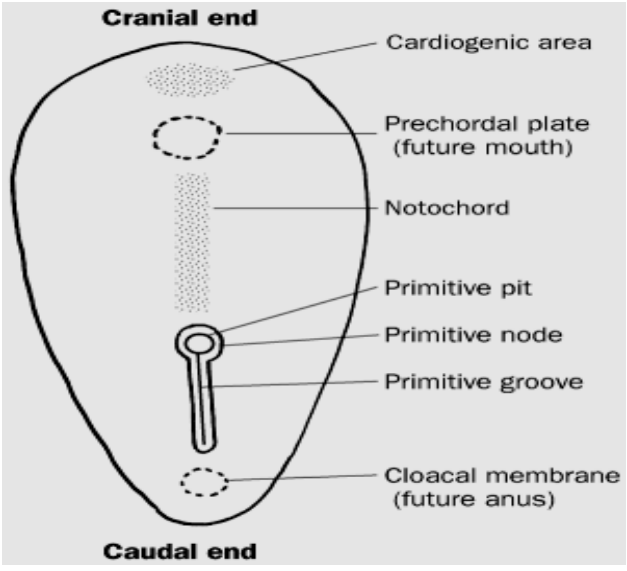
Embryology3 Dr. Ban

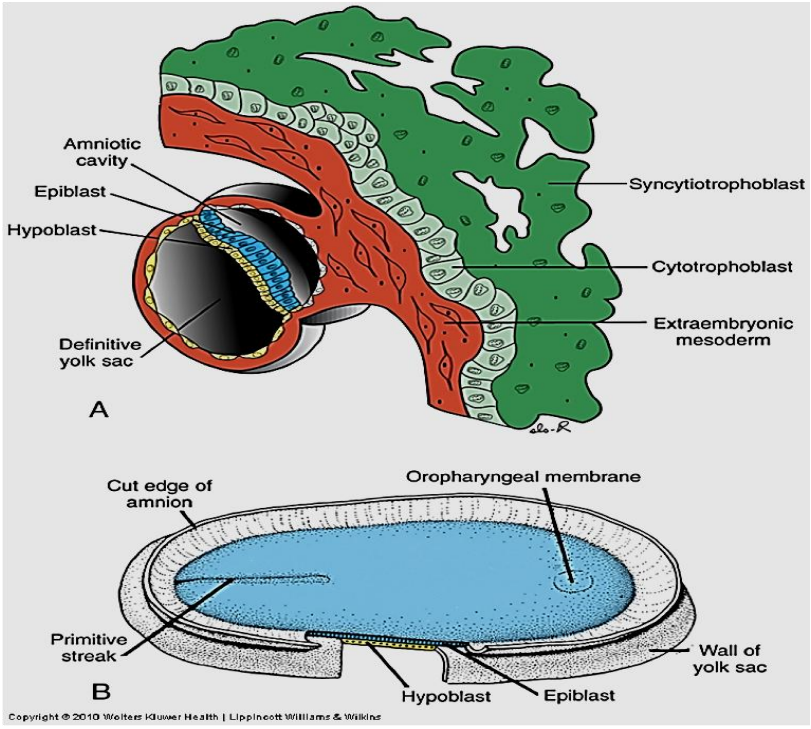
Third week of development:

During the third week of development conceptus *(conceptust includes all structures that develop from the zygote, both embryonic and extraembryonic)* implantion in the uterus wall is complete and trophoblast cells continue to invade uterine wall in the process of early placentation. Within the conceptus, gastrulation converts the bilaminar embryo into the trilaminar embryo (ectoderm, mesoderm, endoderm). Morphological changes include an epithelial to mesenchymal cell transition and folding of the embryonic disc. **Gastrulation** is a phase early in the embryonic development of most animals, during which the single-layered blastula is reorganized into a multilayered structure known as the **gastrula**.

Development of the primitive streak:

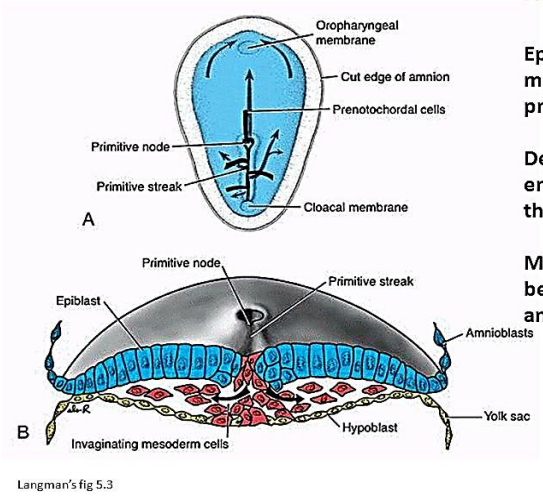
Primitive streak appears near the end of week 2 and is clearly seen about day 15 as a narrow midline, thickened linear band of embryonic epiblast in the caudal end of the dorsal aspect of the embryonic disk. Its appearance enables identification of embryonic axes, cranial and caudal ends, top and bottom surfaces, and sides of the embryo.





