أبنائى الطلاب الآعزاء

كلية التربية ـ برنامج اللغة الانجليزية ـ الفرقة الثالثة البيولوجية و الجيولوجية ـ جامعة جنوب الوادى

[أهلا و سهلا بكم مع تمنياتى لكم بعام دراسى موفق]

المحاضر...،

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Early development of Amphioxus

-Fertilization in Amphioxus is external, taking place in the surrounding sea water as eggs and spermatozoa are shed.
-After fertilisation the cytoplasm of the zygote gets so arranged as to foreshadow the future parts of the embryo.
-Clear cytoplasm occupies the animal hemisphere
-Granular yolky cytoplasm at the vegetal pole

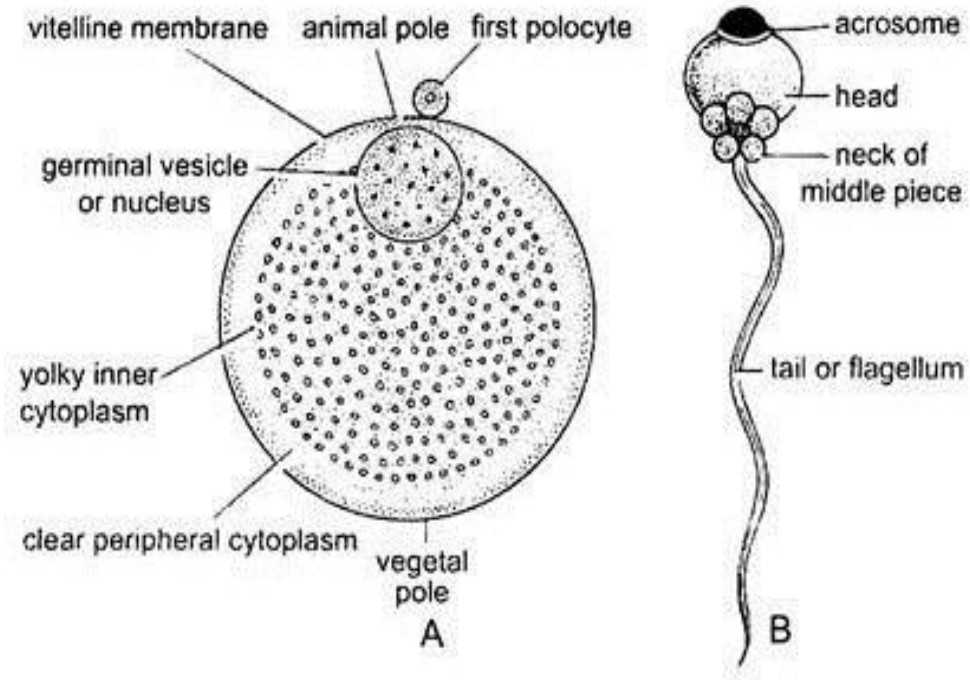


Figure 5 *Amphioxus*. A–Unfertilised ovum; B–Sperm.

Cleavage and Blastulation

First cleavage is meridional which cuts through the egg along its median axis, resulting into two equal sized blastomeres

The second cleavage is again meridional, but at the right angle to the first and divides the first two blastomeres into four equal-sized blastomeres.

Third division is horizontal passing just above the equator forming four upper smaller micromeres near the polar body, and four lower large macromeres at the vegetal pole.

Fourth cleavage is again meridional cutting all the eight blastomeres Sixteen-cell stage formed having eight micromeres and eight macromeres.

Fifth cleavage is latitudinal or horizontal and synchronous, resulting into thirty-two cells arranged in four tiers.

Sixth cleavage is meridionalsynchronous producing 64 blastomeres.

Later cleavages will not be synchronous up to this stage, the blastomeres remain loosely packed and form the morula.

-A semifluid material accumulates in the centre of the morula. It pushes all the blastomeres outward during further cleavage of the morula.

-Arranged in a single layer called blastoderm, enclosing a central fluid-filled cavity the blastocoel.

