

## Gastrulation

- Gastrulation is a process where the basic organisation of the organism is established.
- Three germ layers - Ectoderm, mesoderm and endoderm are established and the group of cells move into the right position.
- Morphogenetic movements help the cell get to their proper position for development.

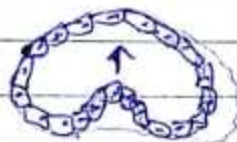
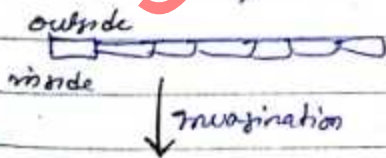
1. Epiboly - The spread of one cell sheet over other sheet.



e.g. Ectoderm formation in Amphibians, sea urchins and turtles.

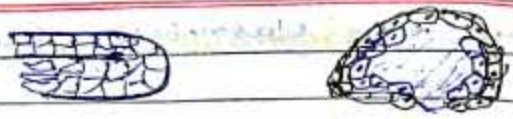


2. Inagination :- Infolding of cell sheet into the embryo.



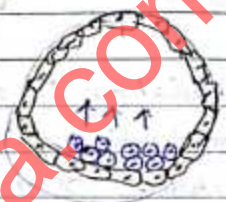
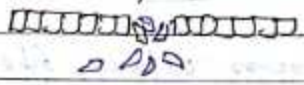
e.g. Sea urchin endoderm.

3.) Involution ↓



Tearing of cell sheet over the local surface of an outer layer. e.g. amphibian mesoderm

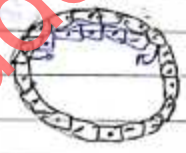
4.) Ingression ↓ migration of individual cells into the embryo.



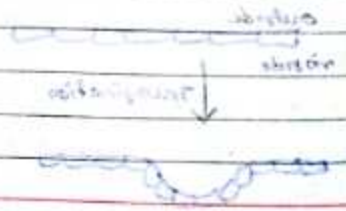
e.g. sea urchin mesoderm.

Ingression, involution and Invas. Invagination are known as embryo, meaning moving in the embryo.

5.) Delamination ↓ splitting or migration of one sheet into two sheets. e.g. mammalian and birds hypoblast formation



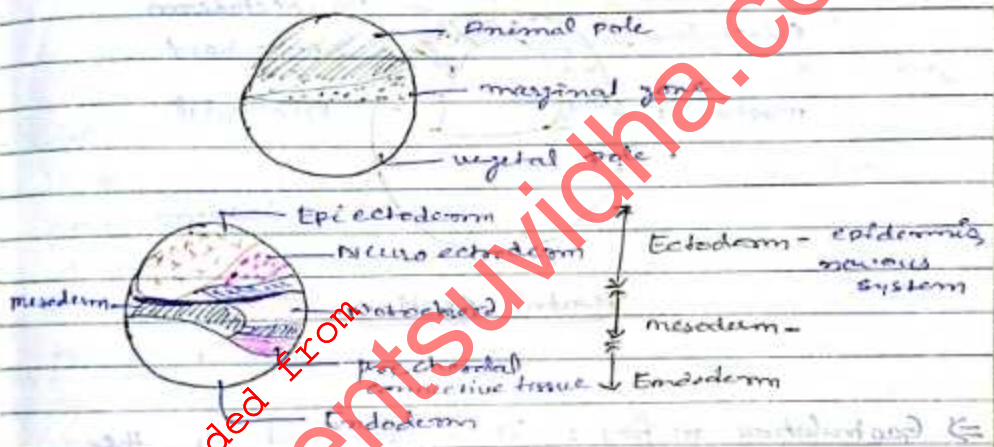
6. Intercalation ↓ rows of cells move between one another, leaving an array of cell that is longer but thinner.





## Gastrulation in Frog

→ Face maps of frog : In case of frog, the whole surface of blastula may be divided into 3 main zones - ① The deeply pigmented animal pole, ② the little pigmented vegetal area, and ③ The intermediate zone also known as marginal zone extending around the equator of the blastula.



