

Third Week of Development

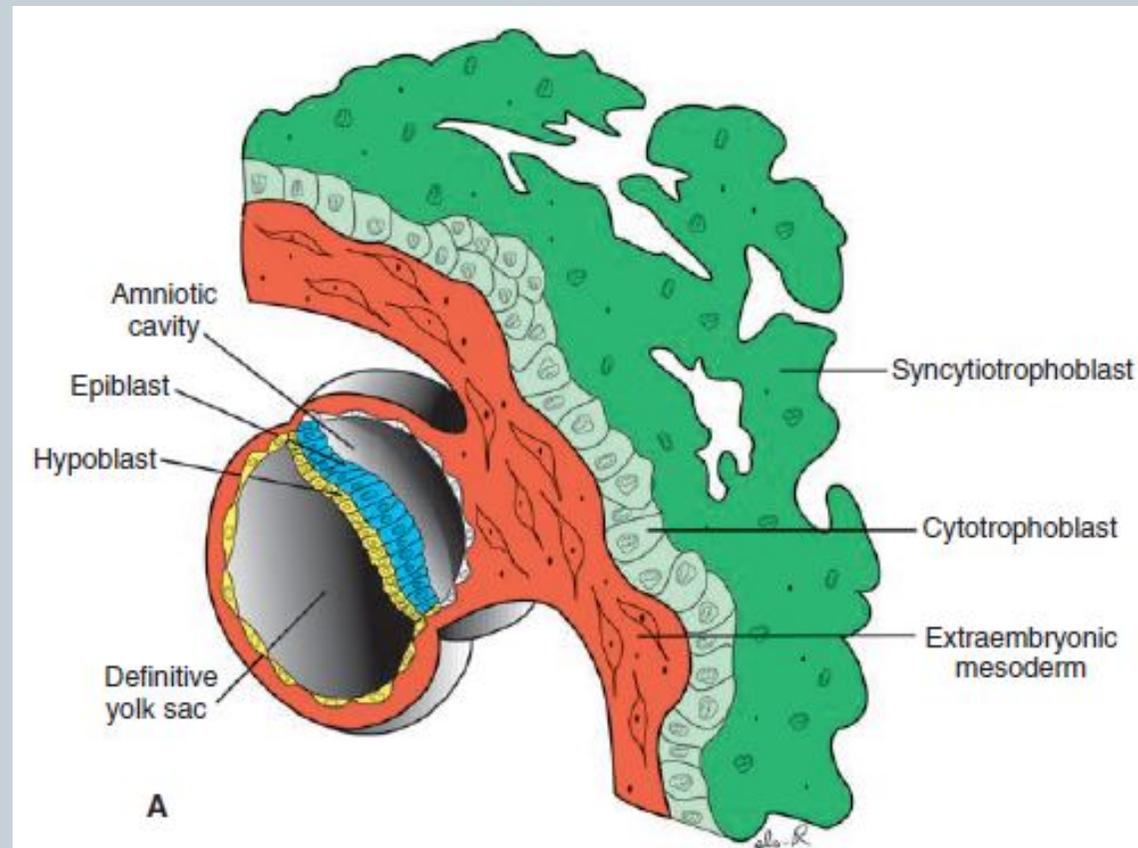


Trilaminar germ disc

GASTRULATION

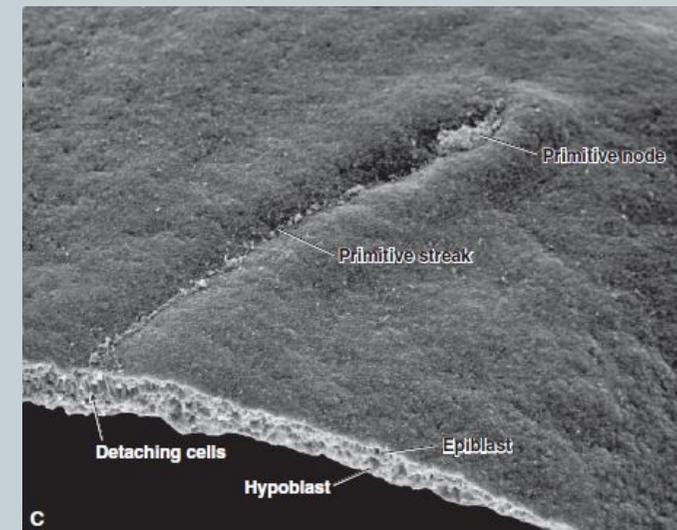
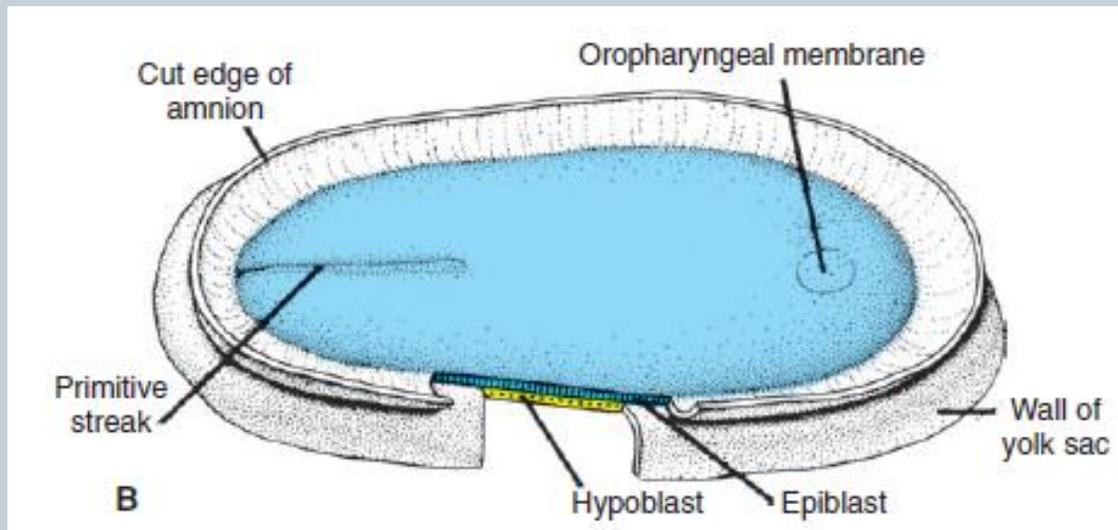
3 germ layers

- Ectoderm