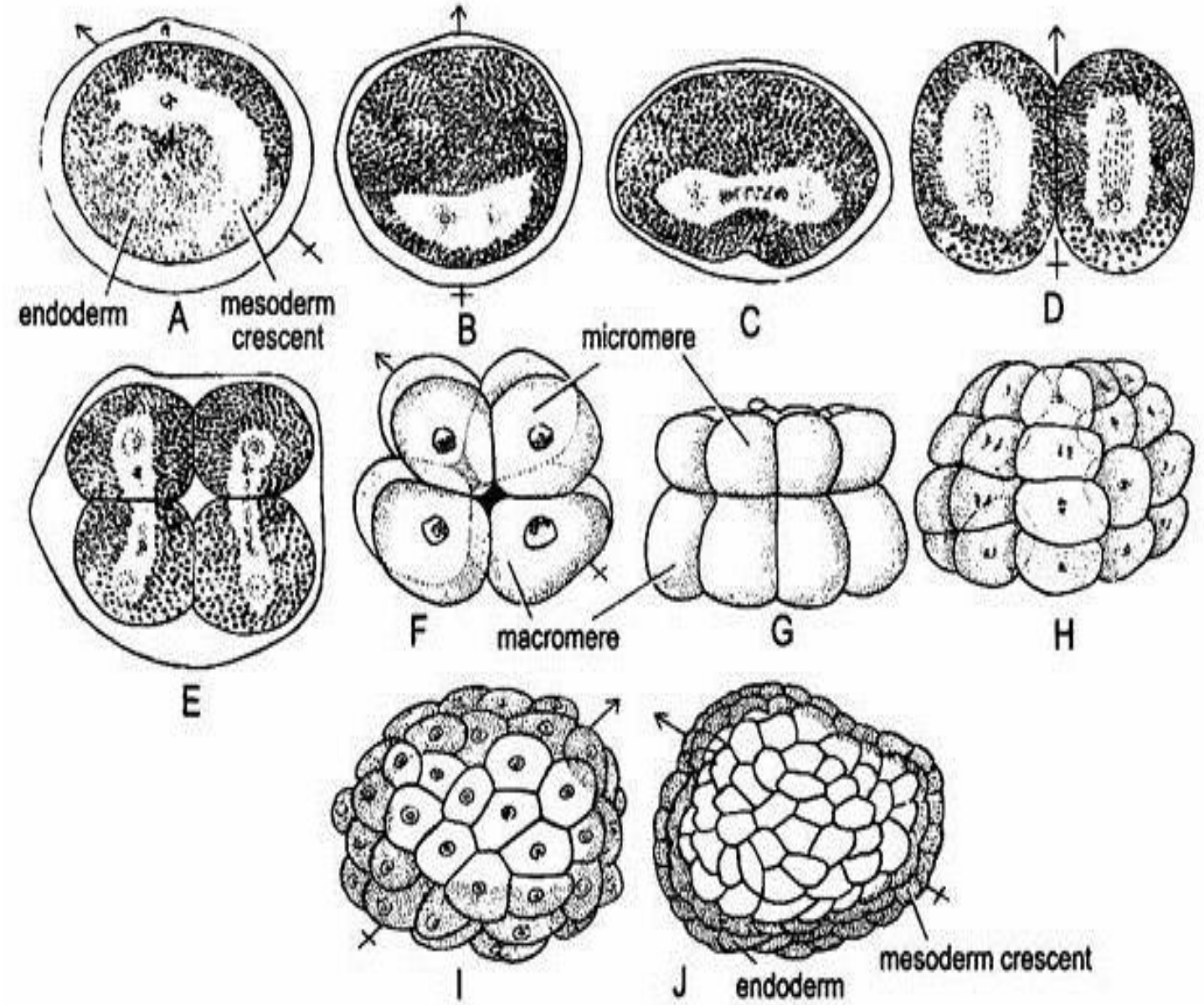


Figure 6. Cleavage and blastulation in *Amphioxus*. A–Fertilised egg; B–Mitosis of first cleavage started; C–Nuclear division is followed by cytokinesis of first cleavage–mitosis; D–Two-cell stage; E–Four-cell stage; F–Eight-cell stage; G–Sixteen-cell stage; H–Thirty-two cell stage; I–Morula stage; J–Blastula stage.

Gastrulation

The gastrulation in Amphioxus involves two basic types of morphogenetic movements of the embryonic cells: Epiboly and Emboly where both the processes go on side by side.

1.**Epiboly**

It is the expansion of ectodermal cells of the embryo.