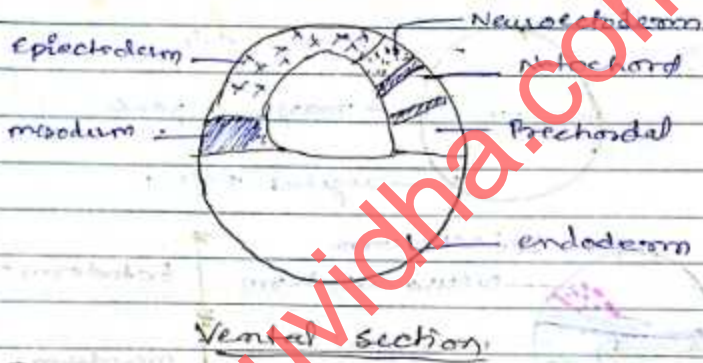
→ Derivatives

- **Neuroectoderm** always give rise to notochord, subcutaneous tissues and other organs.
- **Endoderm** - alimentary canal
- **Mesoderm** give rise to somites.

→ The animal pole region consist of two main areas

- ① **Epiectoderm**
- ② **Neuroectoderm** which develops into epidermis and nervous system resp.

- In the intermediate or marginal zone are the future notochord and the prechordal connective tissue. The parts of the marginal zone on both sides of the notochord are taken up by mesoderm.
- The vegetal pole zone is composed of cells which give rise to the endodermal region like the midgut and the hindgut.



⇒ Gastrulation in frog: It is initiated by the contraction of the vegetal area. The light colored area becomes smaller and the dark colored area reaches down below the equator. The marginal zone which was originally situated around the equator shifts to a position below the equator. The vegetal cells begin to bulge in the blastocoel, converting the floor of blastocoel into a conical structure.

- In the next step, there is the appearance of blastopore b/w the marginal zone and



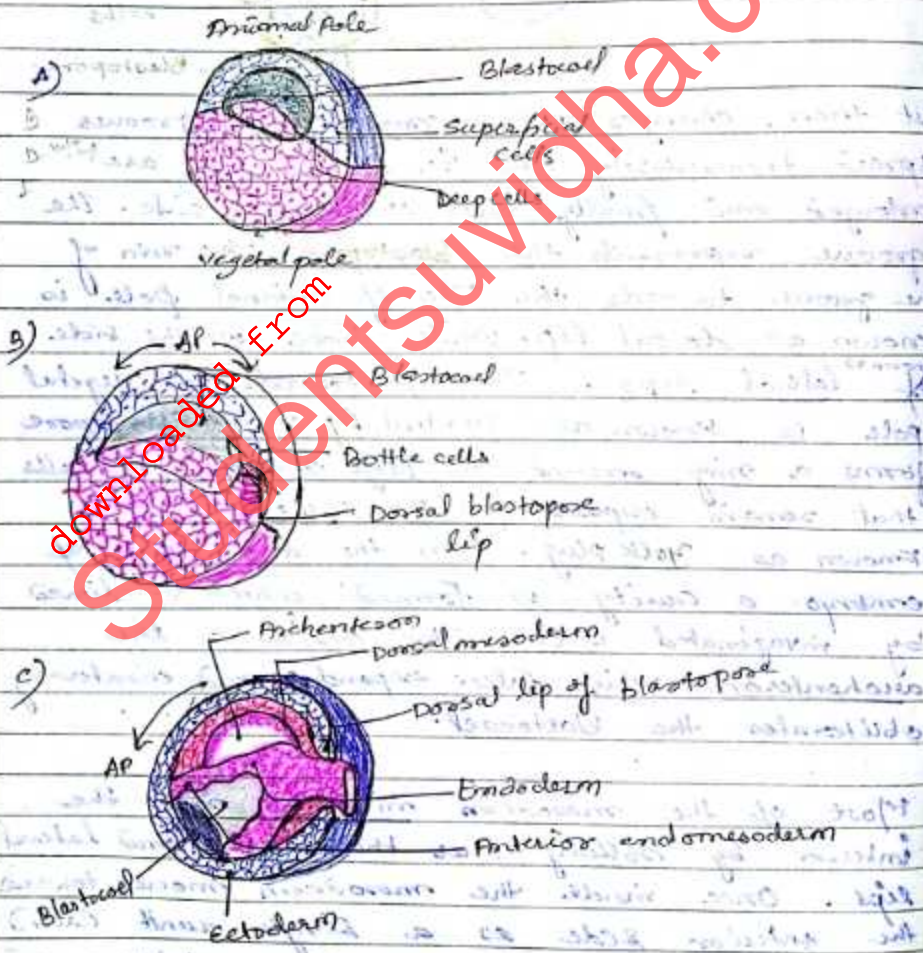
the vegetal field. It is brought about by the change of shape of certain cells at the border of the marginal and vegetal zones. These become bottle shaped with the cell body away from the surface of the embryo. The cells pull the cell's surface and cause it to cave in and a shallow pit is formed on the surface of the embryo.



