Thorax

The insect thorax is divided into three parts: the prothorax (pro=first), mesothorax (meso=middle), and metathorax (meta=last). Each segment consists of hardened plates, or sclerites. Dorsal sclerites are called nota (sing. notum) (pronotum, mesonotum, and metanotum), lateral sclerites are called pleura (sing. pleuron), and ventral sclerites are called sterna (sing. sternum) (prosternum, mesosternum, and metasternum).

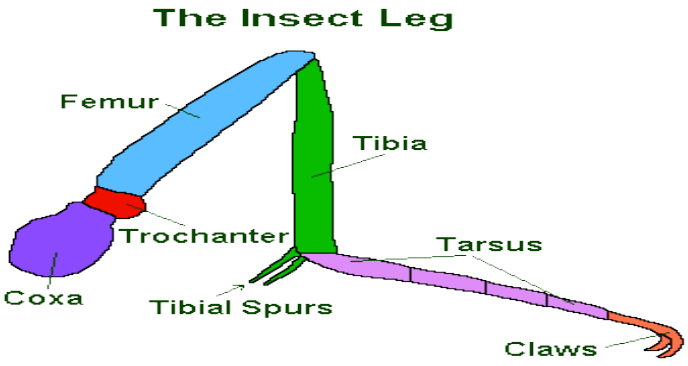
Each of the three thoracic segments contains one pair of legs. Wings are found only on the meso- and metathoracic segments.

The Thoracic Appendages

1-Legs

Most insects have three pairs of walking legs - one pair on each thoracic segment. Each leg contains five structural components (segments) that articulate with one another by means of hinge joints:

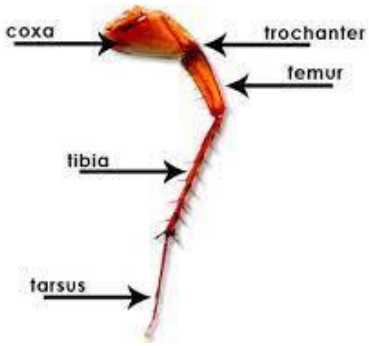
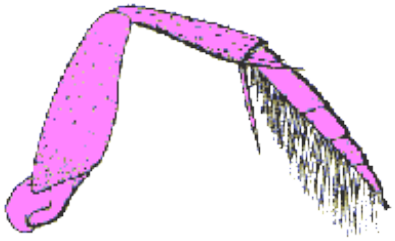
1- Coxa 2- Trochanter 3- Femur 4- Tibia 5- Tarsus



The term **pretarsus** refers to the terminal segment of the tarsus

Leg Adapations and Modifications:

Characteristic	Appearance	Example(s)

Walking legs-- adapted for walking		All legs Cockroaches
Raptorial(grasping)femur spinose and possess a central longitudinal groove.Tibia narrow, blade like spinose and fits into the groove of femur adapted for catching and holding prey		Front legs Praying mantis
swimming legs -- Hind legs pad like. Tibia and tarsus short and broad having dense long marginal hairs. adapted for swimming	 	Hind legs Water beetles
digging legs -- Tibia and tarsus short and broad with teeth adapted for digging in soil	 	Mole crickets

jumping legs :- Femur and tibia elongated adapted for jumping		Grasshopper
Clinging legs:- Tibia possess tibial thumb. Tarsus single segmented and pretarsus with a single long curved claw	 	Head louse
Cleaning legs:- Tibia possess a movable spine, and the first tarsal segment with a semicircular notch **Collecting legs:-**first tarsal segment enlarged and possess short stiff hairs called pollen basket	 	Front leg honey bee Hind legs honey bee

