

***Subsequent  
developments from  
zygote in Amphioxus***

- Fertilization is the process by which the nucleus of a sperm combines with the nucleus of an egg.

Sperm: a male reproductive cell.

Egg: a female reproductive cell; also called an ovum.

- Generally only one sperm enters into a egg.
- This phenomenon is known as monospermy.

- If more than one sperm enters in an egg, this phenomenon is known as polyspermy.

- In mammals, in which fertilization occurs internally, fewer sperm reach the fertilization site in the oviduct. This may be the result of the female genital tract being adapted to minimize the number of sperm reaching the egg.

- Nevertheless, polyspermy preventing mechanisms are essential in mammals; a secretion reaction, the "cortical reaction" modifies the extracellular coat of the egg (the zona pellucida), and additional mechanisms that are not well understood modify the egg's plasma membrane.

- The zona pellucida is modified by serine proteases that are released from the cortical granules. The proteases destroy the protein link between the cell membrane and the vitelline envelope, remove any receptors that other sperm have bound to, and help to form the fertilization envelope from the cortical granules

- The fertilized egg cell (or zygote) multiplies by cleavages.
- The cleavage begins at the animal pole and ends at the vegetative pole.
- This depends on the egg type.



- Thus, the zygote divides in two equal sizes.

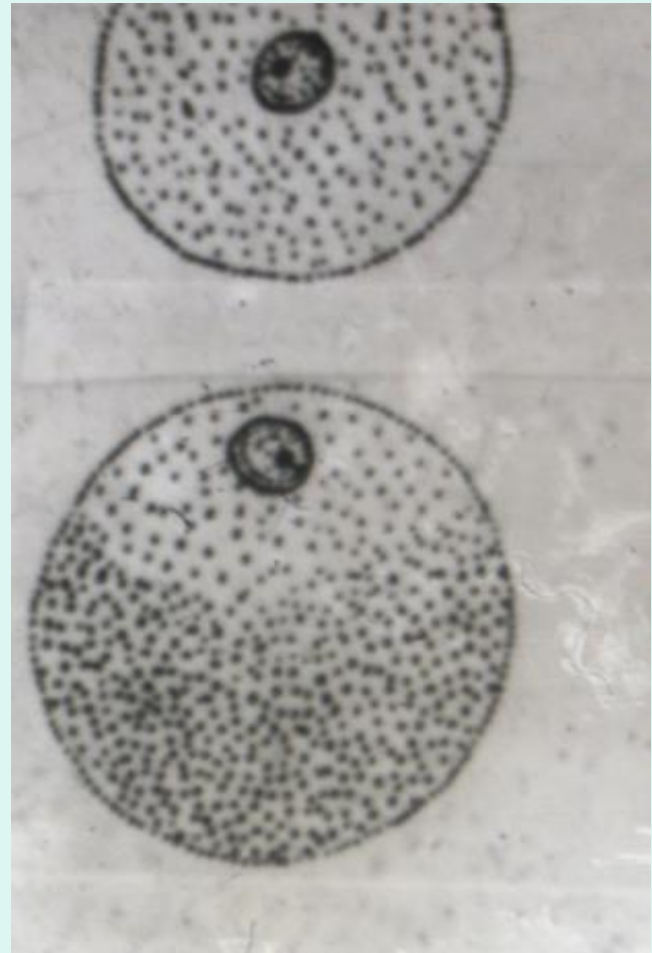
- The cells derived from cleavage are called blastomeres.

- These two blastomeres, which are adhered to each other, undergo a second cleavage perpendicular to the first and occurs 4 blastomeres.

