

# Metamorphosis

'Meta' = Change, 'morph' = form or structure



Series of changes that takes place during the development of an insect from egg to adult are collectively known as metamorphosis.

- Metamorphosis include three developmental processes

Growth- Larva

differentiation - Pupa

Reproduction- adult

- The presence of hard exoskeleton on the body prevents the growth of larva
- The series of moults during larval stage allow them to increase their body size/growth. The number of moults in general may vary from 5-6

**Instar:** It is the form of the body during two inter moults

The larva is known as first instar, immediately after hatching from egg, and as second instar after first moult and so on

**Stadium :** The interval or time period between two moults is known as stadium

**Exuviae :** The skin shed during moulting process is known as exuviae

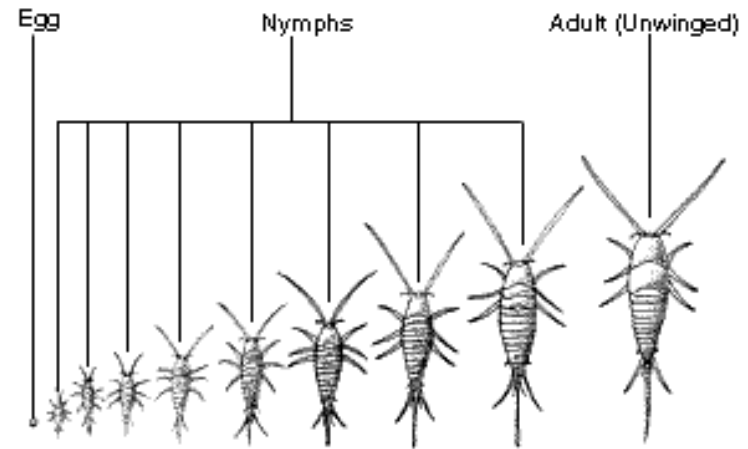
**Imago (or) Adult :** It is the final stage of insect with well developed organs for reproduction, which emerges out from pupal body

**Sub-imago:** It is a pre adult stage with fully developed wings but without reproductive organs **Eg: mayflies (Ephemeroptera)**

## 1. Ametamorphosis :

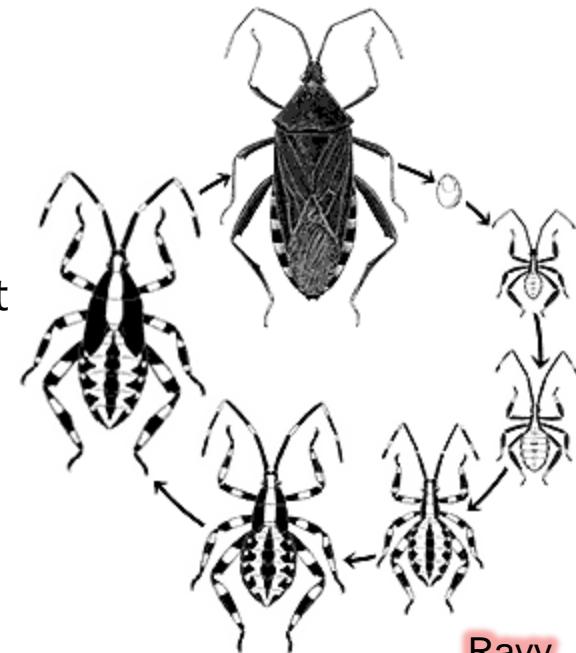
The insect hatches from the egg, it resembles the adult in all the characters except the small body size, which later increases, until they reach sexual maturity with well developed reproductive organs.