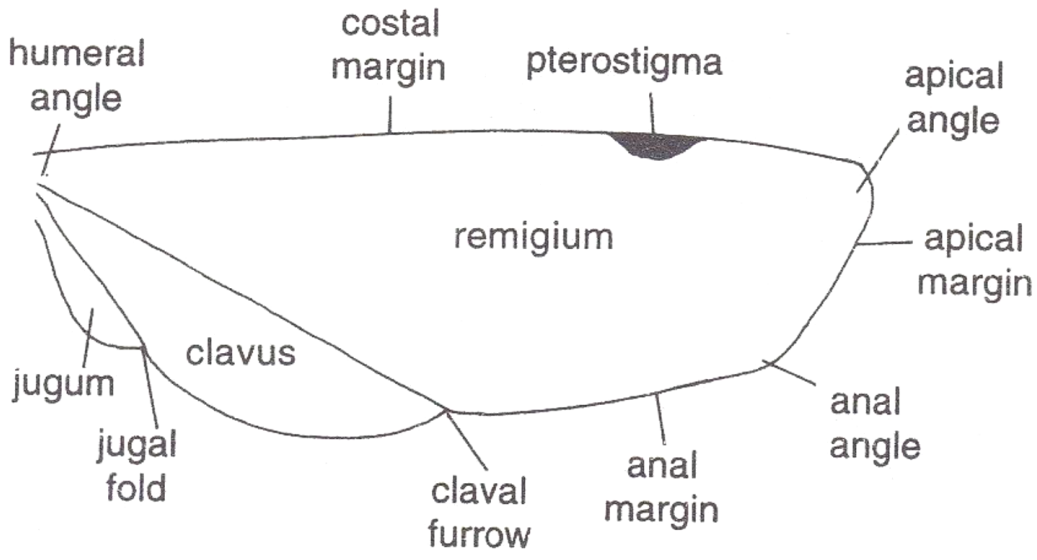
Lab 6

2-Wings

A typical insect wing is triangular with **three margins** and **three angles**. Three margins are: -

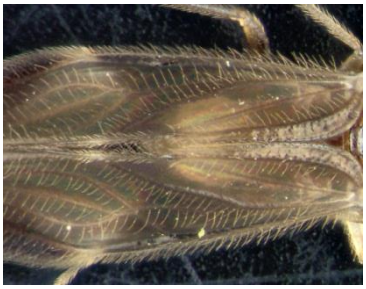
1-costal or anterior,
2-Apical or outer and
3-Anal or inner

Three angles are
1-Humeral angle: between body wall and costal margin
2-Apical or outer angle: between costal and apical margin
3-Anal angle or **tornus:** between apical and anal margin



Wing adapations and modifications:

Characteristic	Appearance	Order(s)
Elytra -- hard, sclerotized front wings that serve as protective covers for membranous hind wings		Coleoptera beetles
Hemelytra The base of the wing is thick like elytra and the remaining half is membranous. This thickened portion is divided in to corium, clavus cuneus and embolium. They are useful of protection and flight		Hemiptera:
Tegmina -- front wings that are completely leathery or parchment-like in texture		Orthoptera, Blattodea,

Halteres -- small, club-like hind wings	 	Diptera
hairy wings -- slender front and hind wings with long fringes of hair	 	Thrips
Membranous :-wing having membranous texture &clear veins	 	Dragonflies wasp
Scaly wings: covered with flattened setae (scales)	 	butterfly

Wing Venation:

Costa (C) -- the leading edge of the wing

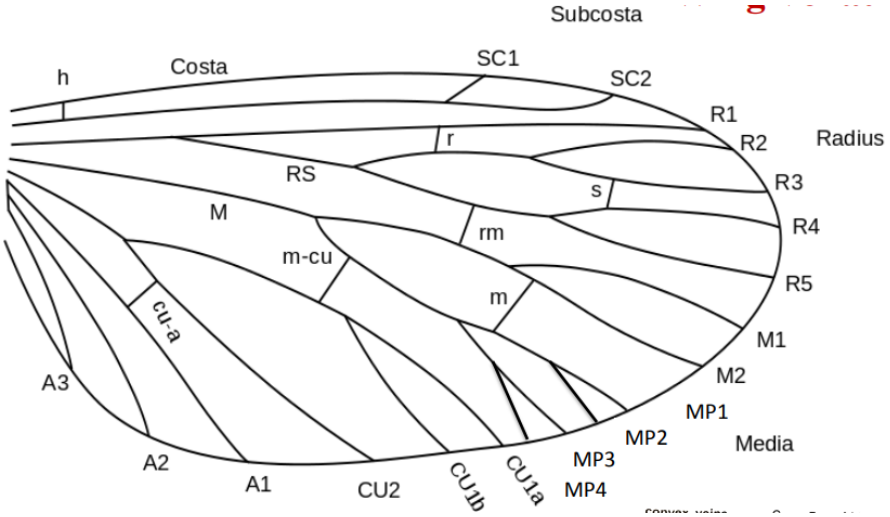
Subcosta (Sc) – second longitudinal vein (behind the costa), typically unbranched