2. Emboly

The blastoderm at the vegetal pole (endodermal plate) becomes flat and subsequently bends inwards (invagination).

The embryo, instead of spherical becomes converted into a cup-shaped structure, having a large cavity.the archenteron, opening outside by a wide blastopore.

The blastopore subsequently narrows due to contraction of the rim of blastopore, leads into a newly formed cavity, the archenteron.

A two layered gastrula is formed, in which the outer layer of cells becomes ciliated but it is enclosed in the vitelline membrane.

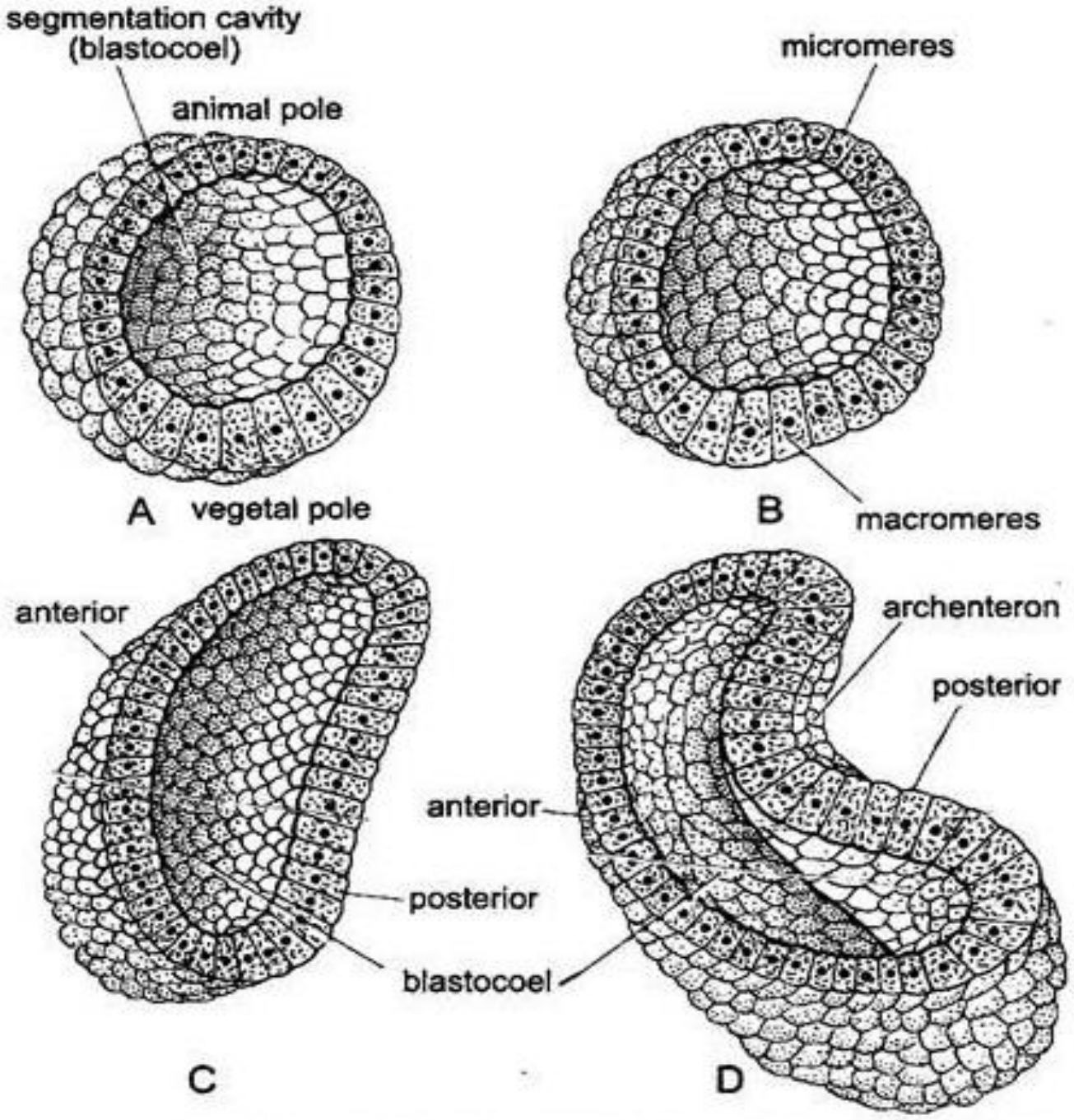


Figure 7. *Amphioxus*. Blastula and its change in polarity during gastrulation.