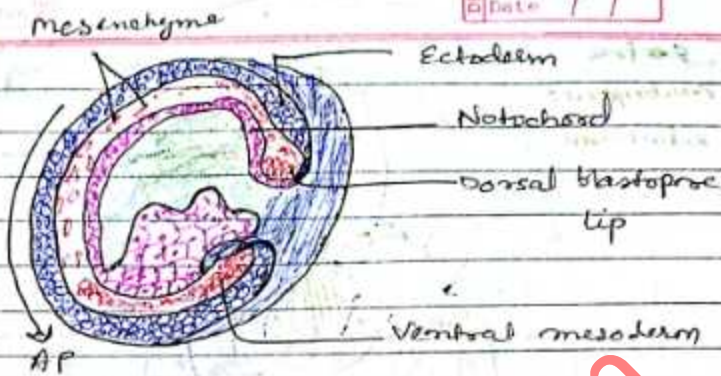
It then, changes into a groove. The grooves spread transversely and the lateral ends are prolonged and finally meet at the opp. side. The groove represents the blastopore. The rim of the groove towards the side of animal pole is known as dorsal lip, while those on the side of lateral lip. The lip towards the vegetal pole is known as ventral lip. The blastopore forms a ring around the large endodermal cells that remain exposed on the surface. This is known as yolk plug. On the dorsal side of embryo a cavity is formed which is lined by invaginated cells. This represents the archenteron, which later expands and eventually obliterates the blastocoel.

Most of the mesoderm invaginate into the interior by rolling over the dorsal and lateral lips. Once inside, the mesoderm focuses towards the anterior side as a elongated unit called chordamesoderm penetrating thro actoderm and

endoderm. Eventually, the mesoderm occupies the whole space between ectoderm and endoderm except a small portion at the anterior end of the embryo, which remains free from mesoderm and represents the place at which the mouth is formed. The entire half of the blastula undergoes epibolic expansion. It is maximal in the dorsal region but extends laterally & ventrally also.





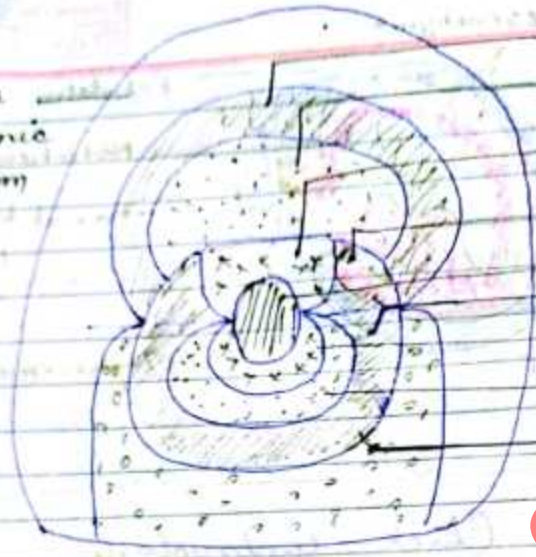


### Chick Embryology

Fate map of chick :

Roughly in the centre of area pellucida lies a small area that will form notochord. Posterior to this in the median plane of embryo lies an elongated oval area which will form the notochord. Further towards the posterior edge lies the extra embryonic endoderm. To the right and left of the notochord and embryonic endoderm lies the presumptive mesoderm. Near to the notochordal area lies the prechordal head mesoderm. Towards the presumptive ectoderm occupies anterior and lateral parts of the area pellucida. Still further and outwards lies the extra embryonic ectoderm.

