

## ***Larva Found in Phylum Echinodermata!***

### ***1. Dipleurula Larva:***

1. The dipleurula form (Fig. 21.39A) is reached during development and is characterised by its bilaterally symmetrical, egg-shaped body.
2. The ventral concave side bears the mouth and is encircled by a circumoral ciliated band.
3. The anus is disposed ventrally
4. The digestive canal is differentiated into oesophagus, stomach and intestine.
5. The pre-oral lobe which is situated at the anterior to mouth, bears an apical sensory plate and a tuft of cilia.
6. The ciliation on the surface of the body becomes reduced to a ciliard band.

This Dipleurula form is regarded by many as the hypothetical ancestral form of Echinoderm, as this form is universally present. The Dipleurula concept was first propounded by Bather (1900). The major changes involved in other Echinoderm larvae are due to differential disposition of the ciliated bands.

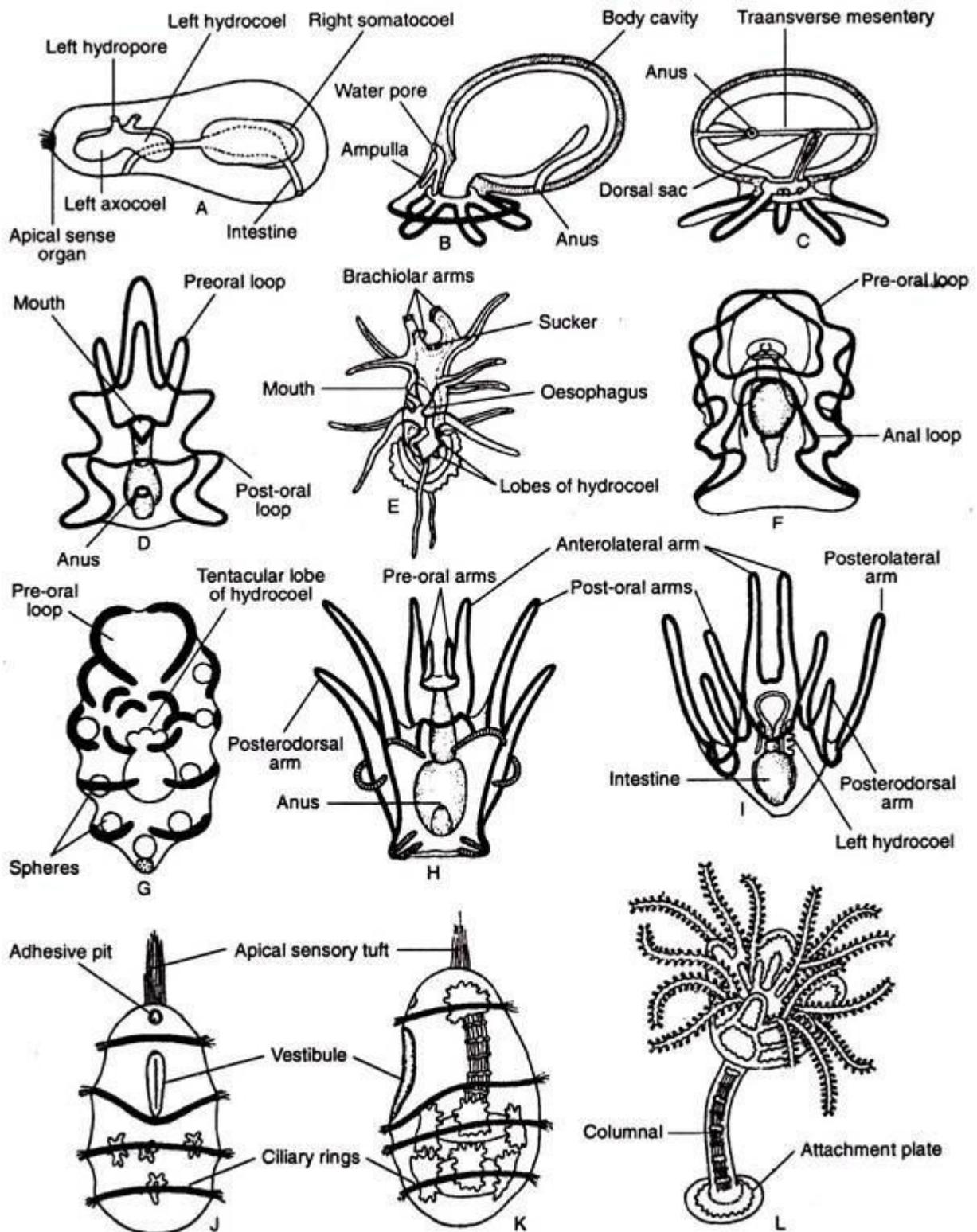
### ***2. Pentactula Larva:***

This larval stage is regarded as the next evolutionary step of the Dipleurula larva. This concept has been supported by Semon (1888), Burry (1895), Hyman (1955) and many others.