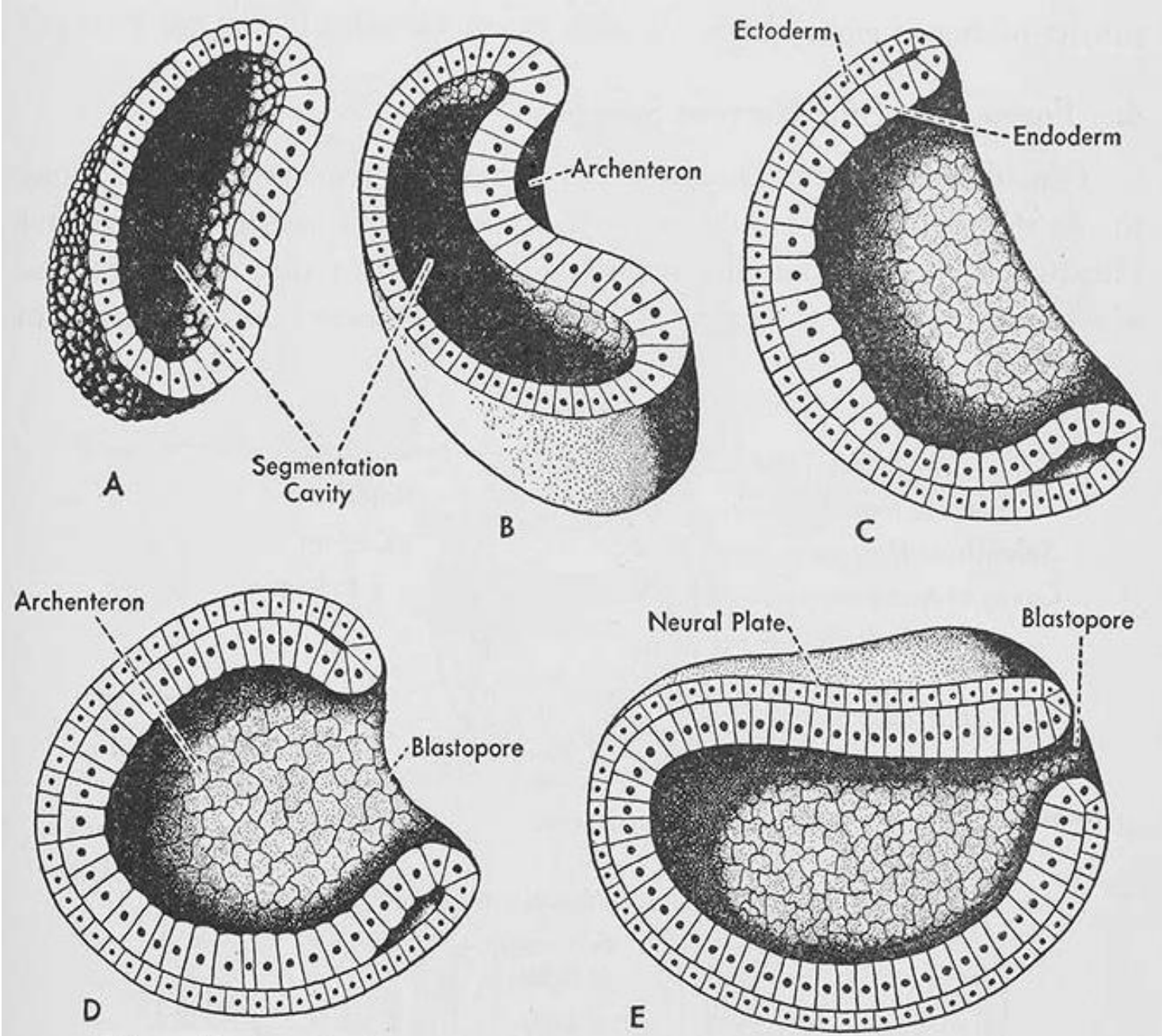


Figure 8. Gastrulation in the development of amphioxus. (From Huettner, *Fundamentals of Comparative Embryology of the Vertebrates,* copyright 1941, by permission of The Macmillan Company, publishers.)