e.g.: Apterygotes like silver fish, springtails



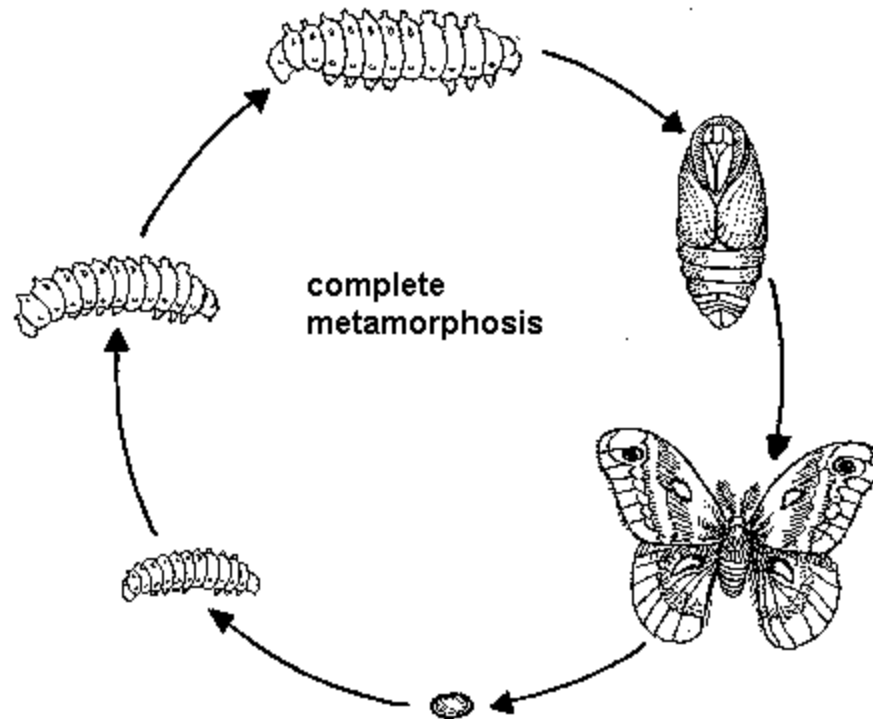
## 2. Incomplete metamorphosis or hemi or direct or simple metamorphosis

- includes egg, nymph and adult stages
- The nymph resembles the adult **except wings**
- **wing buds** transform in to fully developed wings in adult
- wings develop externally and hence **Exopterygota**
- **Pupal stage is absent** hence, development is said to be direct



### 3. Complete (or) holometamorphosis or indirect development

- The life cycle includes four stages; **egg, larva, pupa and adult**
- **Larva differs** from the adult both in body structure and habits
- Larva has both thoracic and **abdominal legs**
- sometimes legs may be absent in larva, where as adult has only thoracic legs
- **Compound eyes** are absent in larva
- Larva undergoes moulting to enter in to pupal stage from which the adult insect emerges
- Wings develop internally, hence **Endopterygotes**

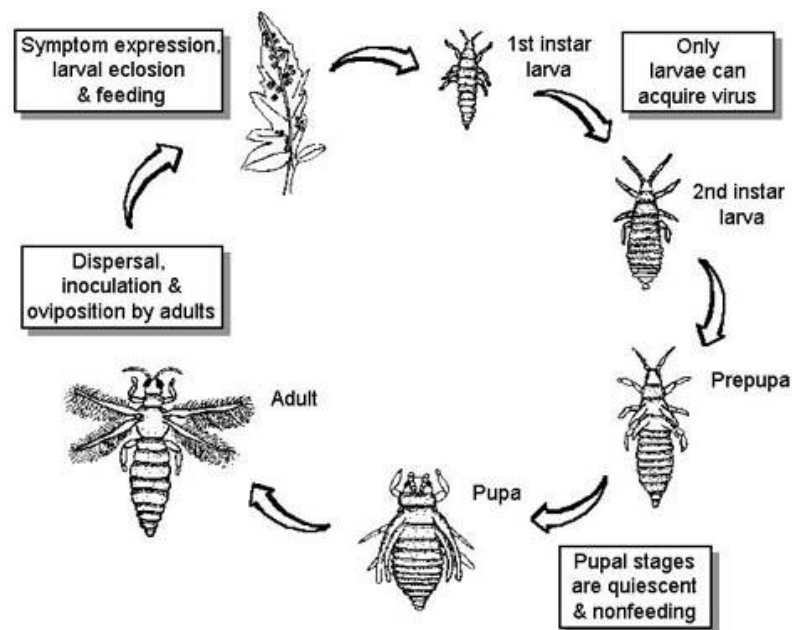


#### 4. Intermediate metamorphosis:

In this case, insects may undergo either **hemi** or **holometamorphosis**.