Extra embryonic  
ectoderm



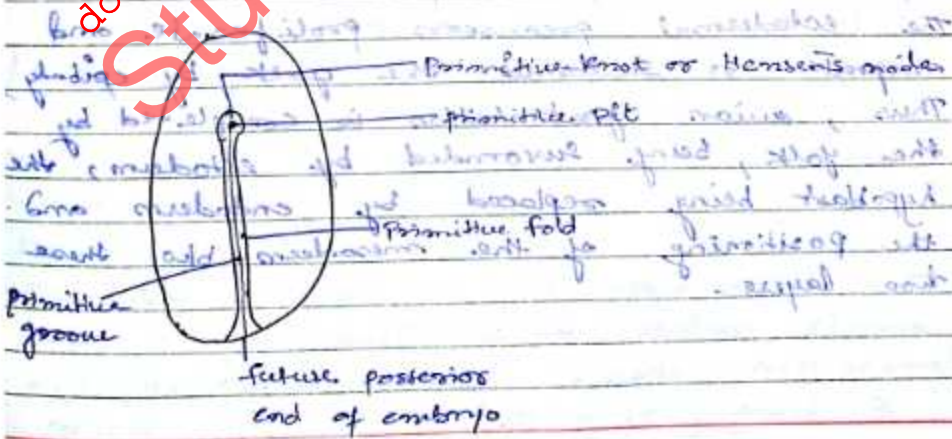
epiblast  
neural ectoderm  
Head mesoderm  
Somites  
Notochord  
Lateral plate mesoderm  
Endoderm  
Extra embryonic mesoderm  
Extra embryonic ectoderm

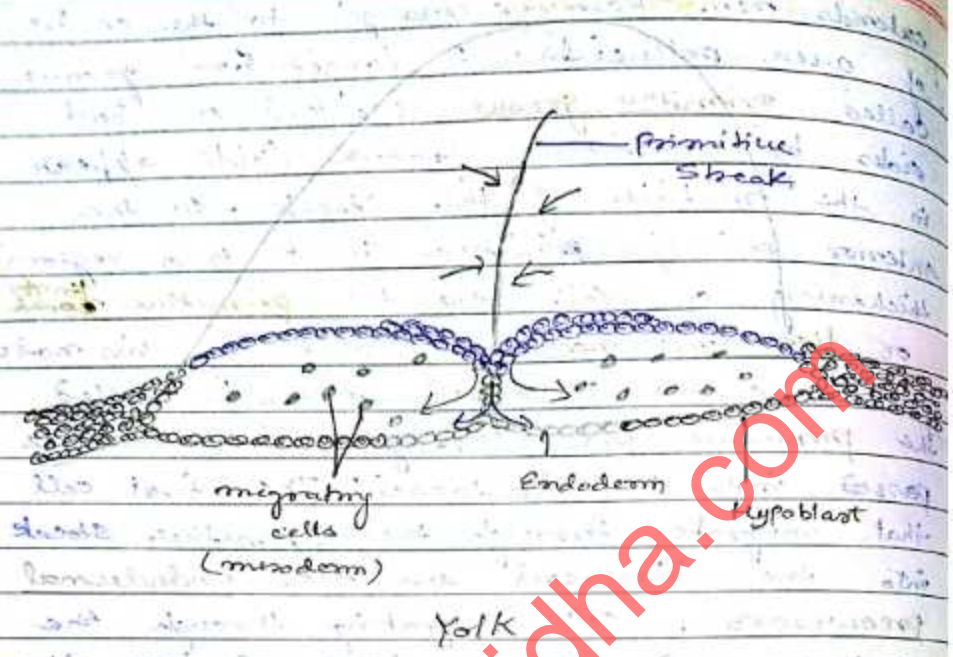
Gastrulation in chick :

