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P.6 SCIENCE

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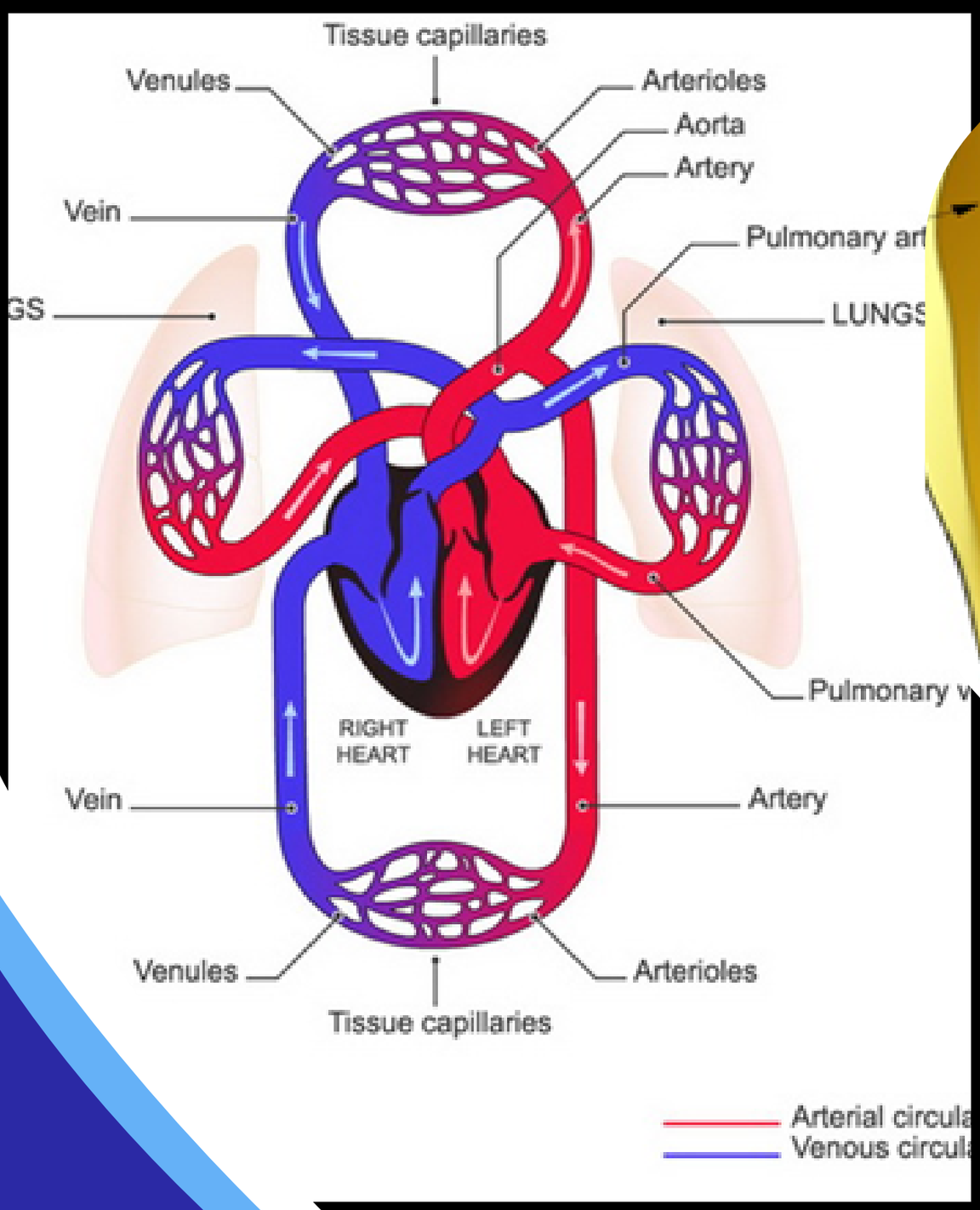

