structure of a vein



Differences between arteries, veins and capillaries

Arteries	Veins	Capillaries
Carry blood away from the heart.	Carry blood towards the heart.	Carry blood from the arteries to veins
Carry blood rich in oxygen except the pulmonary artery.	Carry blood low in oxygen except the pulmonary vein	Oxygen diffuses into the tissue fluid from them.
Blood is under very high pressure	Blood is under low pressure	High pressure of blood for filtration of substances.
Blood flows in pulses	Blood flows with no pulse	Blood flows with no pulse
No valves except at the points where arteries leave the heart	Have valves	No valves
Have thick muscular elastic walls	Walls are thin, less muscular and inelastic	Are one cell thick
Have a narrow lumen	Have a larger lumen	Have very narrow lumen (microscopic)
Are located deep in the body	Are located nearer the skin	Are located in all tissues

Blood

Blood is the red body fluid which transports materials in our body. It is a liquid tissue that contains suspended substances as well as dissolved substances. Blood has three major functions:

- Regulation of body temperature.
- Protection against disease germs.
- A medium of transport of materials to and from other tissues.

Composition of blood

Blood is composed of **components** suspended in a pale-yellow watery fluid known as **plasma**. The components of blood are the **blood cells** and the **plasma**. There are three types of **blood cells: red blood cells** also known as erythrocytes the **white blood cells** also known as leucocytes and platelets.

In a normal health person, there are about 5 to 6 litres of blood.

Plasma

Plasma is the liquid part of blood. It makes up about 55% of the total volume of blood. The other 45% of the blood is made up of the red blood cells, white blood cells and the platelets. Blood plasma is clear and pale yellow in colour when separated from the cells of blood. Ninety per cent of blood plasma is made up of

water. The remaining ten per cent consists of a variety of substances that are dissolved in the water. These substances dissolved in plasma include:

- **Food substances** - glucose, amino acids and fatty acids.
- **Vitamins** and **mineral salts** from digestion.
- **Waste substances** - carbon dioxide and urea.
- **Hormones** – e.g., adrenaline and insulin among others.

Functions of blood plasma

The plasma transports substances dissolved in it from one part of the body to another.

i. **Transportation of carbon dioxide**
   Carbon dioxide is formed from reactions that release energy in the cells. Carbon dioxide can be toxic to the cells at high levels and must be removed before it accumulates.
ii. **Transportation of waste substances**
   End products of metabolic wastes in the body such as urea, carbon IV oxide and urine are transported to various excretory organs for elimination from the body.
iii. **Transportation of heat**
   Transport of heat by the blood helps distribute it evenly within the body tissues. Most heat originates from an organ like the liver in which many heat-producing chemical reactions occur.
iv. **Transportation of hormones**
   The blood plasma serves as a medium in which hormones are transported from the glands that produce them, to specific target organs on which they act.
v. **Transportation of antibodies**
   Antibodies are chemical substances that protect the body from disease causing micro-organisms. They are transported in the plasma.
vi. **Transportation of nutrients**
   Many of the products of digestion such as glucose and amino acids are dissolved in the plasma before they are transported from the small intestines to the liver either for storage or for further transport to cells in body organs

Red blood cells

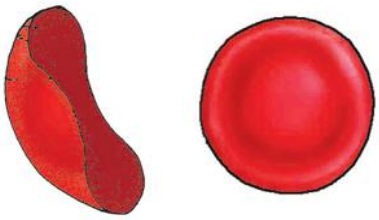
These are very tiny cells. They are **disc shaped** and **biconcave** and appear as discs which are thinner in the centre than around the edge. Each red blood cell lives for about 4 months, after which it breaks down by the help of the **liver**. Iron from destroyed cells is reused in the body to make haemoglobin in new red blood cells.

Characteristics of red blood cells

- They contain a red iron-containing pigment called **haemoglobin**. haemoglobin helps in carrying oxygen from the lungs to the tissues.

- Red blood cells have no nucleus. This creates space for more haemoglobin to be packed in them.
- Red blood cells are also very many in number. There are about five million red blood cells in every cubic millimetre (mm3) of human blood.
- They are made in red bone marrow of short bones like sternum, scapula, ribs, vertebra and pelvis.
- Their function is to transport oxygen in the body.
- They are **disc shaped.**

The structure of a red blood cell.



Functions of the red blood cells

The main function of the red blood cells is to transport **oxygen** from the lungs to the body tissues. The haemoglobin found in these cells readily combines with oxygen when the blood passes through the lungs to form **oxyhaemoglobin**. Blood that contains mainly oxyhaemoglobin is said to be **oxygenated**. Blood with little oxyhaemoglobin is **deoxygenated**.

White Blood cells

White blood cells are larger than the red cells and they all have a nucleus. There is one white cell to every 600 red cells and they are made in the bone marrow. Many of them undergo a process of maturation and development in the thymus gland, lymph nodes or spleen.