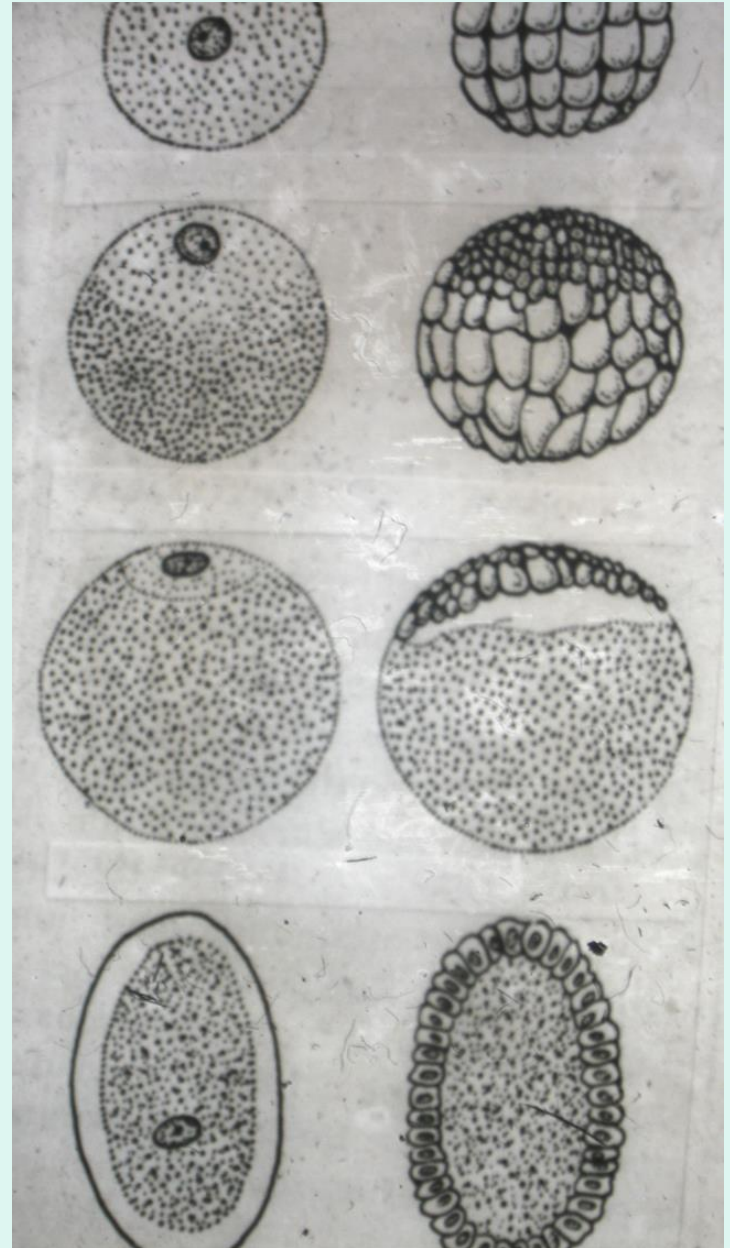
- The third cleavage takes place in the equatorial direction, and this time comes the blastomeres of eight.

- The subsequent divisions continue to be a meridional and a equatorial, resulting in a very blastomeric cell cluster (This is called morula).

- Since different animals differ in terms of cytoplasm and vitellus amount, their division also takes different forms.

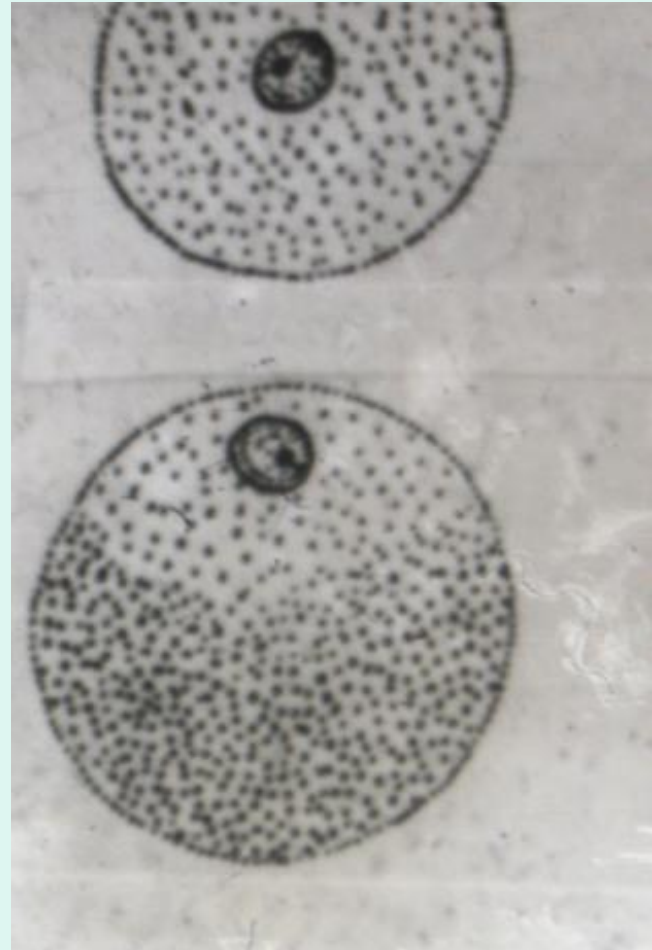


- **Egg types are divided into 4 main groups according to the amount of lecithus (vitellus) substance and the distribution in the egg cell.**



# The amphioxus have an oligolecithal egg type.

- **Oligolecithal eggs:** Lecithus substance is little and has an even distribution within the egg.
- **Amphioxus, human and mammalian eggs.**