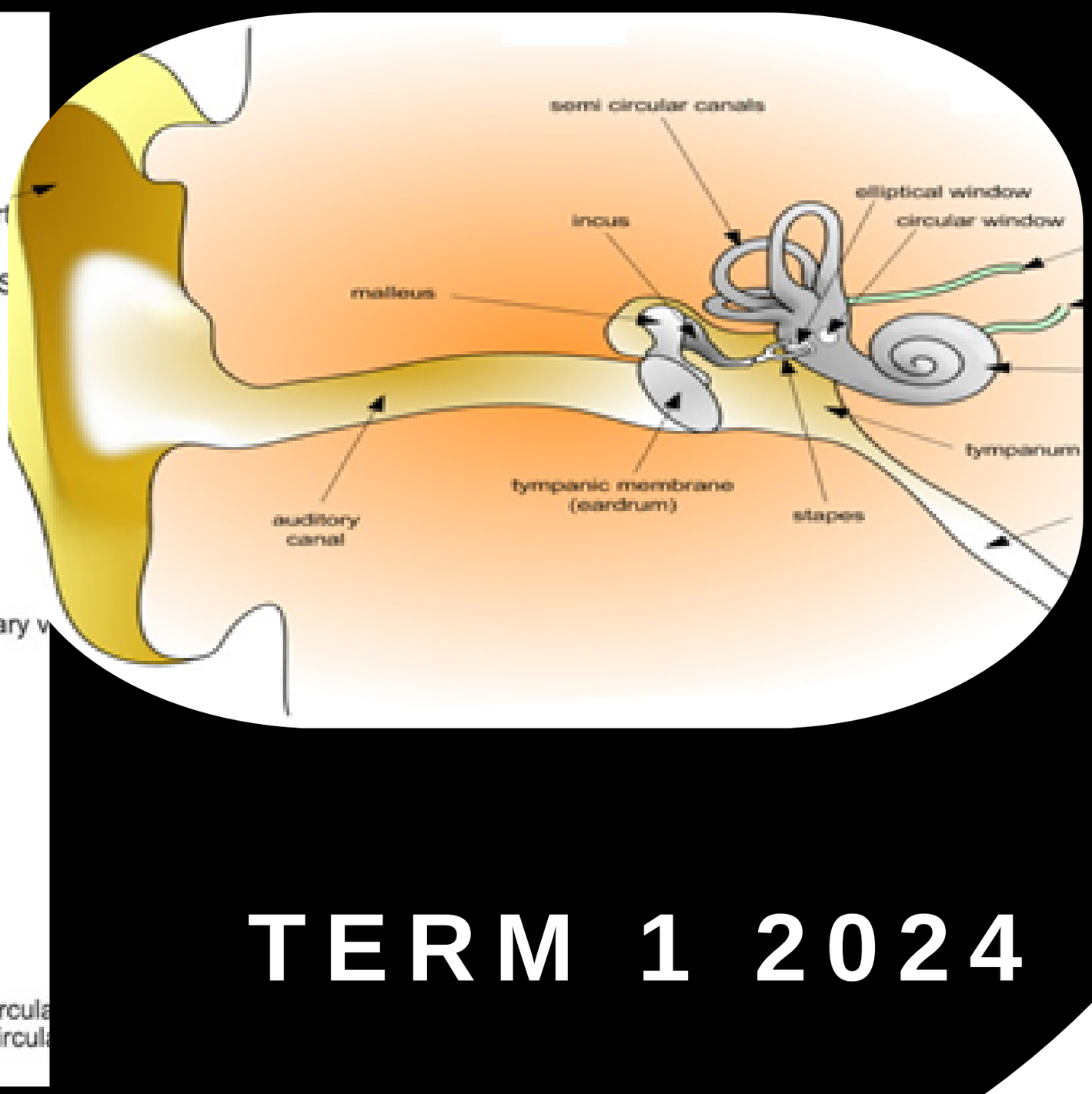

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THEME : THE WORLD OF LIVING THINGS
TOPIC : CLASSIFICATION OF ANIMALS

Living things

- Living things are things that have life.

Main groups of living things.

- Plants
- animals

Examples of living things;

- Plants
- Insects
- Birds
- Human beings
- Worms etc.

Characteristics of living things

a) Living things respire.
b) Living things feed.
c) Living things respond to stimuli.
d) Living things grow.
e) Living things reproduce.
f) Living things excrete.
g) Living things move

Classification of living things

- Classification is the grouping of things according to common characteristics and features.

Common characteristics and features used in classification of living things.

1. Number of legs
2. Ways of breathing
3. Response to stimuli
4. Colour
5. Size
6. Body divisions
7. Ways of movement
8. Hair on the body
9. Shape
10. Adaptation to the environment
11. How they get food.

Reasons for classifying living things

- Makes it easy for us to identify them.
- Makes it easy to name them.

Note:

Living things are classified into five groups called **kingdoms**

- Animal kingdom
- Plant kingdom
- monerans
- Fungi kingdom
- protoctista kingdom(prototists)

1. Animal kingdom

Characteristics of animals

- Animals are multicellular.
- Animals cannot make their own food because they do not have chlorophyll
- They feed on already made food.
- Animal cells have a cell membrane.

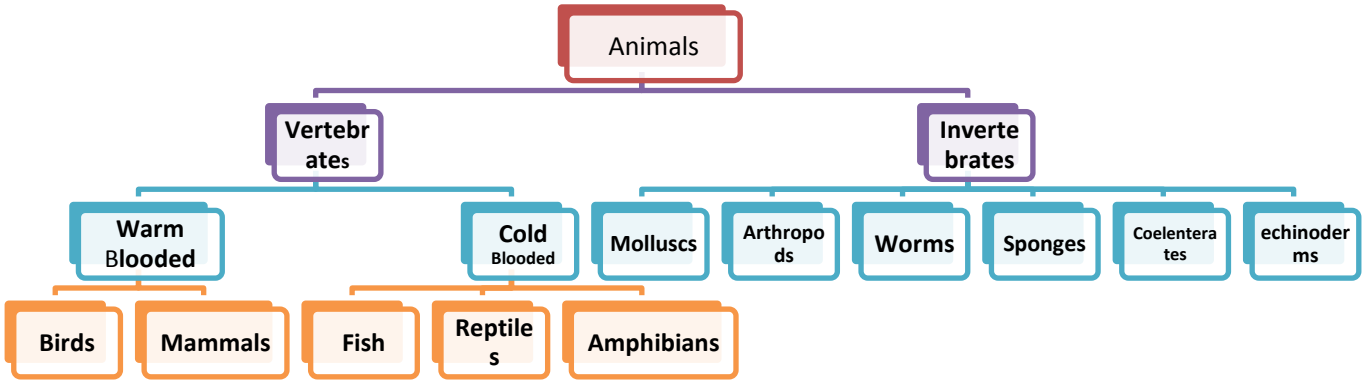
Differences between plants and animals

Plants	Animals
○ Make their own food ○ Green plants contain chlorophyll ○ Growth occurs only at the tips of roots and shoots ○ React slowly to stimuli ○ Continue growing throughout their life	○ Feed on already made food. ○ Don't have chlorophyll ○ Growth occurs equally on all parts of the body ○ React quickly to external stimuli ○ Stop growing long before their death

Animals are divided into two major parts.

- Vertebrates
- Invertebrates

Classification of animals



Vertebrates:

- Vertebrates are animals with backbones.

Characteristics of vertebrates

- They have an Endo (internal) skeleton.
- They have a large brain protected by the skull (cranium).
- They have back bones.

NB: Vertebrates are also grouped into two;

- Warm blooded (homoeothermic or homoeothermic)
- Cold blooded (poikilothermic)

Warm blooded (homoeothermic)

- Are animals that have a constant body temperature.
  - ✓ Mammals
  - ✓ Birds

Cold blooded (poikilothermic)

- Are animals whose body temperature changes according to the surrounding.
  - ✓ Fish
  - ✓ Reptiles
  - ✓ Amphibians

1. Mammals

- Mammals are groups of vertebrates with mammary glands.
- Mammary means breasts.

Characteristics of mammals

- They are warm blooded.
- Their bodies are covered with fur: **prevent heat loss from the body.**
- All mammals care for their young ones.
- They give birth to live young ones except the egg laying mammals.
- They feed their young ones on milk from their mammary glands.
- They breathe through lungs.
- They have well developed ear lobes **(Pinnae).**
- Their hearts are divided into four chambers.
- They undergo internal fertilization.
- They haveteeth which differ in shape and function **(heterodontdentition).**

Main characteristics of mammals.

- They give birth to live young ones.
- Their bodies are covered with fur.
- Have mammary glands.

Groups of mammals

- Primates (flexibly fingered mammals)
- Cetaceans (sea mammals)
- Carnivores (flesh eating mammals)
- Ungulates (hoofed mammals)
- Rodents (gnawing mammals)
- Marsupials (pouched mammals)
- Insectivores (insect eating mammals)
- Chiroptera (flying mammals)
- Monotremes (egg laying mammals)

A. Primates

- Primates are mammals with a well-developed brain.
- Primates are the most advanced group of mammals.

Characteristics of primates

- They have a well-developed brain.
- They have five fingers on their hands and five toes on their feet.
- They have five fingers on each hand and five toes on each foot.
- They are omnivores i.e. feed on both meat and vegetation.
- They use front limbs for holding and hind limbs for walking.
- They have four sets of teeth.