Fate of Germ Cells

The ectoderm will give rise to epidermis, nervous system and receptors. Endoderm will form the alimentary canal and midgut diverticulum. Mesoderm will form muscles, connective tissue and germ cells.

Formation of Notochord

The cells which were invaginated from the dorsal lip of the blastopore lie in the mid-dorsal roof of the archenteron. They evaginate dorsally at the anterior end of embryo and become separated from the endoderm. This evagination of notochordal material also continues caudally and ultimately forms a solid, cylindrical cord of cells, which is called the notochord.

Notochord lies below the neural tube and between the mesodermal somites. It extends in the entire length of the body. Its anterior extension into the rostrum takes place later. A notochordal sheath of fibrous connective tissue will eventually surround the notochord.

Formation of Neural Tube

-The prospective neural ectoderm cells along the mid-dorsal line become flat and thickened to form a neural plate which sinks inwards below the level of lateral epidermal ectoderm.

-The neural plate is then covered by the free edges of the epidermal ectoderm.

-The neural tube opens in front by a neuropore which finally closes and its place is indicated by a Kolliker's pit in the adult. The epidermal ectoderm spreads over the surface of the neural plate from the sides and from the area posterior to the neural plate.

-Posteriorly, neural folds extend around the lateral lips of blastpore and when they meet above they close the blastopore, so that the neural tube communicates with the archenteron by a short neurenteric canal.

-Neurenteric canal persists for a short time until the cavity of the neural tube becomes completely separated from the cavity of archenteron, which in turn becomes the cavity of alimentary canal.

-Neural tube becomes spinal cord and its canal becomes the central canal of the central nervous system.

