Zoology (7)

Seniors Geology and Biology
2022-2023

Part 1

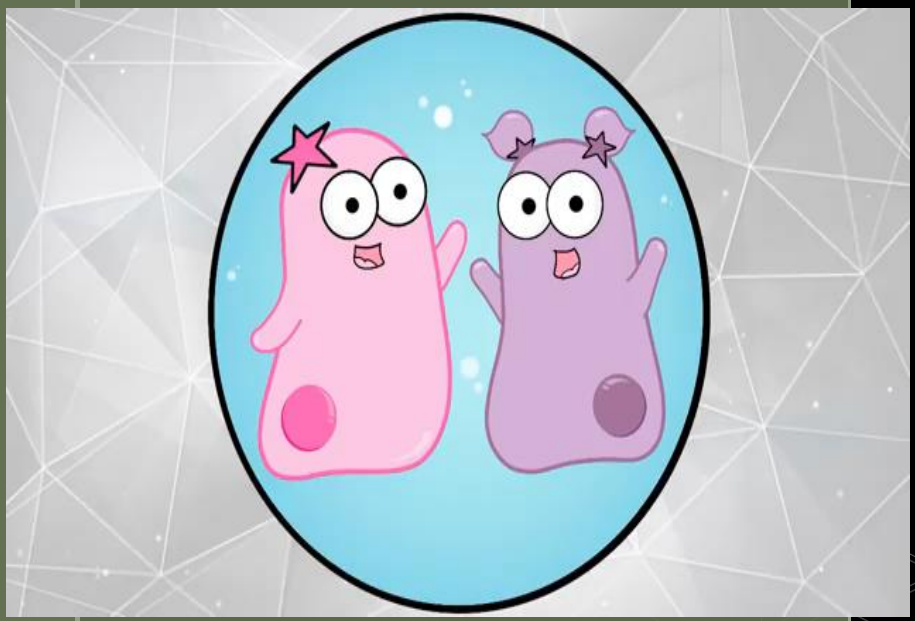
Insect taxonomy

Seniors Geology and Biology
2022-2023

LECTURE (1)

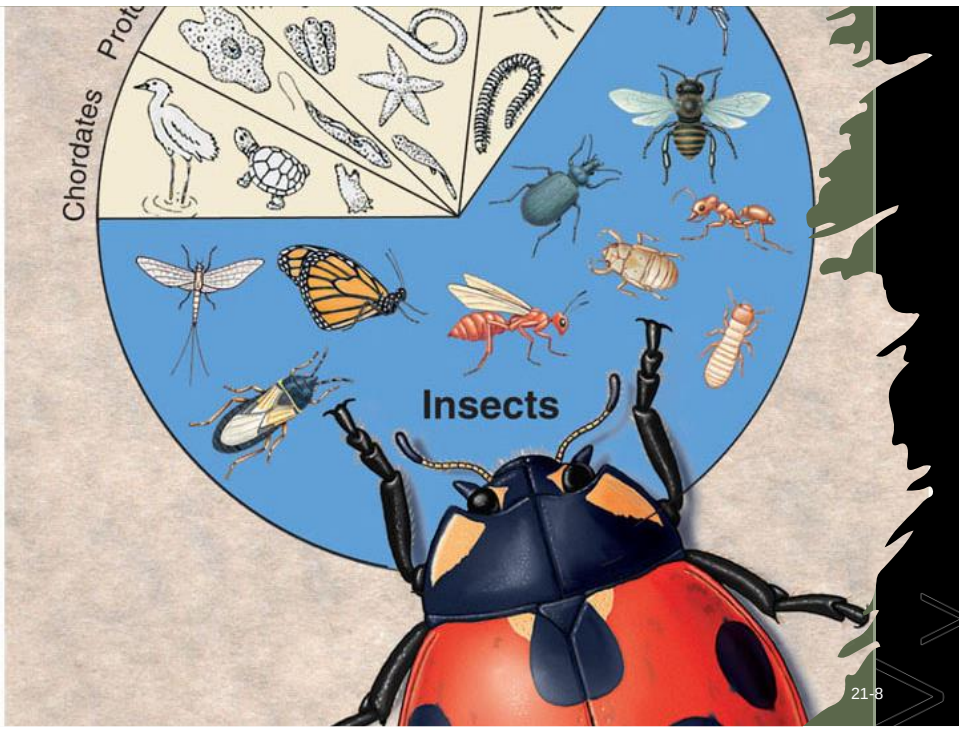
Taxonomy

- Taxonomy is **the practice and science of categorization or classification**.
- A taxonomy (or taxonomical classification) is a scheme of classification, especially a hierarchical classification, in which things are organized into groups or types.



Class Insecta

- **Insects** (from Latin insectum) are hexapod invertebrates.
- They are the largest group within the arthropod phylum.
- Insects have a chitinous exoskeleton
- three-part body (head, thorax and abdomen).
- three pairs of jointed legs, compound eyes and one pair of antennae.
- Their blood is not totally contained in vessels; some circulates in an open cavity known as the haemocoel.



Insect spreading factors

1. Small size
2. Massive offspring
3. Ability for flying and migration
4. The ability for Adaptation
5. Social life
6. The ability to form a body wall

METAMORPHOSIS

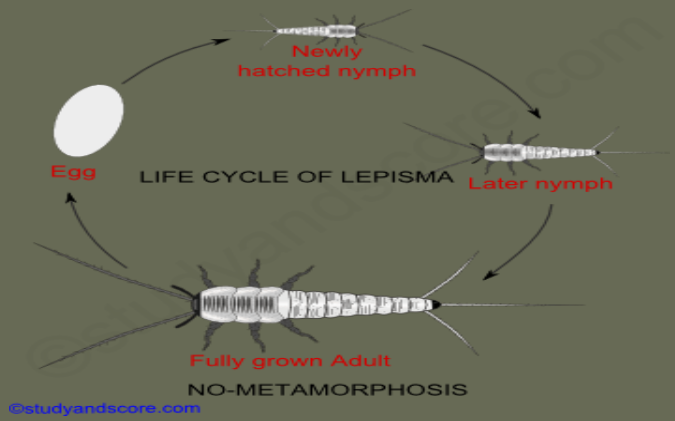
"CHANGE IN FORM"

That some insects go through during their life cycle

METAMORPHOSIS

METAMORPHOSIS

Ametabolous



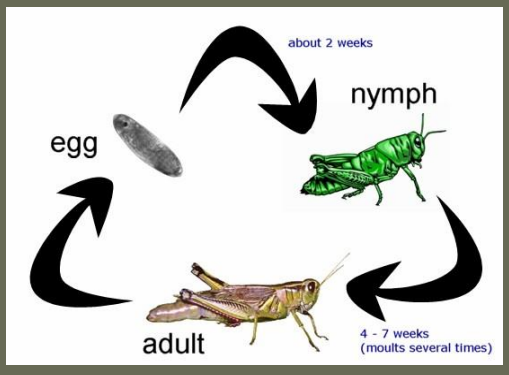
METAMORPHOSIS

Ametabolous

Ametabolism is a type of growth or life cycle in insects in which there is slight or no metamorphosis, only a gradual increase in size. It is present only in primitive wingless insects

INCOMPLETE METAMORPHOSIS

Hemimetabolous



INCOMPLETE METAMORPHOSIS
Hemimetabolism

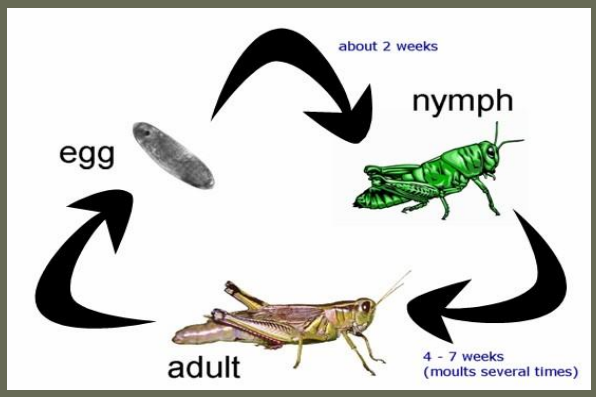
- **Hemimetabolism** or **hemimetaboly.**
- Also called **incomplete metamorphosis**
- includes three distinct stages: the egg, nymph, and the adult stage, or imago.
- there is no pupal stage.
- The nymph often has a thin exoskeleton and resembles the adult stage but lacks wings and functional reproductive organs.
- **The hemimetabolous insects differ from ametabolous taxa in that the one and only adult instar undergoes no further molting means no skin development**

INCOMPLETE METAMORPHOSIS
Hemimetabolous

- **A type of development that includes 3 distinct stages**
  egg*nymph*adult
  (the baby looks like the adult)

INCOMPLETE METAMORPHOSIS

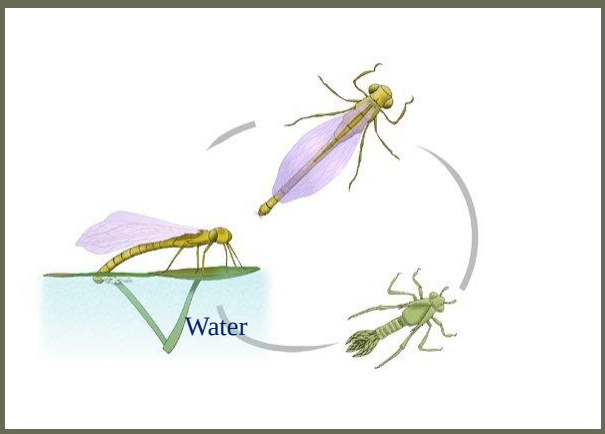
paurometabola



Same environment

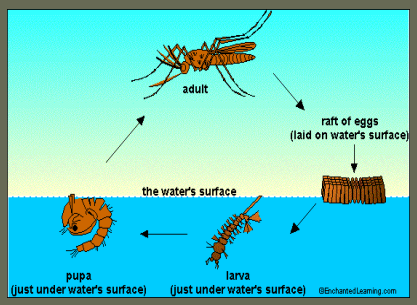
INCOMPLETE METAMORPHOSIS

Hemimetabola

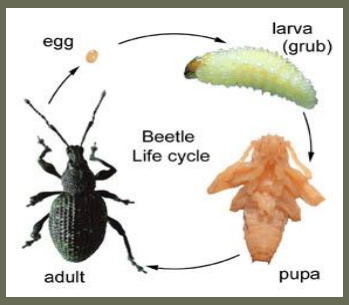


Different environment

COMPLETE METAMORPHOSIS
Holometabolous



Mosquitoes



Darkling Beetle

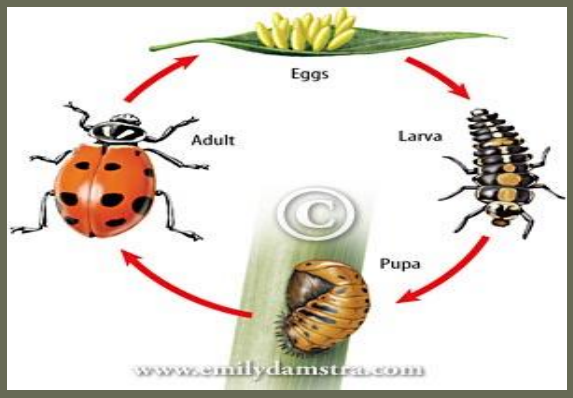
COMPLETE METAMORPHOSIS
Holometabolous

- **Holometabolism**
- also called **complete metamorphosis**.
- is a form of insect development which includes four life stages: egg, larva, pupa, and imago (or adult).

It is very important that you know the difference between complete and incomplete metamorphosis of insects.

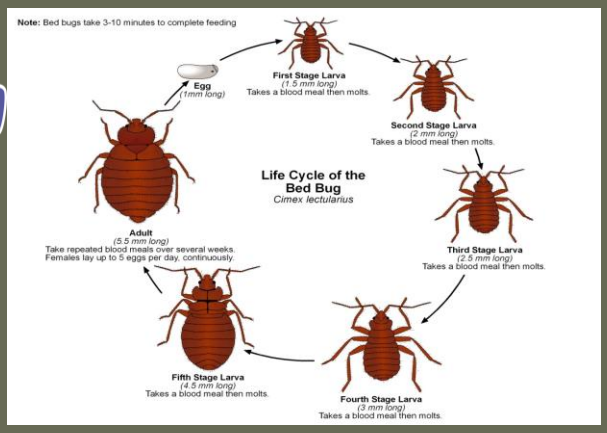
Holometabolous

LADYBUG



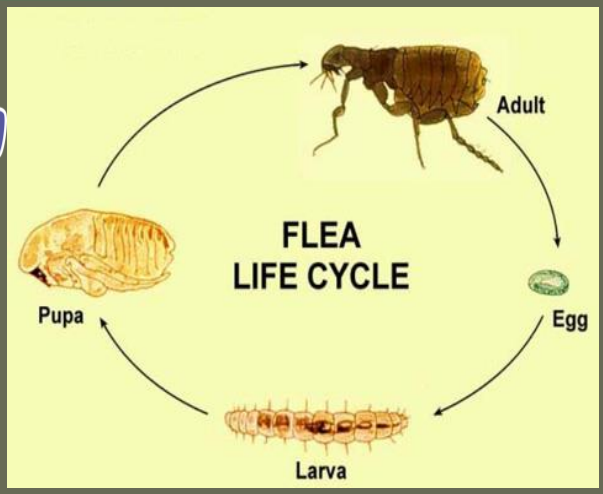
paurometabola

BED BUG



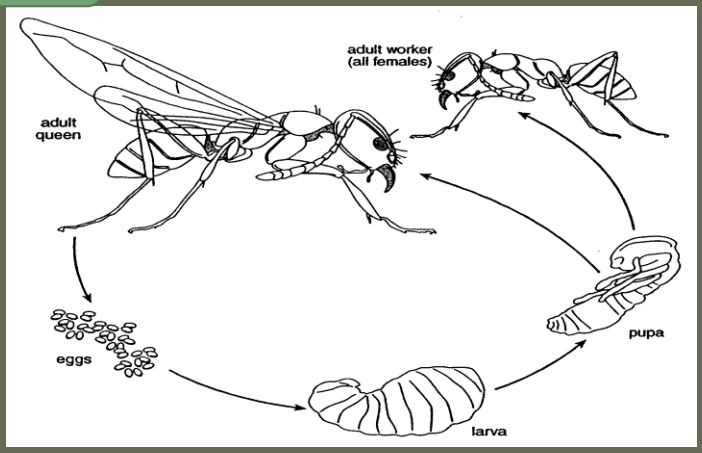
Holometabolous

FLEA



Holometabolous

ANT

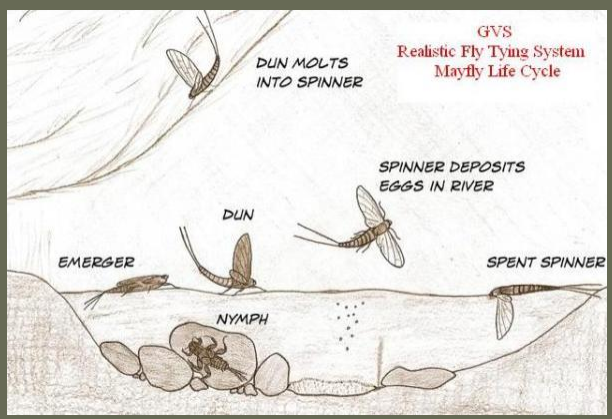


Holometabolous

BUTTERFLY

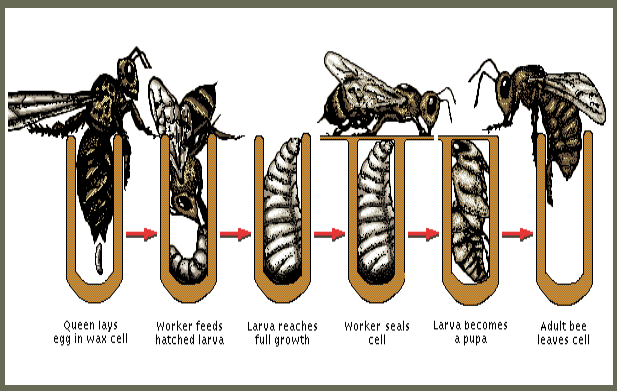
Hemimetabolous

May fly

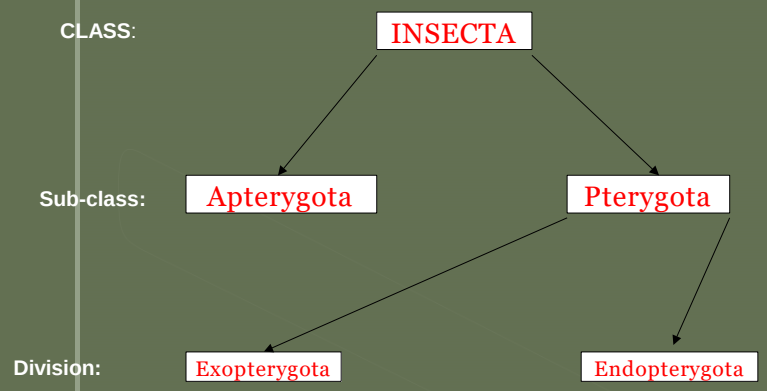


Holometabolous

HONEYBEE



Basic Insect Systematics



Sub class

Apterygota

Apterygota are no longer considered true insects.

Sub class : Apterygota

- primitively wingless.
- Ametabolous metamorphosis.
- Adults possess one or more pairs of pregenital appendages.
- Males deposit sperm packages, or spermatophores, rather than fertilizing the female internally.

Sub class : Apterygota

- They continue to molt throughout life, undergoing multiple instars after reaching sexual maturity.
- whereas all other insects undergo only a single instar when sexually mature.
- Mandibles are articulated at single point.

Sub class : Apterygota

Orders in the Subclass Apterygota:

- Diplura - diplurans
- Protura - proturans
- Collembola - springtails
- Thysanura - silverfish and firebrats

Sub class : Apterygota

Diplura

Sub class : Apterygota

Diplura

- Diplurans are blind and pale.
- small, measuring about 2–5 mm (0.08–0.2 inch) in length, though some tropical species can be larger.
- They live in soil and feed on other insects or decaying vegetation and plant tissues, occasionally damaging growing plants.
- **For reproduction**, female diplurans gather male spermatophores from stalks on the ground, taking the spermatophores up through the genital opening. Eggs are laid on the ground. Young diplurans appear as smaller versions of the adults.

Sub class : Apterygota

Protura

Sub class : Apterygota

Protura

- Proturans are usually regarded as the most primitive of all hexapods.
- but they lack most of the other physical features that are common to arthropods.
- Most species are very small (0.5-2.0 mm) and unpigmented.
- Proturans do not have eyes or antennae.
- The front pair of legs are usually held in front of the body and apparently serve as sense organs.
- habitats -- usually in the humus and leaf mold of temperate deciduous forests. Both adults and immatures feed on organic matter released by decay.

Sub class : Apterygota

- **Collembola**
- **Springtails**

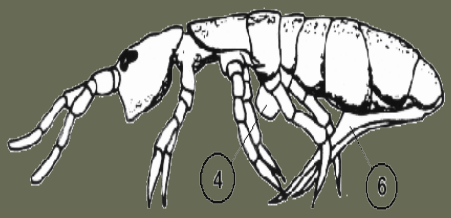
Sub class : Apterygota

- **Collembola**
- **Springtails**

- The springtails are among the most abundant of all soil-dwelling arthropods.
- They live in a variety of habitats where they feed as scavengers on decaying vegetation and soil fungi.
- Most species are small (less than 6 mm in length).
- A unique, tube-like structure, the collophore is located ventrally on the first abdominal segment of most species. The exact function of this organ is unknown, but it probably helps maintain water balance by absorbing moisture from the environment.

Sub class : Apterygota

- **Collembola**
- **Springtails**



Collophore Furcula

Sub class : Apterygota

- **Collembola**
- **Springtails**

- Springtails are named for a forked jumping organ (the furcula) found on the fourth abdominal segment.
- The furcula is retracted against the ventral wall of the abdomen and held there, in cocked position, by a special catch (the tenaculum) on the third abdominal segment.
- Releasing the tenaculum causes the furcula to snap down against the substrate and flip the organism some distance through the air.

Sub class : Apterygota

Thysanura

Sub class : Apterygota

Thysanura

- Silverfish are fast-running insects that hide under stones or leaves during the day and emerge after dark to search for food.
- Economic Importance: may cause extensive damage to household goods.
- They often feed on wallpaper paste, bookbindings, and the starch sizing of some textiles. Cardboard and other paper products may also be damaged.

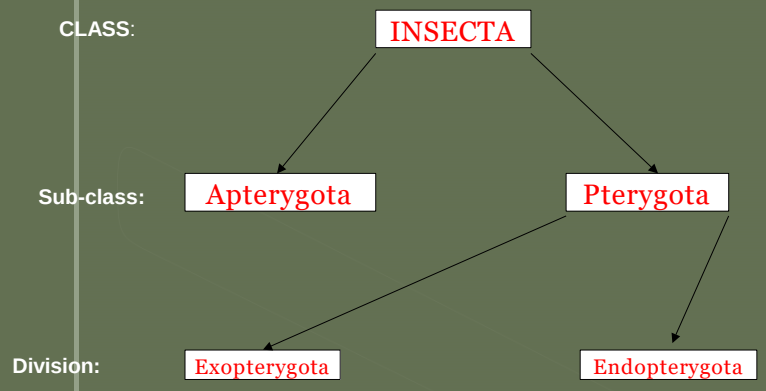
Sub class : Apterygota

Thysanura

- Silverfish have an elaborate courtship ritual to insure exchange of sperm.
- The male spins a silken thread between the substrate and a vertical object.
- He deposits a sperm packet (spermatophore) beneath this thread and then coaxes a female to walk under the thread.
- When her cerci contact the silk thread, she picks up the spermatophore with her genital opening
- Sperm are released into her reproductive system, and then she ejects the empty spermatophore and eats it.

LECTURE (2)

Basic Insect Systematics



Division Exopterygota

Characteristics of Exopterygota

1. Wings develop externally.
2. Metamorphosis **is incomplete**.
3. Immature stages (nymphs) resemble adults in structure, habitat and feeding habits.
4. Pupal stage is absent.
5. All hemimetabolus insects

Orders of Exopterygota

- Biting and Sucking lice (Order: Phthiraptera)
- Booklice and Barklice (Order: Psocoptera)
- **Cockroaches (Order: Blattodea)**
- **Dragonflies and Damselflies (Order: Odonata)**
- **Earwigs (Order: Dermaptera)**
- **Grasshoppers and Crickets (Order: Orthoptera)**
- **Praying Mantids (Order: Mantodea)**
- **Mayflies (Order: Ephemeroptera)**
- Stick insects and Leaf insects (Order: Phasmatodea)
- Stoneflies (Order: Plecoptera)
- **Termites (Previously Order: Isoptera but now part of Order: Blattodea)**
- **Thrips (Order: Thysanoptera)**
- **True Bugs (Order: Hemiptera)**
- Web-spinners (Order: Embioptera)
- Zorapterans (Order: Zoraptera)

Order : Ephemeroptera

Ephemeros = short-lived; pteron = wing)

Characteristics Order : Ephemeroptera

- 2 pair of membranous wings
- Hind wings much smaller than the forewings
- Short, fine antennae.
- Mandibulate mouthparts.
- Tip of abdomen usually with 3 very long filament.
- Mayfly nymphs are aquatic and have a similar body shape to the adults but lack wings.
- The nymphs have gills along the sides of their abdomen, which look similar to fine leaves.

Characteristics Order : Ephemeroptera

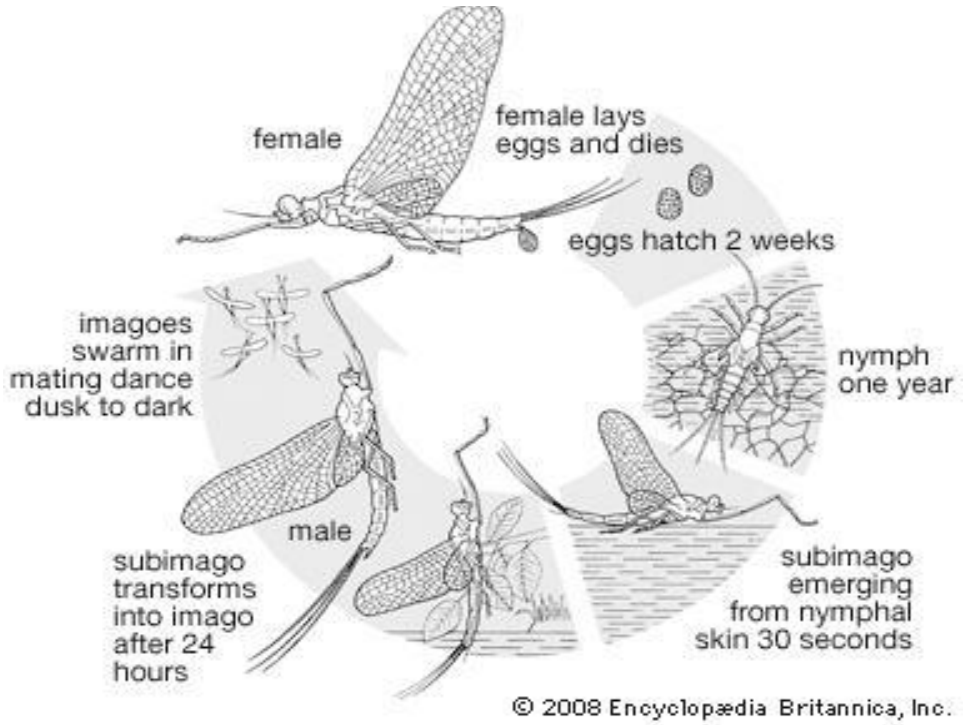
Type of metamorphosis?