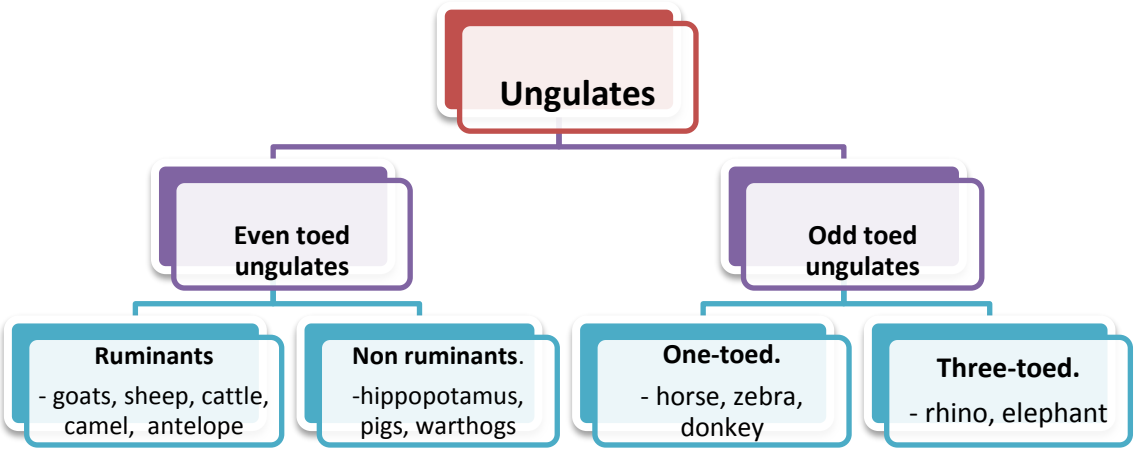
Examples of primates

- Man
- Gorilla
- Baboon
- Monkeys
- Bush baby
- Chimpanzee

B. Ungulates (hoofed mammals)

- Are hoofed mammals that feed on vegetation.
- They are herbivorous mammals.

Classification of ungulates



Even toed ungulates

- Are animals whose toes are in even numbers.

Groups of even toed ungulates.

- Ruminants
- Non-ruminants

Ruminants.

- Are ungulates that chew cud and have four chambered stomachs.

Non-ruminants.

- Are ungulates that have a single stomach and do not chew cud.

C. Carnivores (flesh eating mammals)

- They are mammals which feed on flesh (meat).
- They are also called **preying mammals**.

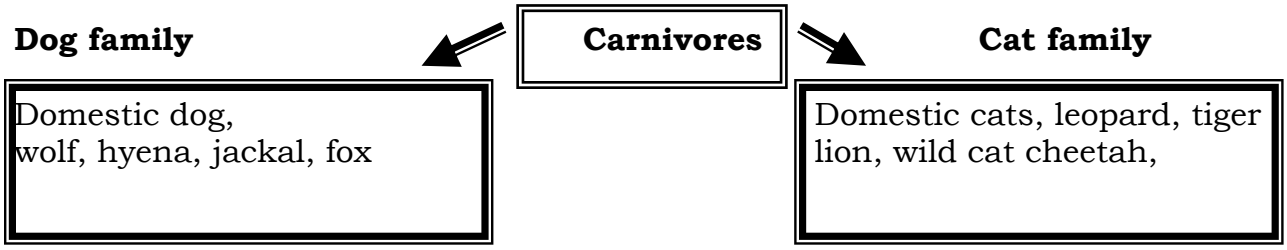
Characteristics of carnivores

- They have long stout legs: **for running very fast.**
- They have well-developed canines for **tearing flesh**.
- They have strong curved claws for **grabbing grey**.
- They have a very good sense of smell.
- They have good eye sight.
- They have soft pads in their feet to move softly.

NB: Carnivores are sub-divided into two groups namely;

- Cat family: **resemble cats.**
- Dog family: **resemble dogs.**

Classification of carnivores



Note:

- Some carnivores (dog family) are scavengers e.g. the hyena and jackals.
- Others are predators (cat family). They hunt and kill prey.

D. Rodents (gnawing mammals)

- Have well developed incisors for biting even hard surfaces.
- They produce many young ones at once.
- Most rodents feed on vegetables.
- They have strong claws for digging the ground.
- They are called gnawing mammals,because **they use their incisor teethto bite hard surfaces to keep them short**.

Examples of rodents

- Rats
- Porcupines
- Guinea pigs
- Squirrels
- Mice
- Hare

NB. Porcupines have spines for protection.

E. Insectivores (insect eating mammals)

- These are mammals which feed on insects.

Characteristics of insect eating mammals

- They have a high sense of smell.
- They have strong claws for digging the ground to get food.
- They mostly hunt at night.
- Have sticky tongues for catching insects.
- Have long snouts.

Examples of insect eating mammals

- hedgehog,
- moles
- antbears

NB A hedgehog has spines on its body for protection.

F. Chiroptera (flying mammals)

- They are mammals that move by flying.

Characteristics of flying mammals

- Their fore limbs are modified into wings.
- They are nocturnal.
- They can find their food at night using echoes.
- They give birth to live young ones.
- Have mammary glands.

NB: Bats are the major examples of flying mammals.
Moths, hedgehogs are other examples of nocturnal animals.

Types of bats

a) Fruit eating bats
b) Insect eating bats
c) Blood sucking bats.

G. Marsupials (pouched mammals)

- Marsupials are mammals with a pouch.
- Pouch is used to carry its young one until it matures.
- Have breasts inside the pouch.

Characteristic of pouched mammals:

- They have a pouch for carrying young ones.

NB: Marsupials are found in Australia and South America

Example of pouched mammals:

- Kangaroo
- Wallabies
- Koala bear
- wombat

H. Monotremes (Egg laying mammals)

- These are mammals which lay eggs.
- Feed their young ones on milk from their mammary glands.

Note:

- They are regarded as the most primitive mammals because;
  - ✓ They have characteristics of reptiles, birds and mammals.
  - ✓ They lay eggs and have beaks similar to those of birds.
  - ✓ They feed their young ones onmilk from their mammary glands.

Examples of egg laying mammals:

- Duck billed platypus
- Spiny ant eater**(echidna)**

I. Cetaceans (sea mammals)

- Cetaceans are mammals that live in the sea and oceans.
- They have a layer of fats called **blubber** which keep them warm in water.

Characteristics of cetaceans

- They live in seas.
- They breathe by means of lungs.
- Have a high level of intelligence next to primates.

Examples include;

- Whales
- otter
- Dolphins
- walrus
- Seals
- Porpoises

Importance of mammals to man.

- Some ungulates and rodents are a source of food to man
- Some mammals are used for transport.
- Some mammals provide raw materials such as hides and skins, horns and tusks for industries.
- Oxen are used to plough land for man.
- They are tourist attractions
- Some rodents can be used to reduce or kill pests on a farm.

Dangers of mammals

- Some rodents are crop pests.
- Dogs and cats are diseases vectors.

Differences between mammals and birds.

Similarities between mammals and birds.

2. Birds

Characteristics of birds.