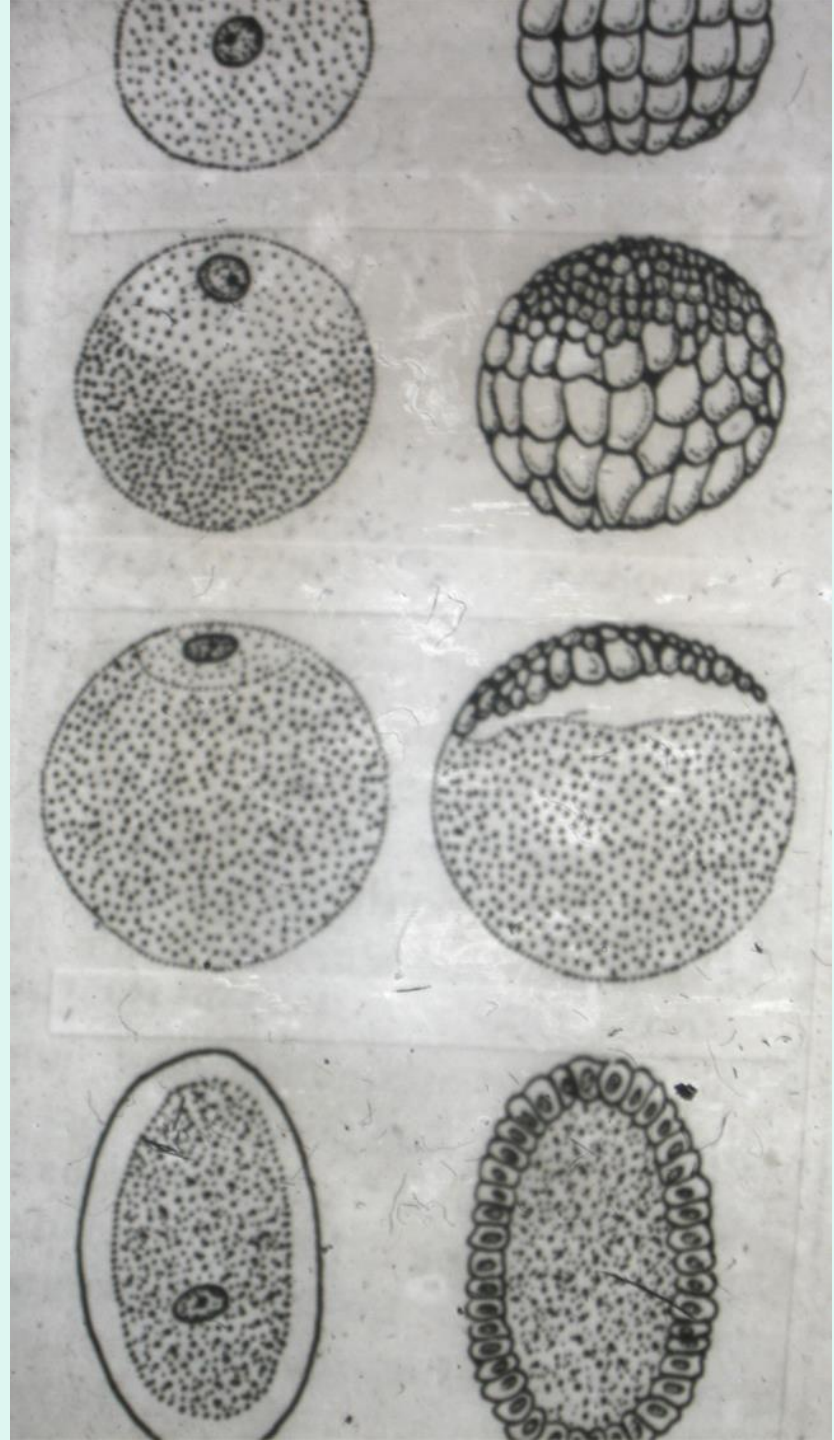
- ***Amphioxus (Branchiostoma lanceolatum)***:
- The amphioxus is not a vertebrate.
- Amphioxus, in the shallow waters, live in burrows dug in the sand.
- Fertilization is external. .
- Male and female germ cells are fertilized in the water.

- Amphioxus, because of the many features in common with the vertebrates, is considered as a transition form vertebrates.
- It is an aquatic species.

