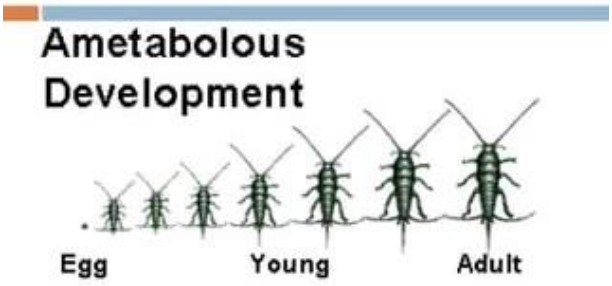
Metamorphosis and immature stages in insects:

The word "**metamorphosis**" comes from the Greek which means to transform. Metamorphosis is the process of transformation of an immature individual into sexually mature reproducing adult. The transformed adult is completely different from larvae in form, structure and habit. It is the way insects grow and mature. Their lives are divided into separate stages for resting, growing and reproducing.

So, **Metamorphosis** is the change in growth and development an insect undergoes during its life cycle from birth to maturity. There are four basic types of metamorphosis in insects.

There are four types of metamorphosis in insects namely,

- **Ametabola**: (No metamorphosis) e.g. Silver fish. These insects have only three stages in their life namely egg, young ones and adult. It is most primitive type of metamorphosis. The hatching insect resembles the adult in all respects except for the size and called as young. Moulting continues throughout the life.

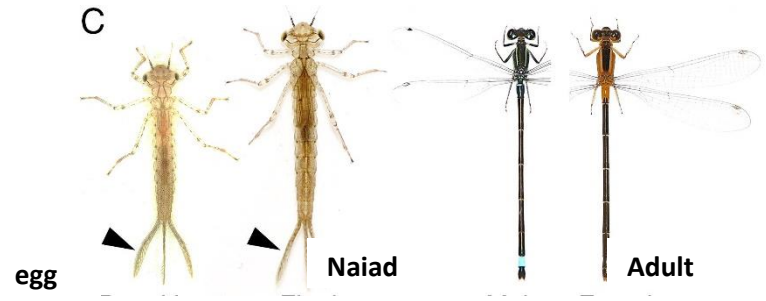


Examples	Orders
Silverfish	**Thysanura**
Springtail	**Collembola**

- **Hemimetabola**: (Incomplete metamorphosis) e.g. Dragonfly, damselfly and may fly. These insects also have three stages in their life namely egg, young one and adult. The young ones are aquatic and are called as **naiads**. They are different from adults in habit and habitat. They breathe by means of tracheal gills. In dragonfly naiad the lower lip (labium) is called mask which is hinged and provided

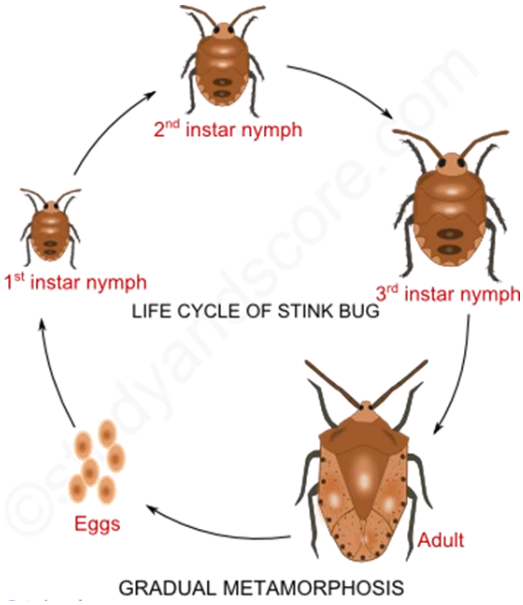
with hooks for capturing prey. After final moult, the insects have fully developed wings suited for aerial life.

Examples	Orders
Mayflies	**Ephemeroptera**
Dragonflies	**Odonata**
Stone-flies	**Plecoptera**

- 

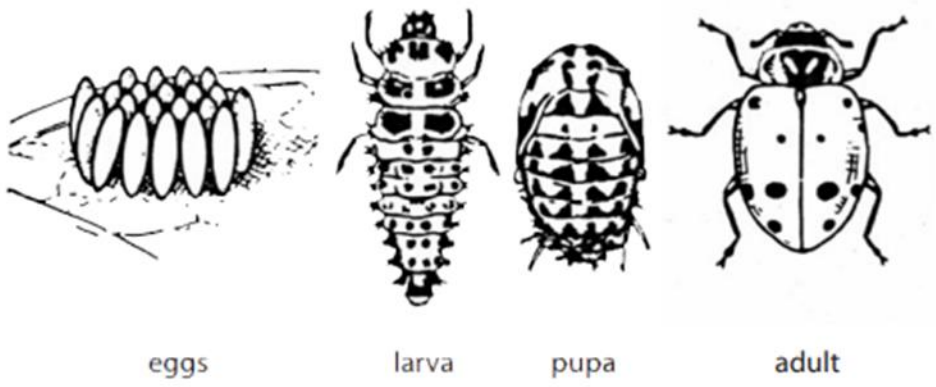
- **Paurometabola**: (**Gradual metamorphosis**) e.g. Cockroach, grasshopper, bugs. The young ones are called nymphs. They are terrestrial and resemble the adults in general body form except the wings and external genitalia. Their compound eyes and mouth parts are similar to that of adults. Both nymphs and adults share the same habitat. Wing buds externally appear in later instars. The genitalia development is gradual. Later instar nymphs closely resemble the adult with successive moults.