- Have streamlined bodies.
- Their bodies are covered with feathers.
- Have scales on their legs.
- They are warm blooded **(homoeothermic)**.
- They breathe by means of lungs
- Their front limbs are modified as wings.
- They reproduce by laying eggs.
- They have four chambered hearts.
- They take care of their young ones.
- They undergo internal fertilization.

Groups of birds

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

A. Birds of prey

- These are birds which hunt and kill prey.

Characteristics of birds of prey:

- They feed on flesh (meat).
- They have strong eye sight to spot their prey even at a distance.
- They have strong, sharp, hooked beaks for tearing their prey.
- They have strong, sharp curved talons for gripping and killing their prey.
- Do not have a crop in their alimentary canal.

Why?

- They feed on already moistened food.

Examples of birds of prey:

- Hawks
- Vultures.
- eagles
- secretary birds
- owls
- kites
- falcons

Structure of the beak and feet

B. Perching birds

- Have three toes pointing forward one back ward.
- This helps them to grasp twigs and small branches.

Groups of perching birds

1. Seed eaters

- Are perching birds that feed on seeds.
- Have strong conical beaks for breaking seeds.

Examples include;

- pigeons,
- doves
- weaverbirds

Structure of a seed eater

2. Insect eaters

- These are perching birds that feed on insects.
- Some have wide beaks when open for catching insects in flight.
- Some have short beaks for picking insects.

Examples include;

- Sparrows
- Robins
- Bee eaters
- Swallows
- Swifts

NB: Swallows and swifts have short wide open beaks to catch insects even when flying.

Structure of an insect eater

3. Nectar suckers

- These are perching birds that feed on nectar.
- They have thin long slender beaks for sucking nectar from flowers.

Examples include; sun bird and humming bird.

Structure of beak

4. Fruit eaters

- These are perching birds that feed on fruits only.
- They have strong long beaks like a horn bill.

C. Scratching birds

- These are groups of birds that scratch the ground searching for food.
- They have strong blunt claws for scratching the ground.
- Scratching birds mostly feed on insects, worms, small grains etc.
- These birds are unable to fly high because: **their bones contain marrow that makes them heavy**.

Examples of scratching birds

- Domestic fowls e.g.
  - ✓ Chicken,
  - ✓ Turkey,
  - ✓ Guinea fowl.

Structure of beak

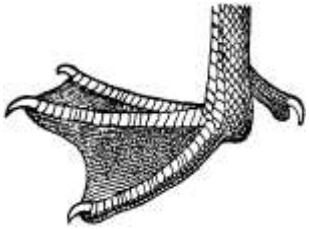
D. Swimming birds

- These are birds with fully webbed feet:**for swimming**.
- They have a flat broad breast bone:**for floating on water**.
- They have flat spoon shaped beaks:**to help them to sieve and scoopfood from mud.**
- Their skin has many oil glands:**that produce oil to make featherswater proof.**

Examples of swimming birds

- Ducks
- Pelicans
- Sea gulls
- Geese
- Swans
- King fisher

Structure of beak and feet



E. Wading birds

- These are groups of birds that find their food in water.
- They have long thin legs:**to prevent them from sinking in water.**
- They have partly webbed feet: **to enable them walk in mud**.
- They have long slender necks: **for swinging the head while spearing food.**

Examples of wading birds

- flamingoes
- herons
- ibis
- crested crane

Structure of beak and feet

F. Flightless birds or walking birds

- These birds that are unable to fly but can run very fast.
- They have weak and small wings compared to their body weight.
- They have compact bones filled with bone marrow.
- Do not have flight feathers.

Examples of flightless birds

- Ostrich
- Penguin
- Kiwi
- Emu

Foot of an ostrich

NB: An ostrich is the largest and fastest flightless bird
Penguins have **wings** and **feet** modified for swimming.

G. Climbing birds

- They are able to climb or walk on tree trunks.
- They have two toes pointing forward and two toes pointing back ward**: toenable them climb trees easily.**
- They have short, curved and strong beaks.

Examples

1. A parrot has a short strong and curved beak **which is used for holding andcracking seeds and nuts**.

Structure of beak and feet

2. **Wood pecker**
    - It has a strong pointed beak for:
    - For probing insects.
    - For making holes in barks of trees.

H. Scavenger birds

- These are birds that feed on **Carrion**.
- Have strong curved beaks to enable them tear flesh.

NB: They help to clean the environment by feeding on carrion.

Examples of scavenger birds

- vultures,
- crows,
- marabou storks

Structure of beak and feet

Ways in which birds are adapted to flying

- They are streamlined to reduce friction in air.
- They have hollow bones which help to reduce weight.
- Their front limbs are modified into wings.

- They have a nictitating membrane which cover the eyes and protect them against moving air during flight.
- They have flight feathers.
- They have no pinna to obstruct the flow of air.
- They have hollow air sacs from the lungs.

Importance of birds

- They are a source of food to man and animals.
- Their feathers can be used for decoration on hats, hand bags.
- Their bones can be used for making glue.
- Birds are a source of income to farmers.
- Some birds like sun birds pollinate flowers when collecting nectar.
- Some bird like vultures, crows and marabou storks clean our environment

Dangers of birds

- Many birds destroy farmer'scrops.
- Some birds cause accidents on run ways at airports.
- They make a lot of noise especially weaver birds
- They keep vectors like fleas and mites.
- Some birds of prey such as kites and eagles kill and eat the chicks of domestic birds.

THE COLD BLOODED VERTEBRATES

- These are vertebrates whose body temperature changes according to the surrounding.

Groups of cold blooded animals

- Reptiles
- Amphibians
- Fish

1. Reptiles

Common characteristics of reptiles

- They have back bones.
- They all move by crawling along the ground
- Their bodies are covered with scales
- Their eggs undergo internal fertilization.
- They breathe by means of lungs.
- They have three chambered hearts
- They reproduce by laying eggs.
- They are poikilothermic (cold blooded)
- They do not take care of their young ones
- They have a set of teeth of the same kind

Classes of reptiles

Reptiles are divided into the following groups

- Snakes
- Lizards
- Turtles and tortoises
- Crocodiles and alligators

a) Snakes

- Are reptiles that are limbless.

Characteristics of snakes

- They are limbless.
- They are carnivorous animals.
- Do not have eyelids.
- They have a forked tongue: **for smelling and tasting food.**
- They moult**: to grow.**
- They move by gliding.

Features of snakes.

- They have a forked tongue: **for smelling and tasting food.**
- Have teeth curved inwards: **to prevent the prey from escaping.**
- Do not chew food but just swallow it because: **they do not have molar and pre-molar teeth for chewing.**

Groups of snakes

- Poisonous snakes
- Non-poisonous snakes
- Constrictors

i.Poisonous snake

- These are snakes that produce venom.
- They have fangs: **for injecting venom in the prey.**
- They have triangular shaped heads.
- Have dark scaring colours.