Radius (R) -- third longitudinal vein, one to five branches reach the wing margin

Media (M) -- fourth longitudinal vein, one to four branches reach the wing margin

Cubitus (Cu) -- fifth longitudinal vein, one to three branches reach the wing margin

Anal veins (A1, A2, A3) -- unbranched veins behind the cubitus



Names of crossveins are based on their position relative to longitudinal veins:

c-sc crossveins run between the costa and subcosta
r crossveins run bewteen adjacent branches of the radius
r-m crossveins run between the radius and media
m-cu crossveins run between the media and cubitus

Wing coupling apparatus/Organs/Mechnisms:

For taking flight, insect need to keep both the fore and hind wings together as a single unit. The structures in the form of lobes, bristles, hairs or spines that help the wings to be together are known as wing coupling organs

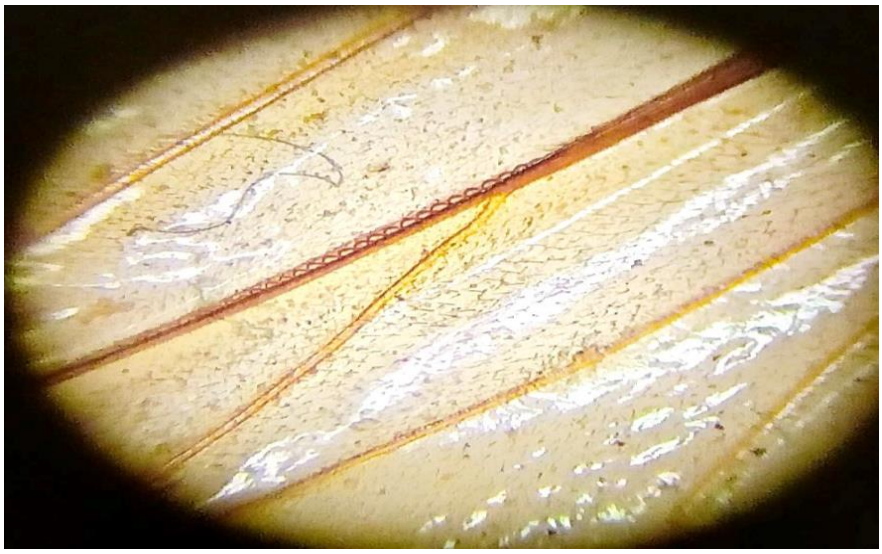
1. Jugate type or jugum type:

The more primitive groups of moths have an enlarged lobe-like area near the basal posterior margin, i.e. at the base of the forewing, called *jugum*, that folds under the hindwing in flight.

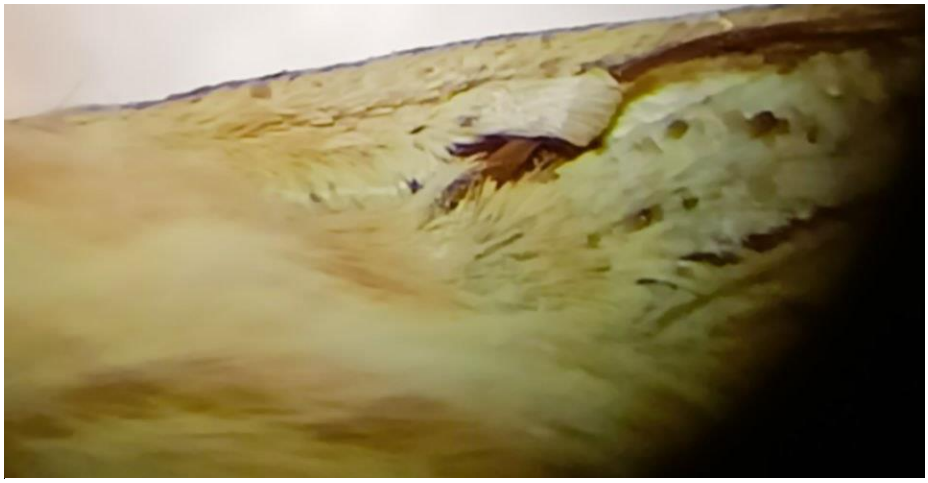
e.g.: primitive lepidopterans of the family Hepialidae