Examples	Orders
Grasshoppers	**Orthoptera**
Termites	**Isoptera**
Thrips	**Thysanoptera**
True bugs	**Hemiptera**
Aphids	**Homoptera**
Earwigs	**Darmaptera**



- **Holometabola**: (**Complete metamorphosis**) e.g. Butterfly, moth, fly and bees. These insects have four life stages namely egg, larva, pupa and adult. Majority of insects undergo complete metamorphosis. Larvae of butterflies are called caterpillar. Larva differs greatly in form from adult. Compound eyes are absent in larva. Lateral ocelli are the visual organs. Their mouth parts and food habit differ from adults. Wing development is internal. After hatching larva moults several times to become fully grown one. It later becomes a pupa within a secreted case called as **Puparium**. Inside the puparium, the pupa differentiates into adult. During the non-feeding pupal stage, the larval tissues disintegrate and adult organs are built up.

Examples	Orders
Lacewings	**Neuroptera**
Beetles	**Coleoptera**
Moths, Butterflies	**Lepidoptera**
Flies	**Diptera**
Fleas	**Siphonoptera**
Wasps, bees	**Hymenoptera**



Developmental (Immature Stages):

I) Egg: The first stage of development in all insects is egg. Majority of insects are oviparous. Egg stage is inconspicuous, inexpensive and inactive. Yolk contained in the egg supports the embryonic development. Eggs are laid under conditions where the food is available for feeding of the future young ones. Eggs are laid either individually or in groups. The outer protective shell of the egg is called chorion. Near the anterior end of the shell of the egg, there is a small opening called micropyle which allows the sperm entry for fertilization. Chorion may have a variety of textures. Size and shape of the insect eggs vary widely.

Types of eggs

II. Larva: Larva is the second stage of holometabolous life cycle. Sometimes, insects lay their eggs on food sources so that the larva can start feeding as soon as the egg hatches. The larva (plu: larvae) has simple eyes rather than compound eyes and possesses no wings or wing buds. Most of the larval stage is worm-like and mobile. On the basis of their body type, the larvae are of three types:

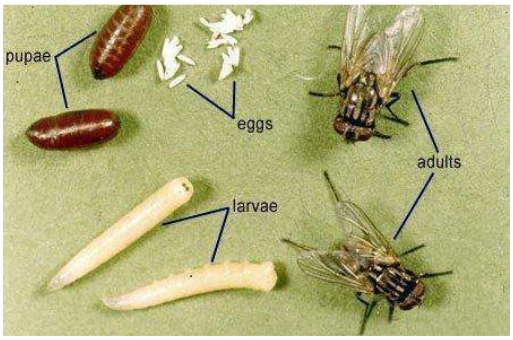
A) Apodous Larvae

They are larvae without appendages for locomotion (No Legs). Based on the degree of development and sclerotization of head capsule, there are three subtypes.

1) Eucephalous: larva with well-developed head capsule with functional mandibles, maxillae and antennae. Mandibles act transversely.
eg: Wriggler (larva of mosquito) and grub of red palm weevil.

2) Hemicephalous: Head capsule is reduced and can be with drawn into thorax. Mandibles act vertically. eg: Larva of horse fly.

3) Acephalous: Head capsule is absent. Mouth parts consists of a pair of protractible curved mouth hooks and associated internal sclerites. They are also called vermiform larvae.
eg: maggot (larva of housefly)



B) Oligopodous Larvae: Thoracic legs are well developed. Abdominal legs are absent. There are
subtypes:

1) **Campodeiform Larvae**: Body is elongate, depressed dorso-ventrally and well sclerotised. Head is prognathous. Thoracic legs are long. A pair of abdominal cerci or caudal processes is usually present. Larvae are generally **predators** and are very active. eg: grub of ant lion or grub of lady bird beetle

2) **Scarabaeiform Larvae**: Body is 'C' shaped, stout and subcylindrical. Head is well developed. Thoracic legs are short Larva is sluggish, burrowing into wood or soil. e.g: grub-like along with a head capsule, e.g., family Scarabaeidae.