May fly larvae

Ephemeroptera life cycle

- Mating occurs during flight and large swarms of mayflies gather close to the fresh water habitats they prefer.
- Eggs are laid on the water surface of lakes and streams where they sink, scattering along the substrate and amongst aquatic plants and debris.
- Upon hatching the nymphs live on the bottom, sheltering under stones or in the substrate.
- Development can take from several months up to a year and can involve from 20 to 50 moults depending on the species.

May fly larvae



Ephemeroptera life cycle

Order : Odonata

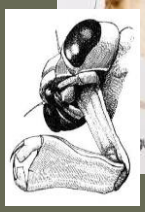
Odonata, derived from the Greek "odonto", meaning tooth, refers to the strong teeth found on the mandibles of most adults.

Characteristics of Order : Odonata

- 2 pair of membranous wings
- Rectangular stigma (pigmented patch) near tip of each wing
- Short, bristle-like antennae.
- Mandibulate mouthparts.
- Large compound eyes.
- 3 ocelli.
- Complex wing venation with many cells.
- Larvae are aquatic feeding on other insects.

Characteristics of Order : Odonata

- Larvae mouth parts modified for sizing prays.
- Larvae breathe by gills.
- Adults live aerially near water sources.
- Females lay eggs while flying.



Larvae or nymph

Female lay eggs

Classification of Order : Odonata

Order : **Odonata**

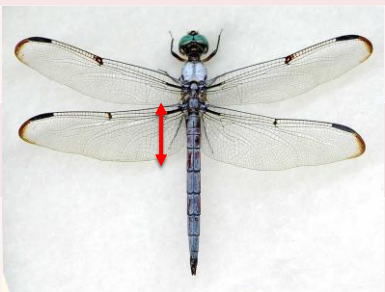
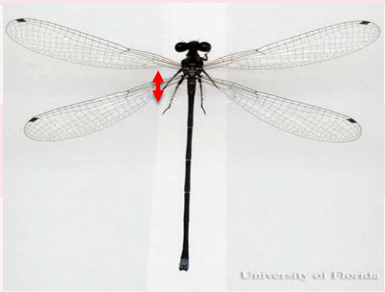
Suborder : Anisoptera (dragonflies)
Family : Libellulidae
Species :*Crocothemis erythraea*

Suborder :Zygoptera (damselflies)
Family :Coenagrionidae
Species :*Ischnura senegalensis*

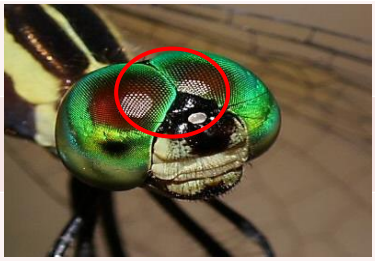
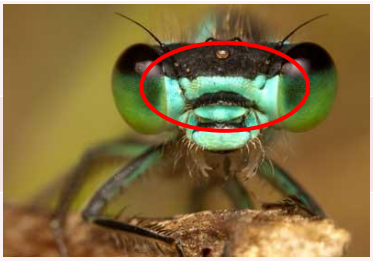
Different between odonata suborders

Anisoptera	Zygoptera
Wings are extended laterally at rest 	Wings are perpendicular dorsally 

Different between odonata suborders

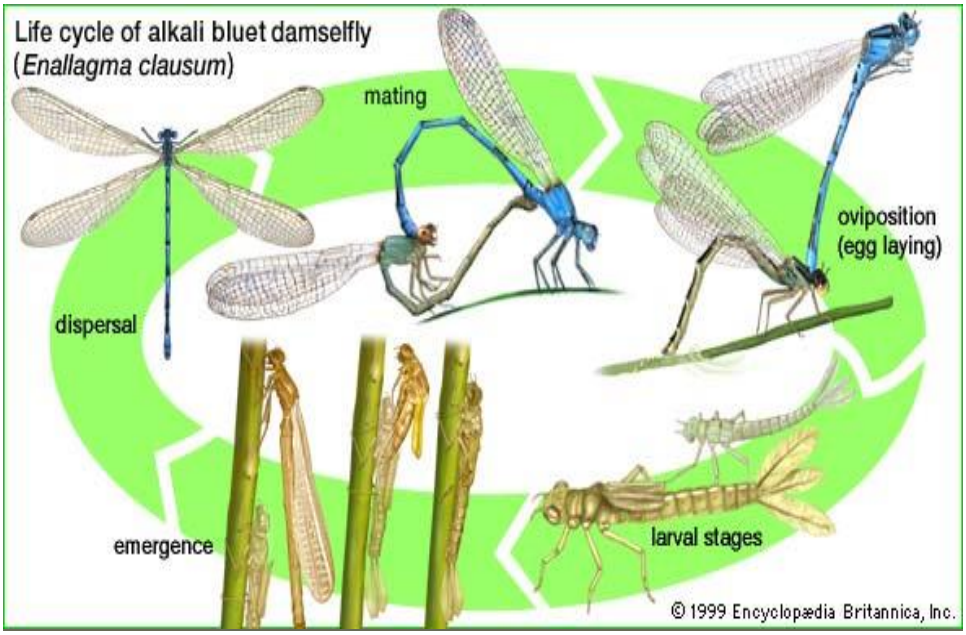
Anisoptera	Zygoptera
The base of hind wings are more wide than fore wings 	Two pairs of identical wings 

Different between odonata suborders

Anisoptera	Zygoptera
No space between compound eyes	Large space between compound eyes
	

Different between odonata suborders

Anisoptera	Zygoptera
Larvae breath with gills situated internally in rectum called rectal papillae	Larvae breath with 3 long filamentous gills at the terminal of the abdomen
	



Odonata Life cycle

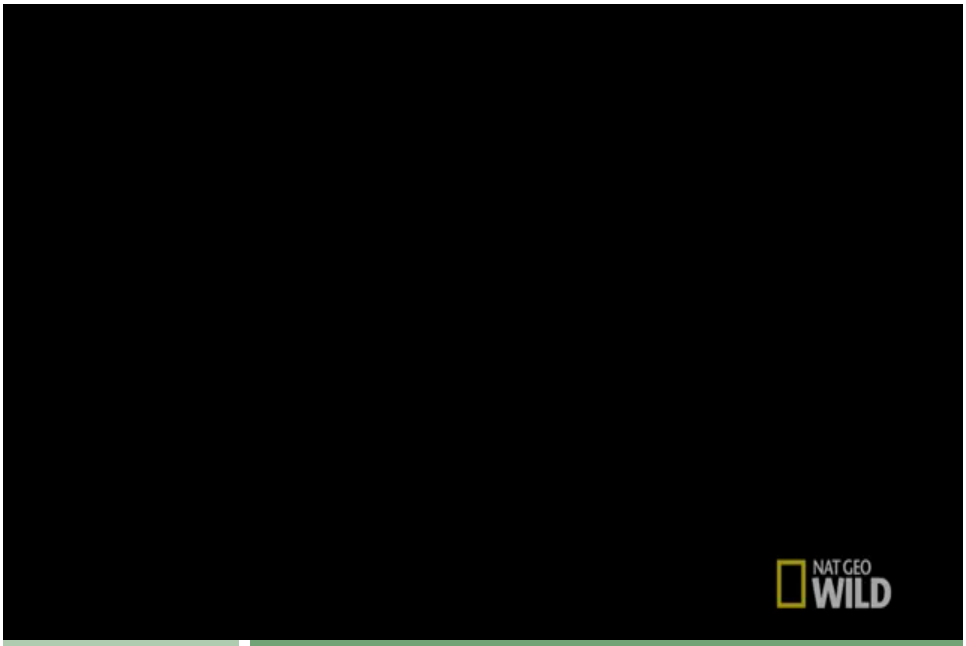
odonata Life cycle

Egg Laying in various Odonata

(Videos courtesy Takashi Aoki)

odonata Life cycle

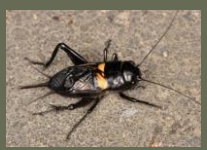
odonata Life cycle



odonata Life cycle

Order : Orthoptera

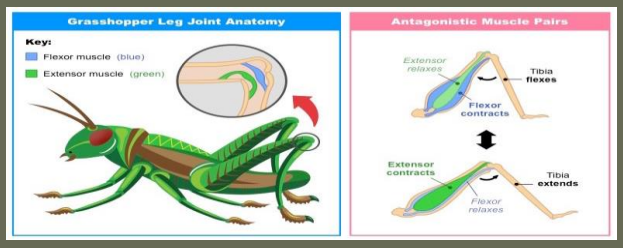



Orthos = Straight

Characteristics of Order : Orthoptera

- Fore wings are tegmina type.
- Hind wings are membranous.
- Wings veins are straight and arranged radially.
- Biting mouth parts.
- Hind legs are modified for jumping.



Characteristics of Order : Orthoptera

- Female have ovipositor.
- Cerci are not segmented .
- Paurometabolous metamorphosis.
- stridulatory organ

ovipositor

stridulatory organ

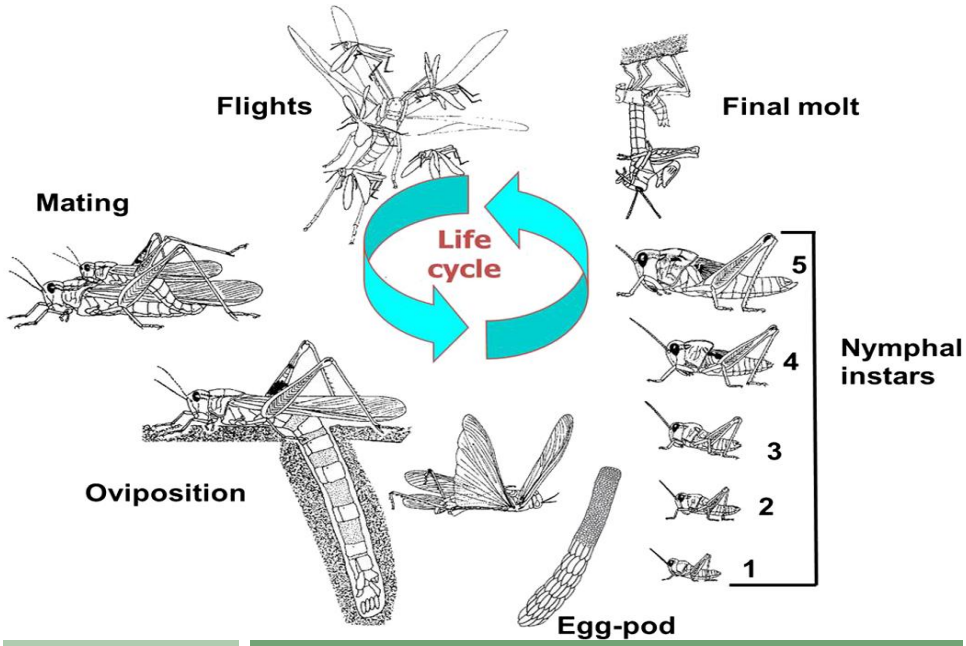
Female oviposition

Stridulation

Classifications of Order : Orthoptera

Order : Orthoptera

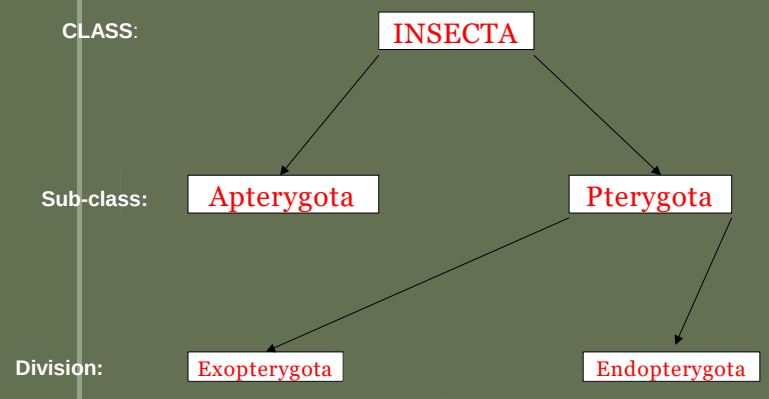
- Suborder: Caelifera
  - Family: Acrididae
- Suborder: Ensifera
  - Family: Gryllidae
  - Family: Gryllotalpidae
  - Family: Tettigoniidae



Orthoptera Life cycle

LECTURE (3)

Basic Insect Systematics



Division Exopterygota

Order : Blattodea or Dictyoptera (Cockroaches)

Blattodea is derived from “blatta”, the Greek word for cockroach.

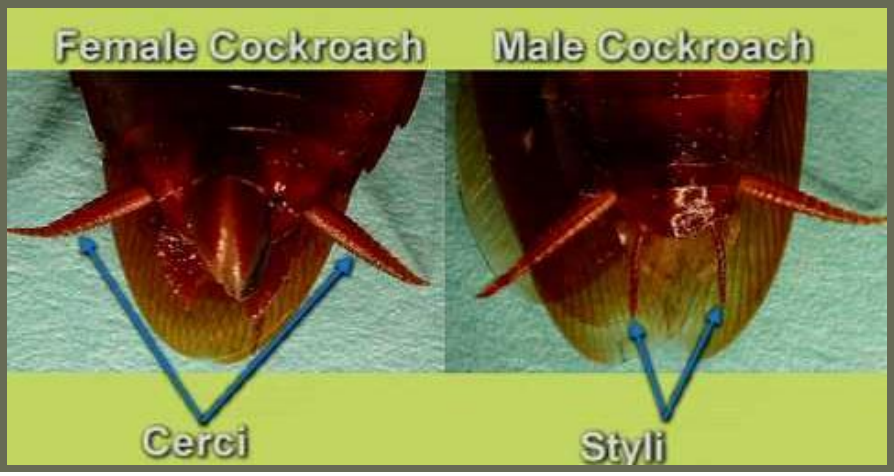
Characteristics of order Blattodea or Dictyoptera (Cockroaches)

- 2 pair of wings (fore wing are tegmina).
- Setaceous antennae.
- Chewing (Mandibulate) mouth parts.
- Legs for walking .
- Cerci is segmented.
- Prothorax is enlarged and extended to cover head and thorax.
- Two large compound eyes, 2 ocelli.
- Omniverous or scavengers.
- Found in tropical or subtropical climates,

Characteristics of order Blattodea or Dictyoptera (Cockroaches)

- This “cucaracha” is known as the American cockroach, *Periplaneta americana*, although it is probably a native of Africa.
- Today, it enjoys a worldwide distribution, living as a close (and undesired) companion to the human species. The stamp pictured here is one of sixteen insect stamps issued by the African country of Equatorial Guinea in 1974.

Characteristics of order Blattodea or Dictyoptera (Cockroaches)



Life cycle of (Cockroaches)

- Cockroaches have incomplete metamorphosis.
- Female deposited eggs is special capsule called ootheca (bean like shaped).
- Eggs in each capsule ranged from 16 to 20.
- The young are active from hatching and resemble the adults but are usually lighter in color and lack wings.
- The young cockroaches develop through a number of nymphal instars, which may range from 2 to 12 depending on the species and may take from a month or so up to 12 months to reach maturity.

Life cycle of (Cockroaches)

Ootheca

Ootheca

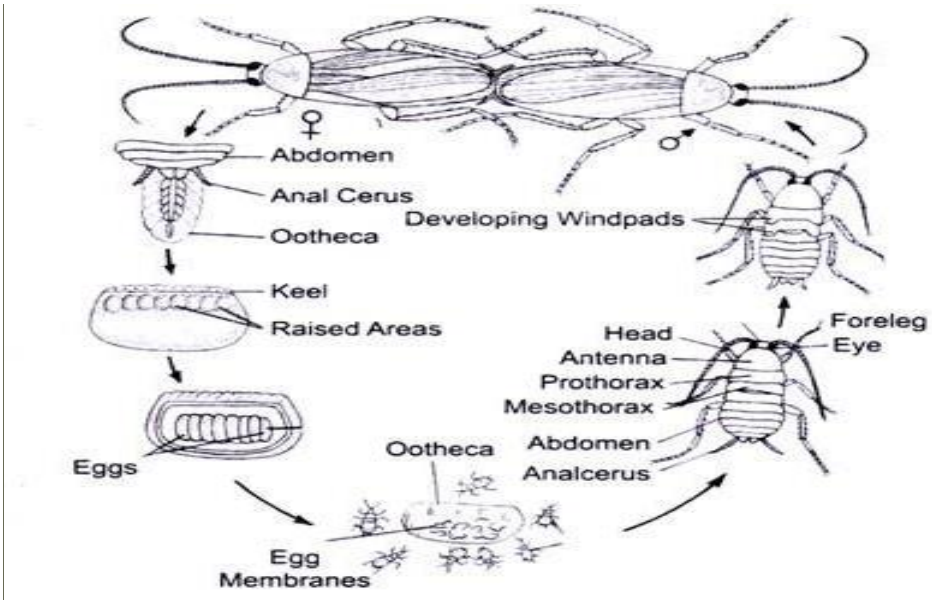
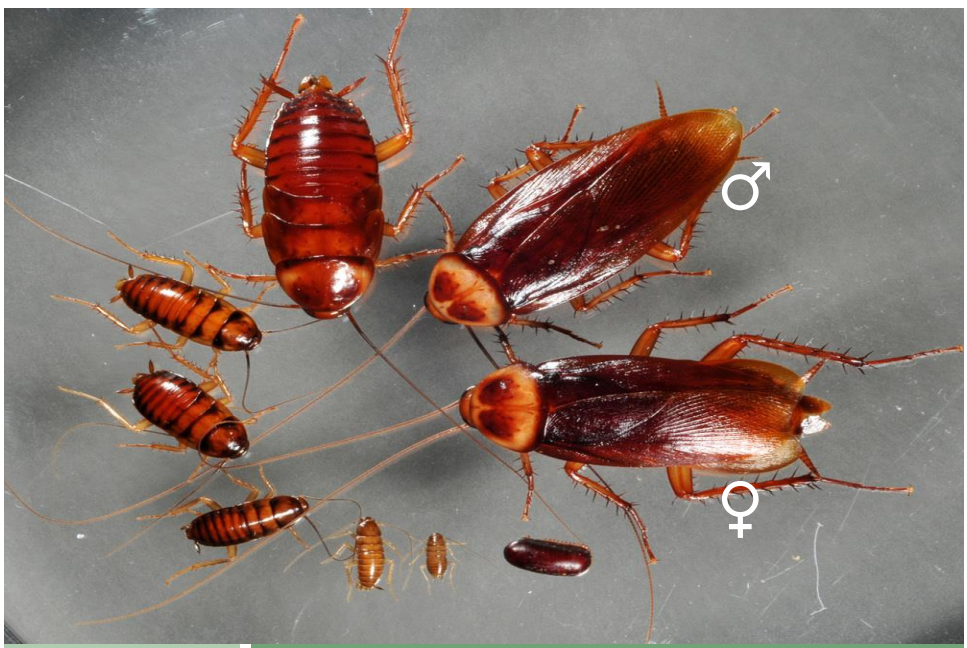


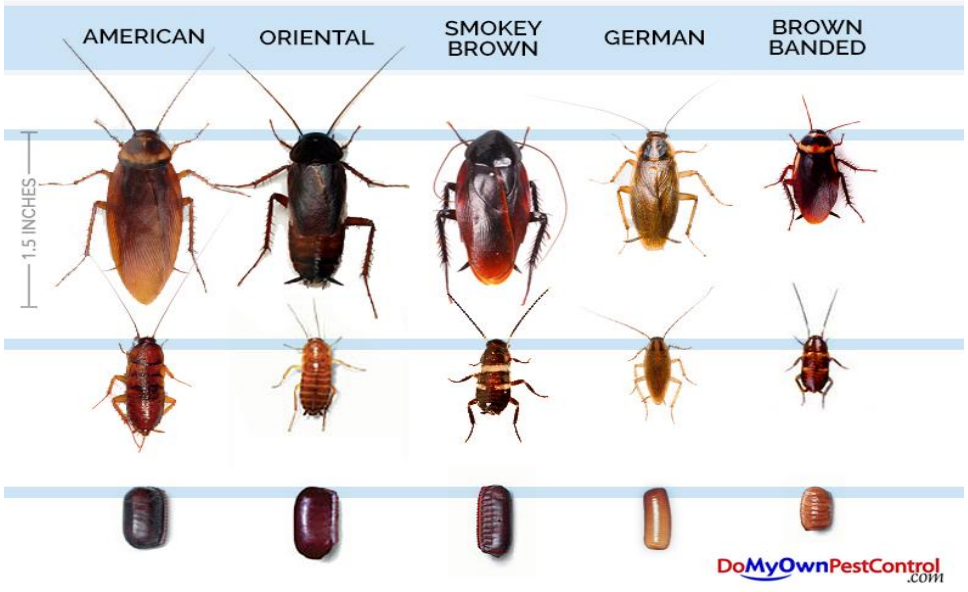
Fig. 8.4 Life cycle of a Cockroach

Life cycle of (Cockroaches)



Life cycle of (Cockroaches)

Life cycle of (Cockroaches)



DIFFERENT COMMON SPECIES

Order :Mantodea
Praying Mantids

Mantodea is derived from "mantis", the Greek word for these insects.

Characteristics of Order :Mantodea

- 2 pair of wings (fore wing are tegmina).
- Shot filiform antennae.
- Chewing (Mandibulate) mouth parts.
- Grasping (raptorial) front legs for catching prey.
- Cerci is segmented.
- Very mobile triangular shaped head
- Prothorax is enlarged twice as mid and hind thorax
- Two large compound eyes, 3 ocelli.
- Development is Hemimetabola, i.e. incomplete metamorphosis.

Characteristics of Order :Mantodea

- Praying mantids are carnivorous as both adults and nymphs and eat a wide variety of insects.
- they seize with their powerful forelegs.
- They can often be observed slowly stalking their prey or waiting in ambush on vegetation.

- Praying mantids are found almost everywhere.
- In natural environments they can generally be seen on tree trunks and bushes or among grasses and other plants.
- Some species also live on the ground.
- Many species are camouflaged to blend in with particular sites such as flowers, rocks or tree trunks where they hunt and live.

Mantids attack a rat

Life cycle of Mantodea

- Mating in praying mantids is direct .
- the female may attack and eat the male during or after mating.
- The female lays her eggs in a foamy substance that hardens into a distinctive case.
- these cases attached to branches, tree trunks, logs and even paling fences and houses.
- This egg case known as an ootheca may contain up to 400 eggs depending on the species.
- Some female mantids stay with the eggs until they hatch while others leave as soon as the eggs are laid.
- The nymphs hatch resembling small adults and develop through a series of stages.
- molting several times before reaching maturity.
- there may be up to 2 generations in one year.0

Mantids mating

Life cycle of Mantodea

Life cycle of Mantodea

Life cycle of Mantodea

Order :Dermaptera

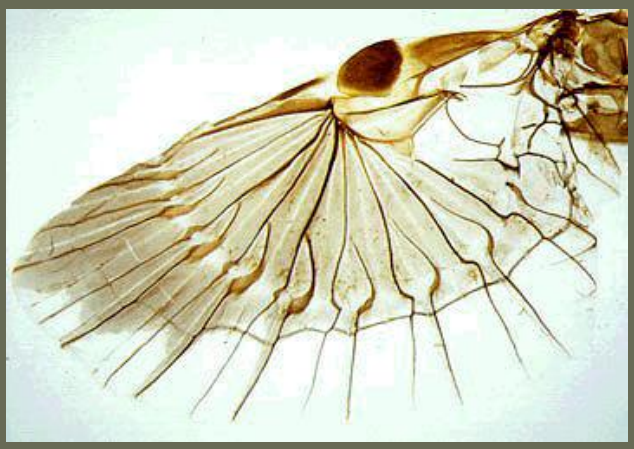
Dermaptera, derived from the Greek “derma” meaning skin and “ptera” meaning wings

Characteristics of Order : Dermaptera

- Flattened elongated body
- Heavily sclerotized pincer-like cerci. Females have straight cerci with an inward pointing tip and males have curved cerci
- 2 pairs of wings.(The forewings are short and protectively hardened. The hind wings are membranous and folded in a fan-like way underneath the forewings when not in use.
- Chewing (mandibulate) mouthparts
- Moderately long antennae, filiform type.
- Nocturnal insects, omnivorous.