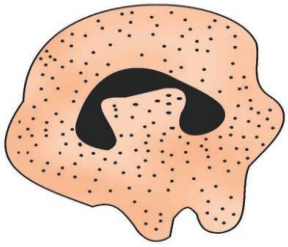
Characteristics of white blood cells

- They are colourless and are fewer in number. There are about 6000 white blood cells per cm3 of blood.
- These are larger than red blood cells.
- They have a nucleus but no haemoglobin.
- They are made in red bone marrow. Lymph nodes and the spleen.
- Their main function is to fight against disease germs.

Qn. How do white blood cells defend the body?

- By engulfing and digesting germs.
- By producing anti bodies against the germs.

An illustration of a white blood cell



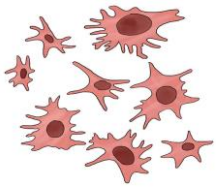
Platelets

Blood platelets are also known as **thrombocytes**. They are fragments from larger cells. They are very small and have no nucleus. Platelets are formed by the pinching off of bits of cytoplasm from large cells inside the bone marrow. Although these bits of cytoplasm contain no nuclei, they are surrounded by a membrane. About 300,000 platelets are found in 1 cm3 of blood. They live for about seven days. Platelets are involved in blood clotting when an injury occurs on the skin.

Blood clotting

A blood clot is a seal that forms to close blood vessels that are cut or damaged. This stops further bleeding at the wound and therefore prevents excessive blood loss. It also prevents entry of harmful bacteria into the body through the damaged tissue.

Structure of platelets



Comparing blood cells

Red blood cells	White blood cells	Platelets
Bi-concave disc in shape	Irregular shape	Cell fragments
Have no nucleus	Have nucleus	No nucleus
Cytoplasm packed with haemoglobin	Several different types, some with granules in the cytoplasm, some without	Composed of cytoplasm surrounded by a membrane
Very many in number. Smaller than white blood cells.	Fewer than red blood cells. Larger than red blood cells.	Few in number Tiny

Made in red bone marrow e.g. ribs and vertebrae	Made in the bone marrow but migrate to lymph nodes	Made in the red bone marrow
Transport oxygen as oxyhaemoglobin. Also transport carbon dioxide	Some destroy bacteria by engulfing and digesting them; others destroy bacteria by producing antibodies	Responsible for clotting of blood

Functions of blood

1. **Transportation of Oxygen:**
   - Red blood cells (erythrocytes) carry oxygen from the lungs to tissues and organs. Oxygen is essential for cellular respiration, where it is used to produce energy.
2. **Transportation of Nutrients:**
   - Blood transports nutrients, including glucose, amino acids, fatty acids, and vitamins, from the digestive system and storage areas to cells throughout the body. These nutrients are necessary for energy production, growth, and repair.
3. **Transportation of Carbon Dioxide:**
   - Blood carries carbon dioxide, a waste product of cellular respiration, from tissues back to the lungs. Carbon dioxide is expelled from the body when we exhale.
4. **Transportation of Hormones:**
   - Hormones, produced by endocrine glands, are carried by the bloodstream to target organs and tissues. Hormones regulate various physiological processes, including metabolism, growth, and reproduction.
5. **Immune Response:**
   - White blood cells (leukocytes) in the blood play a crucial role in the body's immune system. They help defend against pathogens, such as bacteria and viruses, by identifying and destroying them.
6. **Blood Clotting:**
   - Platelets in the blood play a key role in blood clotting. When a blood vessel is injured, platelets adhere to the site and help form a clot to prevent excessive bleeding. This process is essential for wound healing.
7. **Maintaining pH Levels:**
   - Blood helps maintain the body's pH balance by acting as a buffer. It absorbs excess hydrogen ions, preventing the blood from becoming too acidic.
8. **Regulation of Body Temperature:**
   - Blood helps regulate body temperature by redistributing heat. Blood vessels near the skin can dilate to release heat, promoting cooling, or constrict to conserve heat.
9. **Distribution of Heat:**

- Blood circulation helps distribute heat throughout the body, contributing to temperature regulation.

10. **Waste Removal:**
    - Blood carries metabolic waste products, such as urea and other byproducts, to the kidneys for filtration and excretion in the form of urine.
11. **Maintenance of Water Balance:**
    - Blood helps regulate water balance in the body by distributing fluids among tissues and organs. It ensures that the body maintains proper hydration.
12. **Transportation of Electrolytes:**
    - Blood carries electrolytes (such as sodium, potassium, and calcium) that play a crucial role in maintaining cellular function, nerve impulses, and muscle contractions.

Extension work

Blood groups

Everybody's blood is classified into a blood group or blood type. Do you know your blood group? What about those of your family members and friends? What does it mean to have a given blood group?