Examples of poisonous snakes

1. Cobras
2. Gabon Viper
3. Black Mamba
4. Puff adder.

ii. Non-poisonous snakes

- These are snakes that do not produce venom.
- They do not have fangs.
- They have slender heads.
- They move swiftly to run away from enemies.

Examples include;

- house snakes,
- grass snakes,
- tree snake

iii. Constrictors

- They are big non-poisonous snakes with strong muscles.
- They have strong muscles:**for squeezing and crushing prey**.
- They have flexible jaws: t**o enable them swallow larger prey**.

Examples include;

- Python, king snakes
- Boas
- Anaconda.

Identifying marks of a poisonous and non-poisonous snake.

First aid for snake bites

- Rest the victim in one place
- Clean the bitten part with methylated spirit.
- Tie a piece of cloth just above the bitten part and apply a black stone.
- Take the victim to a nearby health Centre.

Describe first aid for a snake bite in one sentence.

- Tie a piece of cloth just above the bitten part.

Qn: why do we tie a piece of cloth just above the bitten part?

- To prevent quick spread of venom in the body.

Qn; **How can the victim of a snake bite be carried to a nearby health Centre?**

- Using a stretcher.
- Two people carry
- Piggy back.

How to control snake bites.

- Slashing bushes in the compound.
- Covering holes in houses and compound.

Importance of snakes to man

- They provide skin that can be used for making drum membranes, shoes, belts, hand bags.
- They eat pests and vectors.
- Venom is used to make anti-venom drugs.

Lizards

- Are reptile with limbs and movable eyelids.
- Their tongues are fleshy.
- They have movable eyelids.
- Their heads are flat and triangular.

Examples of lizards;

1. **Geckoes**
    - These are small and yellowish-brown.
    - They have short and broad tongues.
    - They can cast off their tails and develop new ones.
    - They feed on small insects and worms.
    - They lay eggs in cracks and holes in buildings where they mainly

live.
- They have suction pads on their feet:**which enable them tomove upside down on ceilings**.
- They are useful because they feed on mosquitoes and other harmful insects.

2. **Chameleon**
   - They have large heads and protruding eyes.
   - The eyes can work independently of each other.
   - The feet and tails are well developed for catching and gripping small twigs and branches of trees.
   - They have long sticky tongues which are sticky used to trap insects.
   - They change colour according to the surrounding.
   - for protection and get food.

Tortoises and turtles
- Have hard shells on their bodies for protection.
- Tortoises are land animals that feed on grass and insects.
- Have four limbs that end in clawed toes.
- Have sharp cutting edges in their jaws instead of teeth.
- They reproduce by laying eggs which are fertilized internally.
- Terrapins are a kind of turtles that live in fresh water.

Crocodiles and alligator
- They have a strong tail.
- They have long strong jaws
- The female lays hard-shelled eggs and covers them in sand or mud.
- They are covered with scales.

Qn. What is the use of a tail of a crocodile?
- For swimming
- For defense

Note: A crocodile uses a tail and teeth for protection.

Uses of crocodiles and alligators to man
- We get skins for making shoes, bags and belts.
- Man can eat their meat.

2. **Amphibians**
   - Are animals that live both on land in water.

Characteristics of amphibians:
- They live both in water and on land.
- They are poikilothermic
- Have two pairs of limbs (hind limbs are fully webbed to enable them to swim).
- Their eggs undergo external fertilization.
- They breathe through lungs on land and moist skin while in water.

- But tadpoles breathe through gills.
- Frogs and toads don't have tails while newts and salamanders have tails in the adult stage.

Examples of amphibians

- Frogs
- Toads
- Newts
- Salamanders

Differences between frogs and toads

Frog	Toad
❖ Has a smooth moist skin. ❖ Has fully webbed toes. ❖ Lays eggs in mass. ❖ Has longer hind legs and larger eyes. ❖ Spends most of its time in water ❖ Most active during day.	❖ Has a rough dry skin. ❖ Has partly webbed toes. ❖ Lays eggs in a string-like jelly. ❖ Has short hind legs and smaller eyes ❖ Spends most of it time on land. ❖ Most active during night.

Structure of a frog and toad

Functions of the parts

Mouth – for feeding
Nostrils – sense organ for smell
Eyes – sense organ for sight
External eardrum – for hearing
Poison gland – produce poisonous substance that prevents other animals from eating a toad
Strong hind legs – enable a toad hop to escape from enemies
Webbed feet – enable a toad to swim in water.

Feeding, life history, respiration and adaptation of frogs

Feeding in frogs / toads

- Adult frogs and toads are carnivores.
- They feed on worms, beetles, cockroaches and other insects.
- They have wide mouth and sticky tongues for picking food.
- They have a series of small teeth in the mouth to hold their prey so that they don't escape.

Life cycle (metamorphosis) of a frog / toad

- During rains the male and female form a pair in water
- The males make noises (croaks) to attract females.
- The male climbs the female's back
- The female lays eggs as the male sheds sperms over them and get fertilized externally.
- Eggs are also smeared with a sour jelly called spawn:**to protect them against predatorsand keep them together.**
- After about 2 weeks the eggs hatch into young ones called tadpoles.

Qn. How do eggs of amphibians hatch?

- By help of heat from the sun.

Diagrams showing eggs of a toad and frog.

frog	toad
	

Respiration in a toad/ frog

A frog can breathe in three different ways;
i) lungs ,bucal cavity and moist skin.
ii) A toad can breathe through the bucal cavity and lungs only

Differences between a tadpole and an adult frog / toad

Tadpole	Adult
- It has gills for breathing. - Has a tail for swimming	- uses lungs and moist skin for breathing. - uses its webbed feet for swimming

Ways in which a frog is adapted to living in water

- Has a streamlined body that enables it to move easily in water.
- Have strong hind legs with fully webbed feet so it can swim rapidly.
- The eyes and nostrils are arranged in such a way that they can float on water and its body is hidden from its enemies.
- They can hibernate during dry season i.e. rest or sleep.

Importance of amphibians

- They feed on harmful insects such as houseflies.
- Used as specimen in science laboratories.