Characteristics of Order : Dermaptera

Characteristics of Order : Dermaptera

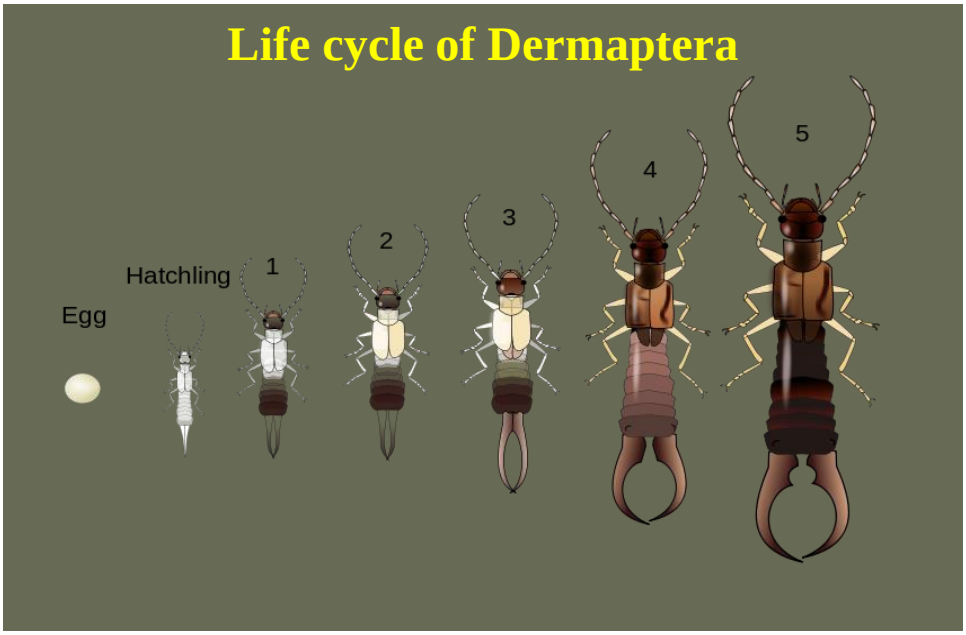


Earwigs (looks like human ears)

Life cycle of Dermaptera

- Earwigs mate end to end, often grasping each other's pincers.
- Female earwigs can store sperm for several months before fertilization.
- A female will lay her eggs in a burrow she has excavated or in natural crevices in the soil.
- where she will stand guard protectively until the young hatch.
- The female guards the eggs from predators and constantly turns and cleans them, preventing fungus diseases.
- Upon hatching the young earwigs resemble small adults and remain under the protection of their mother for a short period of time.
- They must then disperse to new areas or risk being eaten by her.

Incomplete metamorphoses

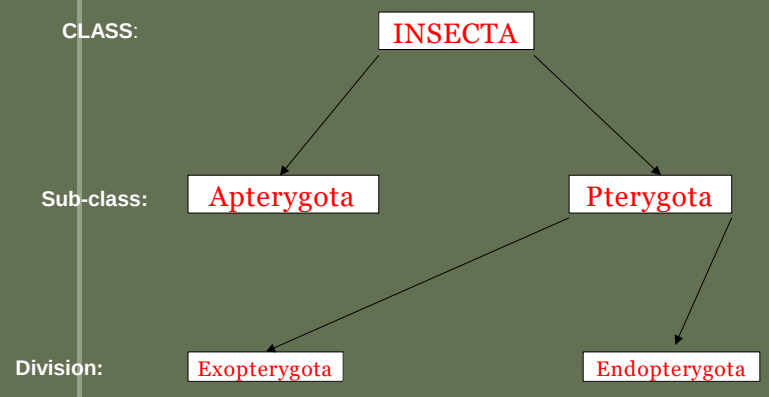


Incomplete metamorphoses

Life cycle of order Dermaptera

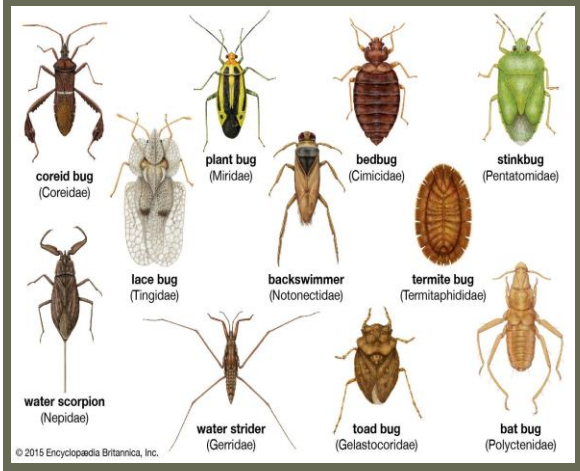
LECTURE (4)

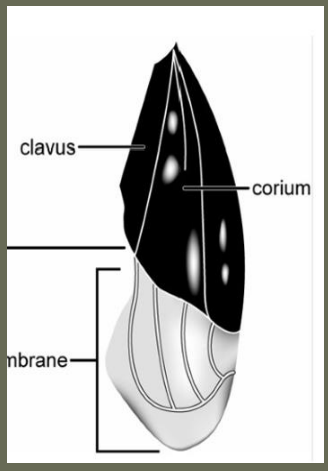
Basic Insect Systematics



Division Exopterygota

Order : Hemiptera

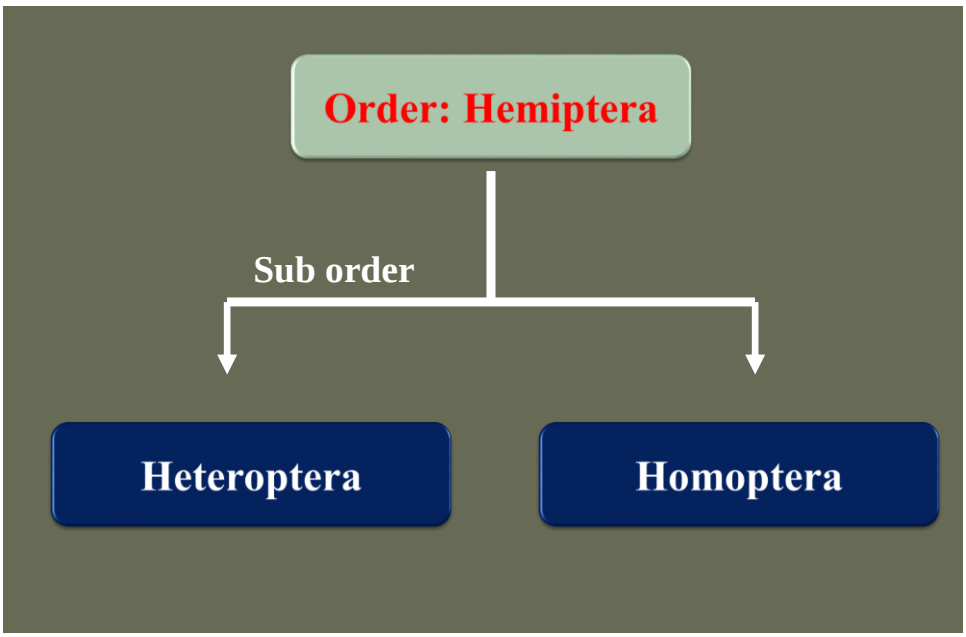




Ancient Greek hemipterus 'half-winged'

Characteristics of Hemiptera

- 2 pairs of wings fore wing is hemielytera.
- Piercing or sucking mouthparts appearing as a sharply pointed tube known as a proboscis or rostrum, which extends from the underside of the head
- Compound eyes of various forms
- Up to 3 ocelli present
- Antennae vary and may be either short, or long and conspicuous.
- Triangular scutellum in center of back.
- The young of hemipterans look like small adults.
- Incomplete metamorphoses.



Suborder heteroptera

- The true bugs have forewings that are hardened at the base and membranous at the tips.
- They sit flat over the abdomen hiding the membranous hind wings.
- The head and proboscis can flex forward.

Heteroptera, derived from the Greek "hetero-" meaning different and "ptera" meaning wings, refers to the fact that the texture of the front wings is different near the base (leathery) than at the apex (membranous).

Suborder heteroptera

Family :Pentatomidae

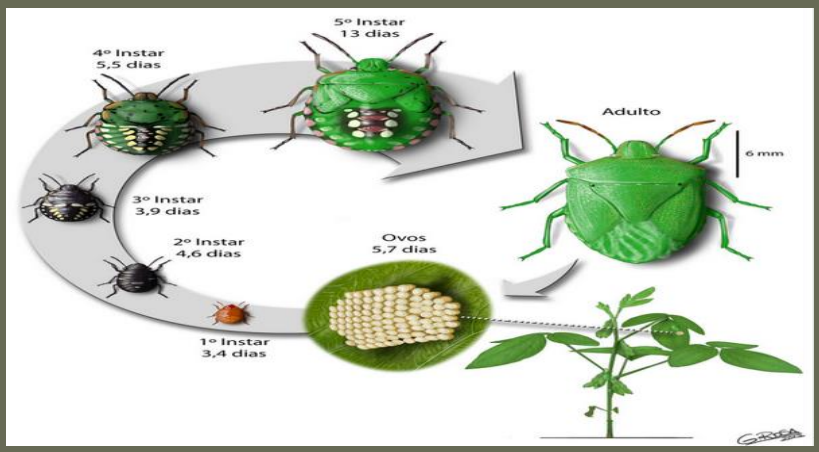
Description: These creatures vary in color and most of them are 6-8 mm or a bit longer. Stink bugs are easily spotted by their five segmented antennae and a sizable triangular scutellum on their shield shaped body. The tibiae lack hairs and the tarsi are three-segmented.

1.Five-segmented antennae
2.Three-segmented tarsi
3.Large triangular scutellum in center of back
4.Shield-shaped body

Common Name: Stink Bugs

Suborder heteroptera

Family :Pentatomidae life cycle



Common Name: Stink Bugs

Suborder heteroptera

Family :Pentatomidae life cycle

Common Name: Stink Bugs

Suborder Homoptera

Suborder homoptera

- Common Name: Leafhoppers, Planthoppers, Treehoppers, Cicadas, Aphids, Psyllids, Whiteflies, Scale Insects.
- Greek Origins of Name: Homoptera, derived from the Greek "homo-" meaning uniform and "ptera" meaning wings, refers to the uniform texture of the front wings.

1. Short proboscis (beak) emerges near back of head
2. Wings held tent-like over abdomen
3. Many with bristle-like antennae
4. Many with wedge shaped head

Common Families:
Aphidoidea — Aphids
Cercopidae — Spittlebugs
Cicadellidae — Leafhoppers
Cicadidae — Cicadas
Coccoidea — Scale Insects
Membracidae — Treehoppers

Suborder homoptera

Scaly insects

Aphids

Order : Phthiraptera or Anoplura

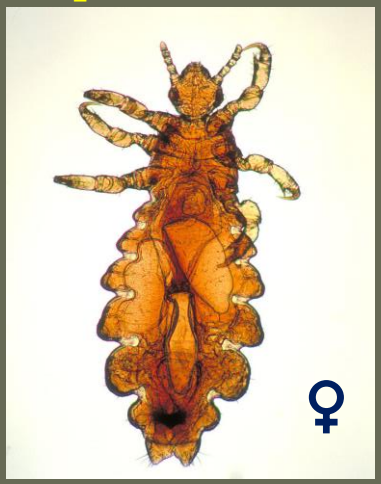
phtheir (louse) and aptera (wingless)

Order : Phthiraptera

Common chracters : Sucking Lice

- The sucking lice are wingless.
- flat-bodied insects that look much like the chewing lice.
- The head, however, is narrower than the thorax, and the mouthparts are fitted for piercing the skin and sucking blood.
- They develop with incomplete metamorphosis.
- the life stages being the egg, nymph, and adult.
- All adults are wingless.
- Sucking lice are parasitic on mammals but never attack birds.

Order : Phthiraptera

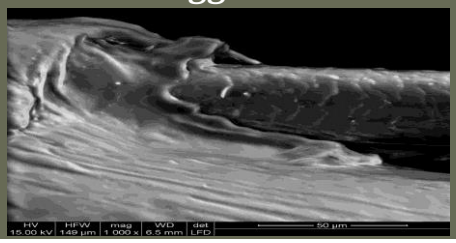


Head louse

Order : Phthiraptera

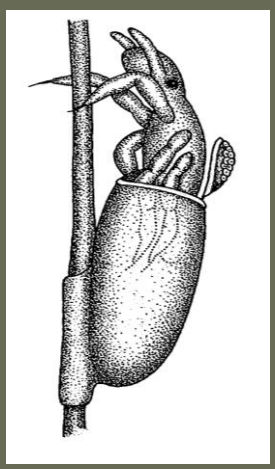
Egg

Egg lid



Cement adherent material

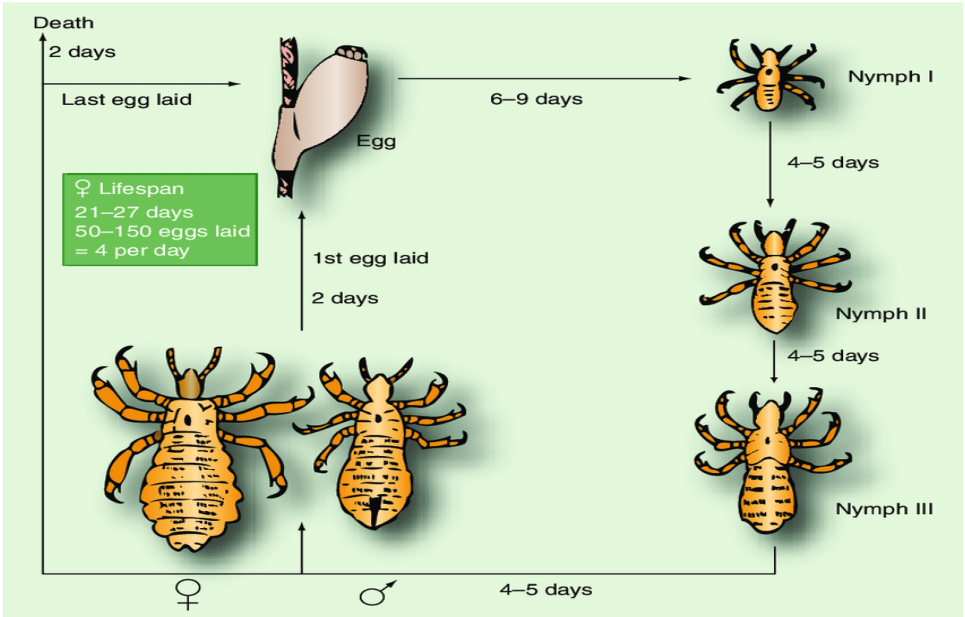
Order : Phthiraptera



Larvae

Order : Phthiraptera

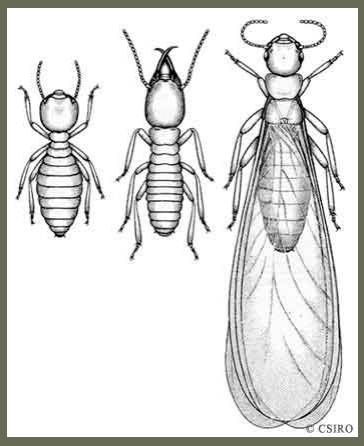
Larvae



Order : Phthiraptera life cyle

Order : Phthiraptera life cyle

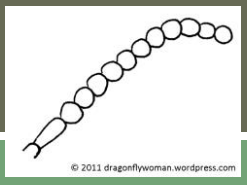
Order : Isoptera

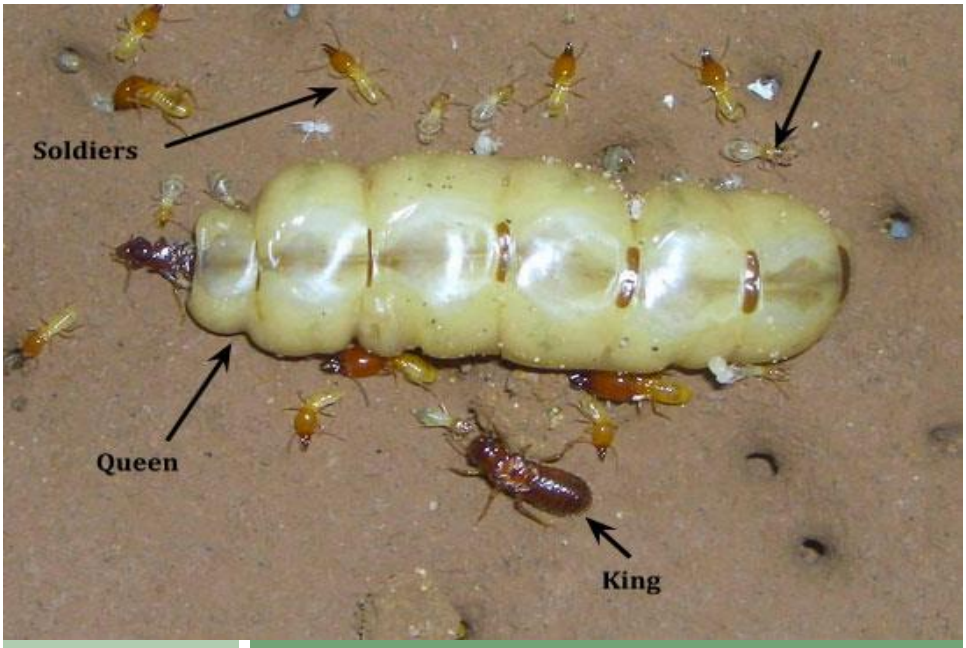


Isoptera, derived from the Greek “iso” meaning equal and “ptera” meaning wings, refers to the similar size, shape, and venation of the four wings.

Characteristics of order isoptera

- Termites are small to medium sized insects ranging form 3-20 millimetres in body length.
- These insects are not often seen although evidence of their presence is observable in the large mounds they construct or the damage they do to wood products and structures.
- Pale, elongate body.
- 2 pairs of membranous wings of equal length. Wings are present in reproductive castes only and shed after mating.
- Mandibulate (chewing) mouthparts.
- Monilioform antennae



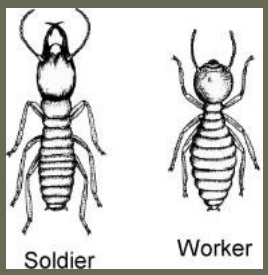


Castes of order isoptera

Castes of order isoptera

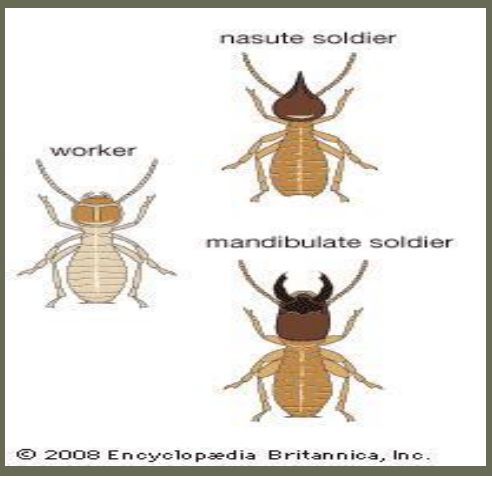
Appearance of Immatures:

1.Body pale in color, somewhat ant-like in appearance but with a broader junction between thorax and abdomen
2.Compound eyes small or absent
3.Head large and cylindrical or small and round
4.Antennae moniliform
5.Mouthparts chewing; sometimes with large mandibles



Castes of order isoptera

Appearance of Immatures:



Appearance of Immatures:

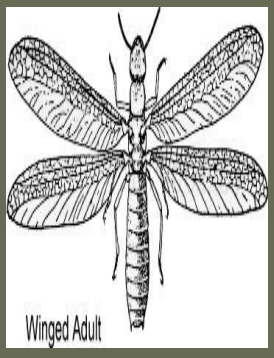
Workers

Slodiers

Castes of order isoptera

Appearance of Adults (Reproductives):

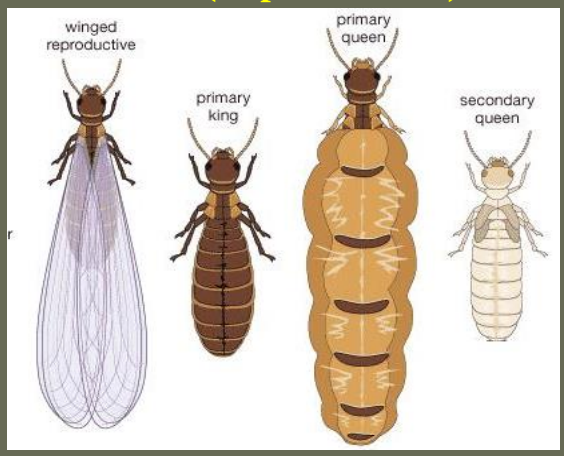
1.Body may be darkly pigmented
2.Head well-developed, with chewing mouthparts and beaded antennae
3.Compound eyes present
4.Two pairs of membranous wings, all similar in shape and size; wings are shed after mating



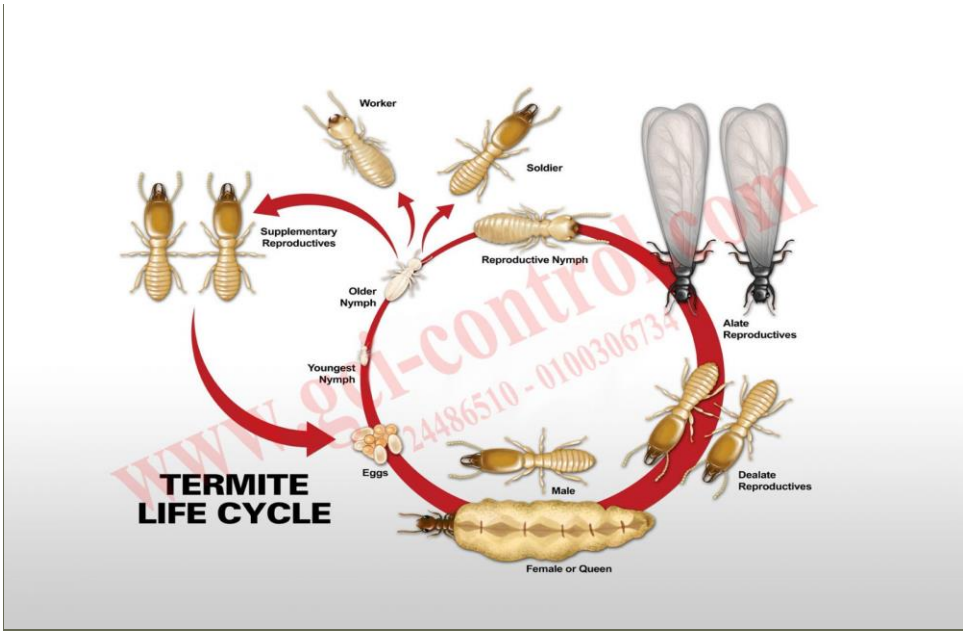
Immature castes

Castes of order isoptera

Appearance of Adults (Reproductives):



Reproductive castes

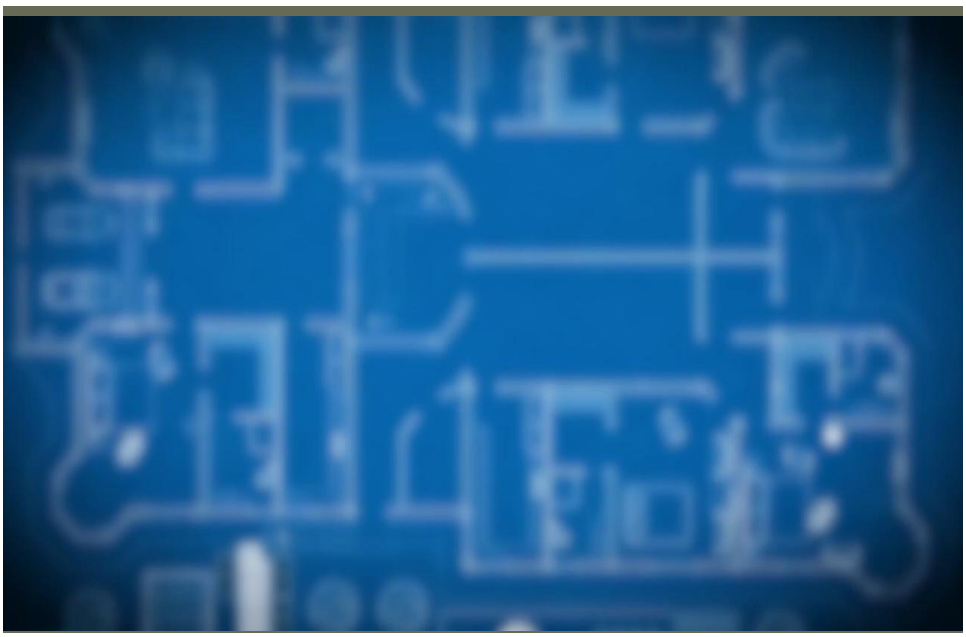


Order : Isoptera life cycle

Order : Isoptera life cycle

Termites

Mond's termites

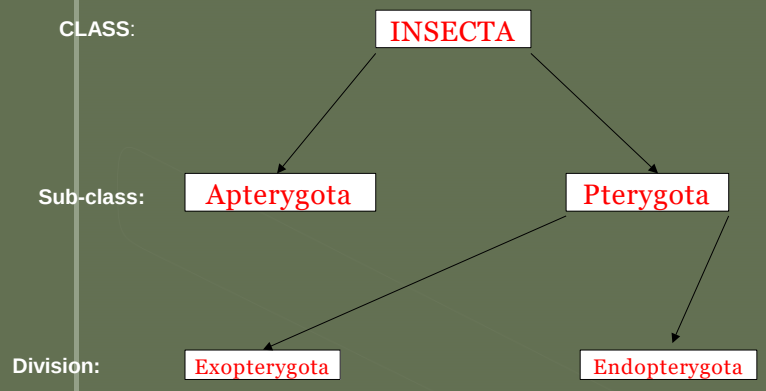


Subterranean Termites

Termites	True ants	
Moniliform	Geniculate	Antennae
Equal wings	Fore wing larger than hind wing	wings
Equal in size	First 3 segments are compacted forming waist like shape	Abdomen