Types of blood groups

The red blood cells of humans have special types of protein called **antigens**. There are many types of such antigens, including **antigen A** and **antigen B**. Antigens determine the **blood type or blood group** of a person. A person with only antigen A on their red blood cells is said to belong to **blood group A**. People with antigen B only belong to **blood group B**. Sometimes both antigens A and B are found on the red blood cells of the individual. In such a case, the person is said to belong to **blood group AB**. In other people the blood has no antigens on the red blood cells. Such people have blood group **O.** Study the table below.

Table: Antigen and blood groups

Antigen present on red blood cell	**Blood group**
A	A
B	B
A and B	AB
None	O

Blood transfusion

A **blood donor** is a person who voluntarily goes to a hospital or a health centre to give blood. Blood is taken from the donor through a vein in the arm and passed into a bag containing anticlotting substances. This blood is kept in a **blood bank** under suitable conditions, to be given to a patient who needs it. Donated blood is introduced into the arm of the person receiving it through a vein. It is allowed to move slowly into the person receiving the blood, known as a **recipient**. The process of putting donated blood into the recipient is known as a **blood transfusion**.

A blood transfusion may be necessitated by situations such as the following:

- When a person loses too much blood due to an injury that may result from a motor accident, a fall, a fight, among others.
- When a person becomes anaemic due to a disease such as malaria, sickle cells etc.
- When a woman loses too much blood due to childbirth.
- A patient may sometimes need a blood transfusion during surgery.

Fig: A person donating blood.

A person with blood group O can **donate** blood to recipients of all the four blood groups. This is because type O blood lacks antigens on the red blood cells that could be agglutinated by the antibodies from the recipient's plasma. People with blood group **O** are therefore described as **universal donors**. Individuals with blood group **AB** can **receive** blood from all the blood groups. This is because AB blood has no antibodies to agglutinate the recipient's blood. People with **AB** blood are therefore described as **universal recipients.**

Did you know?

When you donate blood to a blood bank or a hospital, you receive a blood donor's card bearing your name and type of blood. It is important to carry this card with you, especially when you travel. It may be useful during a medical emergency.

Topic 4: Alcohol, smoking and drugs in society

Alcohol is a colourless liquid substance that makes people drunk when they drink too much of it. It is contained in many drinks like beer, wines and spirits.

Types of alcohol

There are two types of alcohol namely

- Methanol
- Ethanol

Methanol is found mostly in home distilled alcohol.

- It is very dangerous and poisonous and causes blindness and death.
- It is mainly used as a fuel or for sterilizing medical instruments.
- Ethanol is contained in all alcoholic drinks that are consumed.
- It can also be used as fuel.

Production of alcohol

Common alcoholic drinks are made from juices of bananas, pineapples, sugar cane, maize, millet, sorghum, rice, barley, cassava, potatoes.

Yeast is added to the mixture of water and these food substances to speed up fermentation.

Methods of producing alcohol

i. Fermentation
ii. Distillation

Fermentation is the process by which sugar in juice is turned into alcohol with the help of yeast.

- Fermented fruit juices make wine.
- Fermented starch mixture from grains or cereals from beer.

Examples of drinks produced locally by fermentation

- Mwenge bigere - from bananas
- Malwa (ajon) - from millet/ sorghum
- Kwete - from cassava / maize
- Munanansi - from pineapples
- Omurambi - from sorghum
- Beer - from oats and barley.

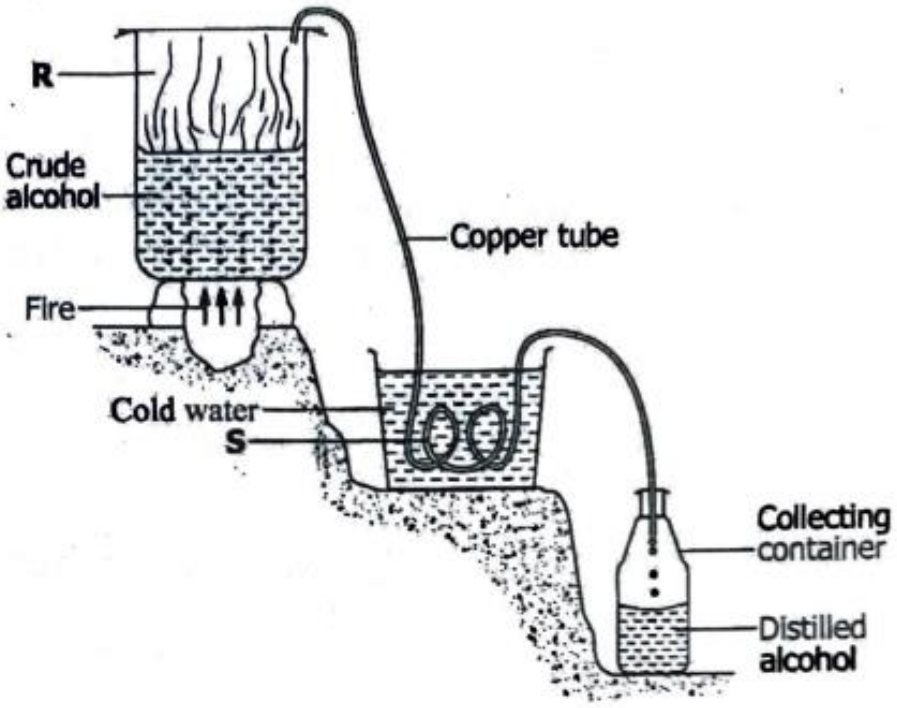
Distillation

- This is the process by which we get alcohol from fermentation.
- The alcohol in the fermented juice is heated and it evaporates.