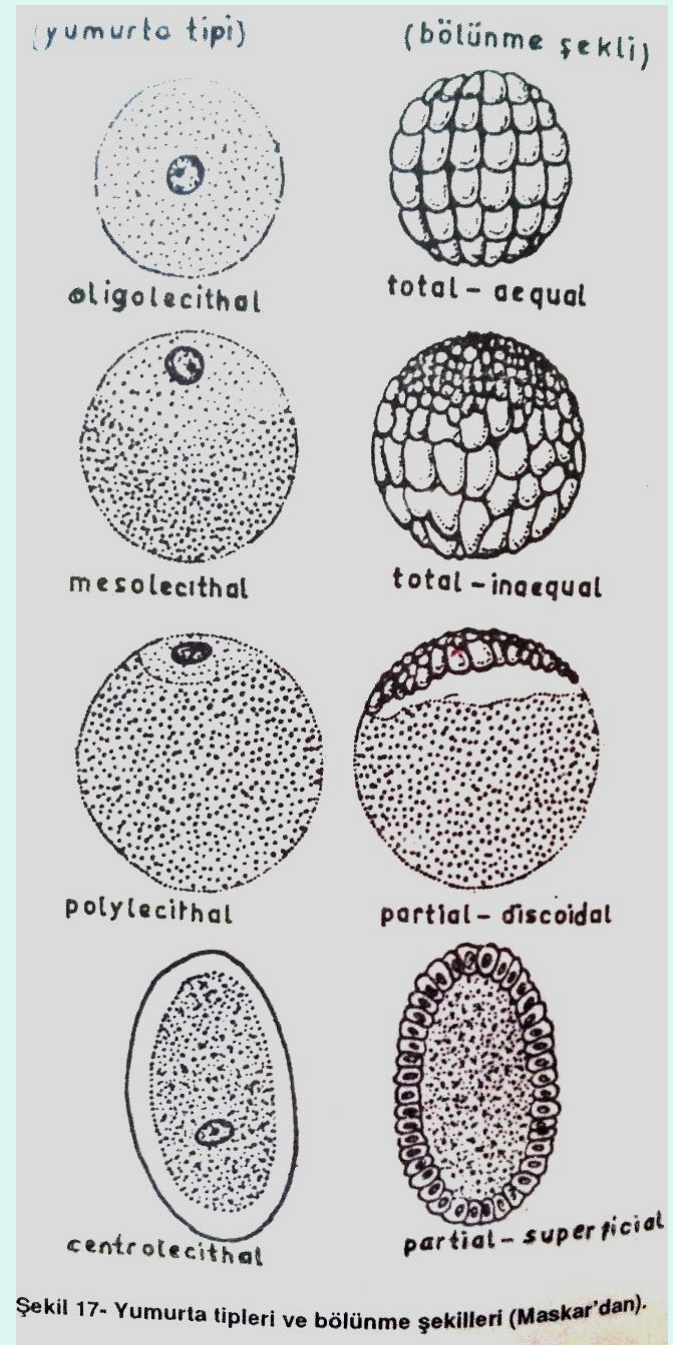
- An oocyte is fertilized by only one sperm (monospermy).
- Divisions and larvae formation occur in water. In the end of the third month, puppies is separated from water and begin to live in the sand.

- Embryogenesis starts with the fertilization of the ovum by a spermatozoon. Once fertilized, the ovum is referred to as zygote. The zygote undergoes mitotic divisions with a process known as cleavage and cellular differentiation, leading to development of a multicellular embryo.

The nucleus usually located in the middle of the egg cell and **the cell participates in the division as a whole.**



- This cleavage is called **TOTAL EQUAL DIVISION**.
- The egg cell is having an "animal pole" and a "vegetative pole"



- About an hour after fertilization the fertilized egg divides into two equal parts. The first cleavage is meridional (along the animal-vegetative axis of the egg).

- The first cleavage therefore will produce two equal and symmetrical daughter cells.
- Each of the cells is called a blastomere.



- These two blastomeres will become the right and left halves of the embryo.

- The second cleavage plane falls at a right angle to the first, cutting both the animal and the vegetative pole. So, this is meridional.
- 4 small blastomeres occur.

- Third cleavage runs equatorial.
- It produces the 8-cell stage (8 blastomere).

- The subsequent divisions continue as an meridional and an equatorial. Cell cluster with multiblastomeres occurs. This cluster of cells is referred to as a morula.

Later cleavages occur more rapidly.

- In practically there is a slight difference in blastomere size and quality after the third cleavage. In amphioxus after this third (equatorial) cleavage the four cells at the so-called “animal” pole are slightly smaller than the four at the “vegetative” pole.

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- A small cavity or blastocoel is formed in the middle of the blastomeres (Morula gap).

- The growth of the morula cavity, liquid increase in the cavity and result in thinning of the wall of the pressure formed the blastula.
- The entire structure is now the blastula.



- Cells (blastomeres), with rapid division cycle is completed usually within 24 hours blastula formation.

- The blastomeres are arranged in a single layer around the enlarged blastocoel. In amphioxus, the blastula is called coeloblastula.