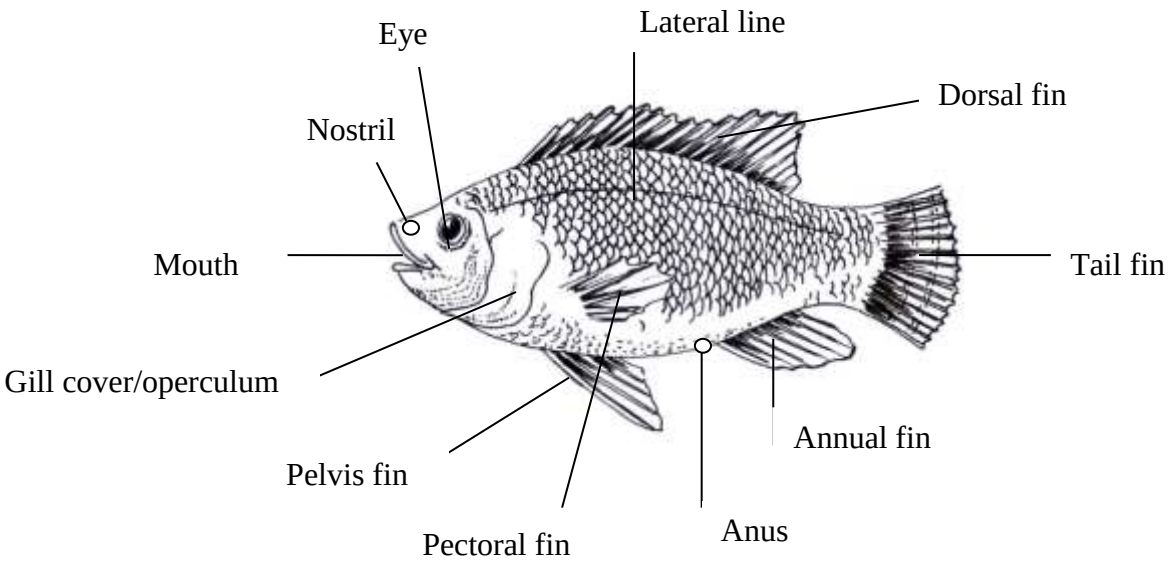
f. Fish

Characteristics of Fish

- They are poikilothermic animals.
- They live in water.
- They have fins used for swimming.
- Their eggs undergo external fertilization.

- They have streamlined bodies to reduce friction while swimming.
- Some fishes' bodies are covered with scales.
- Have nostrils used for smelling and tasting food.

External features of fish



Functions of the parts

The mouth– helps fish to take in food and water.
Nostrils – used for smelling and tasting food
Scales – protect the body from external injuries.
Gill cover or operculum- protects the gills from damage.
Lateral line – to detect sound movement in water
Qn. How does a lateral line detect movements in water?

- By vibration of the fluid.

Fins – make fish stable and control the direction in water.
Caudal fin: helps a fish to swim forward
For changing direction.
The median fins
Dorsal fin: keeps the fish upright
For protection
Controls the fish from rolling and yawing.
Ventral fin: keeps the fish upright
Controls the fish from rolling and yawing.
Paired fins
Pelvic fin: helps to reduce speed
Helps a fish to swim upwards and downwards.
Pectoral fin: helps to reduce speed
Helps it to swim upwards and downwards.
Anus – used for passing out waste.
Gills – used for breathing
Classification of Fish

Types of Fish

- Bony fish
- Cartilaginous
- Lung fish

Boy fish

- Their skeletons are made of bones
- Their eyes have no eyelids.
- Their bodies are covered with scales that overlap.
- Their gills are covered by a bony structure called operculum.
- They have a swim bladder which prevents them from sinking (keeps them buoyant)

Examples of bony fish;

- Nile perch
- Tilapia
- Salmon
- Pike

Cartilaginous fish

- Their skeleton is made of cartilage.
- The mouth is situated on the underside of the head.
- They have tough and spiny scales.
- They have no gill cover but have gill slits on the surface of the body
- They have no swim bladder.

Examples of cartilaginous fish;

- Dog fish
- Skates
- Rays
- Shark

Lung fish

- They breathe by means of gills in water and by the swim bladder when the gills can't supply enough oxygen.
- They have long and thin pelvic and pectoral fins.
- They live in dirty pools, swamps or rivers that dry up during the dry season.
- They hibernate during the dry season.

Examples of lung fish;

- Common lung fish,
- Diponi

Reproduction in fish

- The female lays eggs in shallow water and the male sheds sperms over them.
- The eggs hatch out by the heat from the sun.
- Young fish are called fry.
- Most fish don't care for their young ones except tilapia.

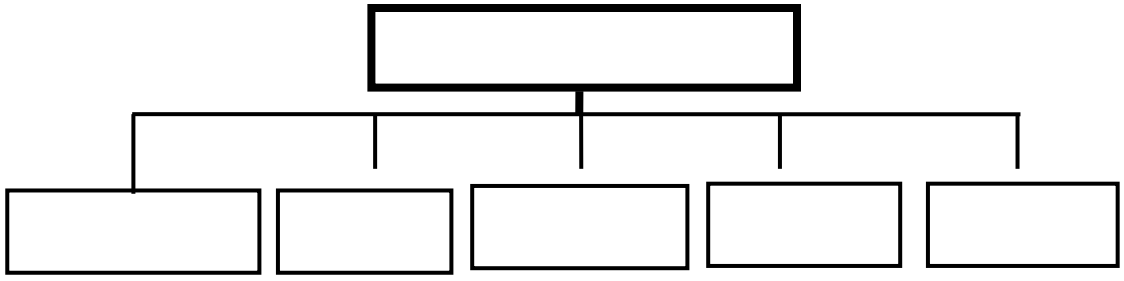
How do fish carry out external fertilization?

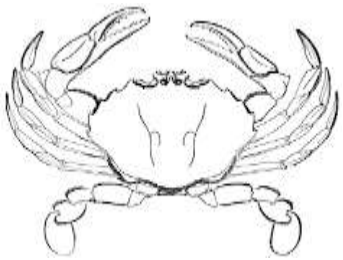
The male fish sheds sperms on eggs.

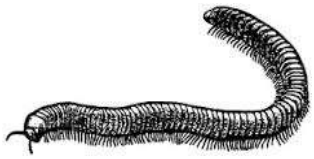
How fish protect themselves against enemies

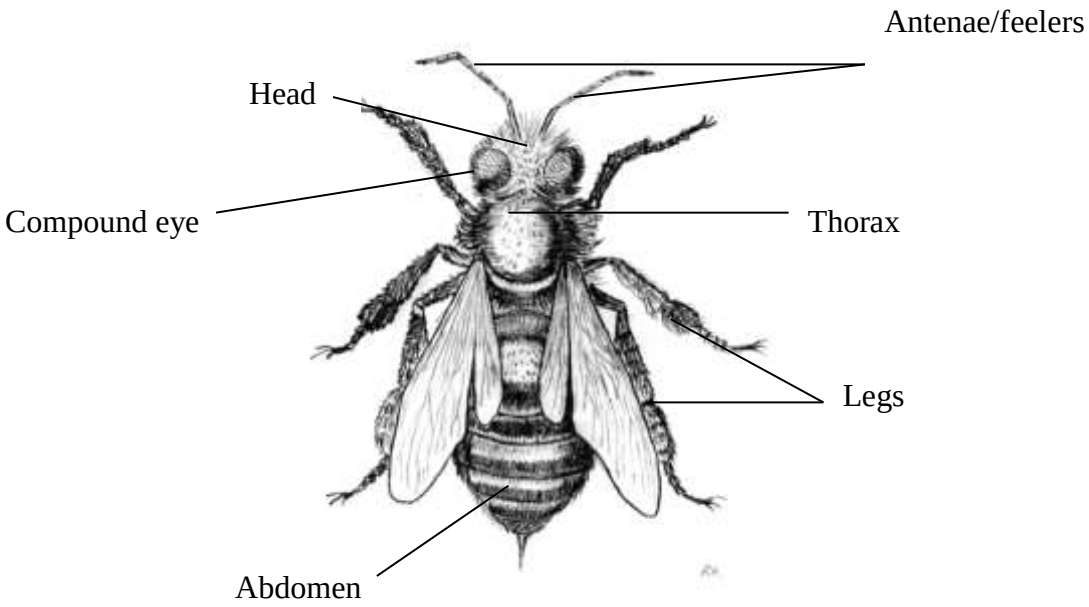
- By use of dorsal fins and teeth.
- Some fish have electric organs which give out high voltage electricity to shock the enemy i.e. electric ray fish.