1. The Pentactula larva (Fig. 21.39B, C) has five tentacles around the mouth.
2. The hydrocoel is separated from the rest of the coelom to form the future water vascular system.

### ***3. Bipinnaria Larva:***

1. This type of larva (Fig. 21.39D) is characteristic of the class Asterozoa.



**Fig. 21.39:** Different larval forms in Echinodermata. A. Hypothetical *Dipleurula* larva. B. Bilateral stage of *Pentactula* larva. C. *Pentactula* larva after torsion of radial position. D. *Bipinnaria* larva. E. *Brachiolaria* larva. F. *Auricularia* larva. G. Transitional stage from *Auricularia* to *Doliolaria* larva. H. *Echinopluteus*. I. *Opiopluteus*. J. *Doliolaria* or *Vitellaria* larva of *Antedon*. K. Late *Doliolaria* larva of *Antedon*. L. *Pentacrinooid* stage of *Antedon*.

2. It possesses two ciliated bands—the pre-oral and the post-oral.

3. The pre-oral ciliated band surrounds the pre-oral lobe of the larva.
4. The pre-oral lobe is highly developed.
5. The post-oral ciliated band appears to be longitudinally placed and forms a complete ring between the mouth and anus.

The bipinnaria larva bears a close resemblance with the auricularia larva of Holothurians.

6. The body of bipinnaria larva is externally bilaterally symmetrical but subsequently the internal structures assume asymmetry.
7. It is a free-swimming larva and the anterior end of the archenteron develops as mouth and blastopore becomes the anus.
8. The pre-oral and post-oral ciliated bands are continued over a series of prolongations of the body, called arms.

**9. The name and number of the arms developing from pre-oral and post-oral ciliated bands are as follows:**

<b>Name of the arms</b>	<b>Number</b>
<b>1. Postero-lateral</b>	<b>Two</b>
<b>2. Post-oral</b>	<b>Two</b>
<b>3. Postero-dorsal</b>	<b>Two</b>
<b>4. Antero-dorsal</b>	<b>Two</b>
<b>5. Pre-oral</b>	<b>Two</b>
<b>6. Ventro-median</b>	<b>One</b>
<b>7. Dorso-median</b>	<b>One</b>

10. The pre-oral and ventro-median arms develop from the pre-oral ciliated band and the rest of the arms develop from the post-oral ciliated band.
11. The arms are provided with muscles and are contractile in nature.
12. The antero-lateral arms are absent.
13. These two ciliated bands are regarded to have arisen from a single ciliated band (as in auricularia) which becomes subsequently divided. This is evidenced by *Asterias rubens* and *A. glacialis* where these two ciliated bands remain initially dorsally connected.

14. In artificially cultured bipinnaria larvae, sometimes a single ciliated band is seen. In *Asterina gibbosa*, the typical bipinnaria larva is slightly modified and it moves by the action of the cilia present in the larval organ.

15. In the genus *Luidia*, the bipinnaria larva is peculiar in having a slender long anterior part which terminates into two wide arms. This larval form is named by Sars (1835) as *Bipinnaria asterigera*.

The bipinnaria is a feeding larva and leads a free-swimming life. After a short period of free-swimming existence it transforms into a lecithotrophic brachiolaria larva.

#### ***4. Brachiolaria Larva:***

1. This type of larva (Fig. 21.39E) is present in Asteroidea and is regarded as a modified form of bipinnaria larva. It possesses the following special features.

2. There are three additional arms which are not ciliated in their courses except in *Bipinnaria papillata*. These arms are called the brachiolar arms and are beset with warts to help in temporary adhesion.

3. These arms are devoid of calcareous rods and have prolongations from the coelomic cavity.

The bipinnaria stage is followed by the brachiolaria stage in all Asteroidea but direct evidence is only furnished in two cases, e.g., *Asterias glacialis* and *A. vulgaris*. In *Astropecten* the brachiolaria stage is absent and the bipinnaria larva metamorphoses directly into adults.

#### ***5. Auricularia Larva:***

1. The externally bilaterally symmetrical larva (Fig. 21.39F) is present in Holothuroidea and is characterised in having a single longitudinal ciliated band.