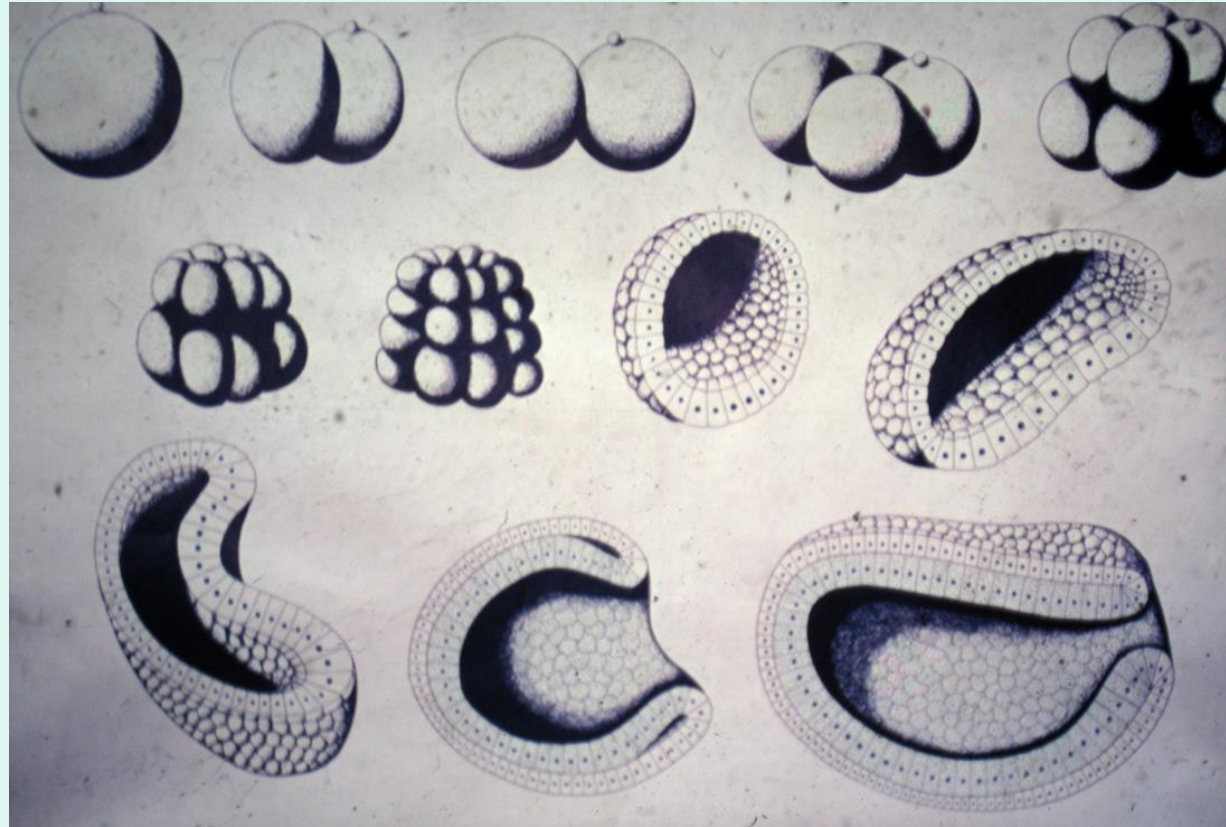
- Six to seven hours after fertilization the cells in vegetative half of amphioxus blastula begin to collapse inward.

- This process is called invagination, and when it is complete, the hollow, spherical blastula has been transformed into a two layered cup, the gastrula.

- Cells forming the ventral half of the blastula by progress of invagination approaches animal half.

- Blastocoele becomes smaller and similar to the stomach format. Therefore, this structure is called gastrula. The event is defined as gastrulation.

- The newly formed cavity of the gastrula is the gastrocoel or archenteron, and its exterior opening is the blastopore.



- The other word, the place where invagination begins is called blastopore.



- Invaginated layer merges with animal half.