If they undergo **holometamorphosis**, there is a short pupal stage.

**e.g.:** coccids, thrips etc



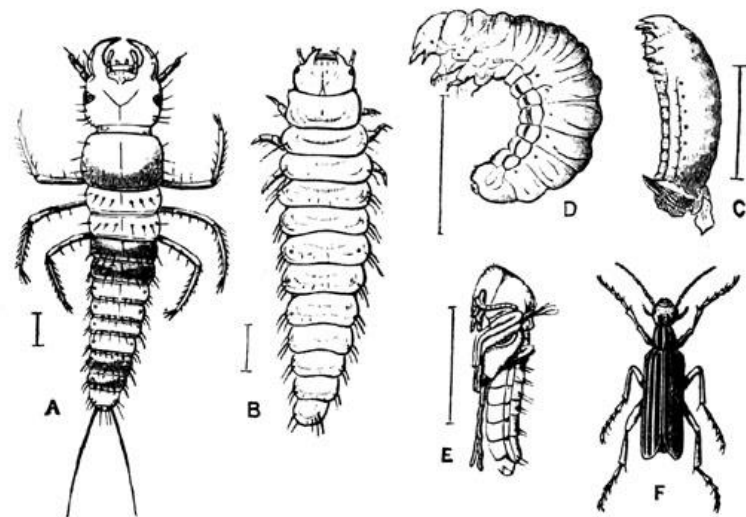
#### 5. Hypermetamorphosis:

This is a peculiar type of development which consists of two or more types or forms of larvae in the life cycle of insects

In majority of the cases the first larval instar is campodeiform and the subsequent larval forms depends on type and mode of life of the larva

**E.g.:** In blister beetle (Meloidae; Coleoptera),

The first larval instar is campodeiform followed by scarabeiform larval type



# Diapause

- Diapause is represented by low rate of metabolism, O<sub>2</sub> consumption and body weight
- low body water content and vitamin deficiency in the blood
- Diapause may occur in egg, larva, nymph, pupa or adult stage
  
- **Egg - Bombyx mori;**
- **Larval - Euproctis sp., Pectinophora gossypiella;**
- **Pupal- Red hairy Caterpillar (Amsacta albistriga)**
- **Adult - Mango nut weevil (Sternochaetus mangiferae)**

