

S. S. College, Jehanabad

Department: Zoology

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Topic: Metamorphosis in Insects

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Q21 Metamorphosis in insect :

Metamorphosis is a biological process by which an animal physically develops after birth or hatching. It involves abrupt change in the animal body structure through cell growth and differentiation. Metamorphosis is an inherited induced and an ancestral feature in some insects, fishes, amphibians, mollusks, tunicates etc. It is accompanied by a change of nutrition source or behaviour.

Animal can be divided into two categories that is complete, incomplete metamorphosis or no metamorphosis. Scientific usage of the term is technically to precise and it is not applied to general aspects of cell growth. In insect growth and metamorphosis are controlled by hormones. Neurosecretory cells in an insect brain secrete a hormone Prothoracicotropic hormone (PTTH), responsible for metamorphosis.

Types of metamorphosis

Q1 Simple metamorphosis (incomplete) :

The immature

insects and the adults are similar in appearance and differ mostly in size.

(b) Complete metamorphosis The immature insects and the adults have different forms, different habitats and may have very different behaviours. In Cockroach the immature nymph as like as adult Cockroach.

Insect show various types of Metamorphosis

(A) Paleometabola, Ametabola, anamorphosis.

(B) Hemimetabola.

(A) Paleometabola

This type of metamorphosis occurs in order Protura, Diplura, Collembola and Thysanura. The nymph upon hatching from the egg is similar to the adult in general morphology but there are only eight (8) appendages and coxae are lesser in number & size is small. As the nymph grows and molts it segments the abdomen increase gradually to become 11 in adult.

These nymphs live in same environment as the adult and feed on the same diet as the adult. The insect are living less both in larval as well as in adult stages. Some biologists called it ~~as~~ anamorphosis as there is a little change during development.

13) Hemimetabola :

There are 15 orders of insect which demonstrate this kind of metamorphosis in which Juveniles are similar to the adults and there is a gradually change from nymph to adult. The transformation takes place in the growth of wings as external buds and development of secondary sexual characters. Nymph generally live in the same environment as the adult.

ex - Grasshoppers, Cockroach, dragonflies, mayflies, lice, bugs etc.

Hemimetabola have two categories :

14) Heterometabola :

These insect do not show any dormant stage during development and nymph are active through out their growth stage. It is two

It is two type: —

(i) Archimetabola : — Those insect whose larvae are aquatic while adults are flying terrestrial insect. It shows difference in the morphology of nymphal stages owing to their aquatic habitat.
Ex - Dragon and Damselflies, mayflies, Stoneflies. Larvae breathe tracheal gills.

(ii) Psammometabola : — Nymph lives in the same habitat as the adult and eats similar food.
Ex - Grasshoppers, locusts, cockroaches, bugs and lice.

(b) Neometabola : — This type of metamorphosis found in Thysanoptera and Coccids. Nymph live in same habitat and feed on same food as the adult. But they have a dormant or resting stage after the larval development is completed. This dormant stage is different from pupal stage of the holometabolous insects.

(c) Holometabola : — This type of metamorphosis is found in Lepidoptera, Hymenoptera, Coleoptera, Diptera, Tricoptera etc. Larvae and adults are completely different in general features and eat different

a type of food and live in a different type of habitat. The larvae develop into pupal enclosed in cocoon. The development of adult stage takes place inside the cocoon and the adult emerges after rupturing the cocoon.
ex = silk worm, butterfly, housefly, beetle.

Hormonal Control

In insect growth and metamorphosis are controlled by hormones synthesized by endocrine glands near the front of the body. Neurosecretory cells in an insect's brain secrete a hormone called prothoracicotropic hormone (PTTH) that activates prothoracic gland, which secretes a second hormone usually ecdysone that induces ecdysis. PTTH also stimulates the corpora allata, a retrocerebral organ to produce juvenile hormone. This hormone ~~can~~ prevent the development of adult character during ecdysis. Molts between larval instars have a high level of juvenile hormone and molts between pupal stage has a low level of juvenile hormone and the final molt has no juvenile hormone present at all.

Development of Terminology

In hemimetabolous insects immature stage are called nymph. Development proceeds in repeated stages of

growth and ecdysis. These stages are called instars. The juvenile forms closely resemble adults but are smaller and lack adult wings and genitalia. The size and morphology are different between nymph and adult. Body protection and number of segments are relatively less than adult.

In holometabolous insects immature stages are called larvae which is different from adult. Larvae change into pupa and finally pupa change into adult.

Evolution → Phylogenetically all insects in the Pterygota undergo a marked change in form and physical appearance from immature stage to adult. These insects either have hemimetabolous development or holometabolous development.

More recently scientific attention has turned to characterizing the mechanistic basis of metamorphosis in terms of its hormonal control by characterizing spatial and temporal patterns of hormone expression relative to metamorphosis in a wide range of insects.

Fig. —