A.Implantation site at the end of the second week.
B. View of the germ disc at the end of the second week of development. The amniotic cavity has been opened to permit a view of the dorsal side of the epiblast. The hypoblast and epiblast are in contact with each other, and the primitive streak forms a shallow groove in the caudal region of the embryo.

As the streak elongates by addition of cells at its caudal end, its cranial end thickens to form the *primitive knot or node* (*Hensen's*); simultaneously a narrow primitive groove develops in it which continues into a depression in the knot called the primitive pit.



Langman's fig 5.3

Gastrulation:

Epiblast cells migrate through the primitive streak.

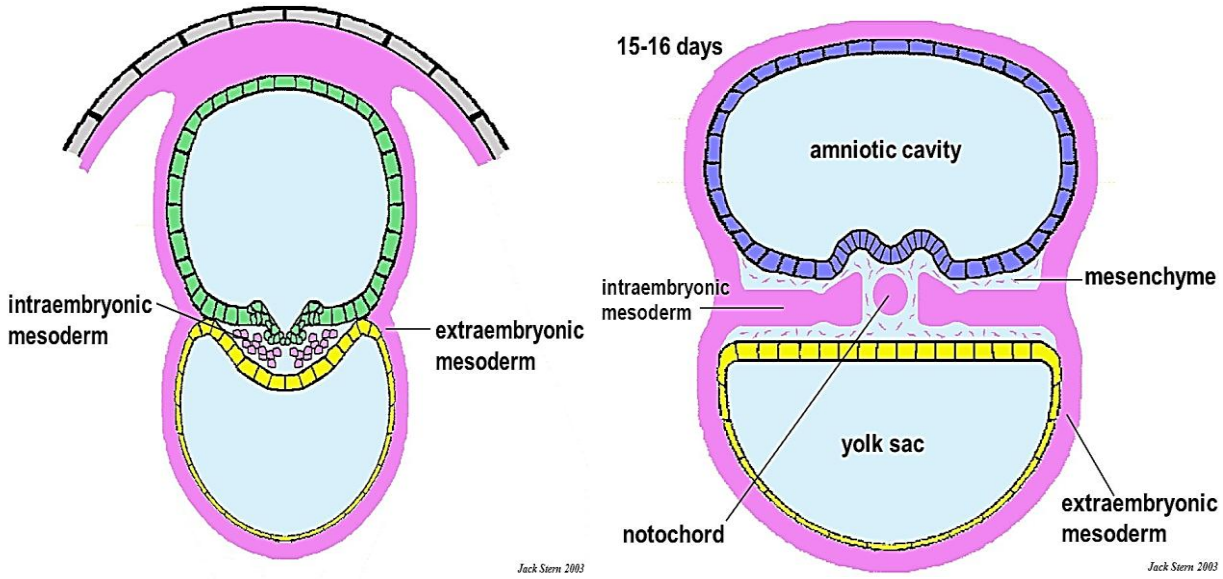
Definitive (embryonic) endoderm cells displace the hypoblast.

Mesoderm spreads between endoderm and ectoderm.

A. Dorsal side of the germ disc from a 16-day embryo indicating the movement of surface epiblast cells through the primitive streak and node and the subsequent migration of cells between the hypoblast and epiblast .
B. Cross section through the cranial region of the streak at 15 days showing invagination of epiblast cells. The first cells to move inward displace the hypoblast to create the definitive endoderm. Once definitive endoderm is established, inwardly moving epiblast forms mesoderm.

Cells of the epiblast migrate toward the primitive streak . Upon arrival in the region of the streak, they become flask-shaped, detach from the epiblast, and slip beneath it . Some cells displace the hypoblast, creating the embryonic endoderm, and others come to lie between the epiblast and newly created endoderm to form mesoderm. Cells remaining in the epiblast then form ectoderm.

Cells of the epiblast migrate medially toward the streak, enter the primitive groove, then leave the basal layer of the groove and migrate laterally between the embryonic ectoderm and endoderm to organize into a layer, the intraembryonic mesoderm .Mesoderm also lies outside the embryo as extra-embryonic mesoderm.