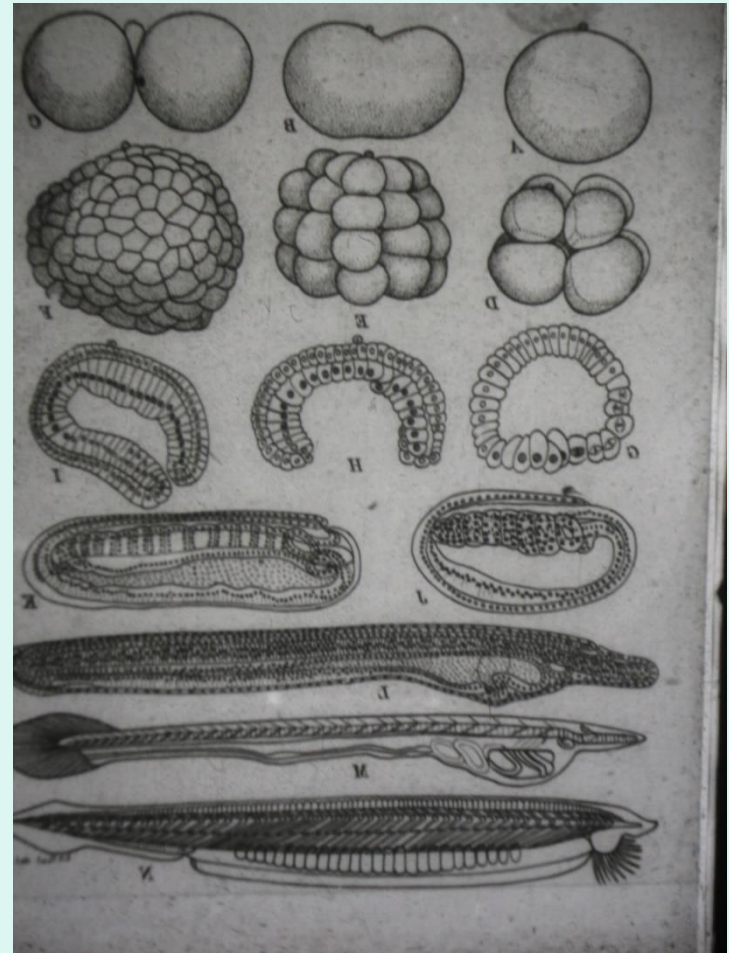
- Thus, gastrula becomes two-layered structure.
- While the outer cell layer creates ectoderm, endoderm occurs from the inner cell layer.

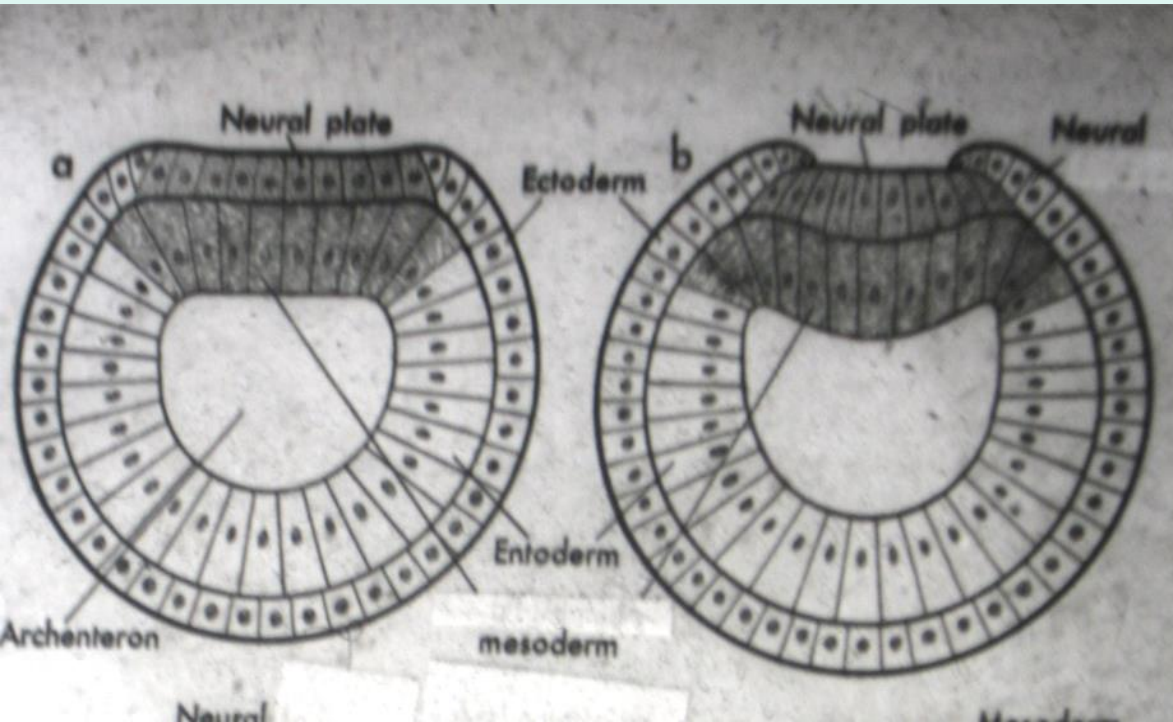
- At the dorsal of the first mouth (blastopore) found dorsal lip, ventral lips also located in the ventral.
- There are delicate hairs on the edges of the lips. Gastrula is displaced in water and also take nutrients into its cavity with movement of this delicate hairs.