- The alcohol vapour is then condensed and collected.

How distillation of alcohol is done.
- Crude alcohol is boiled to produce alcohol vapour.
- The vapour is cooled (condensed) to get liquid alcohol with the help of cold water of a condenser.
- The liquid alcohol now called distillate is passed through a coiled delivery tube in to a clean container i.e., bottles or jerry cans.
- The delivery tube is usually coiled to increase the surface area for condensation of alcohol in the condenser. (cold water)
- The collecting container for alcohol is well sealed to prevent contamination of the alcohol and to prevent it from evaporating.

Illustration on how distillation is done;



Processes involved in distillation
R- Evaporation
S- Condensation
Note: Distilled alcohol is scientifically called a distillate.

Uses of alcohol in the society
1. Beverages:
   - **Consumable Alcohol:** Used in the production of alcoholic beverages such as beer, wine, and spirits.
2. Medical and Healthcare:
   - **Antiseptic:** Used as a disinfectant for cleaning skin before injections or surgeries.

- **Hand Sanitizers:** A key ingredient in hand sanitizers to kill bacteria and viruses.

3. Pharmaceuticals:
   - **Solvent:** Used as a solvent in the manufacturing of various pharmaceutical drugs.
4. Cleaning and Disinfecting:
   - **Surface Disinfection:** Used as a disinfectant for surfaces in homes, hospitals, and laboratories.
   - **Household Cleaners:** Found in many cleaning products due to its disinfectant properties.
5. Personal Care Products:
   - **Cosmetics and Perfumes:** Used in the formulation of perfumes, colognes, and cosmetic products.
   - **Deodorants and Antiperspirants:** Found in some formulations for its antibacterial properties.
6. Industrial Applications:
   - **Solvent:** Used as a solvent in the production of paints, inks, and coatings.
   - **Extracting Agent:** Used to extract essential oils and flavors in the food and fragrance industries.
7. Fuel:
   - **Biofuel:** Can be used as a renewable fuel source, especially in the form of ethanol derived from plants.
8. Laboratory Use:
   - **Solvent:** Widely used as a solvent in laboratories for dissolving, diluting, and cleaning.
9. Food and Culinary Uses:
   - **Cooking and Baking:** Used in various culinary applications, especially in the preparation of certain dishes and desserts.
   - **Preservative:** Used in some food items as a preservative.
10. Deicing Agent:
    - **Windshield Washer Fluid:** Added to windshield washer fluids in cold climates to prevent freezing.
11. Tinctures and Extracts:
    - **Herbal Medicine:** Used in the preparation of tinctures and herbal extracts for medicinal purposes.
12. Insect Repellent:
    - **Insect Sprays:** Used in some insect repellents for its ability to deter insects.
13. Chemical Synthesis:
    - **Chemical Reagent:** Used as a reagent in various chemical reactions and syntheses.

14. Coolant:
    - **Cooling Agent:** Used as a cooling agent in certain applications.
15. Photography:
    - **Developing Solution:** Used in the development of photographs.
16. Alternative Medicine:
    - **Homeopathy:** Used in some homeopathic remedies.

Alcoholism is a condition where an individual depends on alcohol for normal functioning of the body.

Alcoholic is a person who depends on alcohol for normal functioning of the body or a person who is addicted to alcohol.

Addiction is a condition in which a person has a very strong desire to take alcohol every day.

Reasons why people drink alcohol

1. **Socialization:**
    - **Social Events:** Alcohol is often associated with social gatherings, parties, and celebrations. People may drink to relax, socialize, and enhance their enjoyment of social occasions.
2. **Relaxation and Stress Reduction:**
    - **Stress Relief:** Some individuals use alcohol as a means of coping with stress or anxiety. It may provide a temporary escape or a way to unwind after a challenging day.
3. **Cultural and Ritualistic Reasons:**
    - **Cultural Practices:** In many cultures, alcohol is part of traditional ceremonies, rituals, or cultural celebrations. Its consumption may be deeply ingrained in cultural and social practices.
4. **Enhancement of Mood:**
    - **Mood Alteration:** Alcohol can temporarily alter mood and perception, leading to feelings of euphoria or relaxation. Some individuals may drink to experience a positive change in mood.
5. **Peer Pressure:**
    - **Social Influence:** Peer pressure can play a significant role in alcohol consumption. People may drink to fit in with social groups, conform to societal norms, or avoid feeling left out.
6. **Curiosity and Experimentation:**
    - **Exploration:** Some individuals may try alcohol out of curiosity or a desire to experiment. This is often common among young adults.
7. **Coping with Trauma or Pain:**

- **Emotional Coping:** People may use alcohol as a way to cope with emotional pain, trauma, or difficult life experiences. It may be a form of self-medication.