LECTURE (5)

Basic Insect Systematics



Division Endopterygota

Characteristics of Endopterygota

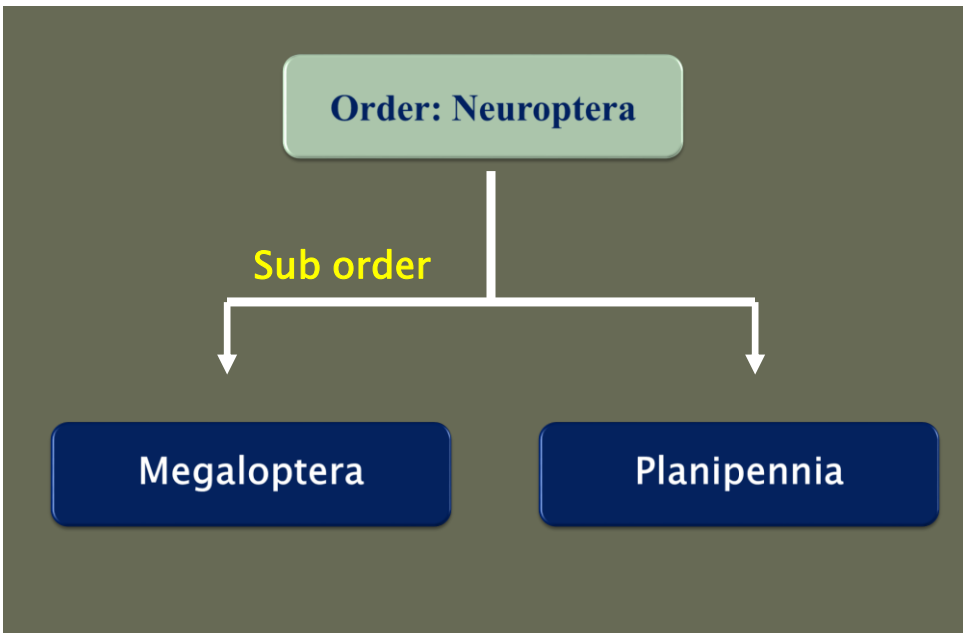
- Wings develop internally.
- Metamorphosis is complete.
- Immature stages (larvae) differ from adults in structure, habitat and feeding habits.
- Pupal stage is present.
- All holometabolas insects

Order : Neuroptera

Neuro =net ,pteron = wing

Characteristics of Neuroptera

- Elongate, soft body
- 2 pairs of membranous wings of relatively equal size
- Complex wing venation with main vein forked along the bottom edge of the wing. Wings are held tent-like over the body when at rest
- Mandibulate mouthparts
- Relatively large compound eyes
- Often long, filiform antennae, which may be clubbed in some species



Suborder Megaloptera

- The terminal of wing veins not branched
- Larval mouth parts are mandibulate (chewing and biting)

Sialioidea

Raphidioidea

Suborder Planipennia

- The terminal of wing veins are branched
- Larval mouth parts are piercing and sucking
- Adults are terrestrial.
- Larva are amphibious living and considered to be biological control agents feeding on aphids and other insect pests.
- Antennae are filiform
- Pro thorax are divided externally to three parts.
- Meso and meta thorax are fused together.
- Abdomen 10 segments.
- No cerci

Suborder Planipennia

Containing four main families

1. Chrysopidae — Aphid lion
2. Nemopteridae — thread like wing
3. Myrmeleontidae — Ant lion
4. Mantispidae — praying mantids

Family Chrysopidae

- Golden eyes
- Filiform antennae
- Vestigial mouth parts in adults
- Female lay eggs in clusters attached o each others with special fluid and each egg carried on a stick like structure near to aphid colonies on plants

Family Chrysopidae

Chrysopa carnea

- Greenish color.
- Larval Mandibles are very strong and elongated to seize prays like aphids and thrips.
- larvae hide underneath debris
- Considered to be one of the biological agents

Aphid lion

Family Chrysopidae

Chrysopa carnea

Adult Aphid lion

Family Chrysopidae

Chrysopa carnea

Larvae Aphid lion

Family Chrysopidae

Chrysopa carnea life cycle

- Female lay more than 300 eggs (2-5 /day).
- Start laying eggs at night.
- Attached their eggs underneath plants leaves near to prays (aphids or thrips).
- Eggs hatched to larvae after 3-6 days.
- Larva are very voracious and molt 3 times.
- Pupae are formed after 2-3 weeks.
- Silk threads are secreted to form a cocoon and are hidden on plants.
- After 14 days, the cocoon is ruptured to remove the entire insect.
- Adults' feeds on honey dew that formed by aphids

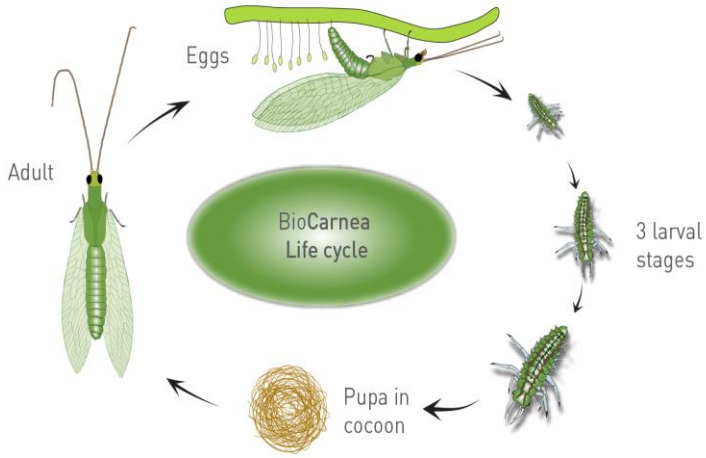
Family Chrysopidae

Chrysopa carnea

female lay eggs

Family Chrysopidae

Chrysopa carnea



life cycle

Family Chrysopidae

Chrysopa carnea

life cycle

Family Myrmeleontidae

- Adults looks like the damselfly (small odonatan)
- Adults hide between trees and nocturnal (active at night)
- Clavate antennae.
- Wings are narrow and have black or brown spots.
- Female lay eggs underneath soil.
- Eggs hatches to larvae called ant lion.
- Larvae buried herself in a con like pit in sand to ambush preys (ants)

Family Myrmeleontidae

Myrmeleon vulgaris

- Grayish color.
- Larval Mandibles are very strong and elongated to seize prays like aphids and thrips.
- larvae hide underneath debris
- Considered to be one of the most biological agents

Ant lion

Family Myrmeleontidae

Damsel fly

Ant lion

Family Myrmeleontidae

Myrmeleon vulgaris

Adult

Family Myrmeleontidae

Myrmeleon vulgaris

Larvae

Family Myrmeleontidae

Myrmeleon vulgaris

Larvae feeding habbits

Family Myrmeleontidae

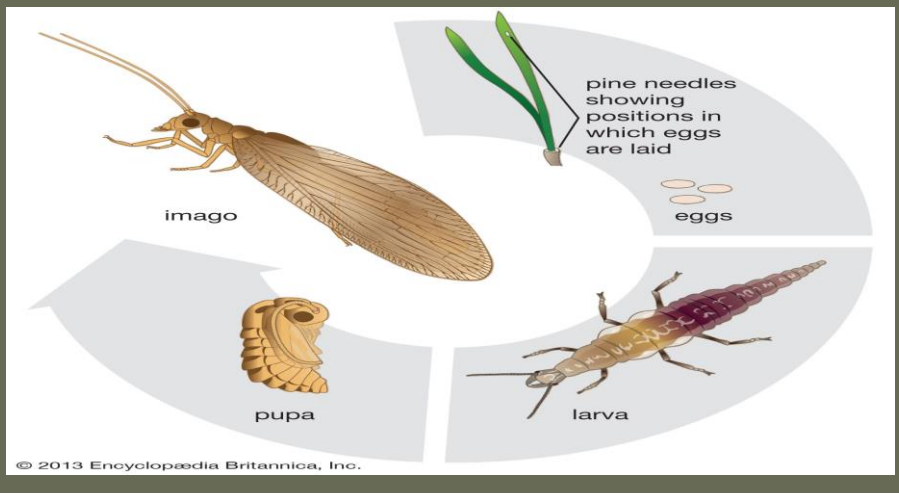
Myrmeleon vulgaris ant lion

- Female lay eggs in soil.
- Eggs hatched o larvae with very strong mandibles for seizing prays.
- Larvae hide under tree leave or buried herself in a con shape pit to ambush her prays.
- After while larvae starts to form cocoon from soil particles and other debris then pupae forms.
- After more than a month the adult emerged.

life cycle

Family Myrmeleontidae

Myrmeleon vulgaris ant lion



life cycle

Family Myrmeleontidae

Myrmeleon vulgaris ant lion

life cycle

Order : Siphonaptera

Flea

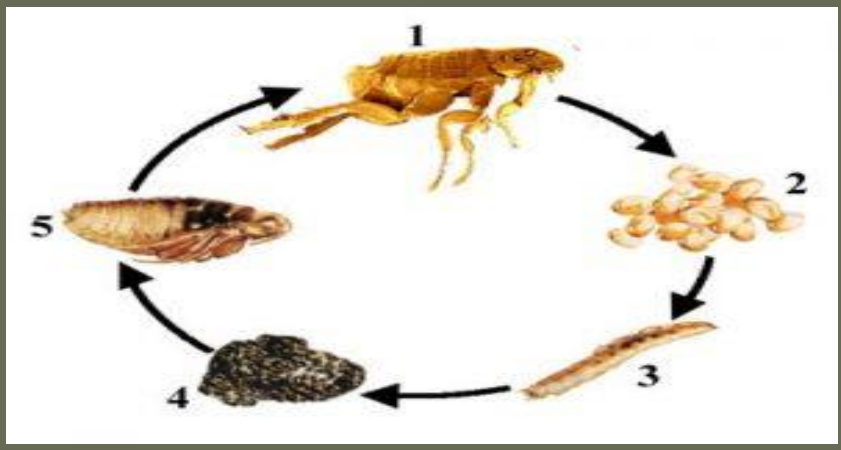
Siphon = tube, pteron= wing

Characteristics of Siphonaptera

- Small insects.
- No wings.
- Ectoparasite for human, animals especially cats and dogs, few parasitized on birds.
- Bilateral compersed.
- Body covered with scaly shield.
- Legs are modified for leaping or jumping.
- Filiform antennae.
- Piercing and sucking mouth parts.
- transmitting diseases.

Order : Siphonaptera

Flea



life cycle

Order : Siphonaptera

Flea

life cycle

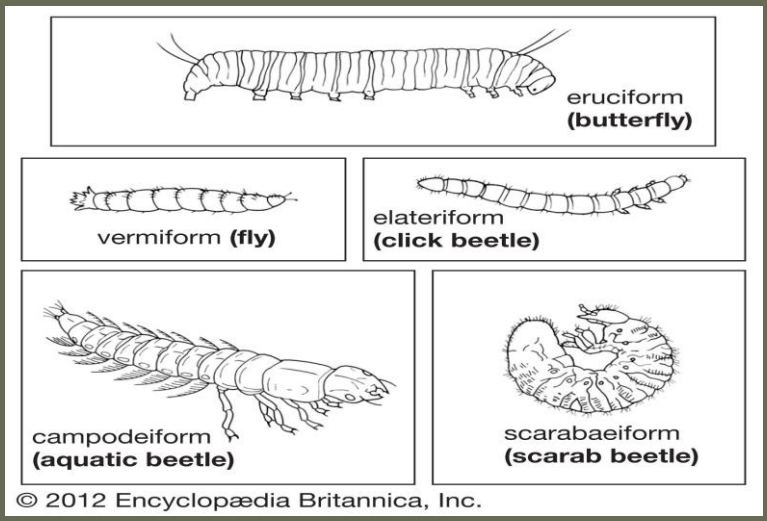
Order : Hymenoptera

hymeno = memberane, pteron= wing

Characteristics of Hymenoptera

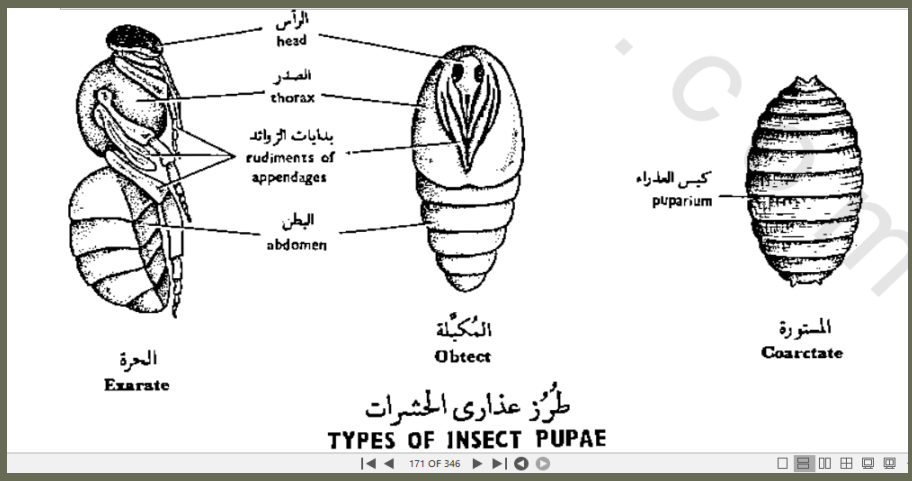
- Contains bees and wasps.
- 2 pairs of membranous wings with hamulate coupling.
- Fore wing larger than hind wing.
- The 1st abdominal segment united with metathorax to form waist.
- The female abdomen ends with ovipositor or sting.
- Holometabolous insects.
- Larva are legless and featureless white grub **(Eruciform)**.
- Pupae are **exarate.**
- It can reproduce with parthenogenesis , as in honeybees.

Characteristics of Hymenoptera



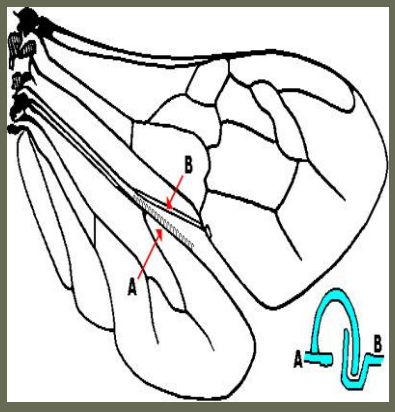
Types pf larvae

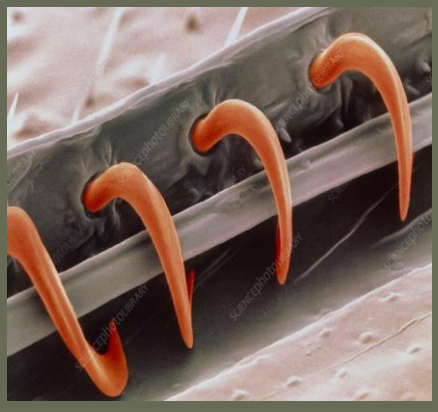
Characteristics of Hymenoptera



Types pf pupae

Characteristics of Hymenoptera





Hamulate wing coupling

Classifications of Hymenoptera

Order: Hymenoptera

Sub order

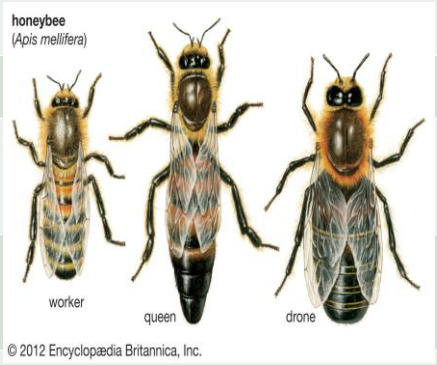
Symphata

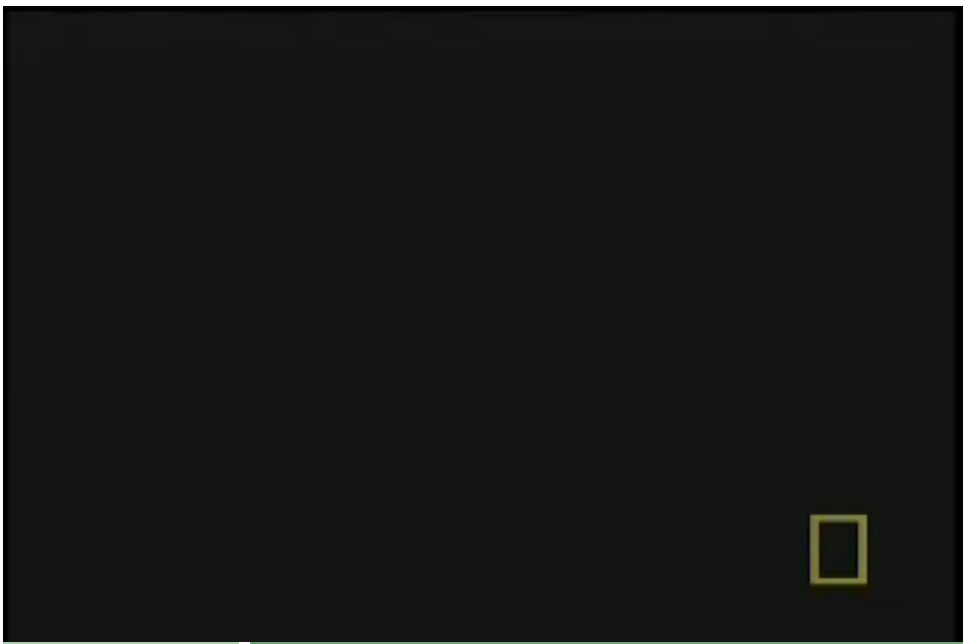
Apocrita

Apocrita	Symphata
Abdomen has waist	No waist
Social insects	Not social
Abdomen ends with sting	Ends with ovipositor
Larvae are legless	Larvae have 3piars of thoracic legs and 6 pairs of abdominal legs
Larvae feeds on special food from honey and pollen	Larvae feeds on plants

Apocrita	Symphata
	
Apis mellifera	*Cephus tabidus*

Bees	Wasp
Using wax to built nest	Using mud and other debris
Pollen as source of protein	Hunting prays
Small week insects	Large strong insects
Insect dies after stinging	Insect doesn’t die after singing
Live in arranged colonies Workers- drones- queens	No arranged colonies
Feed on honey and pollen	Most of them are parasites

Bees	Wasp
	

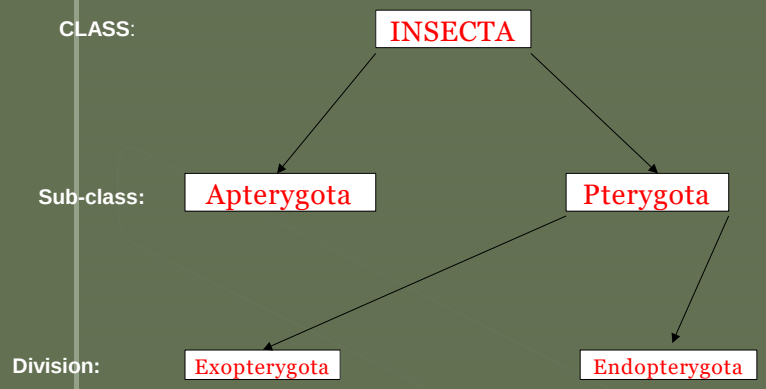


Bees and wasps

Parasitic wasps

LECTURE (6)

Basic Insect Systematics



Division Endopterygota

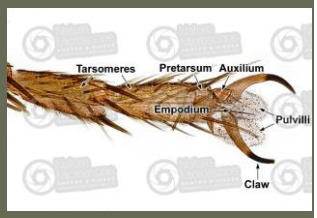
Order

Diptera

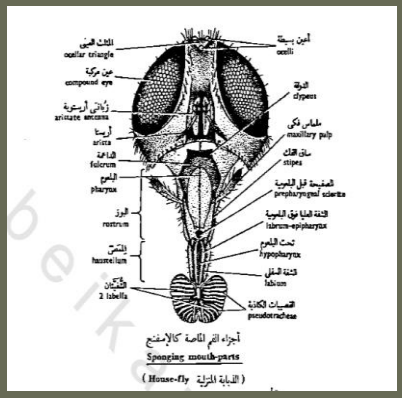
Di= Two, pteron = wing

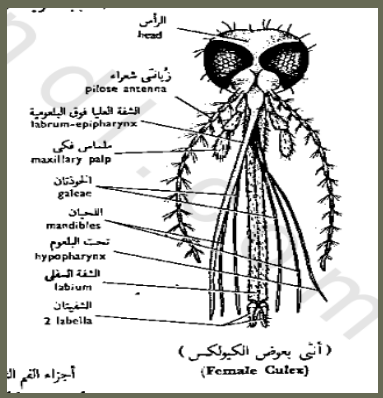
Characteristics of Diptera

- One pair of membranous wings.
- The hind wing modified o halters.
- Mouth parts are sponging type or piercing and sucking.
- Large compound eyes, ocelli.
- Huge variation in antennae types.
- Meso thorax are large .
- legs for walking on smooth surfaces.
- Tubular ovipositor.
- Holometabolous insects.
- Larvae are vermiform.
- **Most of Diptera act as intermediate host for parasites**



Characteristics of Diptera





Classificaion of Diptera

Order: Diptera

Suborder

- Nematocera
- Brachycera
- Cyclorrhapha

Order: Nematocera

- ❑Long antennae feather like shaped.
- ❑Maxillary palp 3-5 segments.

E.g.

Family : Culicidae

Order: Nematocera

Family : Culicidae

- ❖ Piercing and sucking mouth parts in female.
- ❖ Long legs for walking.
- ❖ Pilose antennae for female and plumose for male.
- ❖ Scales covers the wing edges and veins.
- ❖ Larvae and pupae are aquatic.
- ❖ Female feeds on blood, male feeds on nectar.
- ❖ Female transmitting diseases.

Order: Nematocera

Antenna of mosquitoes

Male (Plumose)

Female (Pilose)

Order: Nematocera

Family : Culicidae life cycle

Life cycle of a Mosquito

Family : Culicidae life cycle

Family : Culicidae life cycle

Suborder: Brachycera

- Aristate antennae
- Legs for walking on smooth surfaces.
- Maxillary palp 2 segments.

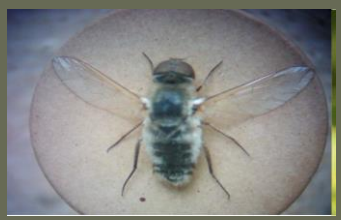
Family : Tabanidae	ذبابة الخيل
Family : Asilidae	الذبابة السارقة
Family: Bombyliidae	ذباب النحل

Suborder : Brachycera

Tabanidae

Asilidae

Bombyliidae



Suborder : Cyclorrhapha

- The Cyclorrhapha is composed of those flies where the adult escapes from the pupal case through a circular opening in the anterior end.
- 3 segmented antennae.

Family : Syrphidae	ذبابة الأزهار
Family : Tephritidae	ذبابة الفاكهة
Family: Drosophilidae	ذباب الدروسوفيلا
Family: Muscidae	الذبابة المنزلية
Family: Calliphoridae	الذبابة الخضراء

Suborder : Cyclorrhapha

Syrphidae

Tephritidae

Drosophilidae

Muscidae

Calliphoridae

Suborder : Cyclorrhapha

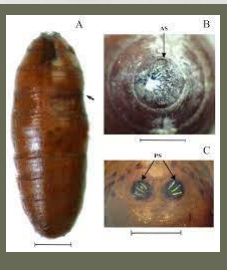
Family: Muscidae

- Sponging mouth parts.
- Large compound eyes wit ocellar triangle.
- Legs for walking on smooth surfaces.
- Aristate antennae 1 segment.
- Whole body covered with hairs, so it considered to be mechanical transmitter for diseases.

Suborder : Cyclorrhapha

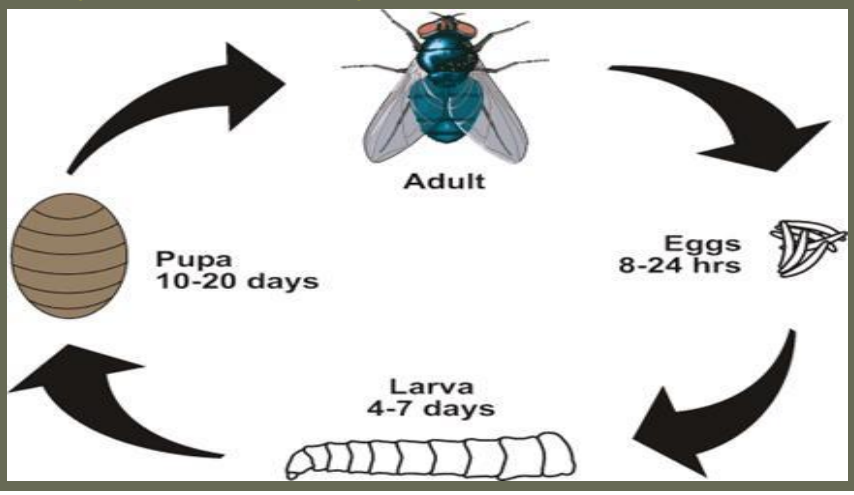
Family: Muscidae life cycle

- Female lay eggs deep inside organic materilas like feces and garbage.
- Egg hatches to vermiform larvae 1-3 days.
- Larvae take 2-3 weeks to become pupae.
- Pupae are coarctate type.
- Adult emerged after 10 days.