- The inner layer (endoderm) surrounding gastrocoel is fed by assimilating this nutrients.
- Ectoderm surrounds endoderm also takes of these nutrients through diffusion.

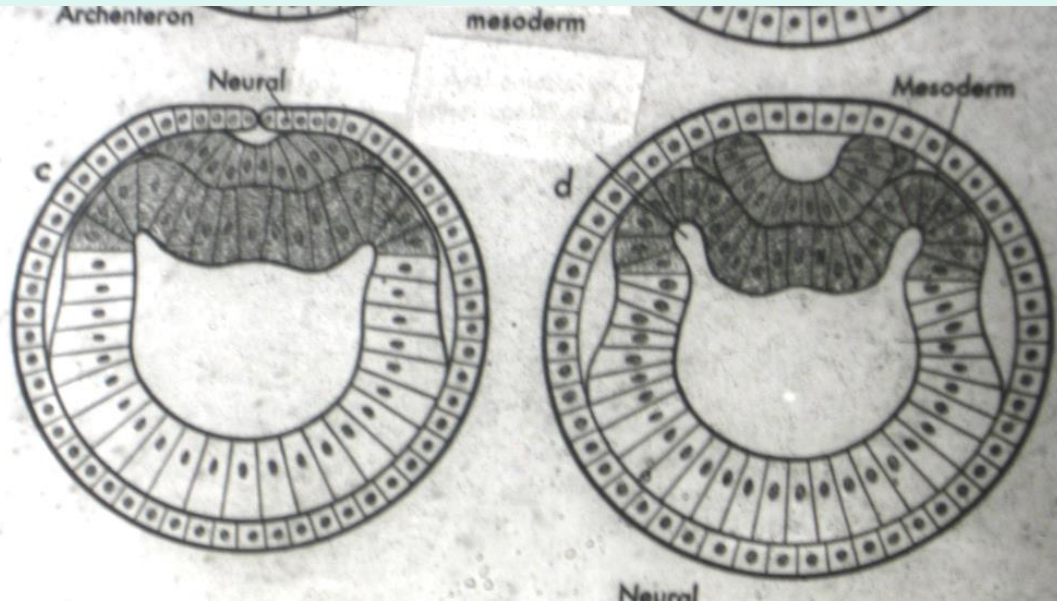
Thus, begins the division of labor between these two layers occurring gastrulation result, the ectoderm is protector and endoderm take upon themselves tasks related to nutrition.

- The gastrocoel is called the first intestinal canal (archenteron) after the division of this labor.