8. **Enhancing Creativity:**
    - **Artistic Expression:** Some artists or creative individuals may believe that alcohol enhances their creativity or helps them overcome creative blocks.
9. **Cultural and Social Norms:**
    - **Normative Behavior:** In societies where alcohol consumption is widely accepted and considered normative, individuals may drink simply because it is socially expected.
10. **Advertising and Media Influence:**
    - **Marketing and Advertising:** Advertising and media portrayals of alcohol consumption can influence perceptions and behaviors. Some people may be influenced by the glamorization of drinking in popular culture.
11. **Tradition and Ritual:**
    - **Family Tradition:** In some families, alcohol consumption is a tradition or part of cultural rituals. Individuals may continue this pattern due to family influences.
12. **Peer Approval and Social Acceptance:**
    - **Acceptance and Approval:** People may drink to gain acceptance from peers or to be part of a social group where alcohol use is prevalent.

Effects of Alcohol

Short-Term Effects:

1. **Impaired Judgment:**
    - Alcohol can impair cognitive functions, leading to poor decision-making and impaired judgment.
2. **Slurred Speech:**
    - Alcohol affects the nervous system and can result in slurred speech and difficulty articulating words.
3. **Poor Coordination:**
    - Motor skills and coordination may be compromised, leading to unsteady movements and an increased risk of accidents or falls.
4. **Memory Impairment:**
    - Alcohol can interfere with short-term memory and the ability to form new memories, leading to blackouts or gaps in recollection.
5. **Reduced Inhibitions:**
    - Alcohol lowers inhibitions, potentially leading to risky behaviors or actions that an individual might not engage in when sober.

6. **Increased Sociability:**
    - Some individuals may experience increased sociability and extroversion, while others may become more withdrawn.
7. **Dehydration:**
    - Alcohol is a diuretic, leading to increased urine production and potential dehydration.
8. **Nausea and Vomiting:**
    - Excessive alcohol consumption can irritate the stomach lining, leading to nausea and vomiting.

Intermediate-Term Effects:

1. **Hangover:**
    - After the immediate **effects** wear off, individuals may experience a hangover, characterized by headache, fatigue, nausea, and irritability.
2. **Sleep Disturbances:**
    - Alcohol can disrupt sleep patterns, leading to difficulties falling asleep or staying asleep.
3. **Mood Swings:**
    - Some individuals may experience mood swings or emotional instability, including irritability and anxiety.
4. **Weight Gain:**
    - Alcoholic beverages are often high in calories, and excessive alcohol consumption can contribute to weight gain.

Long-Term Effects:

1. **Liver Damage:**
    - Chronic alcohol consumption can lead to liver diseases such as fatty liver, alcoholic hepatitis, and cirrhosis.
2. **Cardiovascular Issues:**
    - Long-term alcohol use is associated with an increased risk of cardiovascular problems, including hypertension and heart disease.
3. **Mental Health Issues:**
    - Alcohol abuse is linked to mental health issues, including depression, anxiety, and an increased risk of developing alcohol use disorders.
4. **Impaired Cognitive Function:**
    - Prolonged alcohol use may lead to cognitive impairments, affecting memory, attention, and problem-solving skills.
5. **Weakened Immune System:**
    - Chronic alcohol consumption can weaken the immune system, making individuals more susceptible to infections.
6. **Social and Occupational Issues:**
    - Alcohol abuse can lead to social and occupational problems, strained relationships, and decreased productivity.
7. **Addiction:**

- Continued and excessive alcohol consumption can lead to alcohol dependence and addiction.

Effects of alcohol to a family

- Leads to family neglect
- Leads to poverty in a family.
- It causes spouse and child abuse.
- Leads to bad behavior among children
- It causes violence in homes.

Effects of alcohol on the community

- May lead to job neglect causing low productivity.
- May cause traffic accidents at home, suicidal behavior.
- High crime rate in the society e.g., rape, defilement, robbery etc.
- Can lead to increase of certain diseases in the community e.g., AIDS.
- Alcoholics become public nuisance.
- Nation may lose very important people
- Loss of income tax base due to less production.

How to avoid alcoholism

- Avoid bad peer groups
- Never believe in advertisements which praise alcohol as a good drink.
- Never drink alcohol to overcome a problem.
- Join groups whose members do not take alcohol.
- Engage in activities which help you to append free time properly.
- Take your parents and other people's warning about the dangers of alcohol seriously.