Order: Cyclorrhapha

Family: Muscidae life cycle



Family: Muscidae life cycle

Order
Lepidoptera

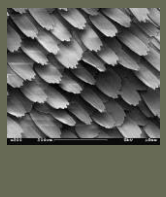
Lepido= Scales, pteron = wing

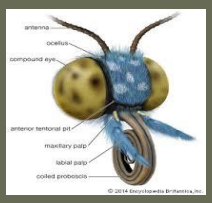
Order Lepidoptera

Lepido= Scales, pteron = wing

Characteristics of Lepidoptera

- Wing are scaly type.
- Mouth parts are sucking type.
- Holometabolous insects.
- Larvae are eruciform .
- Pupae is obtect type with cocoon made from silk or mud.
- All insect of this order are economically important.





Classification of Lepidoptera

Order: Lepidoptera

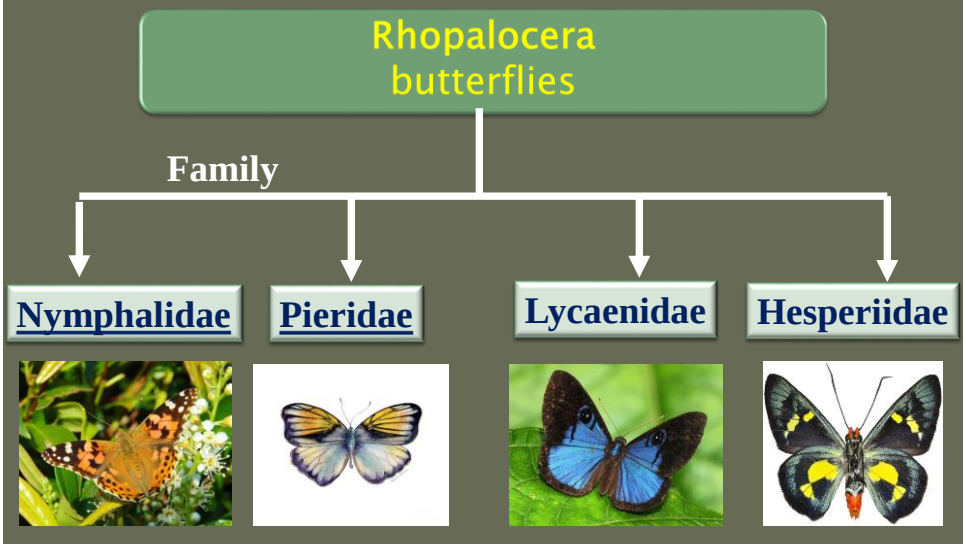
Suborder

Rhopalocera
Butterflies

Heterocera
Moths

Rhopalocera	Heterocera
Antennae geniculate	Antennae pectinate
Eggs are oval	Eggs are rounded
Shiny colors	Pale colors
Diurnal	Nocturnal
Wings lay perpendicular on body at rest	Wings lay horizontally to body at rest
Scales short and few	Scales long and fluffy

Classification of Rhopalocera

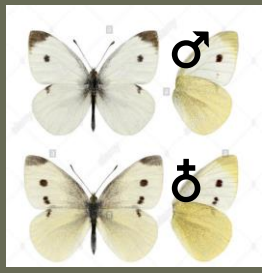


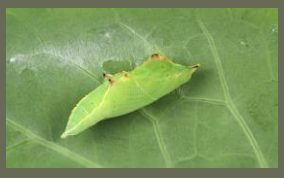
Suborder: Rhopalocera

Family: Pieridae

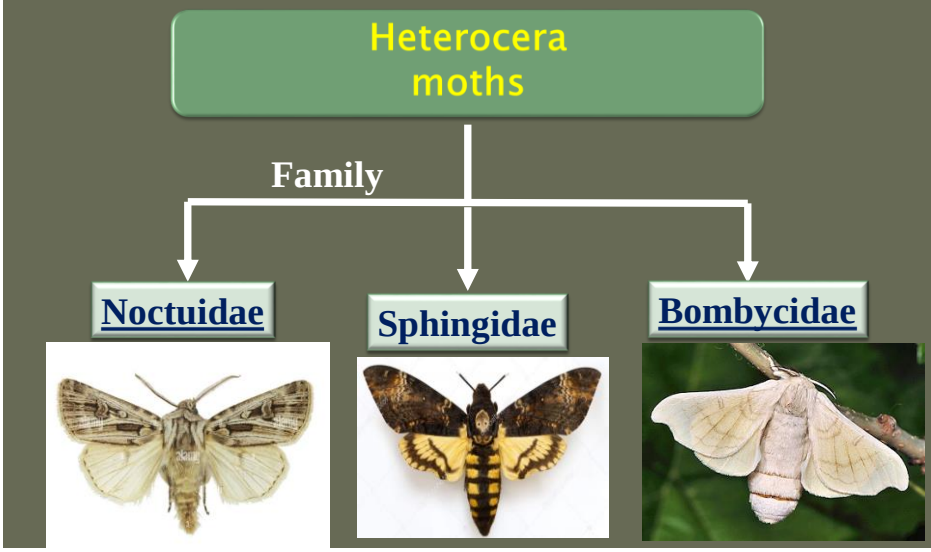
- Legs are very week, same in both male and female.
- Tarsus has 2 claws.
- Female lay eggs in clusters
- Larvae are smooth
- Pupae are hanged from it's end with silky thread.
- Pupae has spine in the head part.

e. g. *Pieris rapae* (cabbage butterfly)





Classification of Heterocera



Suborder: Heterocera

Family: Noctuidae

- ❖ Medium size insects.
- ❖ Attracted to light.
- ❖ Bipectinate antennae.
- ❖ Mouth parts vestigial.
- ❖ Female lay eggs in clusters.
- ❖ Larvae are dark green.
- ❖ Larvae is voracious feeds on plant leaves
- ❖ Pupae is dark brown color

e. g. *Spodoptera littoralis* (cotton leaves moth)





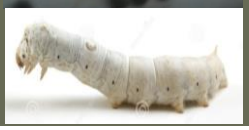
Suborder: Heterocera

Family: Bombycidae

- ❖ Medium size insects.
- ❖ Adult white color.
- ❖ Fore wings have black stripes.
- ❖ Female large than male.
- ❖ Female lay white eggs gradually become black.
- ❖ Larvae feeds on berries leaves.
- ❖ Larvae has 5 instars.
- ❖ Pupae enclosed in a cocoon made from silk.

e. g. *Bombyx mori* (silkworm moth)



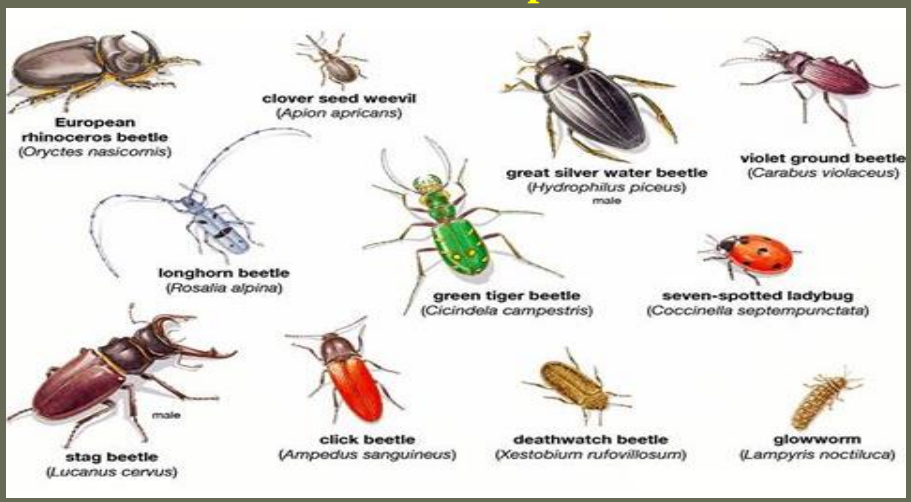
***Bombyx mori* (silkworm moth)life cycle**

Production of silk from silkworm

Order
Coleoptera

koleón= sheath, pteron = wing

Order Coleoptera

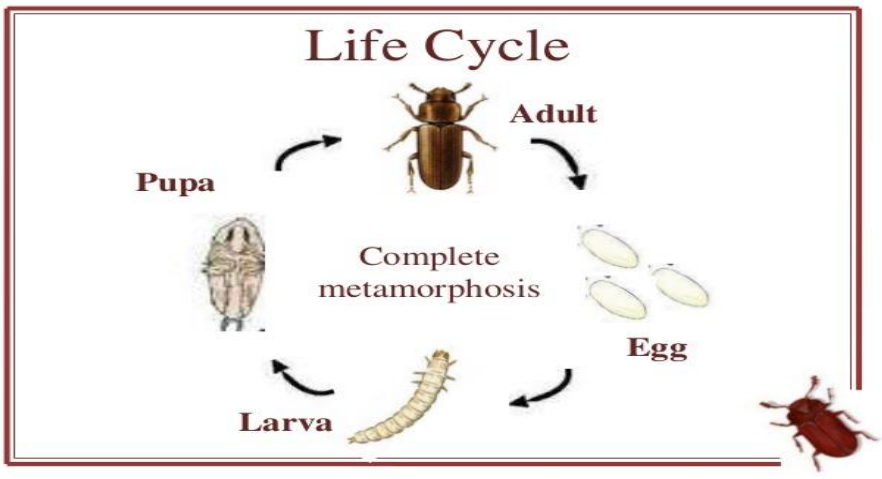


koleón= sheath, pteron = wing

Characteristics of Coleoptera

- Largest order in class Insecta.
- Fore wings are elytra, hind wing membranous.
- Tarsus is 5 segmented .
- Holometabolous insects.
- Larvae are scrabaeiform.
- Larvae is harmful to plants.
-

Characteristics of Coleoptera



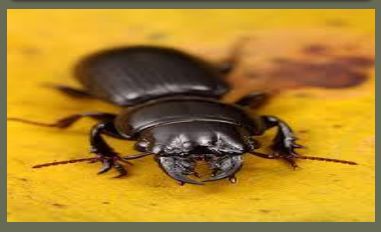
Life cycle

Classification of Coleoptera

Order: Coleoptera

Sub order

Adephaga

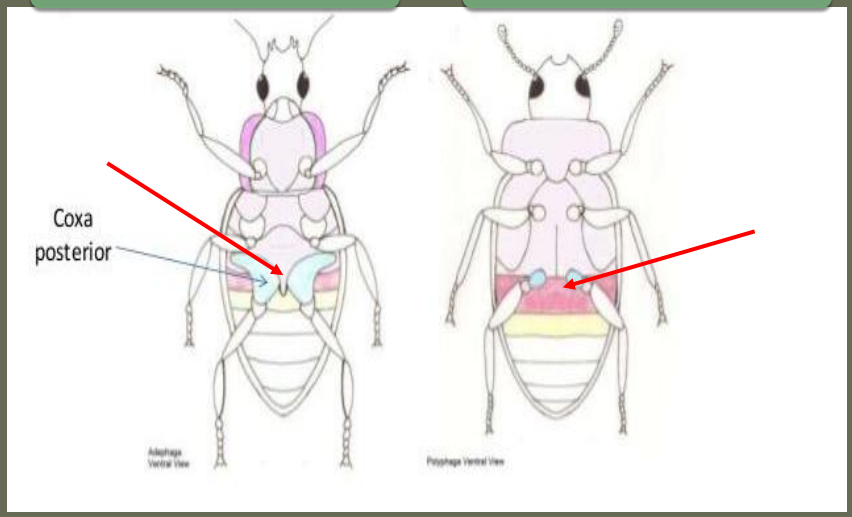


Polyphaga

Adephaga	Polyphaga
Antenna are filiform or moniliform	Antenna are clavate, serrate or lamellate
Tarsus formula :5-5-5	Tarsus formula different
Hind coxae divide the 1st visible abdominal sternite	Hind coxae do not completely divide the 1st abdominal sternite
Adults and larvae are carnivorous	Adults and larvae are omnivorous

Adephaga

Polyphaga



Adephaga

Family: Carabidae
e.g.:*Calosoma chlorostictum*

Ground beetle

Adephaga

Family: Cicindelidae
e.g.:*Cicindela sp.*

Tiger beetle

Tiger beetle

Polyphaga

Family: Staphylinidae
e.g.:*Paederus alfierii*

Rove beetle

Rove beetle

Polyphaga

Family: Scarabaeidae
e.g.: *Scarabaues sacer*

Dung beetle

Dung beetle

Polyphaga

Family: Coccinillidae
e.g.: *Coccinella undecimpunctata*

Lady bug or lady bird

Lady bug life cycle

Part 2

Introduction to Medical Parasitology

Seniors Biology and Geology
2022-2023

LECTURE (1)

Why study Parasitology?

- Many of these parasites are causative agents of major public health problems of the world.
- Recent estimates of prevalence of parasites in the world are:

Ascaris	1.5 billion
Hookworms	1.3 billion
Whipworms	1 billion
Filarial worms	657 million
Malaria	500 million
Schistosomes	270 million
Amebiasis	50 million
Taenia tapeworms	50 million
Clonorchis	20 million
Chagas' Disease	15 million

- These parasites cause untold suffering and death in the world today.

242

Definitions of keys terms

- **A parasite:** a living organism that acquires some of its basic nutritional requirements through its intimate contact with another living organism.
- Parasites may be simple unicellular protozoa or complex multicellular metazoa

Eukaryote: a cell with a well-defined chromosome in a membrane-bound nucleus.

All parasitic organisms are eukaryotes

Definitions of keys terms

- **Protozoa:** unicellular organisms.
- **Metazoa:** multicellular organisms, e.g. worms and arthropods.
- **An endoparasite:** a parasite that lives within another living organism
- **An ectoparasite:** a parasite that lives on the external surface of another living organism e.g. lice, ticks

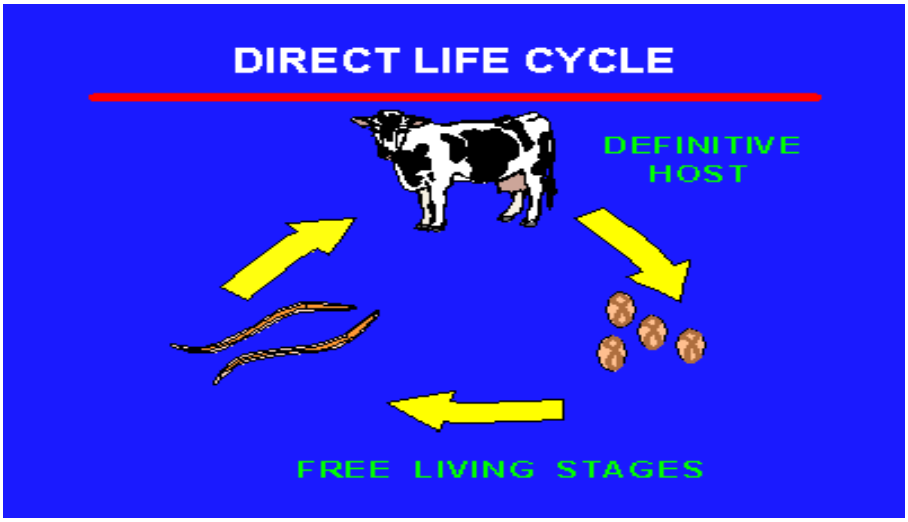
Host and type of host

- **Host** : An organism that harbors the parasite usually larger than the parasite.
- **Intermediate host** : The host harboring the larvae or asexual stage of parasite.
- **Final host** : The host harboring adult or sexual stage of parasite.
- **Reservoir host** : Animals harboring the same species of parasites as man. Potential sources of human infection.

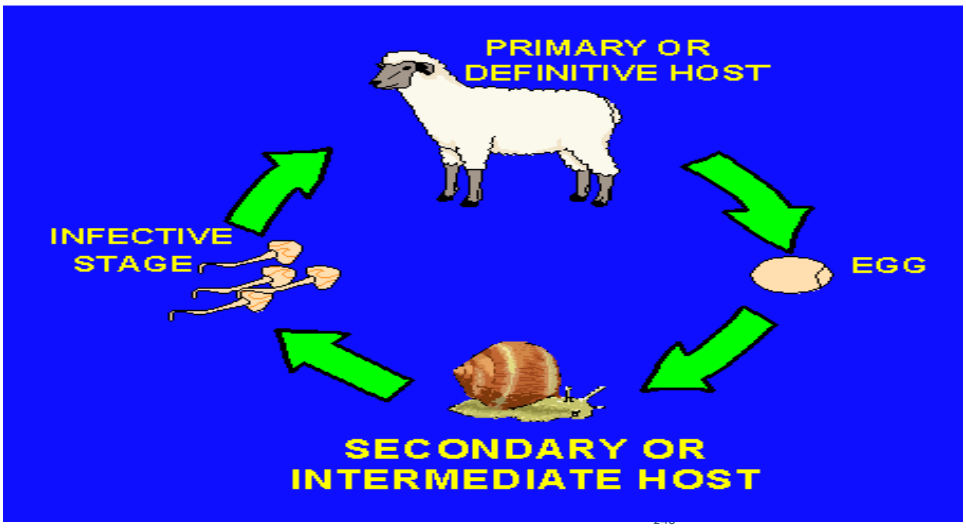
Life cycle and type of life cycle

- **Life cycle** : The whole process of parasite growing and developing.
- **The direct life-cycle** : Only one host (no intermediate host).
- **The indirect life cycle** : Life cycle with more than one host (intermediat host and final host).

Direct life-cycle



Indirect life cycle



Relationship (Effect) between parasite and host

- Effects of the parasites on the host
- Effects of the host on the parasites

Effects of parasites on the host

- Depriving the host of essential substance
- Mechanical effects of parasites on the host
- Toxic and allergy effect

Effects of the host on the parasites

- **The host can produce certain degree resistance to parasites in human body or re-infection.**
- **The resistance (Immunity) is not very strong. In general, It don't wipe out parasites completely, but may limit the number of parasites and establish balance with parasites.**
- **Innate immunity**
- **Acquired immunity**

251

Innate immunity &Acquired immunity

The relationship between Host and Parasite

Symbiosis

- **The relationship between two living creatures**
- **(animals). Two living creatures live together and involve protection or other advantages to one or both partner.**

□ **Commensalism**

□ **Mutualism**

□ **Parasitism***

Commensalism

- Both partners can lead independent lives.
- but one may gain advantage from the association when they are together and not damage to the other.

Commensalism

Mutualism

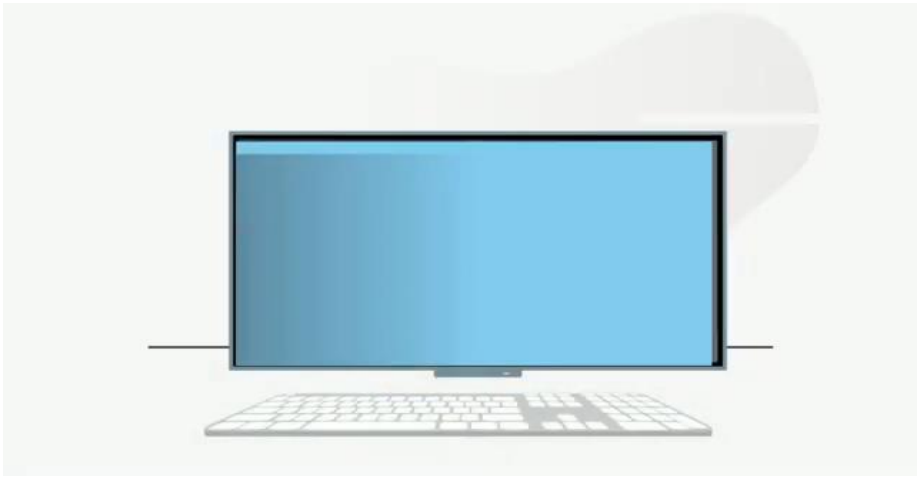
- An association which is beneficial to both living things.

Mutualism

Parasitism

- An association which is beneficial to one partner and harmful to the other partner.
- The former that is beneficial to is called **parasite**, the latter that is harmful to is called **host**

Parasitism



The basic factor of transmission of parasitic diseases

- The source of the infection
- The routes of transmission
- The susceptible host

The source of the infection

- **Patient** : Persons who have parasites in their body and show clinical symptoms.
- **Carrier** : Persons who have parasites in their body, not show symptoms.
- **Reservoir host** : Animals that harbors the same species of parasites as man. Sometimes, the parasites in animals can transmit into human.

The routes of transmission

- **Congenital transmission** : From mother to infant. Eg: Toxoplasmosis
- **Contact transmission** : Direct contact (E.g:Trichomonas vaginalis);Indirect contact (E.g:Ascaris lumbricodes)
- **Food transmission** : The infectious stage of parasites contaminated food / The meat of the intermediate hosts containing
- **Water transmission** : Drink or contact the water contaminated the infectious stage of parasites.
- **Soil transmission** : Contamination of the soil by feces containing the certain stage of parasites.
- **Arthropod transmission** : Vectors of certain parasitic diseases.

The susceptible host

- In general, most people is the susceptible host.
- The parasite reaching a susceptible host must gain entrance and set up a favorable residence in order to complete its life cycle and cause the transmission of parasitic diseases.

The avenues of invasion

- **Digestive tract** : Most common avenue of entrance. (Food/ Water transmission)
- **Skin** : Infective larvae perforate skin and reach to body and establish infection. (soil/ water transmission)
- **Blood** : Bloodsucking insects containing infective parasites bite the skin and inject parasites into human blood. (Arthropod transmission---malaria).

The prevention measures of the parasitic diseases

- **Controlling the source of the infection.**

  Treatment of the patients, carriers and reservoir hosts.

- **Intervention at the routes of transmission**

  Managing feces and water resource, controlling or eliminating vectors and intermediate hosts.

- **Protecting the susceptible hosts**.

Paying attention to personal hygiene, changing bad eating habit, taking medicine.

LECTURE (2)

Nomenclature of parasites

- Each parasite possesses two names, a generic and a specific
- the former begins with an initial capital and the latter with an initial small letter, after which comes the designator's name, followed by punctuation and finally the year.
- The generic and specific names are in **italics** but not the designator's name.
- for example, the common intestinal roundworm of man is named ***Ascaris lumbricoides*** Linnaeus, **1758**. This means that it belongs to the Genus Ascaris and the name of the species lumbricoides was given by Linnaeus in the year 1758.

Classification

- The classification of parasites is controversial - there is no universally accepted system.
- Parasites form part of the animal kingdom which comprises some 800,000 identified species categorised into 33 phyla.
- The parasitic organisms that are of importance for human health are eukaryotes

Classification

- Parasites are classified into 2 sub-kingdoms:
  - Protozoa (unicellular)
  - Metazoa (multicellular)= helminths

  Protozoan (unicellular) parasites are classified according to morphology and means of locomotion.

- Most protozoa species that cause human disease belong to the phyla sarcomastigophora and apicomplexa

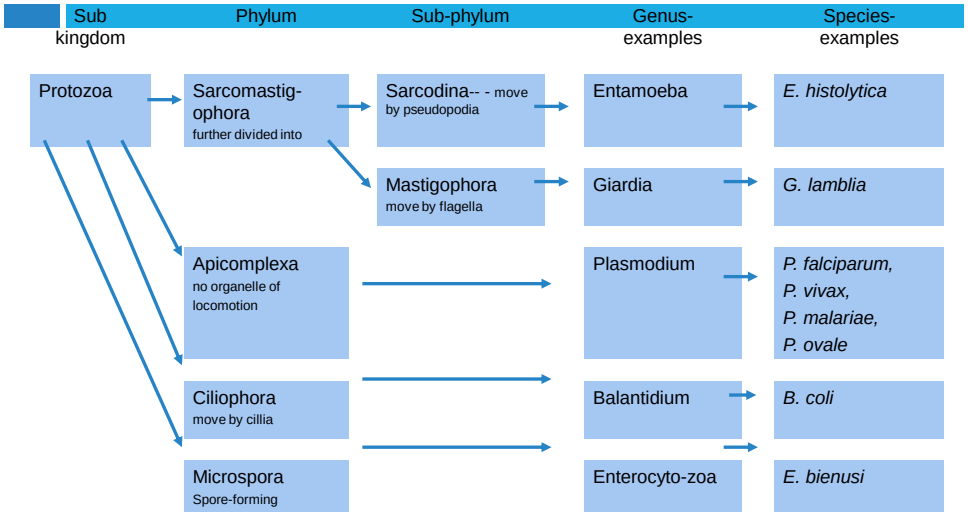
Classification

- Metazoa (multicellular) include:
  - The worms (helminths) and
  - The arthropoda
- Note that the genus starts with a capital letter and the species is always written in italics, e.g. Plasmodium *falciparum*, Giardia *lamblia*

Classification of parasites

- The parasites which medical human have to deal are divided into three main groups:
- Phylum Protozoa- single-celled organism, multiply in human host, Medical **Protozoology**
- Phylum Platyhelminthes and Phylum Nemathelminthes- multicellular worms, do not normally multiply in human host, medical **Helminthology.**
- Phylum Arthropoda – Medical **Entomology**

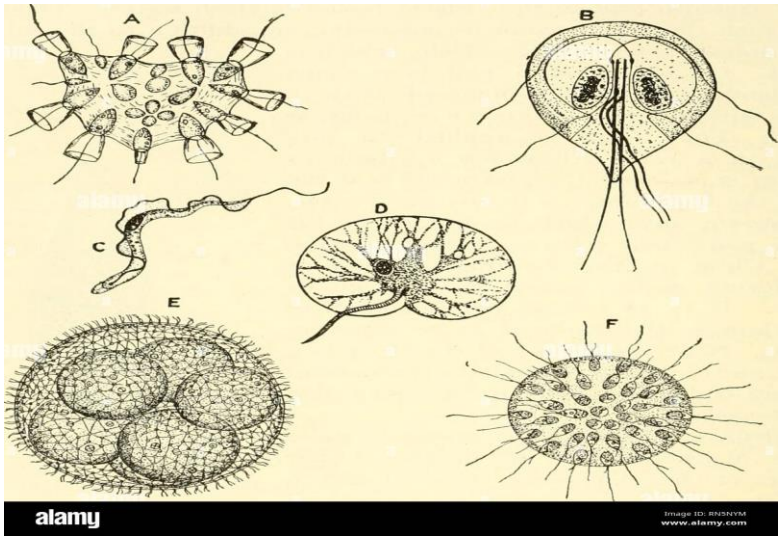
Taxonomic classification of protozoa



Mastigophora

- All are flagellates. They have one or more whip like flagella for locomotion at some stage of their life cycle. In some cases, there is the presence of undulating membrane (Eg. *Trypanosoma*).
- The mastigophore includes the intestinal and genitourinary flagellates and the blood and tissue flagellates.
- The intestinal and genitourinary flagellates are *Giardia, Trichomonas, Dientamoeba, Chilomastik*, etc.
- The blood and tissue flagellates are *Trypanosoma, Leishmania*, etc.