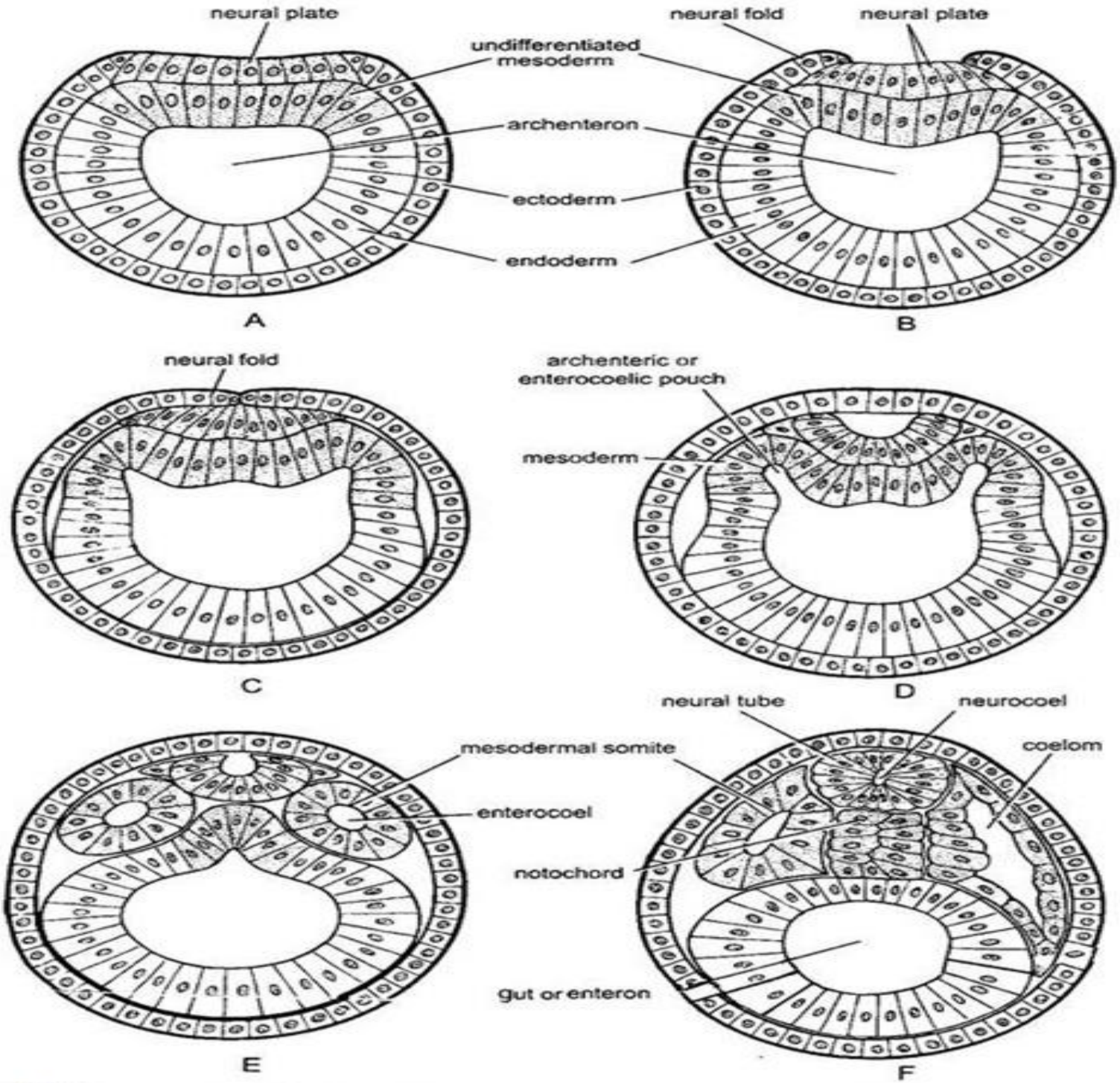


Figure 9. Transverse sections through the *Amphioxus* embryo. A, B – Gastrula. C, F – Post-gastrula stage.

Development of Mesoderm and Coelom

-Cells in the dorso-lateral roof of the archenteron are presumptive mesodermal cells, lie on either side of the notochord.

-Mesoderm cells form two lateral bands, which also get separated from the endoderm by dorsal evagination.

-In each mesodermal band a longitudinal groove appears, deepens and opens widely into the archenteron.

-Longitudinal mesodermal grooves become transversely divided into distinct segments or somites

-These lie on either side of notochord, one behind the other along the entire length of the body.

-The first two anterior somites retain a portion of enterocoel or archenteron and the rest are solid blocks of mesoderm.
Each somite grows ventrally and becomes differentiated into following parts:

1) A portion of each somite continues to grow around notochord and neural tube and becomes thickened to form the myotome.
2) The portion of each somite close to the epidermal ectoderm is called the somatic parietal mesoderm.
3) The portion of each somite close to the endoderm is called the visceral or splanchnic mesoderm.
4) The space found in between the somatic and visceral layer of mesoderm

Differentiation of Myotome

Each myotome has a median muscular portion and a laterally placed, thin-walled parietal part which surrounds the myocoel or coelomic space. The muscular portion of each myotome forms > -shaped myotome or muscle plate of adult Amphioxus. The myocoelic portion in each segment gives rise to the followings:

(i) Lower sclerotomic diverticula which extend between myotome and notochord, and nerve cord. Its inner wall wraps around the notochord, and nerve cord and forms a skeletogenous sheath of connective tissues which ensheath these structures. Whereas its outer wall covers inner side of myotome with a connective tissue covering.

(ii) Ventral diverticulum extends between lateral wall of the splanchnocoel and epidermal layer of the body wall and separates the parietal mesoderm of the splanchnocoel from the epidermal wall. This ventral diverticula together with parietal wall of the myocoel above, forms the dermatome. Both the inner and outer layers of ventral diverticulum fuse to form the dermis of the skin.

(iii) The dorsal sclerotomic diverticala forms fin-ray cavities in dorsal fin.

Development of Head Cavities:

After about eight mesodermal somites have been separated, the dorsal portion of the anterior end of the gut cavity gives rise a dorsal or anterior gut diverticulum, splits to form a left and a right diverticula.

-The right diverticulum extends into the anterior part of embryo in between ectoderm and notochord, in front of first pair of myotomes, and forms the head cavity or cavity of oral hood.

-The left diverticulum remains small and later fuses with an ectodermal invagination to form the Hatschek's pit.

Development of Gut

-After separation of notochord and mesoderm from the endoderm, the edges of these endoderm cells grow towards each other and fuse below the notochord to form a tubular gut or mesenteron.

-Cells lining the gut become ciliated, the splanchnic layer of mesoderm surrounding them gives rise to a layer of smooth muscles of the gut.