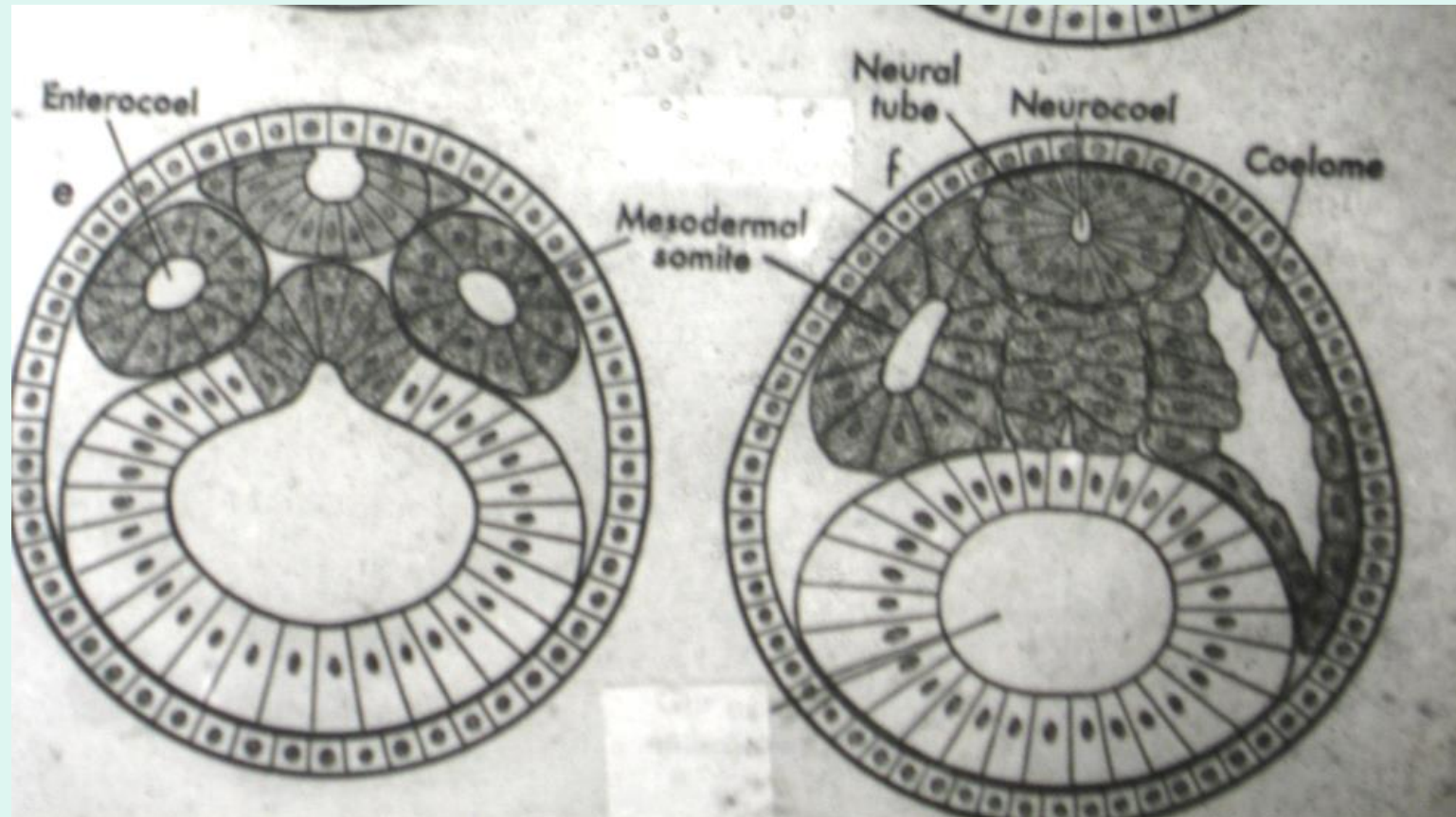
- During this development, the ectoderm in animal half undergoes a change and **neural plate** occurs which is the origin of the nervous system.
- Neural plate communicates with archenteron through blastopore.
- This connection channel between neural plate with archenteron is called canalis neuro-entericus.
- This channel will probably survive for a short time to feed the neural plate.



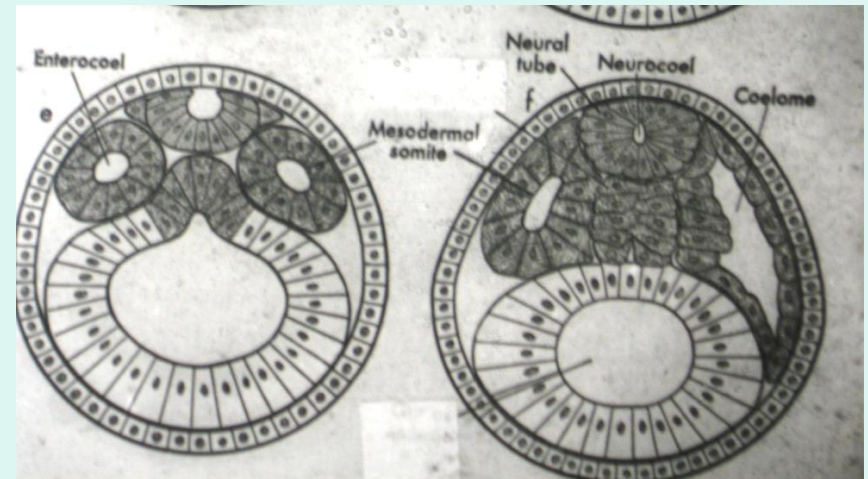
- A groove appears along the median line from cranial to caudal in the neural plate field.
- This groove is called sulcus neuralis which generate neural canal to closing, then.
- This canal is a place to occur of the central nervous system.



It occur dorsal and dorso-lateral direction 3 evagination in endoderm layer below neural plate.



- Then, evagination who transformed the shape of the sac.
- Initially, they are in contact with the endoderm.



- **The sac in the middle differentiates and the notochord (chorda dorsalis) is occurred.**
- **The left and right (bilateral) sacs of the notochord also change and occur mesoderm.**
- **Because the mesoderm is occur from endoderm, mesendoderm is also given to the endoderm layer under the neural plat.**

- Mesodermal segments are completely separated from endoderm and notochord after a while.
- The mesoderm extending in the form of two cordons on the right and left of Canalis neuralis, is knuckled at certain intervals, occurring somites in the form of nodules.

- Somites are the origin of mesodermal structures (connective tissue, muscle, cartilage, bone, blood, etc.).

- KAYNAKLAR

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