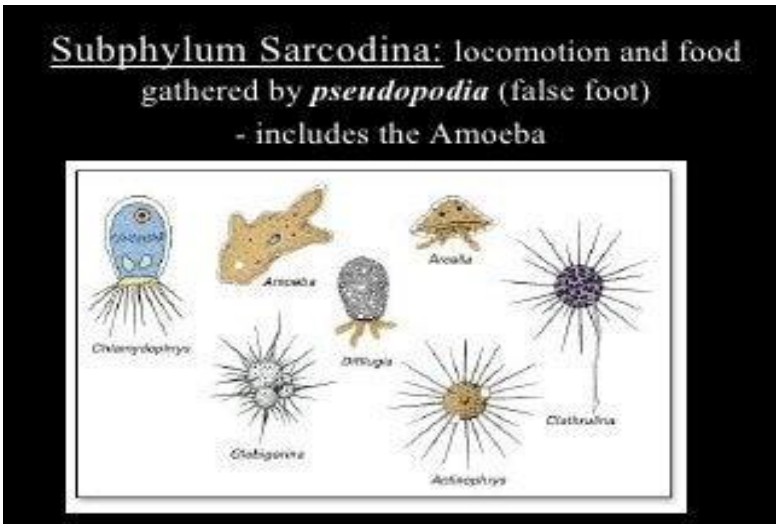
Mastigophora



Sarcodina

- They are all typically amoeboid and include *Entamoeba, Endolimax, Iodamoeba, Naegleria, Acanthamoeba*, etc.
- amoebae consist of a shapeless mass of moving cytoplasm which is divided in to granular endoplasm and clear ectoplasm.
- They move by pushing out the ectoplasm to form pseudopodia (false feet) into which the endoplasm then low.
- Amoebae reproduce asexually by simply dividing into two (binary fission

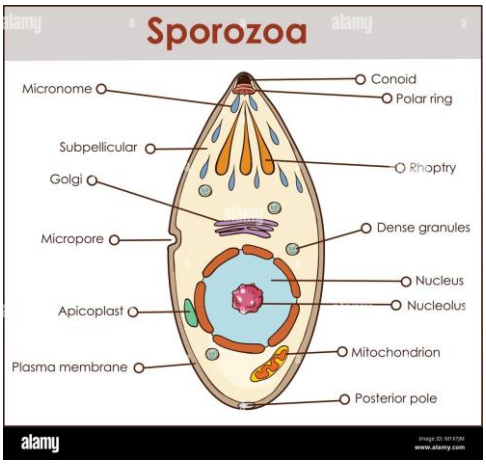
Sarcodina



Sporozoa

- The members of this super-class undergoes complex life cycle with alternating sexual and asexual reproductive phases involving two different hosts.
- Coccidia are intracellular parasites that reproduce asexually by a process called schizogony (merogony) and sexually by sporogony.
- Class Coccidia includes *Isospora* and *Toxoplasma* and class Haematozoa includes the malarial parasites-*Plasmodium* species.

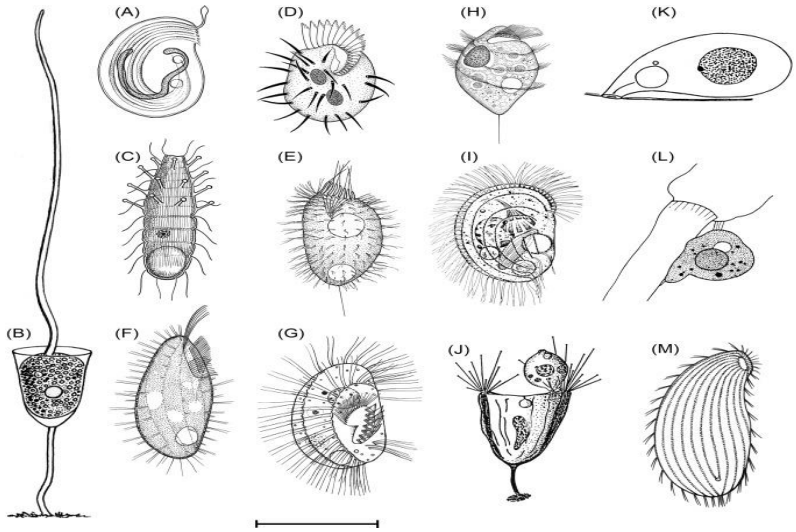
Sporozoa



Ciliophora

- These are the complex protozoa bearing cilia (short hairs) distributed in rows or patches by which they move.
- They have two kinds of nuclei (macronucleus and micronucleus) and a large contractile vacoule.
- *Balantidium coli*, a giant intestinal ciliate of humans and pigs, is the only human parasite representative of this group.

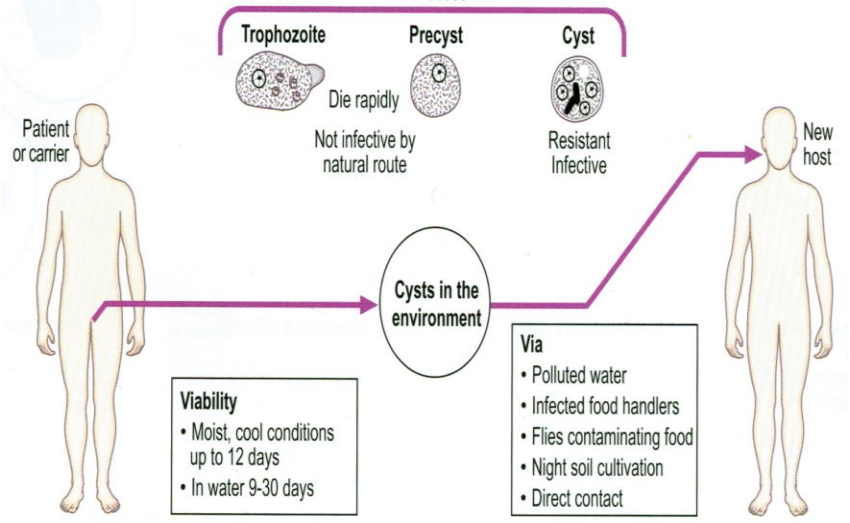
Ciliophora



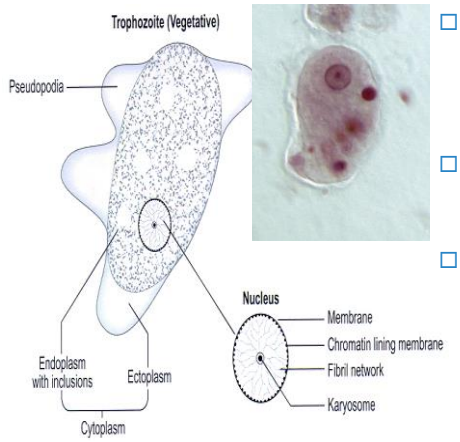
Entamoeba histolytica

- Fedor Alexandrewitch Lösch describes amoebae associated with severe dysentery in a patient in 1873
- He transferred amoebae to a dog by rectal injection, which became ill and showed ulceration of colon
- Patient who died from infection showed similar ulcers upon autopsy

trophozoites and cysts

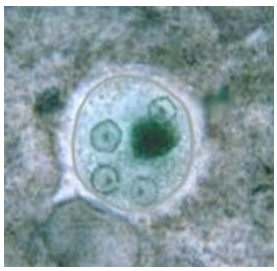


trophozoites and cysts



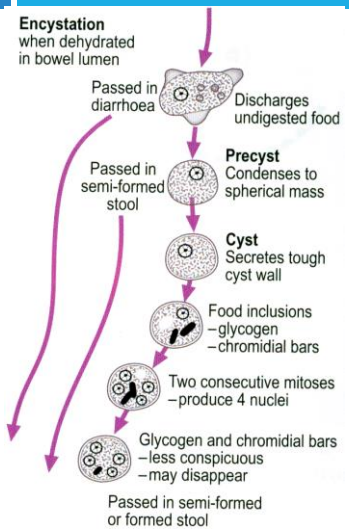
- multiple well defined pseudopodia often extended eruptively
- Differentiation into endo- and ectoplasm
- Spherical nucleus (4-7 mm) with small central nucleolus and characteristic radial spokes

trophozoites and cysts



- Trophozoites 20-40 mm diameter
- Ribosomes arranged in helical patterns
- Tissue forms often contain phagocytized red blood cell

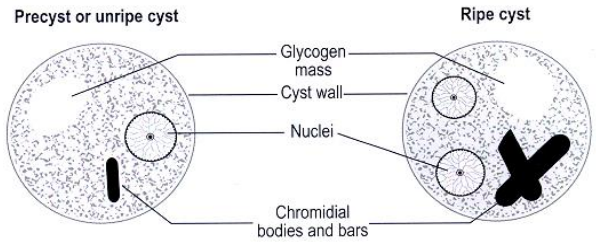
trophozoites and cysts



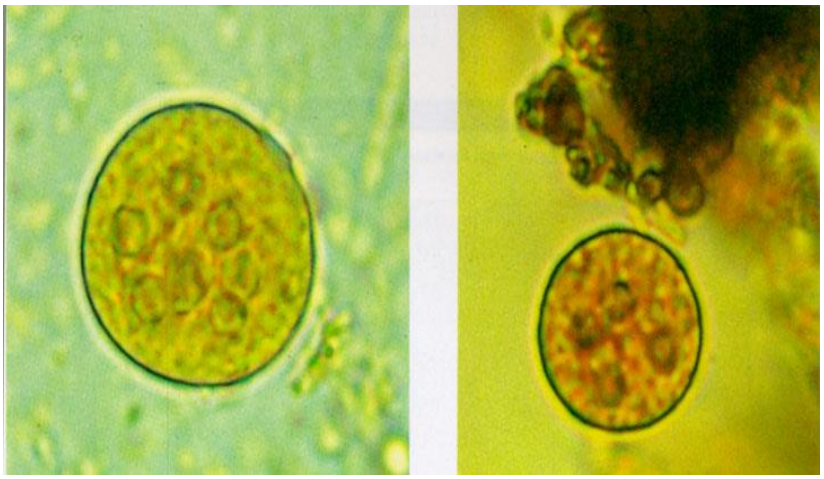
- Trophozoites encyst and cysts mature as they travel through the colon
- Only mature cysts are infective

trophozoites and cysts

- Round (10- 16 μm), 4 nuclei
- 150 nm cyst wall with fibrillar structure
- Chromidial bodies and bars are semicrystalline arrays of riobosomes



Entamoeba cysts (light microscopy)



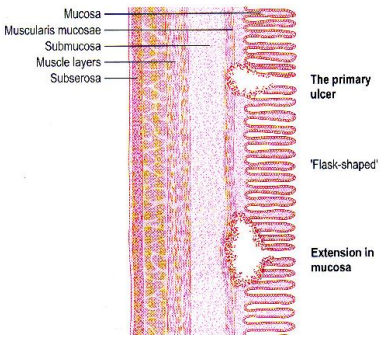
Human infection

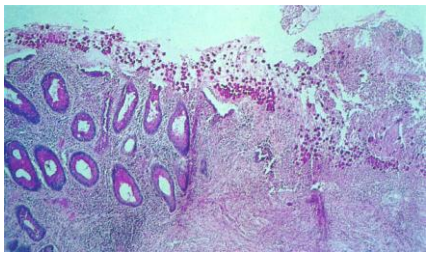
- Major sources for human infection are contamination of drinking water and vegetables (fertilization with material containing or contaminated with human feces)
- Patients without any symptoms might nevertheless shed large amounts of cysts
- If kept cool and moist (water or soil) cysts can stay infectious for up to a month
- Cysts are resistant to chlorination of drinking water (10 mg/l versus 0.1 - 1.0 mg/l for enteric bacteria)

Colitis is the most common form of disease associated with amoebae

- Gradual onset of abdominal pain, watery stools containing mucus and blood
- Some patients have only intermittent diarrhea alternating with constipation
- Fever is uncommon
- Formation of ulcers

Colitis is the most common form of disease associated with amoebae

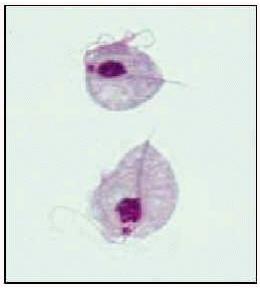




- Amoeba invade mucosa and erode through laminia propria causing characterisitic flask shaped ulcers contained by muscularis

Intestinal flagella and reproductive system

- *Giardia lamblia*
- *Trichomonas hominis*
- *Trichomonas voginalis*



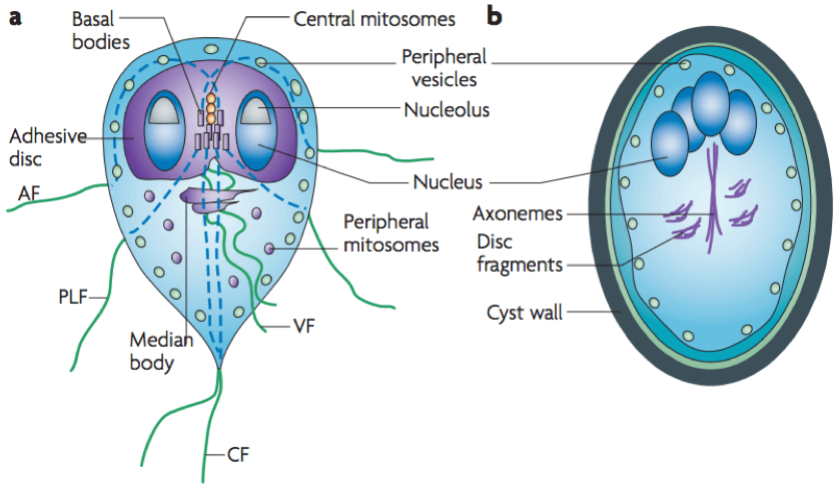
Giardia lamblia

- *Giardia lamblia* is a common cause of diarrhea in humans and other mammals throughout the world.
- Giardia lamblia, also called Giardia intestinalis or Giardia duodenalis,
- is pear shaped and has one or two transverse, claw-shaped median bodies.
- have two nuclei and eight flagella.
- can survive outside of host organisms for prolonged periods of time.

Giardia lamblia

- G. lamblia has two life stages: a **motile**
- replicative trophozoite stage, in which the parasite survives in the small intestines of the host.
- trophozoites adhere to the epithelium of the small intestine, where they then divide by binary fission.
- Fission may result in the production of additional trophozoites or in the generation of cysts.
- a non replicative **cyst** stage, in which the parasite survives in the environment.
- Cysts pass through the intestines, ultimately being shed in host feces.
- Once in the environment, under moist conditions, dormant *G. lamblia* cysts can survive for weeks or even months. Cysts may divide to produce new trophozoites.

Giardia lamblia



Trypanosoma

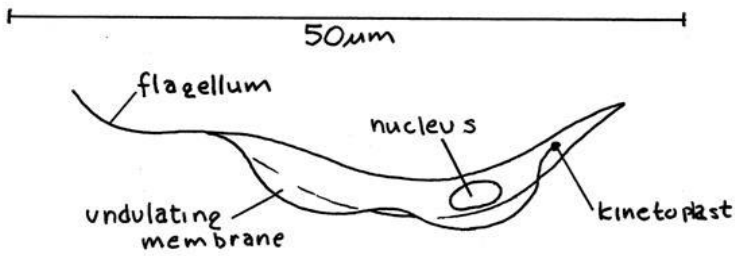
- Trypanosoma species are characterized by the genera features found in typical eukaryotic cells.
- as members of order Kinetoplastida, Trypanosoma have a number of unique features including a kinetoplast, glycosomes, as well as acidocalcisomes (site of mineral storage).
- Trypanosome cells have also been shown to possess a unique cytoskeleton that is mostly composed of microtubules. It also lacks centrioles that play an important role in cell replication.

Trypanosoma

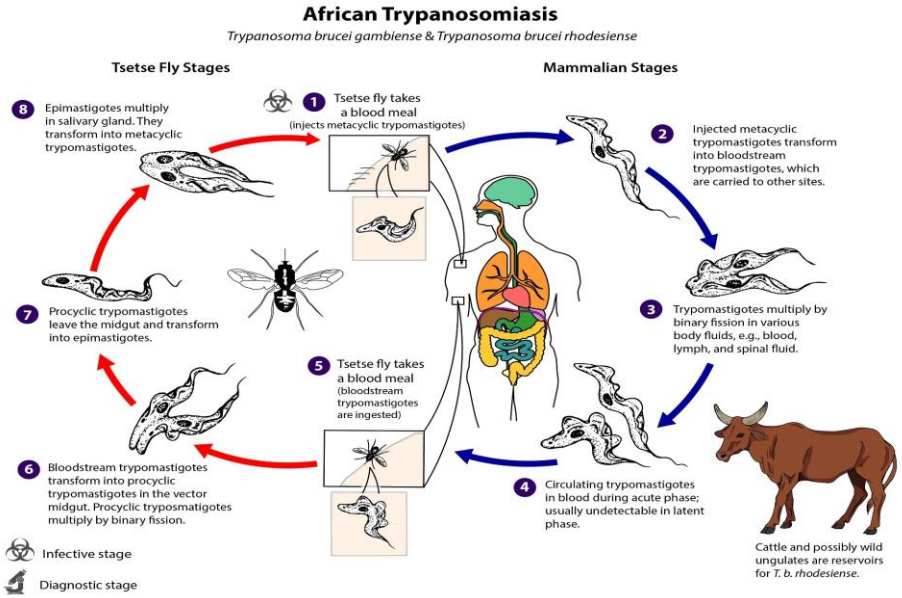
- As a result, poorly defined structures in the cell are responsible for the production of microtubule spindles that contribute to the closed mitosis in these parasites.
- characterized by a single flagellum (ranging from 2 to 20um in length) that is supported by basal and probasal bodies within the cell.
- As is the case with motile cilia and flagella found in various eukaryotic cells, the flagella of trypanosome cells is characterized by a 9+2 configuration consisting of parallel microtubules.

Trypanosoma

- At the point where the flagellum enters the cell, a gap known as a flagellar pocket exists.
- This gap is believed to be the point at which vesicular trafficking and nutrient uptake takes place.
-



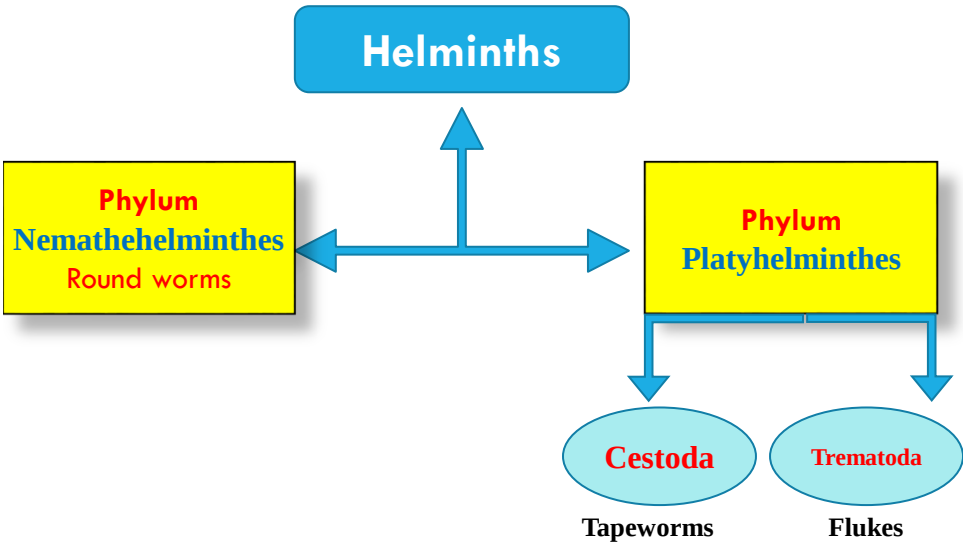
Trypanosoma life cycle



Tsetes fly

LECTURE (3)

Helminths classification

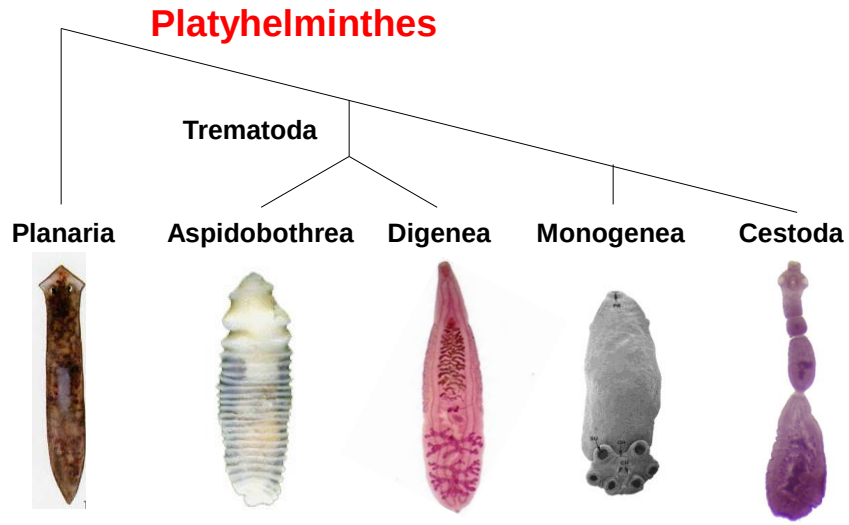


Phylum Platyhelminthes

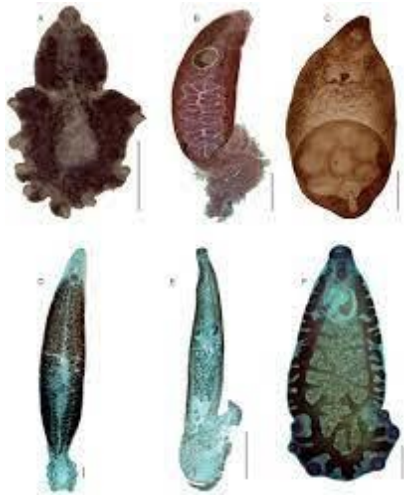
Trematodes

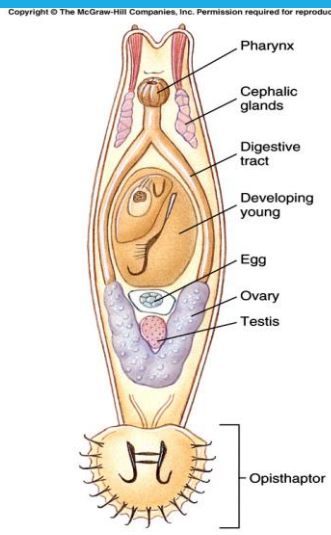
- They are leaf-like unsegmented organism. Sexes are not separate except Schistosomes which are diecious.
- They don't have hooks and suckers in their head. Alimentary canal is present but is not complete (anus absent). The body cavity is absent.
- Examples are *Schistosoma*, *Gastrodiscoides*, *Fasciolopsis*, *Fasciola*, *Clonorchis*, *Heterophyes*, etc.

Flat worms



Phylum Platyhelminthes
Order: Monogenea





Monogeneans

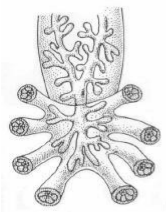
- One host
- Ectoparasites

  Mainly fish
  - Opisthaptor posteriorly
  - Prohaptor anterior end

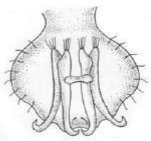
Attachment to host

Opisthaptors

Suckers



Claws and hooks



Monogeneans

Totally parasitic - typical platyhelminth features.

1- Dorso-ventrally flattened.

2- Acoelomate.