2. Frenulum and retinaculum type: -

The hind wings possess bristle or spinelike structure or group of hairs known as **frenulum**. The forewings possess hook like r**etinaculum** on anal side. During flight the frenulum passes beneath the retinaculum and thus the both the wings are kept together. e.g.: moths



3. Hamuli: Small curved hook like structures present on the costal margin of the hind wing known as **Hamuli** that fit into the upward fold of the anal margin of the forewing. e.g.: hymenopterans (wasps and bees)



Lab 7

Abdomen

An insect's abdomen is the third functional region of its body; the abdomen is located just behind the thorax. In most insects, the junction between thorax and abdomen is broad, but in some groups, the junction is very narrow giving the appearance of a "wasp-waist". **Abdomen** has 7-11 segments with genital appendages on 8th and 9^{th} segments

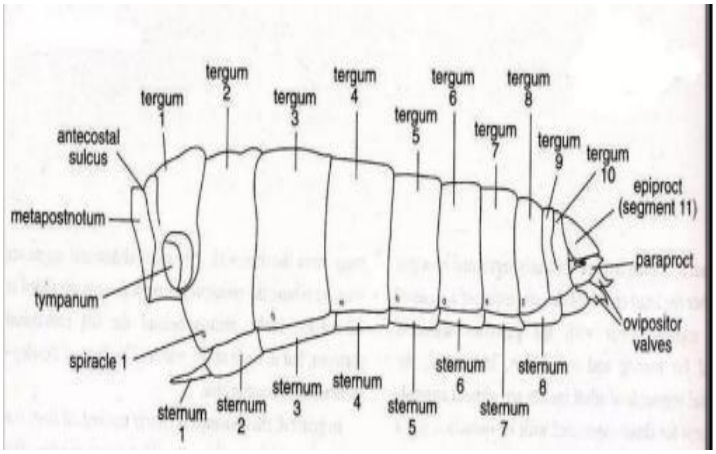
Each segment of abdomen composed of:- tergum, sternum, pleurum

The segments have the same morphological view except segment number 11(last segment) the segment have changes in morphology these are: -

Tergum have 2plates

1-Epiproct

2-paraproct



These are small sclerites covering the anus their function in to control the movement of the anus

Sternum large membranous &half circular

pleurum one plate without any morphological change

abdominal appendages

there are 2 type of appendage

1-non sexual appendage

1- sexual appendage

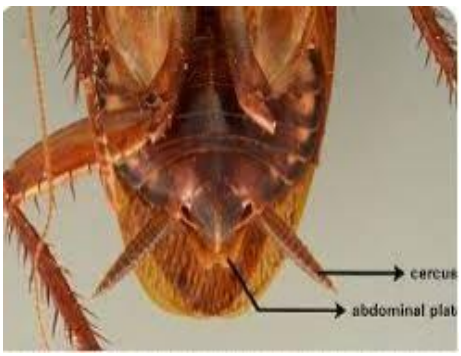
1-non sexual appendage

There is one type of non-sexual appendage called cerci (cercus)

There is 2cerci developed from abdominal seg 11 with different groups of insects

-in grasshopper the cercus consist of one seg triangular in shape

-in american cockroach the cercus consist of 5 segment



-in earwing the cercus is needle shaped

-in silver fish circus is long filament

-in cricket the circus is sord shaped or knife shaped

2-sexual appendage

We have separate sexes male& female in male have circus &style but in female just circus

- **ovipositor**

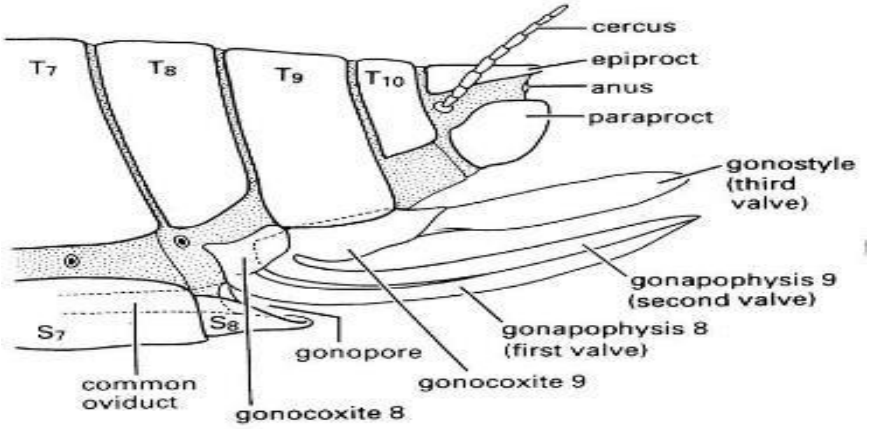
this ovipositor developed from the abdominal seg. 8&9