Uganda laws on alcohol

- People under 18 years of age are not allowed to drink alcohol in public places.
- No one is allowed to drive a vehicle when he is drunk.
- Home distillation of alcohol is forbidden
- No one is allowed to transport or sell home distilled alcohol.
- Public places that use alcoholic drinks are allowed to operate up to a limited time.

SMOKING

Smoking typically refers to the act of inhaling and exhaling the smoke produced by burning tobacco or other substances. Tobacco smoking is the most common form of smoking, and it involves the consumption of nicotine, a highly addictive substance found in tobacco leaves. Smoking can take various forms, including cigarettes, cigars, pipes, and smokeless tobacco products.

A smoker is a person who smokes tobacco frequently.

Chemicals contained in tobacco

- Nicotine
- Tar

Smoking is either active or passive

Active smoking is that one in which the smoker takes in smoke directly from cigarette or smoking pipe.

Passive smoking is the type of smoking in which a non-smoker breathes in air containing tobacco smoke.

Reasons why people smoke.

- To pass time
- To concentrate on what they are doing
- To feel warm
- To fit in a group (peer influence)
- To feel confident
- To look mature
- To look attractive

Effects of smoking on the human body

- Leads to Lung cancer
- Leads to Emphysema
- Leads to Bronchitis
- Leads to Heart stroke
- Leads to Peptic ulcers
- Leads to Cancer of the mouth and throat.

Effects of smoking to a pregnant woman

Maternal Health Risks:

1. **Complications During Pregnancy:**
    - Smoking increases the risk of complications during pregnancy, including premature birth, low birth weight, and placental abruption (the separation of the placenta from the uterine wall).
2. **Ectopic Pregnancy:**
    - There is an increased risk of ectopic pregnancy, where the fertilized egg implants outside the uterus, typically in the fallopian tubes.
3. **Reduced Fertility:**
    - Smoking has been associated with reduced fertility, making it more difficult for a woman to conceive.
4. **Complications During Labor:**

- Women who smoke are more likely to experience complications during labor, such as prolonged labor and the need for assisted delivery.

5. **Increased Risk of Miscarriage:**
    - Smoking is linked to an increased risk of miscarriage, particularly during the first trimester.

Fetal and Neonatal Health Risks:

1. **Low Birth Weight:**
    - Smoking is a major risk factor for low birth weight, which is associated with an increased risk of neonatal mortality and various health problems in infancy.
2. **Preterm Birth:**
    - Smoking during pregnancy is a significant risk factor for preterm birth (delivering the baby before 37 weeks of gestation).
3. **Stillbirth:**
    - There is an increased risk of stillbirth (the death of a baby in the womb after 20 weeks of pregnancy) among women who smoke during pregnancy.
4. **Sudden Infant Death Syndrome (SIDS):**
    - Babies born to mothers who smoke are at an increased risk of Sudden Infant Death Syndrome (SIDS).
5. **Respiratory Issues:**
    - Babies born to smoking mothers are more likely to experience respiratory problems, such as wheezing and asthma, during infancy.
6. **Developmental Delays:**
    - Smoking during pregnancy has been linked to developmental delays in children, including cognitive and behavioral issues.
7. **Nicotine Addiction:**
    - Nicotine from smoking can cross the placenta and reach the developing fetus, leading to nicotine addiction in the unborn child.

Long-Term Consequences:

1. **Behavioral and Cognitive Effects:**
    - Children exposed to smoking during pregnancy may face long-term consequences, including behavioral and cognitive issues.
2. **Increased Risk of Chronic Diseases:**
    - Exposure to tobacco smoke in utero may increase the risk of chronic diseases such as obesity, diabetes, and cardiovascular issues later in life.

How to avoid smoking

- Do not believe in advertisements about cigarette smoking.
- Know that there is no good reason for smoking
- Avoid joining groups smokers.

- Keep yourself busy for example by reading a novel, or doing any other meaningful activities such as playing games etc.

Life skills to safeguard against smoking.

- Keep away from people who smoke
- Never allow any body to convince you to smoke.
- Gather more information on dangers of smoking from health workers.
- Report your friends who smoke to the teachers or their parents for advice.
- Like games and sports during your free time.
- Never use your money to buy cigarettes.

DRUG ABUSE AND DRUG MISUSE

A drug is a chemical substance which affects the way one's mind and how the body works.

- It can either help or harm the body system.
- Drugs are either in manufactured from of raw materials
- Raw drugs are either in the form of plants and animal parts or extracts from animal or plants.
- If drugs are manufactured and tested in laboratories, they are called laboratory manufactured drugs.

Characteristics of laboratory manufactured drugs

- They are carefully made and tested.
- Their strength, stability and purity is known.
- They are the same for each quantity.
- Their effect on human health is known,
- They are packaged and properly protected
- They are well labeled
- They have expiry and manufactured dates.