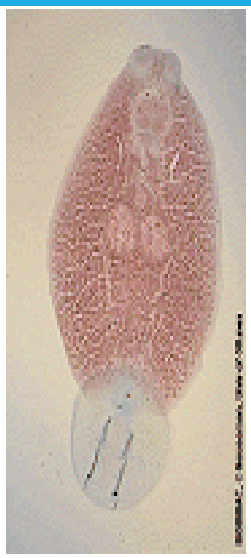
3- Bilaterally symmetrical.

4- Protonephridial excretory system.

5- No definite anus.

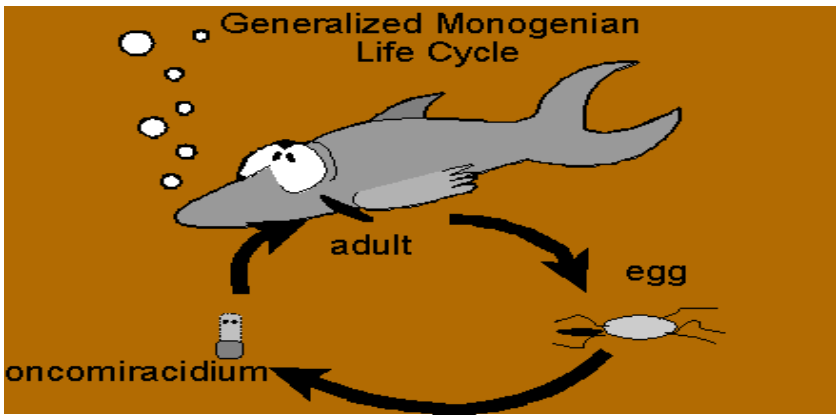
6- No respiratory / circulatory system.

7- Usually hermaphrodite.



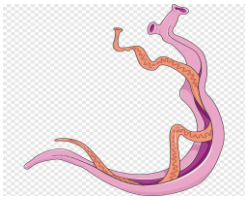
Monogeneans – Life cycle.

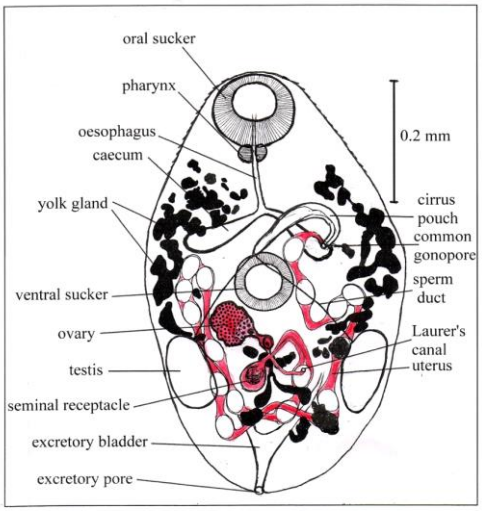
- Direct development.
- "Monogenea" = 1 generation. 1 egg = 1 adult



Digenea

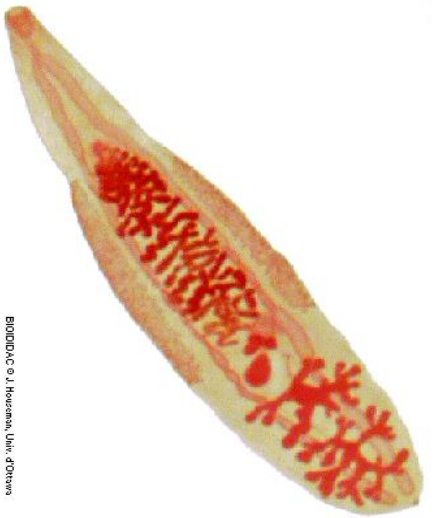
- Most digenea are hermaphroditic.
- i.e., they possess male and female reproductive systems except schistosomes which the only separated sexes.



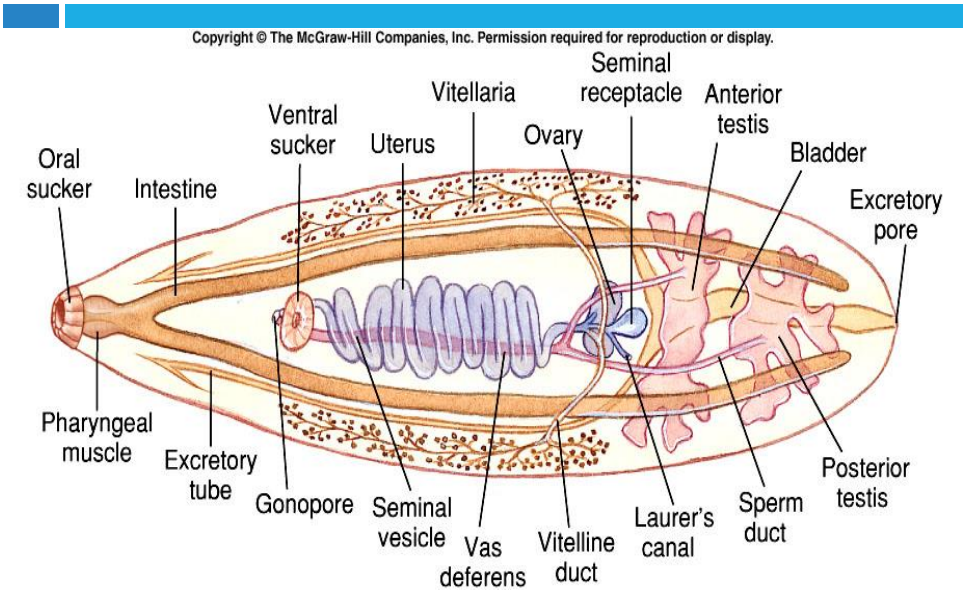


Structure of digenea

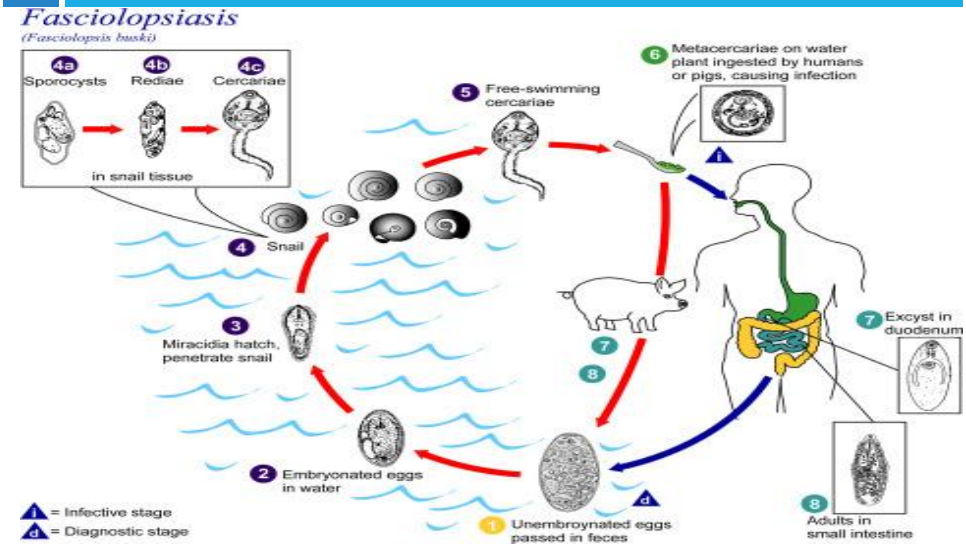
- Flukes
- Parasites
- Holdfast devices (suckers)
- Complex life cycle
- Intermediate host
  - Animal with juvenile stage
- Definitive host
  - Animal with adult stage



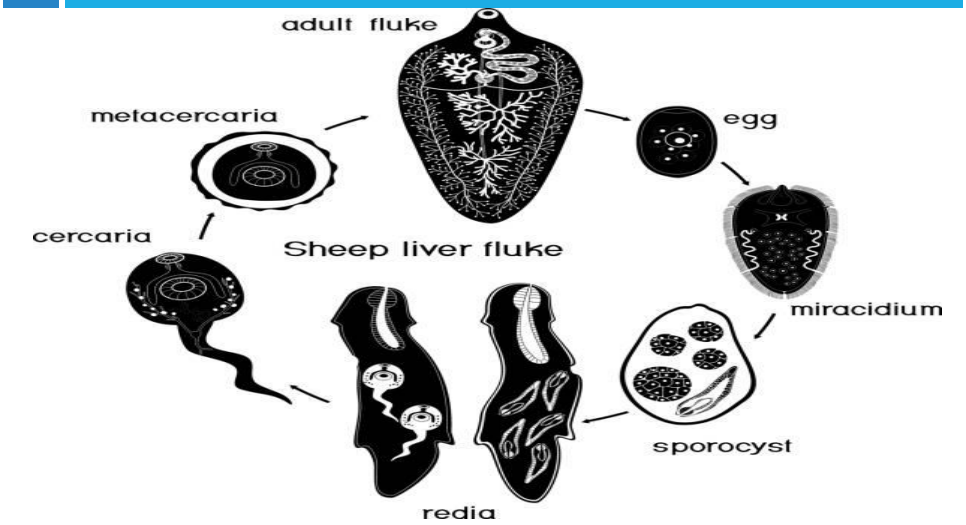
Structure of digenea



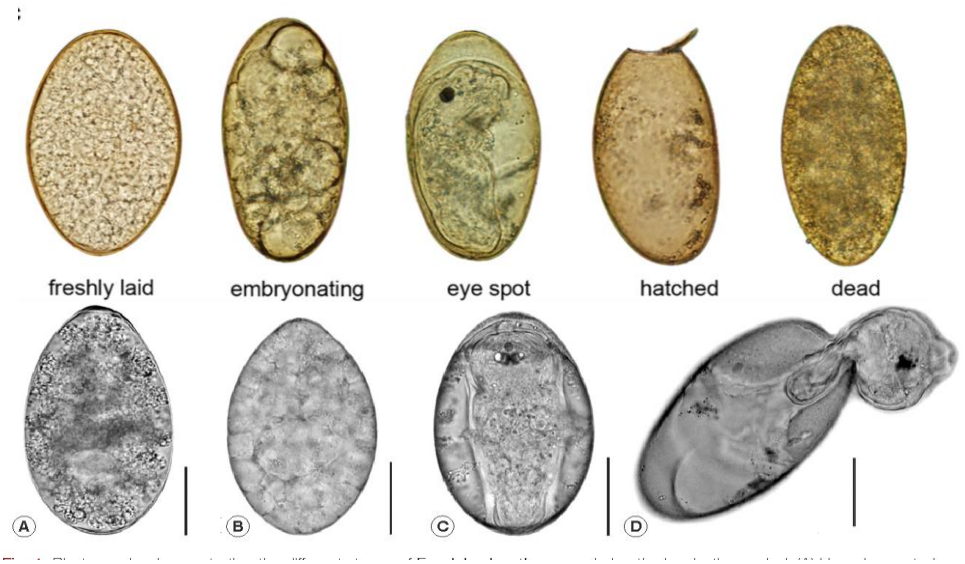
life cycles of digenea



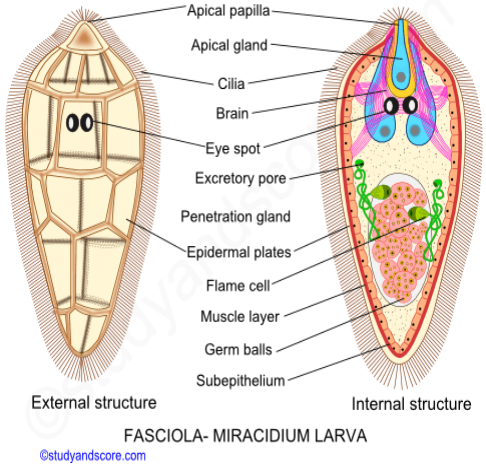
life cycles of digenea



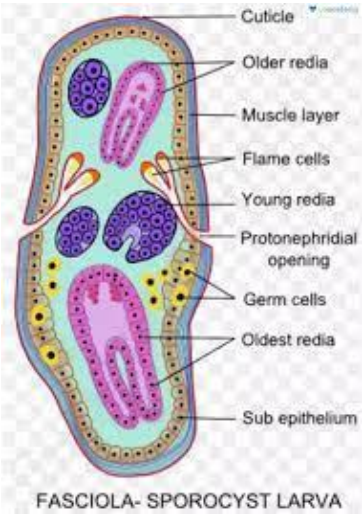
Egg



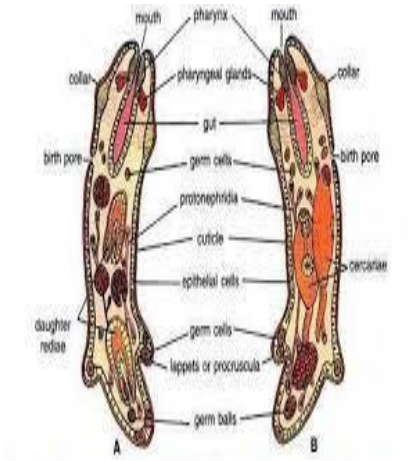
Miracidium



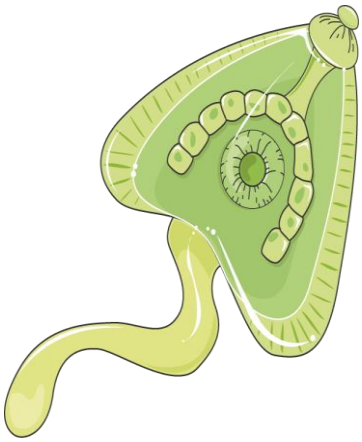
Sporocyst

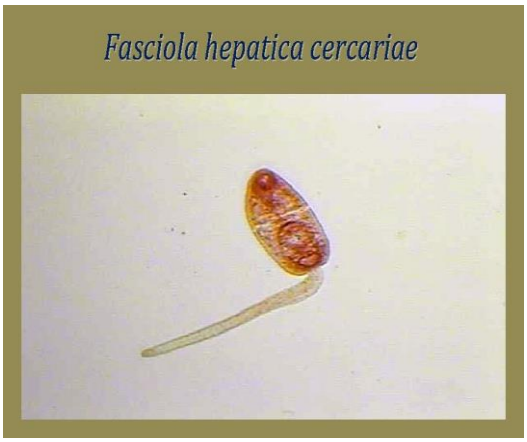


Daughter redia

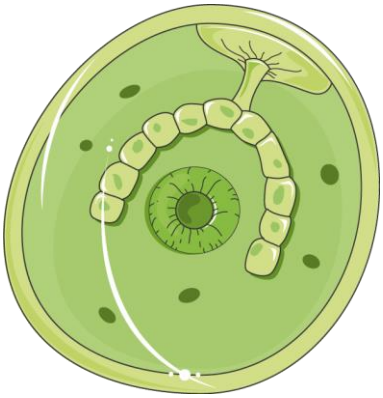


Cercariae





life cycles of digenea

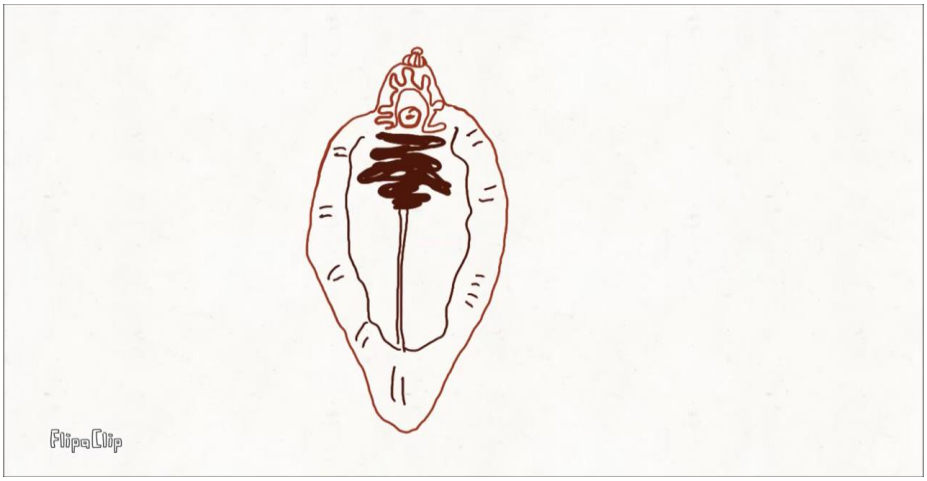


Meta cercaria

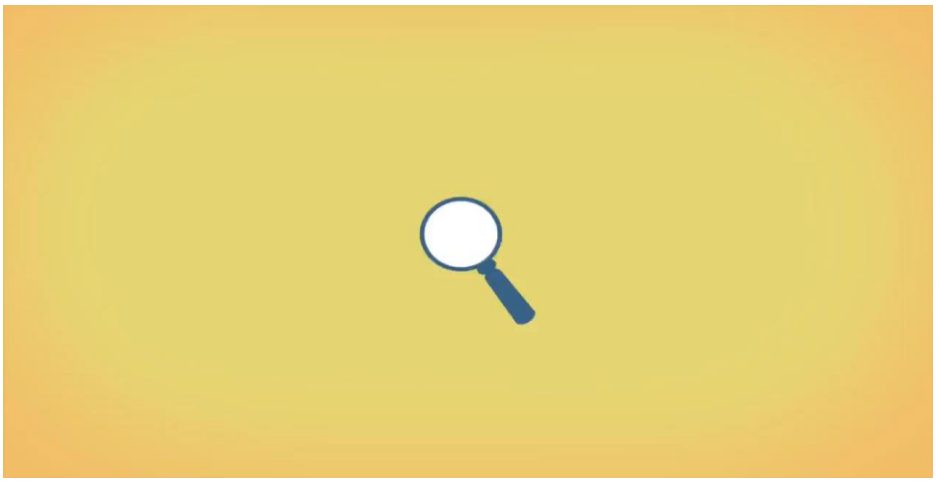
life cycles of digenea

Adult

life cycles of digenea



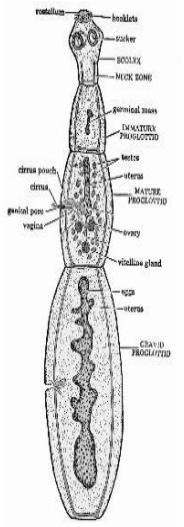
life cycles of digenea

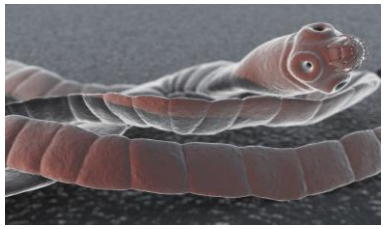


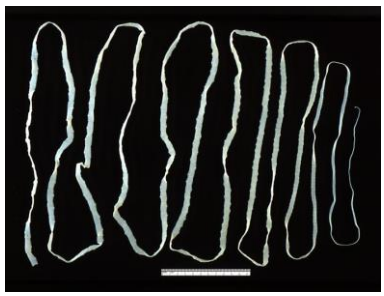
Medical and economic importance of trematodes

- Some of the most important diseases of man in the tropics, are caused by digenean trematodes.
- Foremost among them are liver flukes and blood flukes (Schistosoma)

Tapeworms
Cestodes







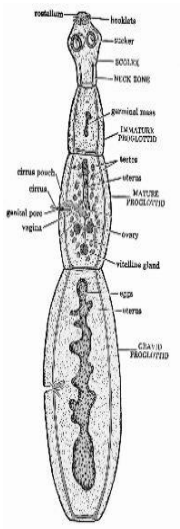
Tapeworms
Cestodes

• The body plan of adult cestodes includes a scolex (looks like the “head”), a neck and strobila that can extend for only a few proglottids or thousands

• The strobila is not truly metameric though as several organs like the excretory system extend through the entire worm

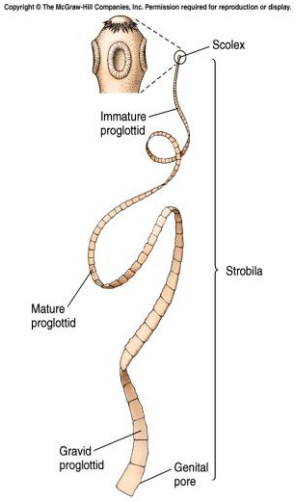
• Proglottid: each individual segment

• Most worms are very long: occupying the entire length of small intestine



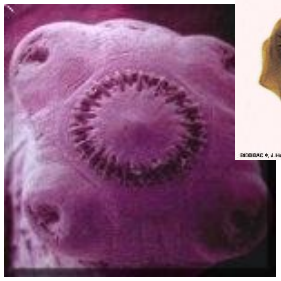
Cestodes

- Cestodes consist of flat tape like.
- mostly reside in the intestines.
- They are hermaphrodite
- They do not have a digestive system so the nutrients are taken up through the absorptive integument.
- These are segmented tape worms that vary in size from a few millimeters to several meters.
- They do not have a body cavity or alimentary canal.



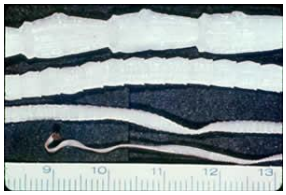
Cestodes

Greek, Kestos- Ribbon) tape like worms



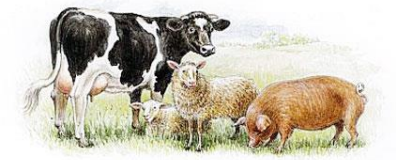
Adult worm: head with suckers

Trunk (Strobila) chain of proglottides or segments



HOSTS

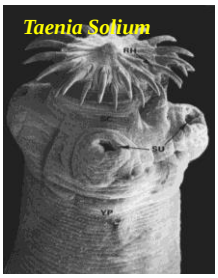
• **INTERMEDIATE**: harbors the immature forms of the parasite. Insect of herbivorous vertebrate that ingest parasite eggs



• **DEFINITIVE**: Harbors the mature forms of the parasite. Carnivorous or omnivorous mammal that acquires infection by consuming larval cysts in the uncooked tissues of an IH

Morphology of tapeworms: The scolex

The scolex is the part of the worm that anchors it to the intestinal epithelium and prevents that the worm is passed with the digested food

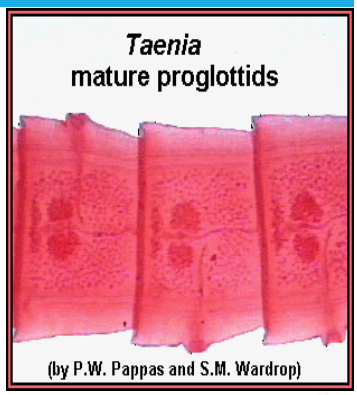


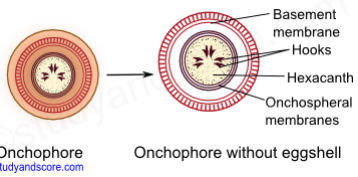
Different types of scolexes

- Some cestodes carry a protrusible rostellum which is armed with hooks
- Muscular holdfast organs include suckers or acetabula (usually 4 per scolex), weakly muscled grooves (bothria, 2 per scoles), and more muscular bothridia (4 per scolex).

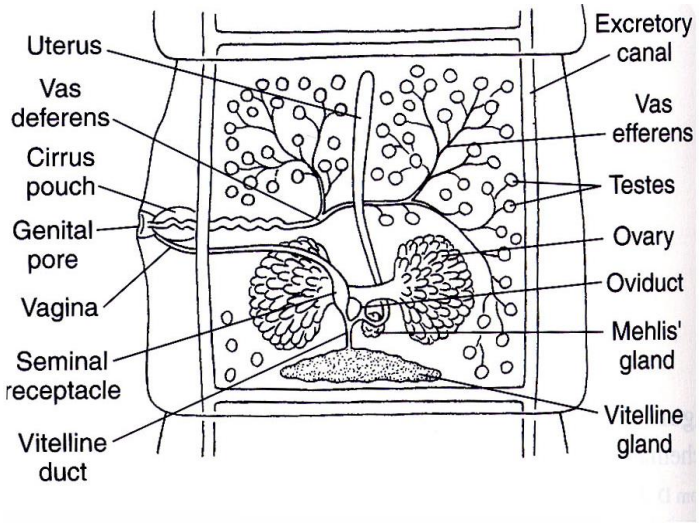
the proglottid

- Proglottids are budded off from the head and neck region.
- Proglottids are hermaphroditic, egg-producing units
- In cross-sections the tapeworm body is seen to be filled with parenchyma.
- Muscle layers separate the body into an outer cortex and an inner medulla. The reproductive organs are usually in the medulla.