The gas blastula in chick consist of two layer blastoderm [epiblast and hypoblast]. It is joined at the marginal zone. of area opacit. The space b/w the two are called as blastocoel. The avian embryo comes entirely from the epiblast and the external membranes arise from the hypoblast. The important characteristic of avian gastrulation is the primitive streak. It is first visible as a thickening of epiblast at posterior marginal zone known as initial primitive streak. The primitive streak appears after 6-7 hrs of incubation. The primitive streak organizes bag of proliferation of cells as well as addition of cells that migrate to it from various parts of area pellucida. After 12-13 hrs of incubation, the primitive streak



extends from posterior margin to the center of area pellucida. A longitudinal groove called primitive groove flanked on both sides by primitive groove folds appear in the middle of the streak. At the anterior end of primitive streak is a regional thickening of cells called the primitive knot or Hensen's node. The centre of this node contains a funnel shaped depression called the primitive pit, through which the cells passed into the blastocoel. The first cell that migrate through the primitive streak into the blastocoel are the endodermal precursors. Cells migrating through the anterior end into the blastocoel form the foregut, head mesoderm of notochord. Cells passing through the posterior region give rise to the endodermal and mesodermal tissue. After the endoderm is form, the next cells migrating into blastocoel move from the endoderm and epiblast to form the mesoderm.





Regression of the primitive streak  
 While the mesodermal ingression continues, the primitive streak starts to regress, moving the Hensen's node to a posterior position. As it moves posteriorly, the notochord is laid down by this type, the endodermal and mesodermal cells have entered the embryo, and the ectoblast is composed of ectodermal cells. The ectodermal precursors proliferate and migrate to surround the yolk by epiboly. Thus, avian gastrulation is completed by the yolk, being surrounded by ectoderm, the hypoblast being replaced by endoderm and the positioning of the mesoderm. <sup>but will...</sup> by these two layers.

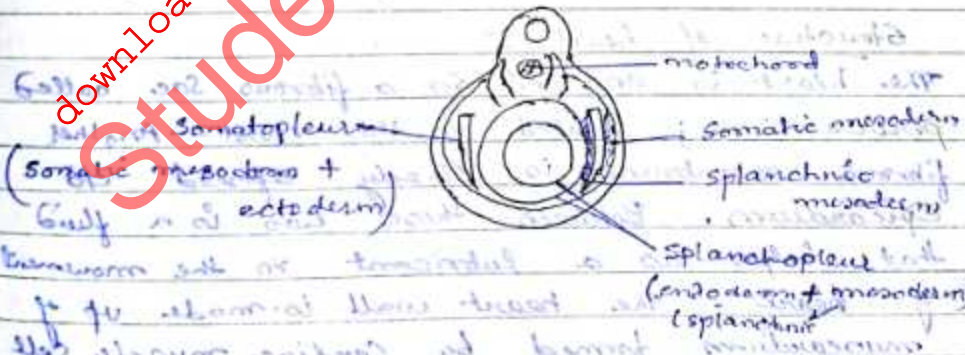
ectoderm  
 mesoderm  
 endoderm



Fate of the Germ layers :

After the three germ layers are formed, organogenesis takes place. In frogs and other chordates, the notochord and the neural tube are formed first. The dorsal mesoderm cells condense just above the notochord to form the notochord. The ectodermal plate above the notochord receives message from the mesoderm and forms the neural plate. The neural plate then folds to form the neural tube. It runs along the anterior-posterior axis of the embryo. The neural tube forms the brain & spinal cord. Lateral to the notochord condense to form blocks called somites. These are arranged on both side of the notochord along its entire length.

Even in adulthood, the notochord persists in b/w the vertebrae. Forming vertebral discs. Lateral to the somites the mesoderm splits in two layers forming lining of body cavity.



Ectoderm -> Epidermis of the skin and its derivatives lining of the mouth, <sup>formed</sup> nervous system, choroid and lens of eye, adrenal medulla, tooth enamel, sensory receptor, ep<sup>m</sup> of pituitary gland & pineal.

Imp't { - Cardiac cycle  
- ECG  
- Heart beat conduction

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Mesoderm - Notochord, muscles, bones, excretory system, circulatory, reproductive system, adrenal cortex, epidermis of skin.

Endoderm - lining of gut, lining of respiratory system, liver, pancreas, thyroid, parathyroid.

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