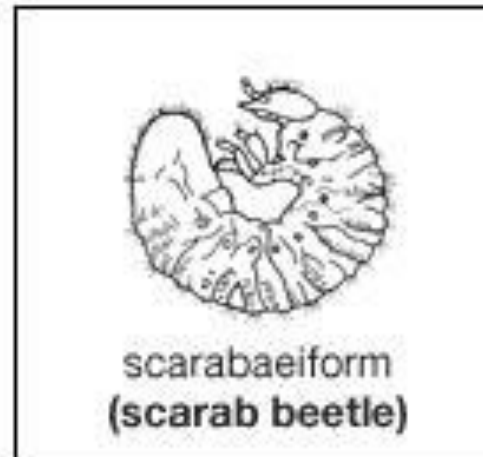
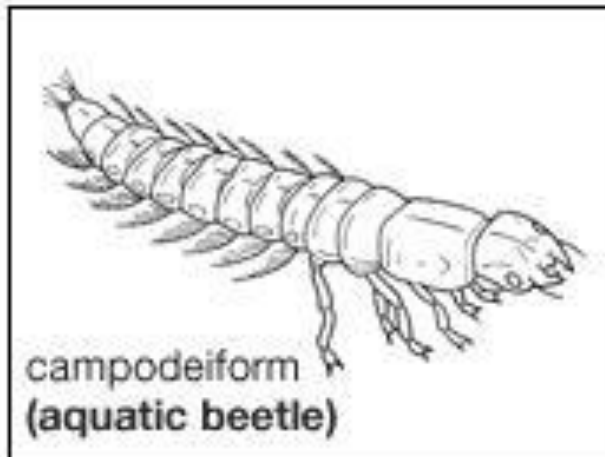
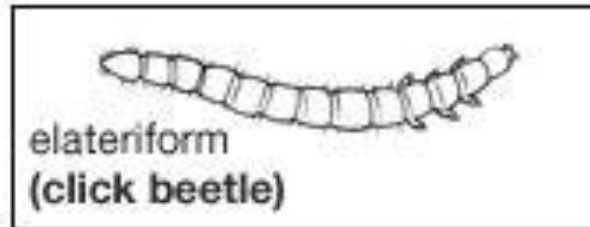
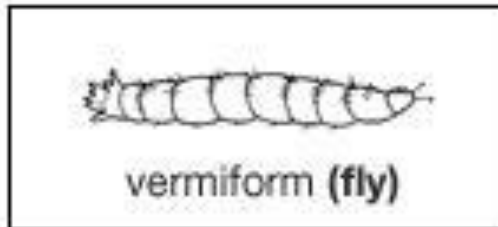
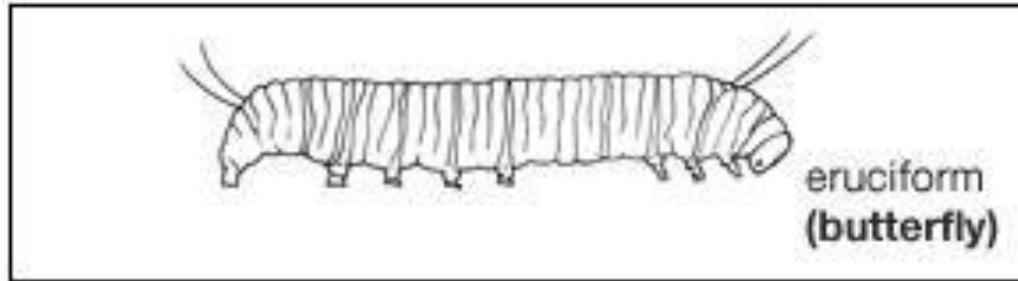
Diapause is of two types:

1. **Obligatory:** It is a **hereditary character** controlled by genes and is species specific  
**e.g. egg diapause in silkworm**
  2. **Facultative:** It is due to **unfavorable conditions** and with the onset of favourable condition, the insect regains its original activity. **e.g. Pectinophora gossypiella**
- The unfavourable conditions may be biotic or abiotic
  - Biotic conditions are natural enemies, population density etc.
  - abiotic conditions are temperature, rainfall, humidity, photoperiod, type of food etc.

“**aestivation**” - diapause during summer due to high temperatures

“**hibernation**” - inactivity during winter due to low temperatures known as

# Types of Larvae and Pupae



# Immature stages of exopterygotes -Nymphs and endopterygotes -Larvae



Larva	Nymph
immature stage of endopterygotes	Immature stage of exopterygotes
undergoes holometamorphosis	undergoes hemimetamorphosis
Body is vermiform	Body resembles the adult in all the characters except wings
Consists of ocelli and reduced antennae	Have compound eyes and antennae
Possess both thoracic and abdominal legs	Possess only thoracic legs
larva is different from adult in feeding habits and behaviour	Nymph resembles the adult in feeding habits and behaviour
The larva enters pupal stage	No pupal stage



# Types of larva

## 1. Protopod larva: Eg: parasitic Hymenoptera

- The larva emerge from egg in an early embryonic phase as the egg contain less yolk
- The larvae are partially developed with well developed head and thoracic segment
- Lack segmentation in the abdomen
- They possess rudimentary cephalic, thoracic appendages but no abdominal appendages
- have partially developed digestive and underdeveloped respiratory, nervous systems



