

RETROGRESSIVE METAMORPHOSIS IN ASCIDIA

Metamorphosis is simply a series of changes which a larva has to undergo before attaining its adulthood. Metamorphosis, in general is a progressive process, but in some animals including ascidians the development is retrogressive.

The retrogressive metamorphosis is a peculiar and uncommon process in which a highly developed tadpole larva, in course of ontogenic processes transforms into a sessile and degenerated adult.

The life cycle of ascidia is divided into several stages. These are —

- 1) Prelarval stage
- 2) Larval stage
- 3) Metamorphosis and adult stage.

1) Prelarval stage :-

- a. The eggs are small and yolkless, with a membrane which help in floating.
- b. Holoblastic and equal cleavage.
- c. At the eight celled stage, four large cell form epiblast or ectoderm and the four smaller cells destined to form hypoblast or prospective endoderm.
- d. Coeloblastula formed with a small blastocoel.
- e. Between the 64 and 128 cell, the gastrulation begins by ~~epiboly~~ epiboly and invagination.
- f. Neurulation forms the neural tube proper.
- g. Archenteron gives rise to notochord.
- h. After about 3 days, and with further development the neurula stage transforms into a free-swimming tadpole larva as it resembles superficially to the larval stage of frog.

2. Larval stage -

- a. Larval stage of ascidia is called tadpole larva, which in course of time transforms into a sessile adult.
- b. A fully grown tadpole larva is elongated with distinct head and tail.
- c. It is highly motile and non feeding forms.
- d. The whole body is covered over by the tunic.
- e. Anterior part of the trunk has three adhesive papillae secreted by ectoderm. One is on the dorsal side and the other two are dorso-lateral in position.
- f. Tail is with tail fins formed from the test. It has oblique striations resembling fin rays of fishes.
- g. The central nervous system is situated dorsal to the notochord.
- h. It includes the cerebral vesicle or brain formed by the enlargement of the anterior part of the neural tube. It opens near mouth in the pharynx.

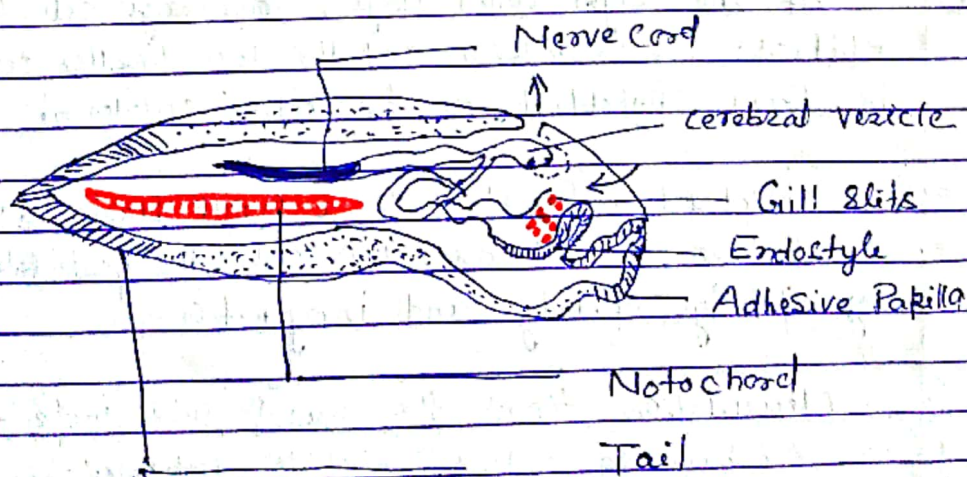


Fig - Free Swimming Ascidian Tadpole larva.

- i. On the dorsal side of the brain is an eye and on the ventral surface is an otocyst which acts as an organ of equilibrium.
- j. Behind the brain is the visceral ganglion and the end part of the nervous system is spinal cord.
- k. Notochord is restricted to the tail region and is formed by vacuolated cells.
- l. Segmental muscle bands are present on either side of the nerve cord in the tail region.
- m. Mouth is present and the ~~mouth~~ alimentary canal is rudimentary.
- n. The pharynx is sac like and is well developed with an endostyle and two pairs of gills slits.
- o. Pharynx is encircled by an apical cavity which opens dorsally to the outside through apical aperture.
- p. Heart is non-functional beneath the endostyle. It is formed by the diverticulum of the stomach.
- q. Just after hatching the tadpole larva becomes positively phototactic and negatively geotactic.