the ovipositor consist of 3 pair of valves :-

ventral valves ,anterior ,outer originate from 9th seg.

Inner valves , lateral originate from 9th seg.

Dorsal valves, posterior originate from 8th seg .



-male genitalia

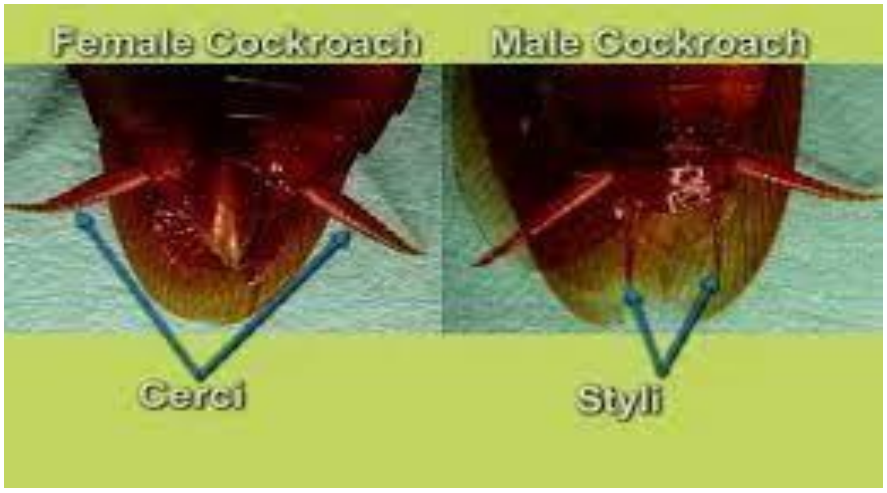
This appendage developed from th abdominal seg. 9&10

This male genitalia have 3 loops

-right lobe called right paramer

-left lobe called left paramer

-middle lobe called aedeagus



Lab 8

Digestive and Excretory Systems

Digestive System: A tube that extends from the mouth to the anus; there are 3 sections:

Foregut:
Pharynx (throat)
Esophagus (gullet)
Crop (storage)
gizzard

Midgut:
Gastric caecae (blind sacs) (food storage and enzymes)
Ventriculus (most digestion, absorption here)
Hindgut:

Anterior intestine (excretory organs empty in)
Rectum (reabsorption of water) Anus

