

LARVAL FORMS IN ECHINODERMATA

Afifa Kausar for BSc second semester

In echinoderms eggs and sperms are released in water and fertilization takes place in water forming zygote. Echinoderms are deuterostomes and hence cleavage is radial, holoblastic and indeterminate. The larvae hatch in water and feed and grow through successive larval stages to become adults. The larvae of echinoderms are bilaterally symmetrical but lose symmetry during metamorphosis. Different classes of echinoderms show structurally different larval stages and their comparisons can reveal their evolutionary ancestry. Echinoderms are unisexual animal with no sexual dimorphism. Fertilization external. Echinoderms are deuterostomes and hence cleavage is radial, holoblastic and indeterminate. Development is mostly indirect having larval stage in between. Larvae of echinoderms are bilaterally symmetrical but lose symmetry during metamorphosis.

Different classes of Echinoderms show structurally different larval stages. Comparison of the larval stages of different classes can reveal their evolutionary ancestry.

A. LARVAE OF ASTEROIDEA

Asteroidea shows three larval forms, Early bipinnaria , bipinnaria and branchiolaria.

1) Early bipinnaria

It appears like hypothetical dipleurula. It has oval body without arms and ciliary bands for locomotion. It has well developed alimentary canal for feeding and grows to become bipinnaria.

2) Bipinnaria larva

Many consider it as the first larval form of Asteroidea.

It is a bilaterally symmetrical, free swimming, free feeding pelagic larva.

The pre oral region is elongated, postoral region is broad.

It possesses two ciliated bands, the pre oral and post oral bands

The anterior end of the archenteron develop as mouth whereas the blastopore becomes the anus. '

When it initially forms, the entire body is covered by cilia, but as it grows, these become confined to a narrow band forming a number of loops over the body surface.

In addition to propelling the larva through the water, the cilia also catch suspended food particles, and deliver them to the mouth.

The pre oral and post oral ciliated bands are continued over a series of prolongation called arms.

Bipinnaria larva The bipinnaria is free-living, swimming as part of the zooplankton. A pair of short, stubby arms soon develop on the body, with the ciliated bands extending into them. After a short period of time, it transforms into branchiolaria larva. In some species, including the common starfish *Asterias*, the bipinnaria develops directly into an adult.

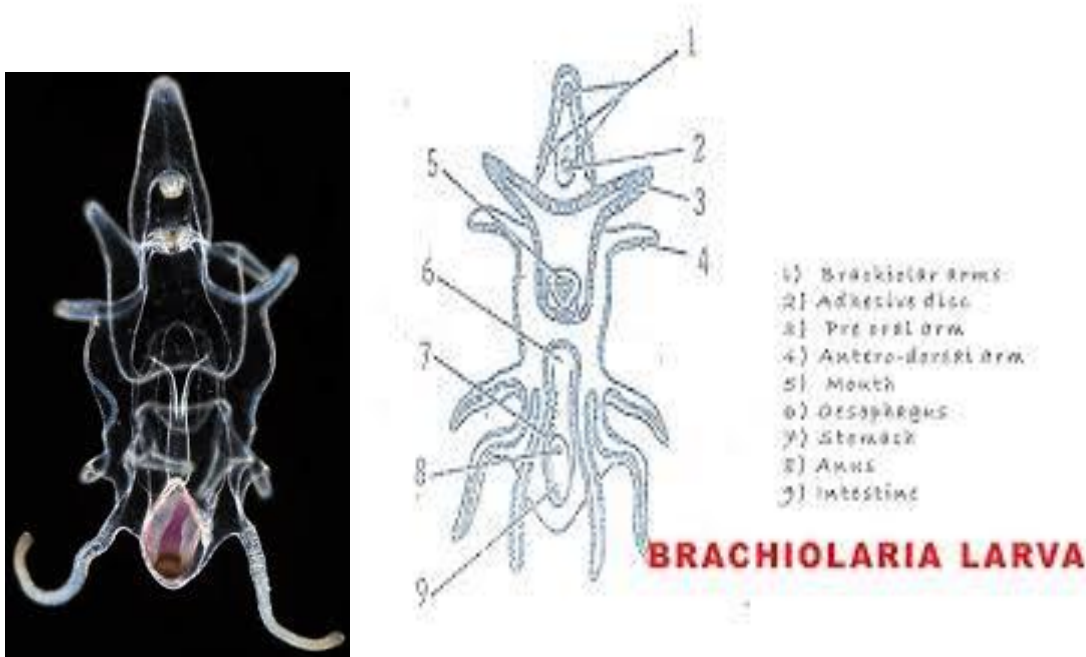


BRANCHIOLARIA LARVA

- 1) Three additional arms develop at the front end of the larva and at this point it becomes a brachiolaria. The arms present in this larval form known as branchiolarian arms.
- 2) Arms help the larva to adhere with the substratum.
- 3) These arms are neither ciliated nor have calcareous rods and the coelomic cavity extends into these arms.
- 4) The three short arms are at pre oral lobe, one median and two lateral arms. They contain adhesive cells at their tips which act as a sucker.
- 5) The rest arms degenerate and become long, narrow and slender.