**2. Oligopod larva :** These are characterized by the presence of well developed thoracic legs, head capsule and without any abdominal legs

Campodeiform	Scarabaeiform
body is long and fusiform	Body is 'C' shaped
dorso-ventrally compressed with sclerotized cuticle	cylindrical or sub cylindrical, stout and fleshy
Prognathous	Hypognathous
Long thoracic legs	Short thoracic legs
Anal cerci are present	Absent
Active	Inactive
Predatory	Phytophagous
Ex: Neuroptera, Trichoptera	e.g.: Scarabidae of Coleoptera



### 3. Polypod larva (Eruciform larva):

larva possess well defined segmentation of the body with 3 pairs of thoracic legs, 2-5 pairs of abdominal legs (3rd, 4th, 5th, 6th and 10<sup>th</sup>). They are phytophagous and destructive

#### A. Hairy caterpillar:

Eg: Red hairy caterpillar (*Amsacta albistriga*)

Castor hairy caterpillar (*Pericalia ricini*)



**B. Spingid caterpillar / larva:** Larva consists of a horn on dorsal surface of 8th abd segment  
Eg: *Acherontia styx* (Gingelly death head moth)



**C. Looper :** Only two pairs of abdominal legs on 6<sup>th</sup> and last abdominal segment.

During walking the insect body forms complete loop like structure hence, looper

Eg: Mango looper, *Thalassodes quadraria*



#### D. Semilooper :

e.g.: Castor semilooper (*Achoea janata*).

First two pairs of abdominal legs (on 3<sup>rd</sup> and 4<sup>th</sup> segments) are reduced hence a part of the insect body forms a small loop during its movement

**4. Apodous larva :** These are characterized by the absence of trunk appendages (or) legs. They possess 3 pairs of sensory papillae in the place of thoracic legs. They are usually derived from Oligopod type.

Based on the degree of development of head capsule and its appendages, they are divided into 3

**a. Eucephalous :** e.g.: Sub order Nematocera of Diptera,  
Mosquito (Culcidae)

The larva consists of a well sclerotized head capsule



**b. Hemicephalous.** e.g.: Brachycera of Diptera,  
robberflies (Asilidae)

Larva possess partially developed head capsule



**C. Acephalous** e.g.: Cyclorrhapa of Diptera,  
Muscidae ( houseflies)

The larva are characterized by the absence of head capsule and mouth parts are represented by mouth hooks



# Types of Pupae

- It is resting and inactive stage of the holometabolous insects
- The wings are developed and the insect attain matured sexual organs
- The pupa is incapable of feeding, locomotion except where they crawl (Neuroptera) (Aphid lion), can swim e.g.: mosquitoes.

Pupa represents a Pharate adult stage and later it emerges as adult, pupation may takes place either in soil, or on the plant surface or within the webs

Based on the presence or absence of powerful mandibles

## I Decticous pupae

Possess relatively powerful mandibles which are used for escaping of the adult from the cocoon i.e. to break the cocoon  
e.g.: Neuroptera

## II Adecticous pupae

Do not possess the mandibles but with the help of other appendages, adults escape from the cocoon  
eg: Lepidoptera, Diptera



II. Based on the attachment on the appendages (or) shape of the pupae.

**1. Exarate pupa** e.g.: most of the Coleoptera

The pupae have appendages which are free without any secondary attachment to the body



**2. Obsect pupa** eg: Lepidoptera (moths)

The pupae have appendages which are firmly pressed against the body and the pupa is highly chitinized

**3. Coarctate** e.g.: Cyclorrhapha of Diptera (housefly)

The pupa remain enclosed in a puparium formed by the last larval skin and the pupa looks like a capsule or barrel



**4. Chrysalis** It is an obsect type of pupa which has Golden/brighter colouration and a stalk eg: butterflies.