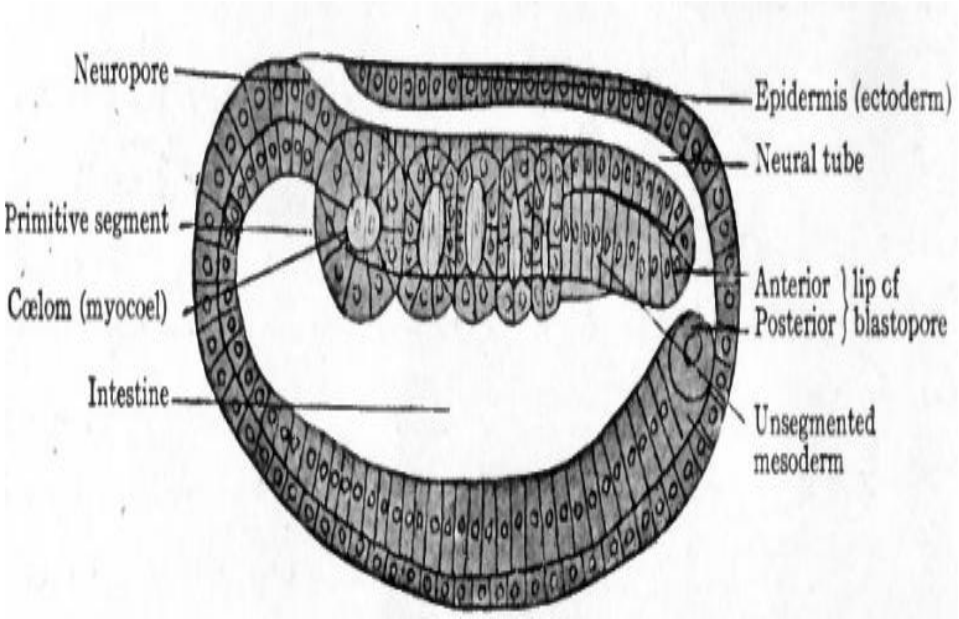
-After separation of anterior gut diverticulum, cells of the floor of anterior part of gut become columnar and form an elongated groove, the hypopharyngeal groove or endostyle.

-Much later a midgut diverticulum or liver will grow out from the gut on the right side. The anterior part of gut also enlarges to form the pharynx.

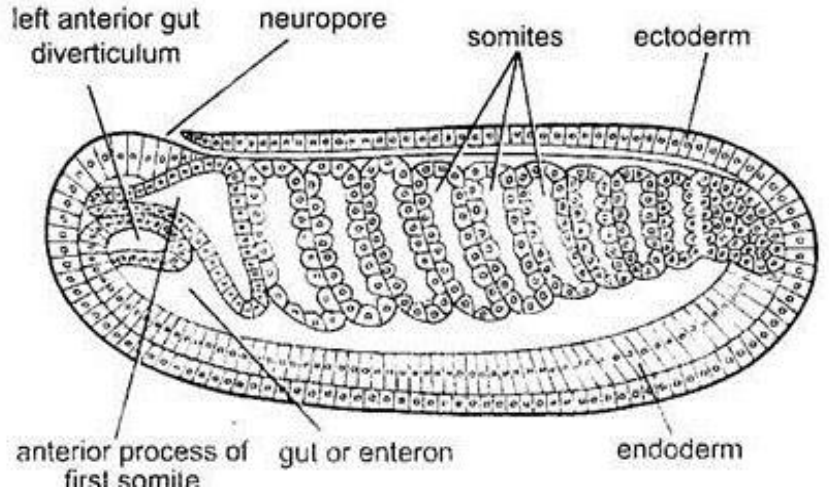
Hatching of Larva

Soon after gastrulation, when only two pairs of somites are formed, the ciliated embryo hatches from the vitelline membrane.