METAMORPHOSIS OF BRANCHIOLARIA

With the help of adhesive structures, it attaches to some object. Anterior portion acts as stalk for some time while posterior part having gut and coelomic chambers convert into a young starfish. This detaches itself and starts leading a free life.



Development of starfish takes place inside the sedentary brachiolaria which ruptures and releases tiny starfish into water.

B. LARVAE OF HOLOTHUROIDEA

Class Holothuroidea demonstrate two larval stages, namely, auricularia and doliolaria larvae.

Auricularia larva has striking resemblance with bipinnaria of Asteroidea

- 1) It is a free-swimming form with bilaterally symmetrical body.
- 2) The preoral lobe is well formed.
- 3) A single winding ciliated band, which may be produced into lobes
- 4) It has a mouth, sacciform stomach, hydrocoel and right and left stomocoels and anus.

After a short period of time, it transforms into doliolaria larva.



Doliolaria larva is the next larval stage after auricularia. It has the following features:

- 1) A free-swimming form.
- 2) It has a bilaterally symmetrical barrel like body with 5 ciliated bands surrounding it.
- 3) Preoral lobe well-developed.
- 4) Wavy, continuous band break into 3-5 flagellated, transverse rings There is neural sensory plate on the anterior side and an apical tuft of cilia for balancing while swimming.
- 5) Mouth or vestibule is on the ventral side for feeding. The gut with distinct zones.

Doliolaria transforms into adult but in some holothurians doliolaria stage may be absent.

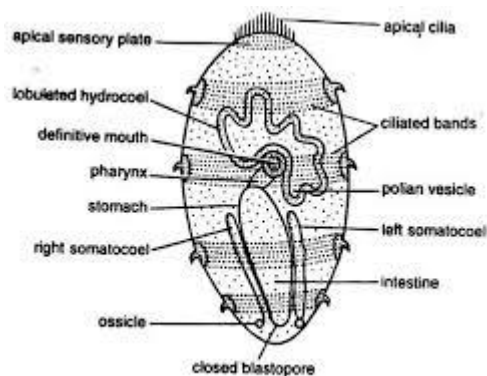


Fig. 27.13. *Leptosynapta inkaerens*. A mature Doliolaria larva



C. LARVAE OF ECHINOIDEA

There is a single larval stage in almost all echinoidea which is known as **Echinopluteus**. It shows following features:

- 1) The echinopluteus is a complex, pelagic, feeding, larva which is bilaterally symmetrical.

- 2) The larva has oval body characterized by anteriorly directed arms long paired ciliated arms that are supported by calcareous skeletal rods except in some cases where there is a medial, unpaired, posterior arm.
- 3) **Preoral arm** is present but posterolateral arm is absent.
- 4) The other three arms are anterolateral, postoral and posterodorsal arms.
- 5) Mouth, anus and gut are well developed.

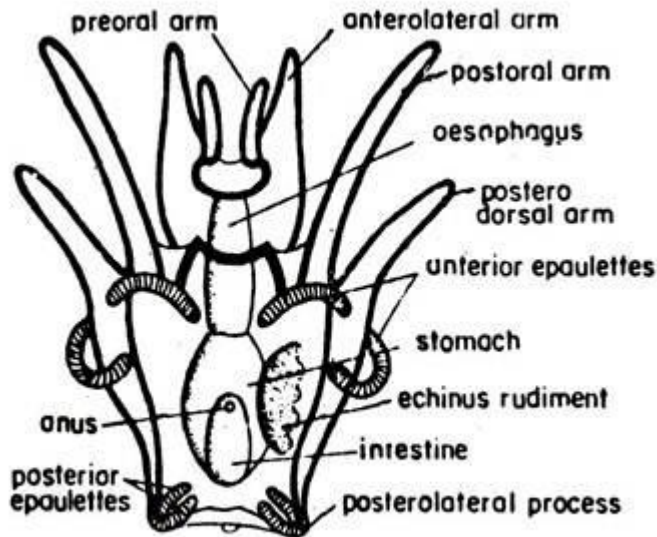


Fig. 27.11. Echinopluteus larva



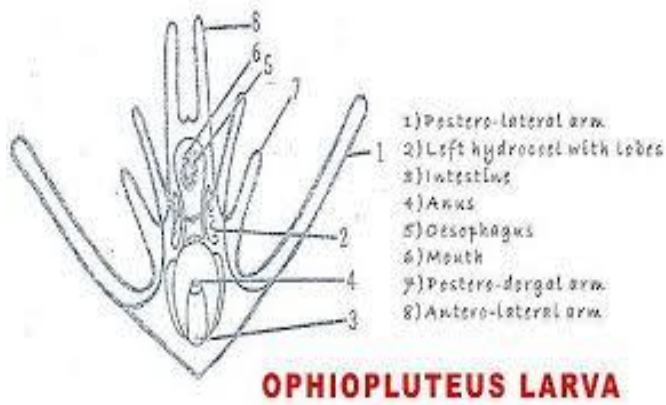
Mesogen

The mesogen is unlike any echinoid larva and is found in the subantarctic brooder *Abatus cordatus* which has direct development. It lacks all features of the echinoid larval body plan. It lacks bilateral symmetry, orientation of the hydrocoel, and novel patterns of morphogenesis of the coeloms, gut, and skeleton.