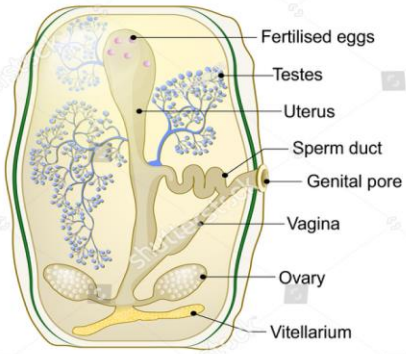
The reproductive system



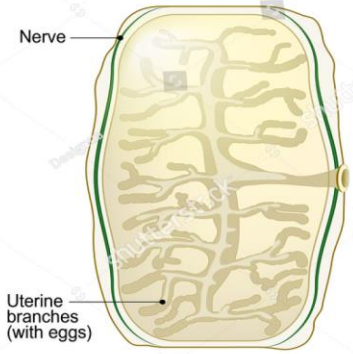
The reproductive system

- The male system consists of numerous **testes**, *vasa efferentia* from each testis to the **sperm duct**. The cirrus is surrounded by the **cirrus pouch**. Most often the cirrus pouch and female vagina enter a common chamber, the **genital atrium**, and share a common opening, the **genital pore**.
- The female includes a **vagina** from the genital pore to a seminal receptacle; an **ovary**; a single oviduct, **the ootype**, the duct from the seminal receptacle.
- The **uterus** leads from the ootype and may have either an opening or uteropore or end blindly. Proglottids without uteropores detach when gravid.
- The **egg** is formed in the ootype with the contributions from the ovary and the vitellaria (or the vitelline gland in some cestodes)

SEXUALLY MATURED PROGLOTTID



GRAVID PROGLOTTID



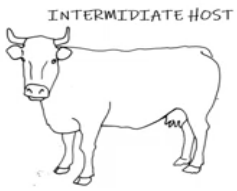
Taenia Gravid Proglotid

Taenia saginata

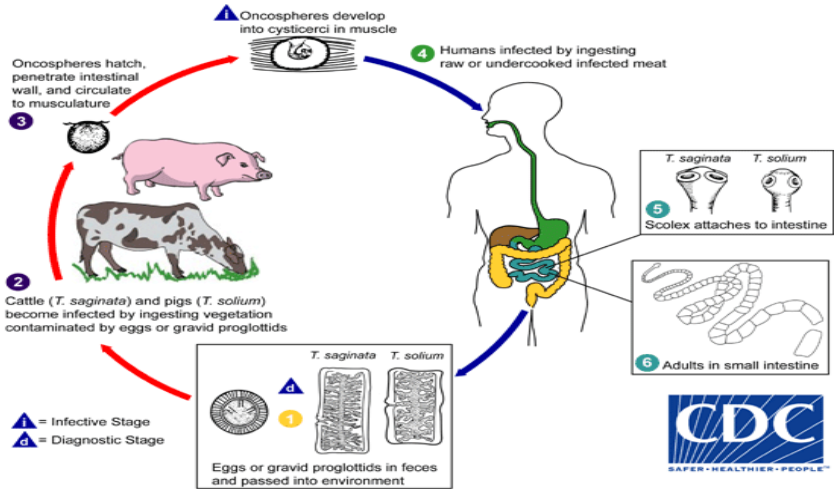
Taenia solium

- In most cestodes the scolex is tiny when compared to the **strobila** which makes up most of the actual "worm"
- The strobila consists of a linear series of **proglottids**
- Tape worms are hermaphrodites and each proglottid carries a set of female and male reproductive organs

Life Cycle of T *solium*/ T *saginata*:



Life Cycle of T *solium*/ T *saginata*:



Life cycle

Life Cycle of T solium/ T saginata:

- The adult worm is present in the intestines of host.
- The ova or the proglottid containing the ova are passed in the stools.
- The ova are then ingested by the intermediate host who could be pig (T. solium) or Cow (T. saginata).
- When a cow or buffalo feeds ingests the eggs the oncosphere hatches in the intestines.
- The larva hatches from the ova in the intestines of the intermediate host.

Life Cycle of T solium/ T saginata:

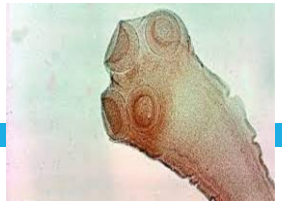
- The larva then penetrates the intestinal mucosa and reaches the muscles and develops into a cysticercus in three months time.
- Man gets infected when man eats the undercooked beef (T saginata) or pork (T solium) containing the cysticercii.
- In man the cysticercus develops into an adult tape worm. The cycle thus continues.

Diagnosis & Treatment

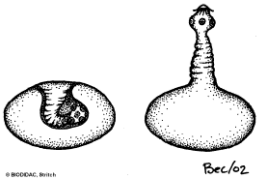
Disease	Digestive disturbances
Diagnosis	Eggs / segments in stool

Treatment	Niclosamide / Praziquantel

Taenia saginata (Beef Tape Worm)



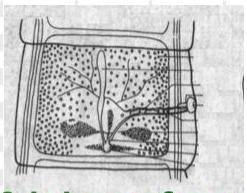
Definitive host	Man
Intermediate host	Cattle
Length	5 meters Max reported 25 meters



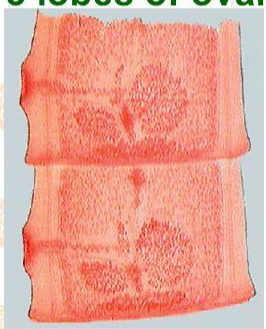
Infective form	*Cysticercus bovis* (larva)
Mode of transmission	Ingestion
Site of localization	Small intestine

Taenia solium
(Pork Tape Worm)

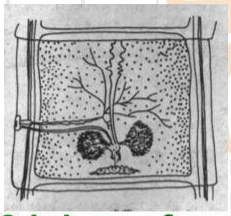
Definitive host	Man
Intermediate host	Pig
Infective form	*Cysticercus cellulosae (larva)* Eggs
Mode of transmission	Ingestion
Site of localization	Small intestine



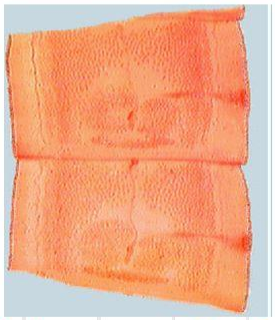
3 lobes of ovary



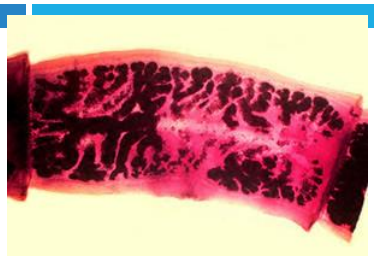
Mature proglottid of *T. solium*



2 lobes of ovary

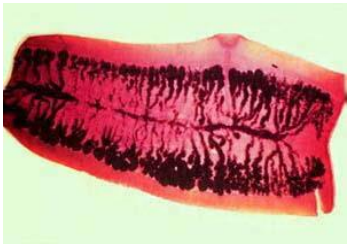


Mature proglottid of *T. sagniata*



T *solium* lateral branches of uterus 7-13

T saginata lateral branches of uterus 15-20



LECTURE (4)

Phylum Nematoda
the roundworms

Classification – Intestinal Nematodes

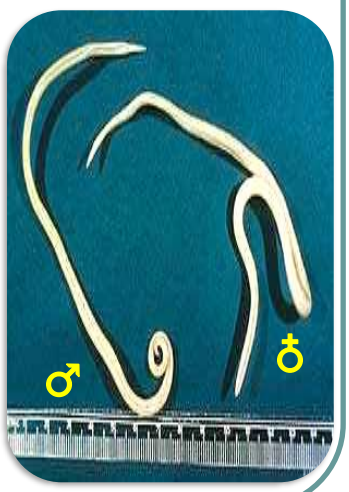
Small Intestine only	*Ascaris lumbricoides* (round worm)
	Necator americanus (american hook worm)
	Ancylostoma duodenale (hook worm)
	Strongyloides stercoralis
	Trichinella spiralis (trichina worm)
	Capillaria philippinensis
Caecum and Vermiform appendix	*Enterobius vermicularis* (pin worm)
	Trichuris trichiura (whip worm)

Classification – Tissue Nematodes

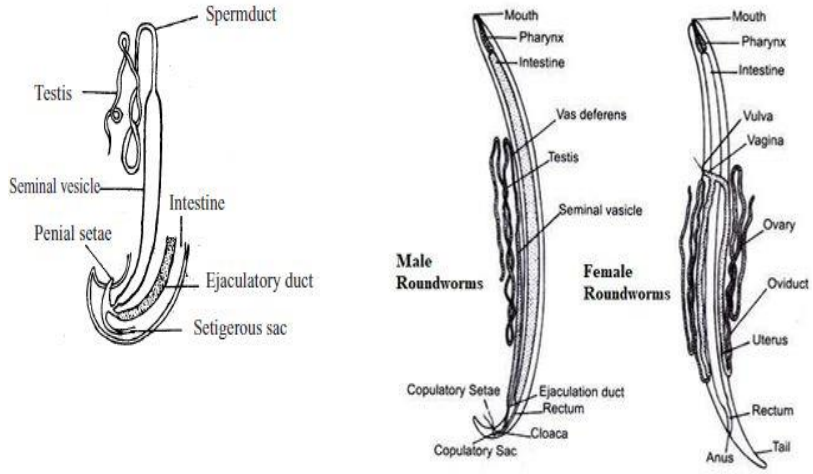
Lymphatic	***Wuchereria bancrofti***
	Brugia malayi
	Brugia timori
Subcutaneous	***Loa loa*** **(african eye worm)**
	Onchocerca volvulus **(blinding filaria)**
	Dracunculus medinensis **(thread worm)**
Conjunctiva	***Loa loa***

Nematodes – General Characters

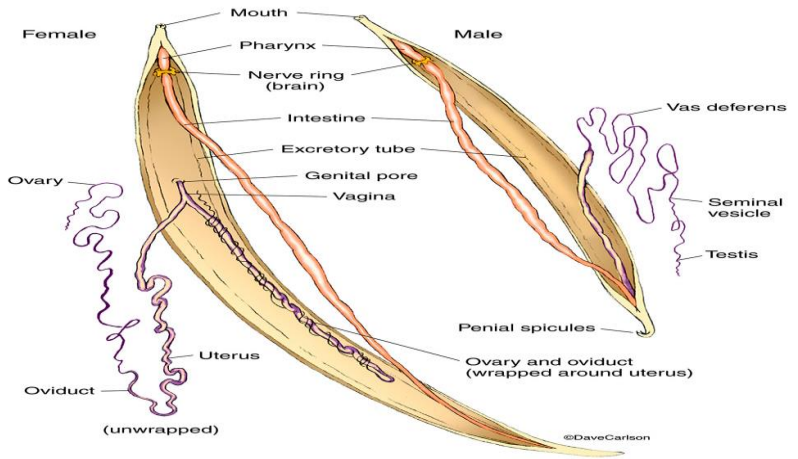
- Non-segmented cylindrical worms tapering at both ends
- Possess cuticle
- Sexes are separate, male is smaller than female & its posterior end is curved ventrally
- Females are either
  - Viviparous (produce larvae/ embryos)
  - Oviparous (lay eggs) or
  - Ovo-viviparous (lay eggs which hatch immediately)
- Live in intestinal tract or tissues



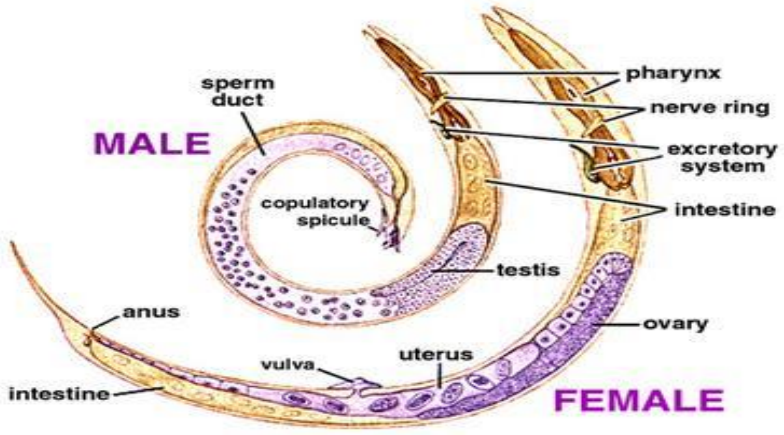
Nematodes – General Characters



Nematodes – General Characters



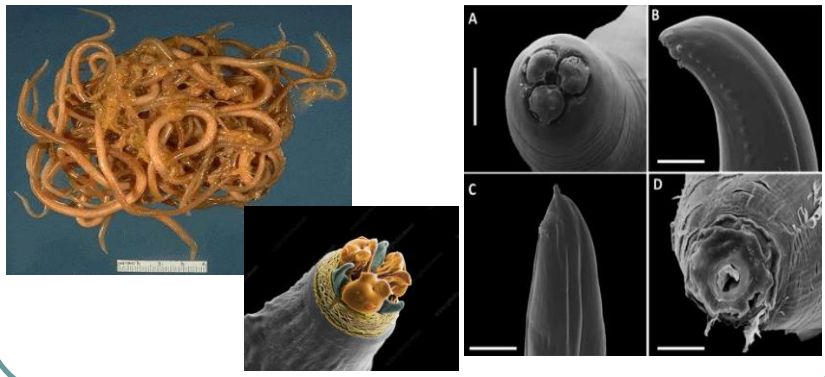
Nematodes – General Characters



Modes of Infection of Nematodes

1. Ingestion of –
   - Embryonated eggs contaminating food & drinks, e.g. *A.lumbricoides, E. vermicularis* & T. trichiura
   - Growing embryos in an intermediate host (infected cyclops) e.g. *D.medinensis*
   - Encysted embryos in infected pig's flesh e.g. *Trichinella spiralis*
2. Penetration of skin – filariform larvae bores through the skin e.g. *A.duodenale, S.stercoralis, N.americanus*
3. By blood sucking insects e.g. filarial worms
4. Inhalation of infected dust containing embryonated eggs e.g. *A.lumbricoides, E.vermicularis*

INTESTINAL NEMATODES



Ascaris lumbricoides (roundworm)

Adult worms	Male 15 to 30 cms Female 20 to 40 cms, oviparous
Eggs	60 µ, bile stained Albuminous coat with unsegmented ovum
Infective form	Embryonated eggs
Mode of transmission	Ingestion
Site of localization	Small intestine

Ascaris lumbricoides (life cycle)

The Life Cycle Of ROUNDWORMS

Ascaris Lumbricoides and Ascaris Suum

Adult males and females are in the small intestine.

↓

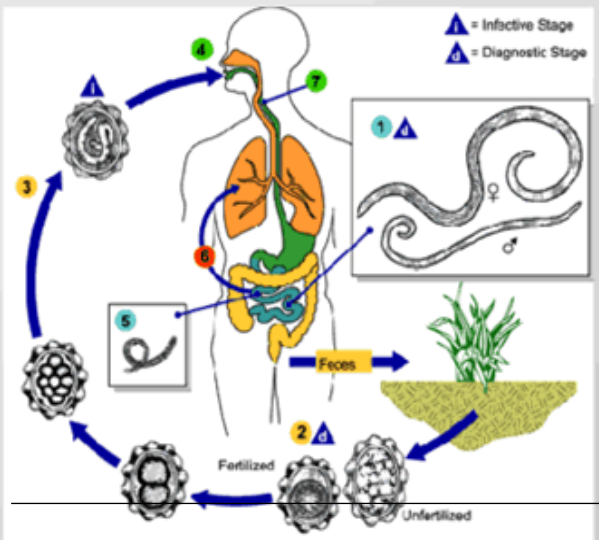
Females produce eggs that are passed in the host's feces. (A single female can produce 200,000 eggs per day.)

↓

Juveniles in eggs mature to the infective (second) stage.

↓

Eggs ingested by host and hatch in the small intestine. The juveniles penetrate the tissues of the intestine and enter the blood stream.



The juveniles are "coughed up" and swallowed. The juveniles complete their development in the small intestine.

↑

The third stage juveniles migrate from the pulmonary capillaries into the alveoli (air sacs).

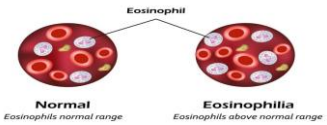
↑

The juveniles migrate to the lungs and molt into third stage juveniles.

(Parasites and Parasitological Resources)

Laboratory Diagnosis

- Macroscopic - Direct detection of worm/s in stool or vomit
- Microscopic – direct examination of feces following floatation method: **bile stained eggs.** (eggs may not be seen at least 40 days after infection)
- Blood examination – **eosinophilia**.



Prevention

- Good sanitation and personal hygiene
- Mass treatments with single dose mebendazole or albendazole for all school-age children every three to four months - serves dual function:
  - treats the children and
  - reduces the overall worm burden in the community

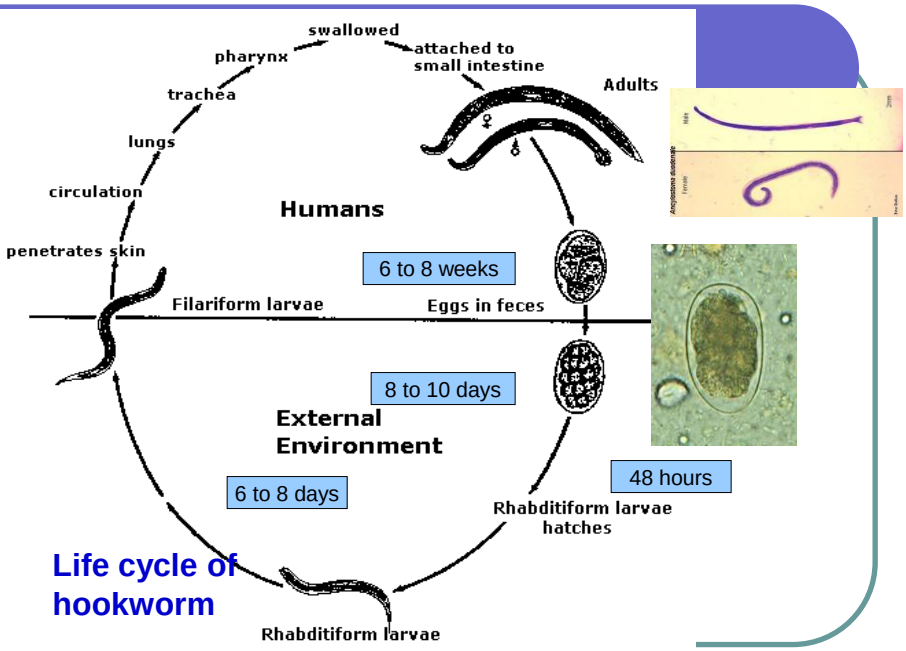
Ancylostoma duodenale (hook worm)

Adult worms	Male 8 -11mm Female 10-13 mm, oviparous
Eggs	60 µ, non bile stained (colorless) Segmented, 4 blastomeres
Infective form	3rd stage filariform larva
Mode of infection	Penetration into skin
Site of localization	Small intestine

Sites of skin penetration

- Most common sites are:
  1. Thin skin between toes
  2. Dorsum of the feet
  3. Inner side of the soles

- Gardeners & miners – skin of hands



Life cycle of hookworm

Ancylostoma duodenale life cycle

Hook worms in the intestine

Laboratory Diagnosis

- Stool examination – microscopy: non bile stained egg, segmented
- Occult blood in stool – positive
- Blood examination – anaemia, eosinophilia

Tissue Nematodes

Classification – Tissue Nematodes

Lymphatic	***Wuchereria bancrofti***
	Brugia malayi
	Brugia timori
Subcutaneous	***Loa loa*** **(african eye worm)**
	Onchocerca volvulus **(blinding filaria)**
	Dracunculus medinensis **(thread worm)**
Conjunctiva	***Loa loa***

Wuchereria bancrofti (Filarial worm)

Definitive host	Human
Intermediate host	Female Culex, Aedes or Anopheles mosquito
Infective form	Third stage larva
Mode of transmission	Inoculation – bite of mosquito
Site of localization	Lymphatics / lymph nodes of man
Geographical distribution	India, China, Far East, Africa, South & Central America

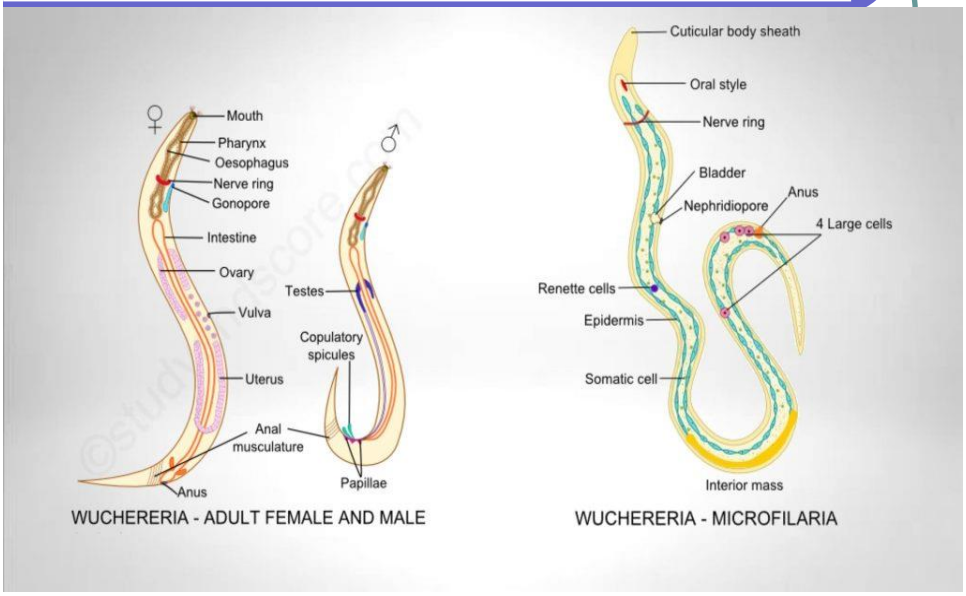
Wuchereria bancrofti (Filarial worm)

- It is a filarial (arthropod-borne) nematode (roundworm).
- the causative agent of lymphatic filariasis.
- This organism shows sexual dimorphism (Sexual dimorphism is the condition where the two sexes of the same species exhibit different characteristics beyond the differences in their sexual organs).
- As adult worm is long, cylindrical, slender, and smooth with rounded ends.
- The worm is white in color or almost transparent.
- The body is very fragile, creating removing it from tissues difficult.

Wuchereria bancrofti (Filarial worm)

- It contains a short cephalic or head region which is connected to the main body by a short neck.
- Dark pinches are disbanded nuclei throughout the body cavity, with no nuclei at the tail tip.
- The male worm is smaller in size, about 40 mm long and 100 μm wide.
- contains a ventrally bowed tail.
- The tail tip contains 15 pairs of minute caudal papillae, the sensory organs.
- The anal area is consisting of 12 sets of papillae, of which 8 are in front and four are after the anus.

Wuchereria bancrofti (Filarial worm)



Wuchereria bancrofti (Filarial worm)

- The female worm is three times larger in diameter than the male.
- It is about 60 mm to 100 mm long and 300 μm wide.
- The tail is gradually tapered and curved at the tip.
- Additional sensory structures are absent.
- Its vulva extends towards the anterior region, about 0.25 mm from the head.
- Sometimes the adult males and females are coiled together and are difficult to separate them
- The average lifespan is about 5 years.
- *W. bancrofti* lacks visual senses and rather relies on chemosensation to identity the chemicals in its environment and pheromones discharged by other members of its species.

Wuchereria bancrofti (Filarial worm)

- Additionally, papillae, both oral and outside of the body, helps in tactile communication with the environment and food.
- It uses its chemosensory capabilities to identify the variation in oxygen levels between arterial and venous blood vessels.
- They use the mouth to feed on the body and tissue fluids of its human host.

Wuchereria bancrofti (Filarial worm)

Microfilariae (Embryos)

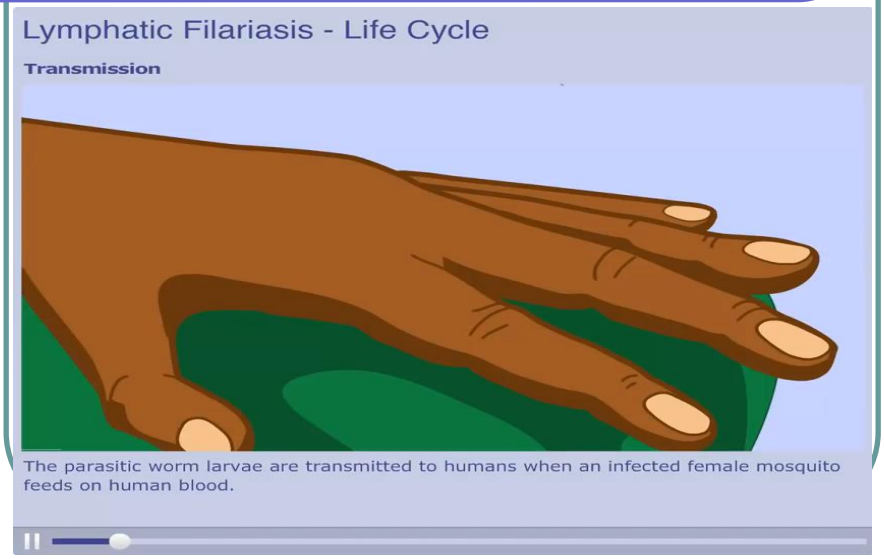
- The female's worms are ovoviviparous and can generate thousands of juveniles termed as microfilariae.
- The microfilaria is a minute adult, which contains the egg membrane as a sheath, and is often called the advanced embryo.
- The microfilaria is about 290 mm in length by 6-7 mm in breadth.
- It looks very structureless in vivo, but histological staining makes its primitive gut, nerve ring, and muscles apparent.
- Microfilariae are very aggressive and can migrate with and against the bloodstream.
- Their life span in the human body is presumably 70 days.

Wuchereria bancrofti (Filarial worm)

Habitat

- They can be found in temporary pools or standing water where mosquitoes are found.
- Humans are the definitive host of Wuchereria b. Adult worms can be found in regional lymphatic vessels, especially in the region of the groin, while Juveniles circulate in the blood and are ingested by mosquitoes when the latter takes a blood meal from a human.

Life cycle



Life cycle