3. Metamorphosis -

The larva after leading free swimming life for 24 hrs becomes sluggish and get attached by its adhesive papillae to some substratum so that the tail lies upwards. The following changes occur during the metamorphosis -

- iv Tail is reduced in length by breaking and due to phagocytosis, is absorbed in the body.

- (ii) Notochord becomes restricted to the trunk region and is finally reduced to a solid nerve ganglion.
- (iii) Like wise spinal cord is also lost.
- (iv) Cerebral vesicle along with the eye and ocell also disappear.
- (v) Three adhesive papillae also disappear.
- (vi) The trunk becomes broadened.
- (vii) The mouth is shifted to 90° from the point of attachment. Shifting of the mouth is caused by the rapid growth of the region between the adhesive papillae and mouth, and due to inhibition of growth of the original dorsal side.
- (ix) visceral ganglion remains as a small trunk ganglion.

During metamorphosis, all the changes are not necessarily degenerative but some changes are progressive like as follows -

- (i) The branchial chamber enlarge and the number of stigmata also increase.
- (ii) ~~the~~ Stomach and intestine increase in length and becomes curved.
- (iii) The space along with the viscera lying between the attached ends and the mouth grows rapidly and the body rotates by 180° due to which the mouth lies opposite to the attached end.
- (iv) The apium becomes more extensive.
- (v) Development of velum is observed.
- (vi) Mesoderm forms mesenchyme, muscle, gonads and their ducts.
- (vii) Tent thickens and foot appears.

The foregoing description shows a systematic retrogression of a complex well organised larva into a simpler degenerated adult. This phenomenon is peculiar as there is no external force is acted upon.

Chemical basis of Retrogressive metamorphosis

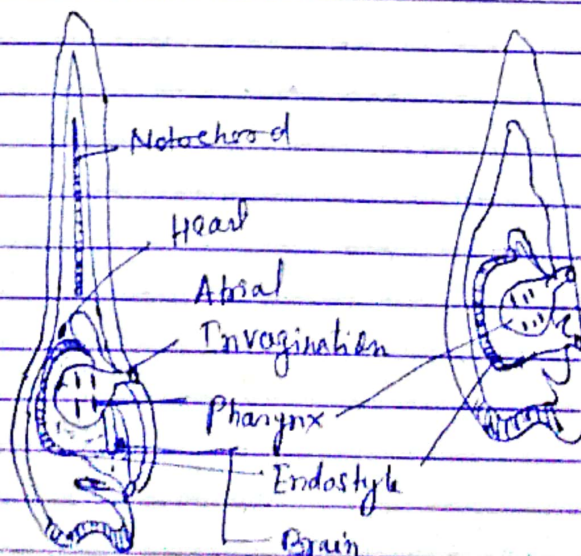
Some physical and chemical factors are concerned with metamorphosis of ascidian tadpole.

According to Herdman - phagocytosis is the primary cause of larval tissue destruction. Beall (1929) advocated that the relative tissue starvation is responsible for larval tissue destruction. Grove (1935) said that normal metamorphosis of tadpole is conditioned by two factors -

- a) Ageing of the larva after the liberation
- b) Swimming activity.

Gilász and Angskov (1949) reported the role of Copper during metamorphosis, released in the tadpole tissue. Besides this, some other factors like metabolic ions, iodine, low concentration of vital dyes, some amino acid, thyroxine, acetylcholine etc may accelerate the metamorphosis.

Five novel genes - manx, lynx, cynic, PS8 and bobcat have been isolated related to the ascidian metamorphosis. In addition, 132 different protein coding sequence have been isolated. Some of these are somewhat related to the metamorphosis.



Stage A

B

Different stage of metamorphosis.