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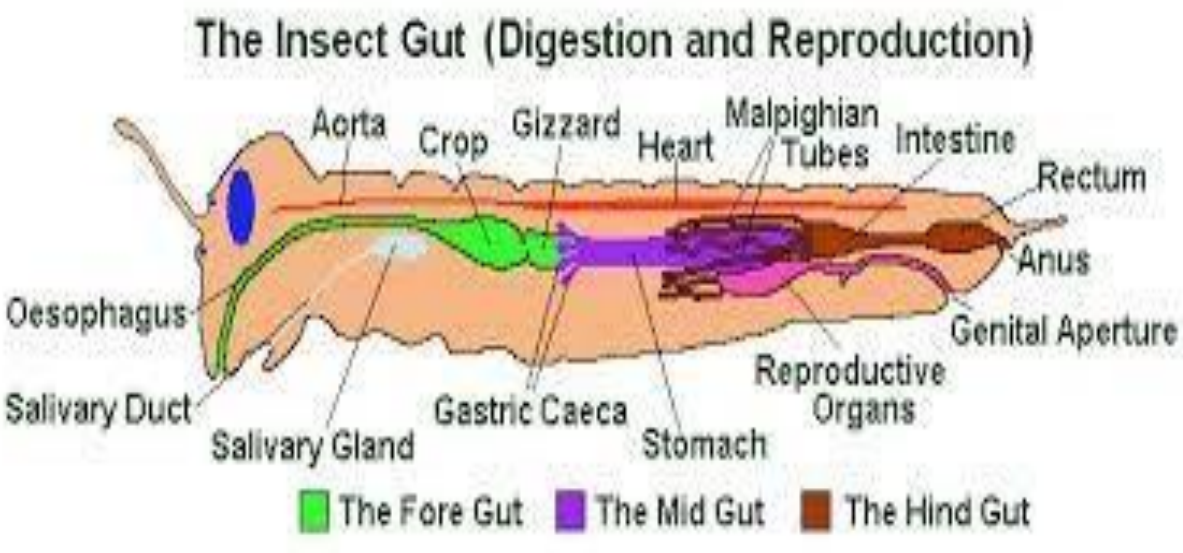
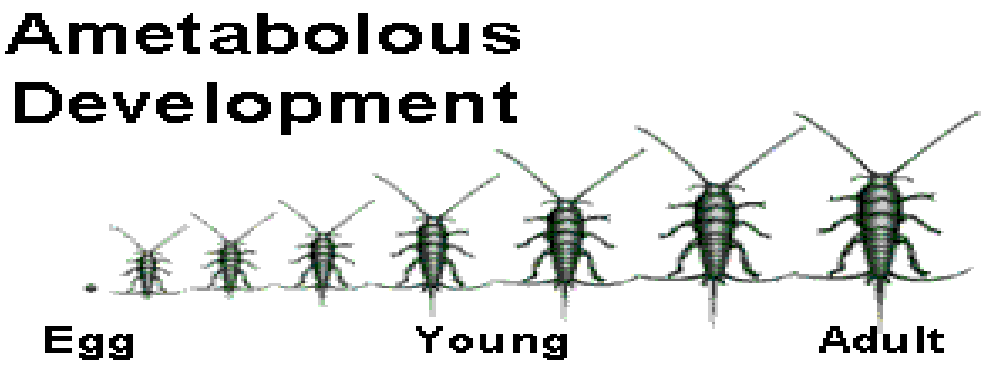


Metamorphosis

Each time an insect molts, it gets a little larger. It may also change physically in other ways -- depending on its type of metamorphosis: ametabola, hemimetabola, or holometabola.

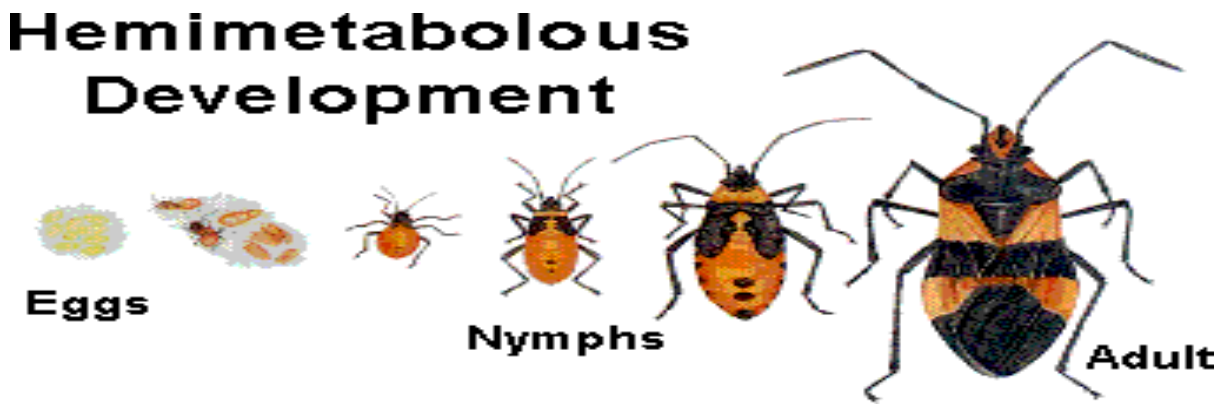
1-Ametabolous insects

undergo little or no structural change as they grow older. Immatures are called **young**; they are physically similar to adults in every way except size and sexual maturity. Other than size, there is no external manifestation of their age or reproductive state.