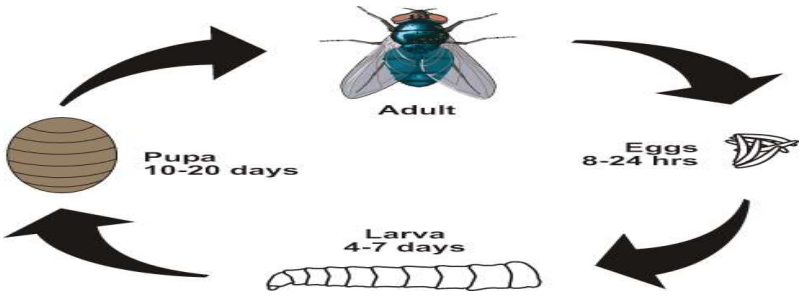
Gill bar

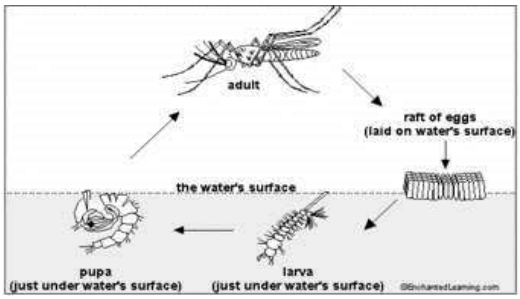


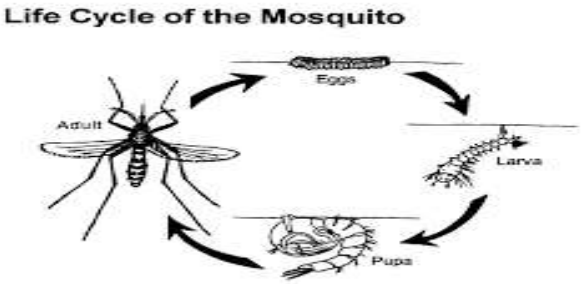


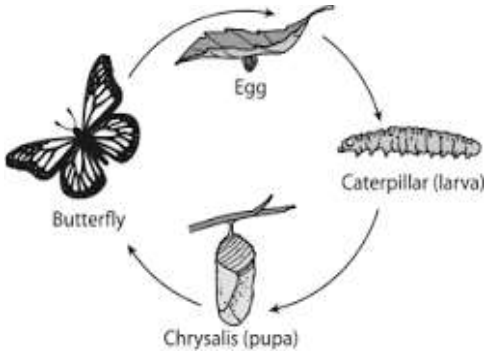


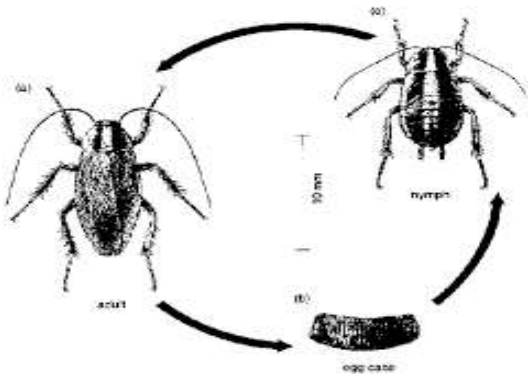

Antenae/feelers
Head
Compound eye
Thorax
Legs
Abdomen

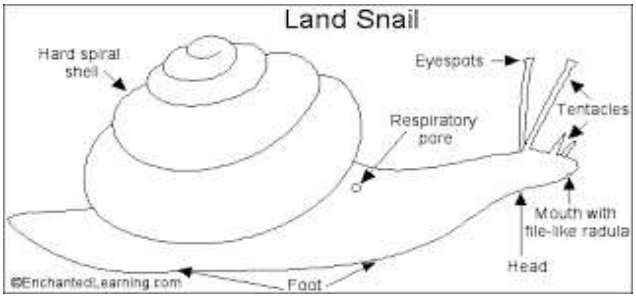

Adult
Eggs
8-24 hrs
Larva
4-7 days
Pupa
10-20 days

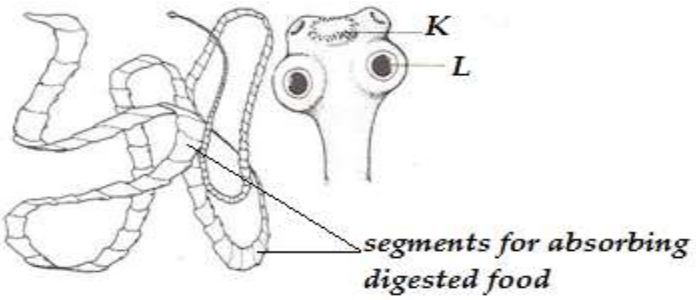

adult
raft of eggs
(laid on water's surface)
the water's surface
pupa
(just under water's surface)
larva
(just under water's surface)