D. LARVAE OF OPHIUROIDEA

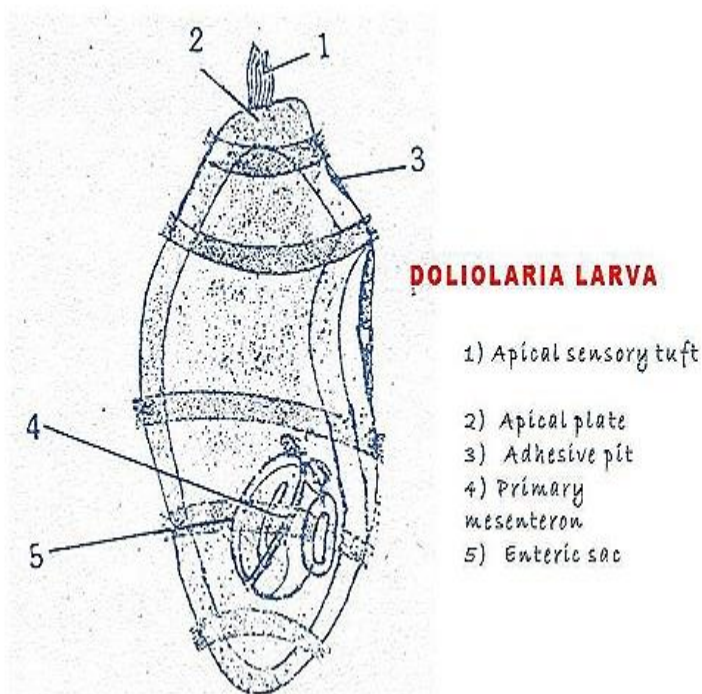
Ophiuroids have three larval types: ophiopluteus, doliolaria and vitellaria; they also have direct development via a mesogen. **Ophiopluteus** is the only larva in most of Ophiuroidea

- 1) **Ophiopluteus** resembles echinopluteus larva of Echinoidea in general features.
- 2) It is a complex feeding larva.
- 3) Anterolateral, postoral and posterodorsal arms are present
- 4) Preoral arm is absent.
- 5) It has very long posterolateral arms.
- 6) All arms are supported by calcareous skeletal rods.
- 7) The larva undergoes metamorphosis to become adult and in some forms develops into a non feeding *Doliolaria* or *vitellaria* larva.



Doliolaria or vitellaria

Nonfeeding larvae of ophiuroids are very diverse. Doliolaria larvae typically have four transverse ciliary rings. Vitellaria lacks ciliated bands and has paired enterocoels and bilateral symmetry.



E. LARVAE OF CRINOIDEA

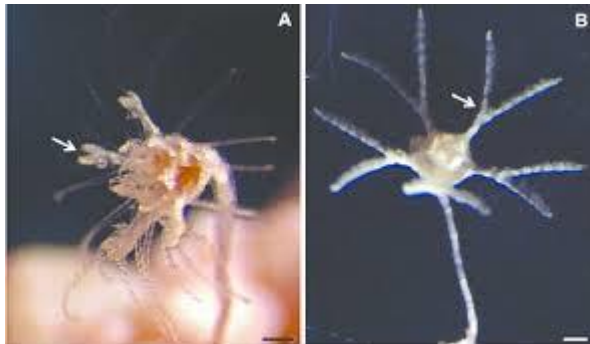
Pentactula is the basic larval stage of Crinoidea but it passes inside the egg. There is one or two larval stages in sea lilies.

Doliolaria Larva of Crinoidea: non-feeding, free-swimming vitellaria larval phase similar to that of sea cucumbers. The larva settles to the bottom, attaches itself and develops into a miniature sea lily.

1. It is also called Vitellaria larva.
2. It has similarities with doliolaria of holothuroids.
 - 1) It is pelagic, lecithotrophic free-swimming form.
3. Body is elongate oval and is narrower posteriorly.
4. Presence of 4-5 transverse ciliated bands around the body.
 - 2) Presence of adhesive pit on the ventral side with which it attaches to substratum and becomes sedentary.

Pentacrinoid larva of Crinoidea: Feather stars pass through this stalked stage as pentacrinoids for a few to several months before breaking off at the crown

- 1) It is sedentary and attaches to substratum with an attachment plate.
- 2) Body is supported by a stalk.
- 3) There are 10 cilia bearing tentacles which are used for capturing food.
- 4) Both mouth and anus are on the same side of the disc. and becoming mobile.



The affinities among larval stages of echinoderms demonstrate evolutionary relationships among different classes. The adults are highly modified organisms in echinoderms where many advanced features present in the larval forms are lost.

P.S. Classnotes contain no original content