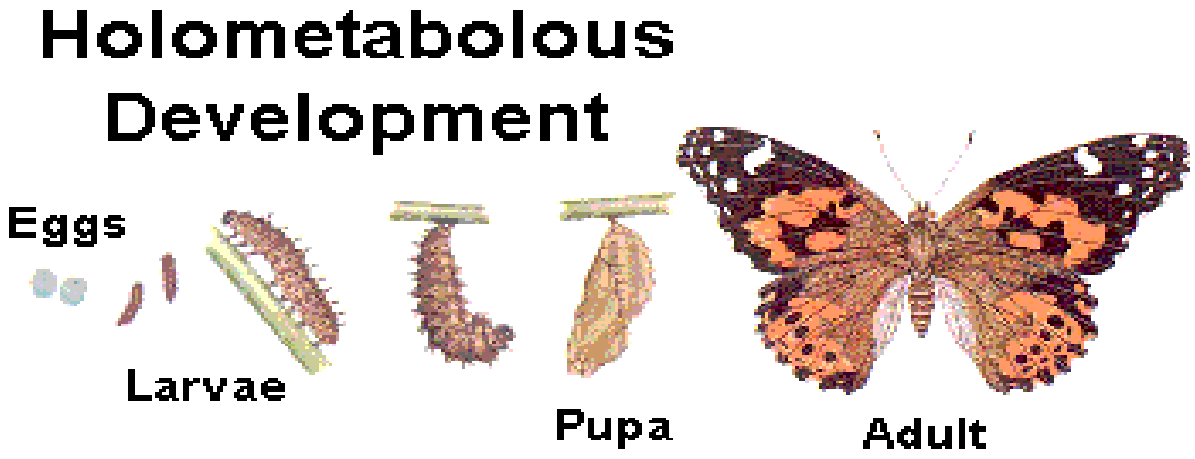
2-Hemimetabolous insects

exhibit gradual changes in body form during morphogenesis. Immatures are called **nymphs** or, if aquatic, **naiads**. Maturation of wings, external genitalia, and other adult structures occurs in small steps from molt to molt. Wings may be completely absent during the first instar, appear in the second or third instar as short wing buds, and grow with each molt until they are fully developed and functional in the adult stage. Developmental changes that occur during gradual metamorphosis are usually visible externally as the insect grows, but adults retain the same organs and appendages as nymphs (eyes, legs, mouthparts, etc.).



3-Holometabolous insects:-

have immature forms (**larvae**) that are very different from adults. Larvae are "feeding machines", adapted mostly for consuming food and growing in size. They become larger at each molt but do not acquire any adult-like characteristics. When fully grown, larvae molt to an immobile pupal stage and undergo a complete transformation. Larval organs and appendages are broken down (digested internally) and replaced with new adult structures that grow from **imaginal discs**, clusters of undifferentiated (embryonic) tissue that form during embryogenesis but remain dormant throughout the larval instars. The adult stage, which usually bears wings, is mainly adapted for dispersal and reproduction.



Most larvae can be grouped into one of five categories based on physical appearance:

Appearance	Larval Type	Common Name	Description	Examples
	Eruciform	Caterpillar	Body cylindrical with short thoracic legs and 2-10 pairs of fleshy abdominal prologs	Moths and butterflies
	Campodeiform	Crawler	Elongated, flattened body with prominent antennae and/or cerci. Thoracic legs adapted for running	Lady beetle, lacewing

	Scarabaeiform	White grub	Body robust and "C"-shaped with no abdominal prolegs and short thoracic legs	June beetle, dung beetle
	Elateriform	Wireworm	Body long, smooth, and cylindrical with hard exoskeleton and very short thoracic legs	Click beetle, Flour beetle
	Vermiform	Maggot	Body fleshy, worm-like. No head capsule or walking legs	House fly, flesh fly

Pupae can be grouped into one of three categories based on physical appearance:

Appearance	Pupal Type	Common Name	Description	Examples
	Obtect	Chrysalis	Developing appendages (antennae, wings, legs, etc.) held tightly against the body by a shell-like casing. Often found enclosed within a silken cocoon.	Butterflies and moths
	Exarate	None	All developing appendages free and visible externally	Beetles, Lacewings
	Coarctate	Puparium	Body encased within the hard exoskeleton of the next-to-last larval instar	Flies