Examples of laboratory manufactured drugs

- Aspirin
- Chloroquine
- Quinine
- Fansidar
- Panadol
- Coartem
- Mebendazole

Characteristics of traditional drugs.

- They are made of raw plants and animals
- Their strength, purity and stability changes.

- They are of different quantities
- Their effects on human health is not known.
- They are not well labeled
- They are not well packaged.

Examples of traditional drugs

- Mululunza
- Kigagi
- Bombo
- Eusuk
- Asimiri

Essential drugs

- Essential drugs are drugs that meet people's health needs.
- Essential drugs are drugs needed to care and prevent common diseases affecting the majority of people in an area or country.

Characteristics/Qualities of essential drugs

- They should be affordable to make the cost of treatment manageable.
- They should be accessible and available whenever needed.
- They should be effective to cure, prevent and control diseases.
- They should be safe when the correct dosage is used.
- They should have a satisfactory value for money.

Examples of essential drugs

- Cough mixture
- Chloroquine
- Paracetamol
- Piriton
- Penicillin
- ORS
- Tetracycline

Drug prescription

This refers to health workers written information on how a drug should be used.

If a drug is taken without a prescription, the patient will either take under or over dose.

Over dose

This is the taking in of more medicine than is required.

An overdose is dangerous to the body because it can lead to poisoning or death.

Under dose

This is when one takes fewer drugs than the required

The major disadvantage of an under dose is that it causes drug resistance.

Factors based on in prescribing drugs

1. **Patient Factors:**
   - Medical History: Consider the patient's medical history, including past and present illnesses, surgeries, and known allergies.
   - Age and Weight: Adjust dosage based on the patient's age and weight, as these factors can influence drug metabolism.
   - Renal and Hepatic Function: Evaluate renal and hepatic function to determine the appropriate dosage and to avoid drug accumulation.
   - Pregnancy and Lactation: Assess the patient's pregnancy or lactation status, as certain drugs may pose risks to the developing fetus or nursing infant.
2. **Clinical Diagnosis:**
   - Establish a clear and accurate diagnosis of the patient's condition, as the choice of medication is based on the identified medical problem.
3. **Symptom Severity:**
   - Consider the severity of symptoms in determining the need for medication and the appropriate level of intervention.
4. **Contraindications and Precautions:**
   - Identify any contraindications or precautions associated with the prescribed medication, taking into account the patient's specific medical conditions.
5. Drug Interactions:
   - Evaluate potential drug interactions with other medications the patient is taking, including over-the-counter drugs, herbal supplements, and vitamins.

Advantages of drug prescriptions.

- It helps the patient to know the correct drug.
- Its dosage relation to age, weight and duration of treatment
- Prevent over doe which is harmful and poisonous to the body
- Prevents and controls misuse of drugs

Proper ways of storing medical drugs

1. **Temperature Control:**
   - Many medications are sensitive to temperature. Store drugs according to the recommended temperature range specified on the packaging or in the product information. Common temperature guidelines include:
     - **Refrigeration:** Store medications that require refrigeration in the designated compartment. Avoid freezing.

- **Room Temperature:** Keep drugs at a consistent room temperature, typically between 15-25 degrees Celsius (59-77 degrees Fahrenheit).

2. **Humidity Control:**
   - Excessive humidity can affect the stability of medications, particularly those in the form of tablets, capsules, or powders. Store drugs in a dry environment and avoid exposing them to moisture.
3. **Light Protection:**
   - Some medications are sensitive to light and may degrade when exposed to direct sunlight or prolonged artificial light. Store drugs in their original packaging or opaque containers to protect them from light.
4. **Childproof Storage:**
   - Keep medications out of reach of children and store them in childproof containers. This is essential to prevent accidental ingestion, which can be dangerous.
5. **Secure Storage:**
   - Store medications in a secure location to prevent unauthorized access. This is important not only for safety but also to maintain the integrity of the medication.
6. **Proper Packaging:**
   - Keep medications in their original packaging to preserve important information such as expiration dates, dosage instructions, and potential side effects. If using a pill organizer, ensure it is clean and appropriate for the type of medication.
7. **Separation of Medications:**
   - Avoid storing different medications together unless specifically instructed by healthcare providers. Some drugs may interact with each other or degrade when stored in close proximity.
8. **Storage in Original Containers:**
   - When transferring medications from their original containers, clearly label the new container with the medication name, dosage instructions, and expiration date. This helps prevent confusion and ensures proper administration.
9. **Regular Inspection:**
   - Periodically inspect medications for changes in color, odor, or texture. If a medication appears different from its normal state, consult a healthcare professional or pharmacist.
10. **Controlled Substance Storage:**
    - If you have medications classified as controlled substances, store them securely and in compliance with local regulations. Controlled substances are subject to strict storage and handling requirements.
11. **Regularly Check Expiration Dates:**

- Discard medications that have passed their expiration dates. Expired drugs may be ineffective or potentially harmful.