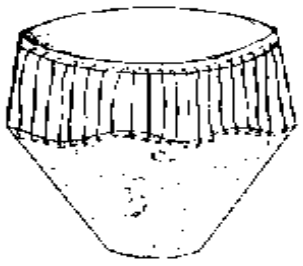

Life Cycle of the Mosquito
Eggs
Adult
Larva
Pupa

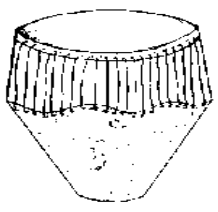

Egg
Caterpillar (larva)
Chrysalis (pupa)
Butterfly

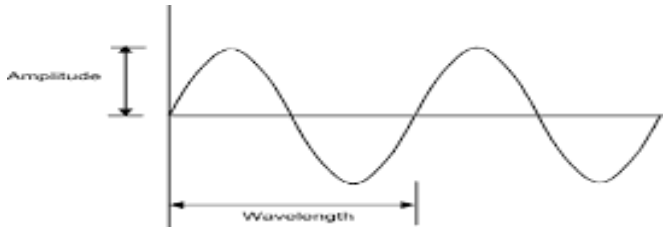

(a)
adult
10 mm
(c)
nymph
(b)
egg case

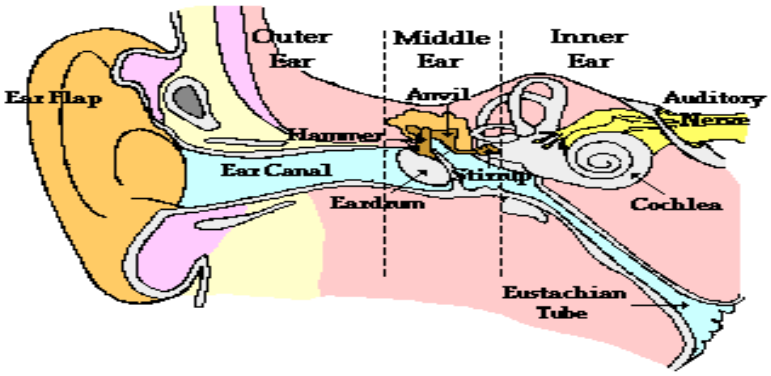

Land Snail
Hard spiral shell
Eyespots
Tentacles
Respiratory pore
Mouth with file-like radula
Head
Foot
©EnchantedLearning.com

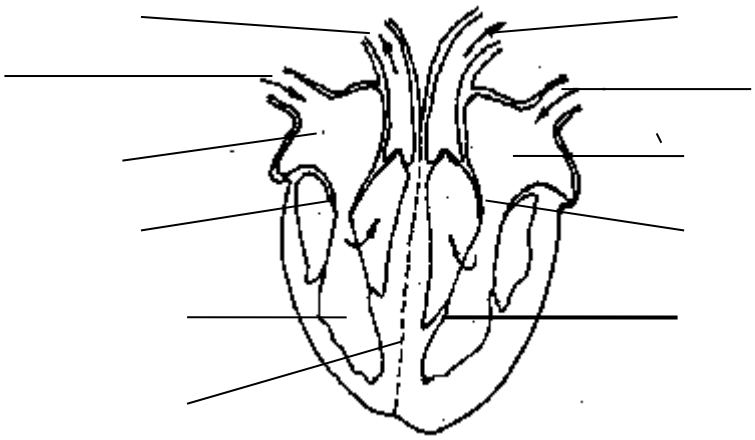

K
L
segments for absorbing
digested food

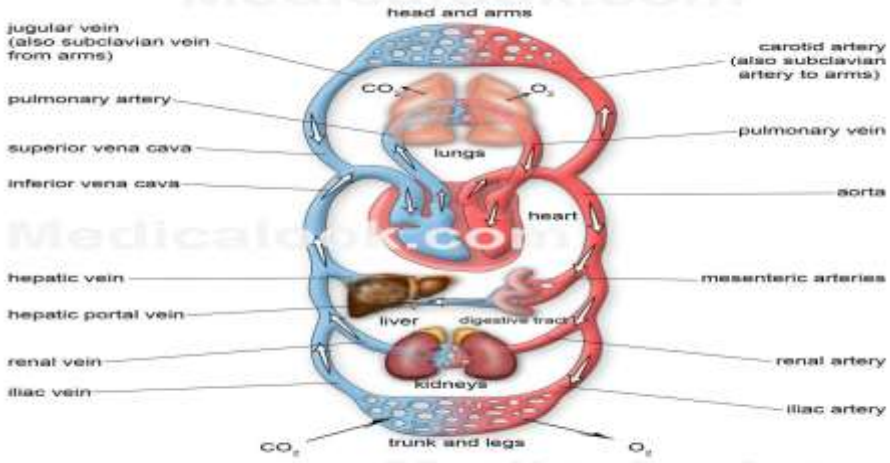


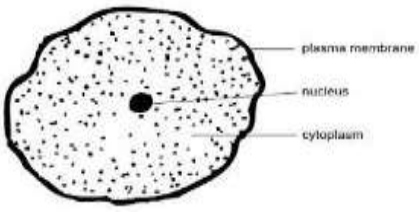


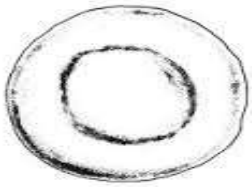

Amplitude
Wavelength


Outer Ear
Middle Ear
Inner Ear
Ear Flap
Anvil
Auditory Nerve
Hammer
Ear Canal
Stirrup
Eardrum
Cochlea
Eustachian Tube

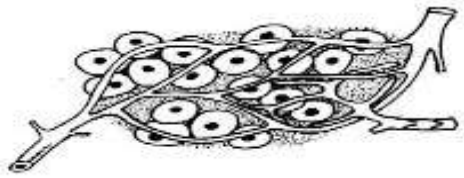



head and arms
jugular vein
(also subclavian vein
from arms)
carotid artery
(also subclavian
artery to arms)
CO_2
O_2
pulmonary artery
pulmonary vein
lungs
superior vena cava
inferior vena cava
aorta
heart
hepatic vein
mesenteric arteries
hepatic portal vein
liver
digestive tract
renal vein
renal artery
kidneys
iliac vein
iliac artery
CO_2
trunk and legs
O_2


plasma membrane
nucleus
cytoplasm

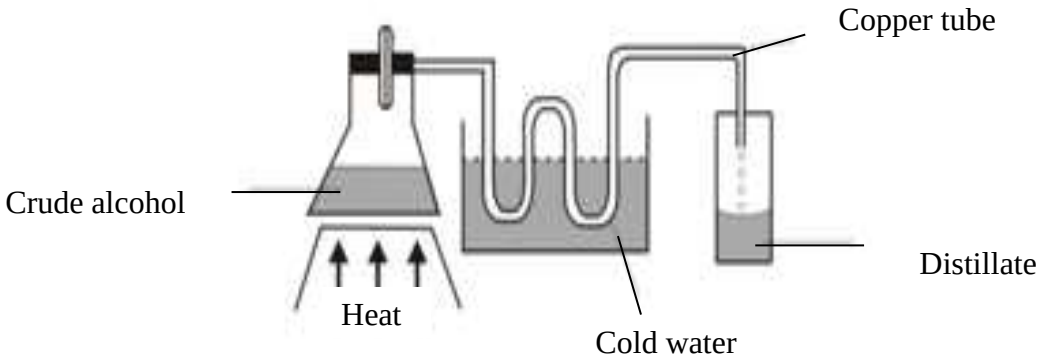



T
R
Artery
Vein
Artery
Vein



Vein

Artery	


Copper tube
Crude alcohol
Distillate
Heat
Cold water