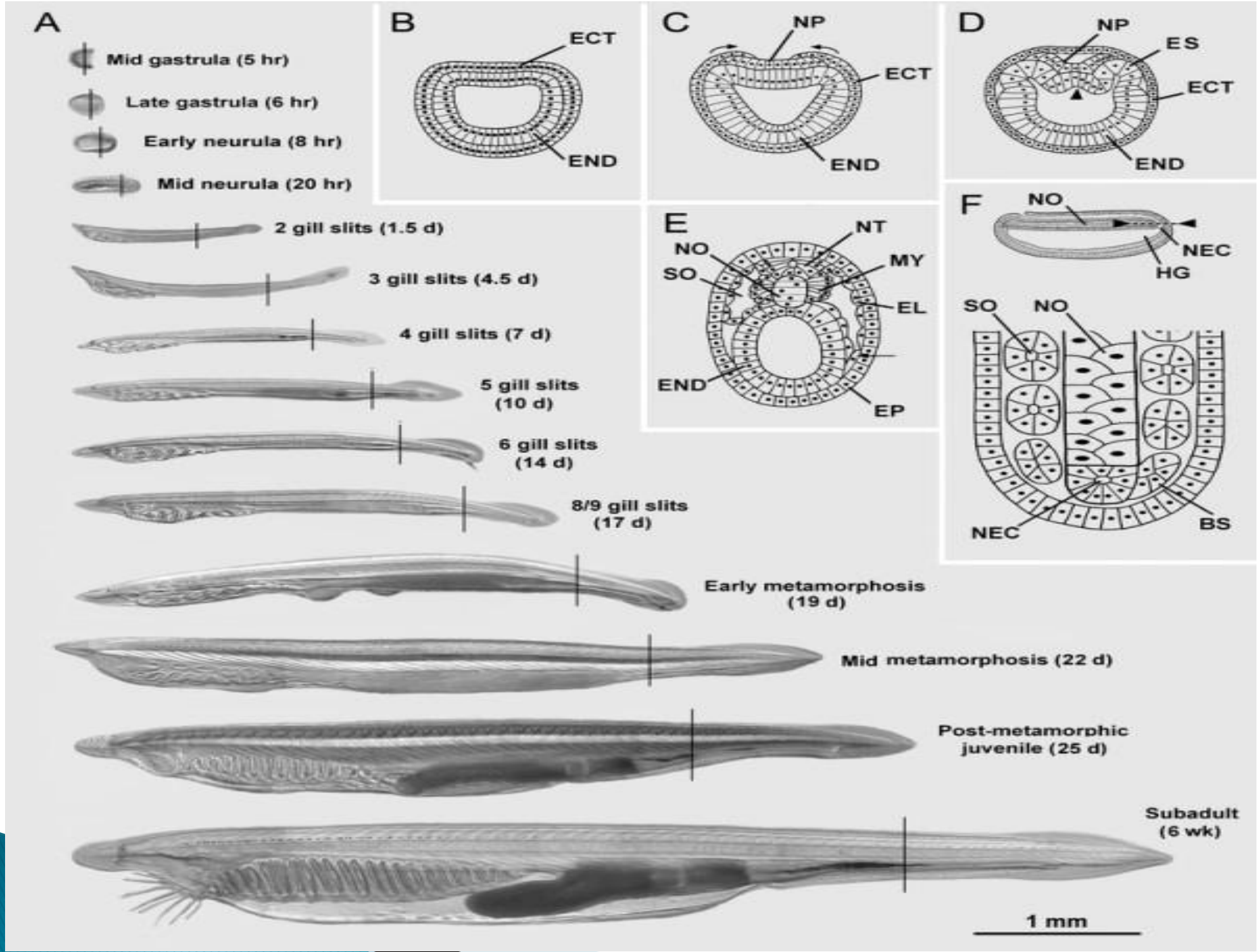
The embryo is now called a larva. It swims actively on the surface of sea with the help of cilia. It does not feed since it has no mouth and anus



Vertical section through Amphioxus embryo with 5 primitive segments.



Amphioxus embryo with the anterior gut diverticulum


A
Mid gastrula (5 hr)
Late gastrula (6 hr)
Early neurula (8 hr)
Mid neurula (20 hr)
2 gill slits (1.5 d)
3 gill slits (4.5 d)
4 gill slits (7 d)
5 gill slits (10 d)
6 gill slits (14 d)
8/9 gill slits (17 d)
Early metamorphosis (19 d)
Mid metamorphosis (22 d)
Post-metamorphic juvenile (25 d)
Subadult (6 wk)
1 mm
B
ECT
END
C
NP
ECT
END
D
NP
ES
ECT
END
E
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NO
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MY
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END
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F
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Until the next lecture,
Have a good time