12. **Travel Considerations:**
    - When traveling with medications, use a travel-friendly container and carry a copy of prescriptions. Be mindful of temperature variations, especially during air travel.

Drug dependency

Drugs of dependency is the medical condition that results from the prolonged use of a drug.

Drugs of dependence

Drugs of dependence are drugs which cause addiction after prolonged use.
An addition to a drug is a strong medical condition that one feels uncomfortable when he / she does not use the drug.

Common drugs of dependency

- Marijuana
- Khat or miraa
- Cocaine
- Glue
- Aviation fuel
- Heroin
- Alcohol
- Tobacco
- Paint thinner.

Why people abuse drugs

- Some people abuse drugs to overcome fear
- Due to peer influence
- To keep a wake or sleep
- Due to good advertisement
- To pass time
- To feel warm
- To get energy
- To concentrate on what they are doing
- To gain more appetite.

Effects of drugs of dependence to an individual

- Brain damage
- Loss of appetite
- Insomnia (inability to sleep)
- Job neglect
- Self-neglect

- Low immunity to disease

Effects to the family

- Family neglect
- Family aggression and violence
- Criminal acts like defilement and rape
- Poverty
- It sets a bad example to the children

Effects to the community

- **Public Health Costs:**
  - Smoking contributes significantly to the burden of public health costs. Treating smoking-related illnesses places a strain on healthcare systems, leading to increased medical expenses for communities and governments.
- **Increased Healthcare Resources:**
  - Smoking-related diseases often require extensive medical care, including hospitalizations, surgeries, and long-term treatments. This increased demand for healthcare resources affects the availability and allocation of medical services for the entire community.
- **Lost Productivity:**
  - Smoking-related illnesses can lead to decreased productivity in the workforce due to absenteeism, disability, and premature death. This loss of productivity affects the overall economic well-being of the community.
- **Environmental Impact:**
  - Cigarette butts and packaging contribute to environmental pollution. The improper disposal of cigarette waste harms the environment, impacting public spaces, water bodies, and wildlife habitats.
- **Fire Hazards:**
  - Smoking poses a fire hazard, especially in areas where smoking is not appropriately regulated. Unattended cigarettes can lead to accidental fires, endangering lives and property in the community.
- Criminal behavior

Life skills that can help you to avoid drugs

Effective Communication:

- Learn to express your thoughts, feelings, and needs clearly and assertively. Effective communication helps build positive relationships and minimizes misunderstandings that can lead to stress and negative coping mechanisms.

Problem-Solving Skills:

- Enhance your ability to identify problems, analyze situations, and generate effective solutions. Problem-solving skills empower you to address challenges without resorting to drugs as a coping mechanism.

Stress Management:

- Develop healthy stress management techniques such as exercise, mindfulness, deep breathing, or engaging in hobbies. Learning to manage stress positively reduces the likelihood of turning to drugs as a way to cope.

Resilience:

- Cultivate resilience by developing a positive mindset and the ability to bounce back from setbacks. Resilient individuals are better equipped to face life's challenges without turning to substances for escape.

Emotional Regulation:

- Learn to identify and manage your emotions in healthy ways. Emotional regulation reduces the risk of using substances as a means of self-medicating or avoiding difficult feelings.

Time Management:

- Efficient time management helps you prioritize tasks, set goals, and maintain a healthy balance between work, school, and leisure activities. A well-organized life reduces stress and the risk of resorting to drugs for escapism.

Healthy Coping Mechanisms:

- Develop a repertoire of healthy coping mechanisms such as exercise, art, music, or spending time with loved ones. Having positive outlets provides alternatives to using drugs as a way to cope with difficulties.

Decision-Making Skills:

- Strengthen your ability to make informed and responsible decisions. Consider the potential consequences of your choices, especially those related to drug use, and make decisions aligned with your long-term well-being.

Self-Esteem and Self-Confidence:

- Cultivate a positive self-image and belief in your abilities. Individuals with healthy self-esteem and confidence are less likely to turn to substances as a way to escape feelings of inadequacy or low self-worth.

Assertiveness:

- Learn to assert your needs and boundaries while respecting those of others. Being assertive helps you navigate social situations and peer pressure, reducing the likelihood of succumbing to negative influences.

Interpersonal Skills:

- Develop strong interpersonal skills, including empathy, active listening, and conflict resolution. Positive relationships and effective communication contribute to a supportive social environment that discourages drug use.

Goal Setting:

- Set realistic and achievable goals for yourself, whether they are academic, career-related, or personal. Goal setting provides direction and motivation, reducing the appeal of substances that may hinder your progress.

Critical Thinking:

- Sharpen your critical thinking skills to evaluate information, make informed judgments, and resist pressure from others who may encourage drug use.

Coping with Peer Pressure:

- Learn to navigate peer pressure effectively by saying no assertively and choosing friends who share your values. Develop strategies to resist negative influences without compromising your integrity.