2. The pre-oral lobe is very well-formed.

3. There are no calcareous rods, being replaced by spheroids or star-shaped or wheel-like bodies.

4. In certain forms, e.g., *Auricularia stelligera* and *A. sphaerigera*, elastic spheres of unknown consistency are present.

## 6. *Doliolaria Larva*:

1. The larval form is observed in Holothuroidea.
2. The auricularia larva transforms into a barrel-like body with five ciliated bands (Fig. 21.39J) which subsequently break into pieces (Fig. 21.39G). This particular stage is also designated as pupa stage.
3. During metamorphosis into an adult form, the ciliated bands disappear and further changes occur.
4. In some species of Holothuroids (Order Dendrochirotida e.g., *Cucumaria*, *Thyone* etc.), a non-feeding barrel- shaped vitellaria larva is seen.
5. This type of larva is also found in crinoids and a few Ophiuroids which possesses ciliated band but no arms.
6. In *Cucumaria planici*, the auricularia stage is absent and the embryo transforms directly into the doliolaria stage. In *Cucumaria frondosa*, *C. saxicola*, *Psolus phantapus*, both of the larval stages may be absent. In *Holothuria floridana*, there is no larval form and the embryo develops directly into a young Holothuroid.

## 7. *Pluteus Larva*:

1. This larval form (Fig. 21.39H, I) can be regarded as a modification of the auricularia larva of Holothuroid.
2. Like the auricularia larva it has a single ciliated band, but it possesses long arms with ciliated bands at the margin.
3. It has comparatively smaller pre-oral lobe.
4. The post-anal part of the body is quite well-developed.
5. The arms are also supported by calcareous rods.

### **The pluteus larvae are of two kinds:**

- (1) Ophiopluteus—in Ophiuroidea.
- (2) Echinopluteus—in Echinoidea.

Both the larval forms possess the post-oral arms, antero-lateral arms, postero-lateral arms and postero-dorsal arms. But they differ in detail which are summarised in Table 21.2—Echinodermata.

6. The typical ophiopluteus may be absent in certain forms.
7. The arms are small in *Ophiopluteus metschnikoffi* and *O. claparedei*.
8. In *Ophionotus hexactis* the ophiopluteus lacks arms.
9. The larva may be elongated and without ciliated bands.
10. The skeletal rods are usually absent; if present, only one in number. This condition is observed in *Ophiopluteus annulatus*, and *O. oblongus*.

**Remark:**

The presence of pluteus larva in both classes is an example of parallel evolution and the similarity between the two larval forms e.g. ophiopluteks and echinopluteus, was once considered a closely related group but phylogenetic analyses do not indicate this (Anderson, 1998).

**8. *Antedon* or *Yolk Larva*:**

1. This particular larva is also called doliolaria larva or Vitellaria larva (Fig. 21.39 J, K).
2. This larval stage is present in *Antedon* and it has many structural peculiarities.
3. It has a barrel-shaped body with slightly flattened ventral side.
4. It is free-swimming and exhibits bilateral symmetry.
5. The ciliated bands are in the form of four or five separate transversely placed bands encircling the body. In *Antedon bifida*, there are four bands. In *Antedon adriatica* and *A. mediterranea* there are five bands.
6. A tuft of cilia with stiff sensory hair springs from a thickened ectodermal patch, called apical neural plate, which is comparable to that of *Tonaria* larva of *Balanoglossus*.
7. The anterior ciliated ring is ventrally incomplete.
8. There is a ciliated depression or larval mouth which is ventrally placed between the second and third ciliated rings.

9. A small adhesive pit develops between the first and second ciliated rings by which the larva adheres to the substratum.

10. The internal structures become rotated at an angle of  $90^\circ$  from the ventral to the posterior side.

### ***9. Cystidean or Pentacrinoid Larva:***

1. This larval stage is also present in Crinoids. It is the second larval stage of crinoids.

2. The anterior end of the antedon larva, after attachment, is prolonged into an elongated narrow stalk and the free end becomes broader (Fig. 21.39L).

3. The ciliated depression becomes a closed ectodermal vesicle which is gradually shifted to the free end.

4. The floor of the depression is perforated by mouth and with the disappearance of the roof; the mouth and the tentacles become exposed.

5. This particular phase is called Cystidean or Pentacrinoid stage. This stage resembles closely the adult Pentacrinus. The stalk in this form develops from the pre-oral lobe.

6. This stage is quite similar to that of Asteroidea excepting that it lacks circumoral vessel.