- The epiblast, through the process of gastrulation, is the source of all of the germ layers, and cells in these layers will give rise to all of the tissues and organs in the embryo.
- As more and more cells move between the epiblast and hypoblast layers, they begin to spread laterally and cranially .
- Gradually, they migrate beyond the margin of the disc and establish contact with the extraembryonic mesoderm covering the yolk sac and amnion.

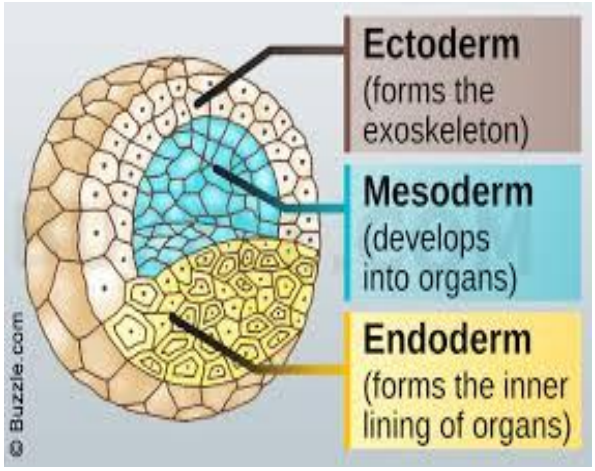
- Some cells of the primitive streak migrate cranially, pass on each side of the notochordal process, around the prochordal plate, and meet cranially in the cardiogenic area where the heart will be formed.

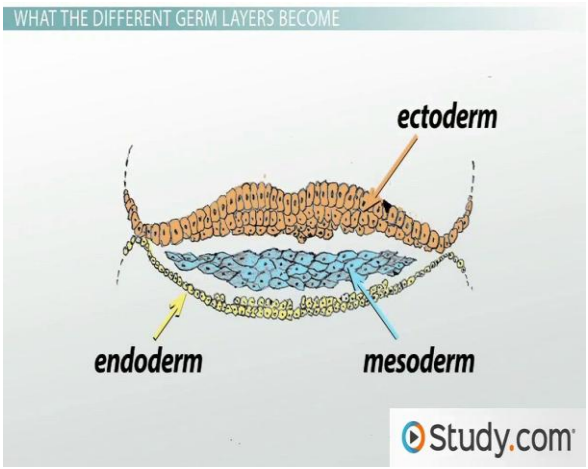
By the middle of week 3, intraembryonic mesoderm separates the ectoderm and endoderm everywhere except at :

a-the oropharyngeal membrane cranially

b-the cloacal membrane caudally

c- in the midline, cranial to the primitive knot where the notochordal process extends, because embryonic ectoderm and (endoderm) fuse at these sites and prevent mesenchymal cells from migrating between them.





Growth of the embryonic disc

- The embryonic disc, initially flat and almost round, gradually becomes elongated, with a broad cephalic and a narrow caudal end . Growth and elongation of the cephalic part of the disc are caused by a continuous migration of cells from the primitive streak region in a cephalic direction.
- Invagination of surface cells in the primitive streak and their subsequent migration forward and laterally continues until the end of the fourth week.

- At that stage, the primitive streak shows regressive changes, rapidly shrinks, and soon disappears.
- In the cephalic part, germ layers begin their specific differentiation by the middle of the third week, whereas in the caudal part, differentiation begins by the end of the fourth week.
- Thus, gastrulation, or formation of the germ layers,continues in caudal segments while cranial structures are differentiating, causing the embryo to develop cephalocaudally.

Germ layers and their derivatives

Ectoderm gives rise to the

1- central nervous system (the brain and spinal cord)
2- the peripheral nervous system
3- the sensory epithelia of the eye, ear, and nose
4- the epidermis and its appendages (the nails and hair)
5- the mammary glands;
6- the pituitary gland
7- the subcutaneous glands
8- the enamel of the teeth

Mesoderm gives rise to

1- connective tissue
2- cartilage, and bone
3- striated and smooth muscles;
4- heart walls,
5- blood and lymph vessels and cells
6- kidneys
7- gonads (ovaries and testes) and genital ducts
8- the serous membranes lining the body cavities
9- the spleen
10- the adrenal cortices

Endoderm gives rise to :

1- epithelial lining of the gastrointestinal and respiratory tracts
2- the parenchyma of the tonsils, the liver, the thymus, the thyroid, the parathyroids, and the pancreas

3- the epithelial lining of the urinary bladder and urethra

4- the epithelial lining of the tympanic cavity, tympanic antrum, and auditory tube

5-Flexion takes the embryo from a flat disk to its basic embryonic body form. The primitive gut originates from endoderm at the time of its flexion.