- Mesoderm
- Endoderm



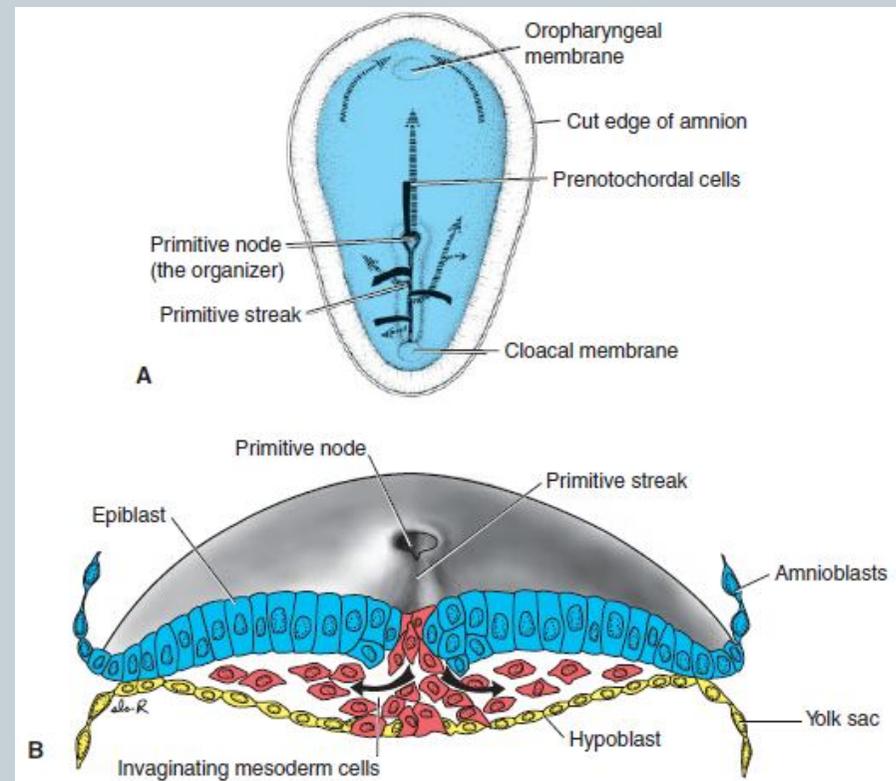
GASTRULATION

- **primitive streak** formation (**epiblast surface**)
in a 15- to 16-day embryo
- **primitive node**
- **Primitive pit**



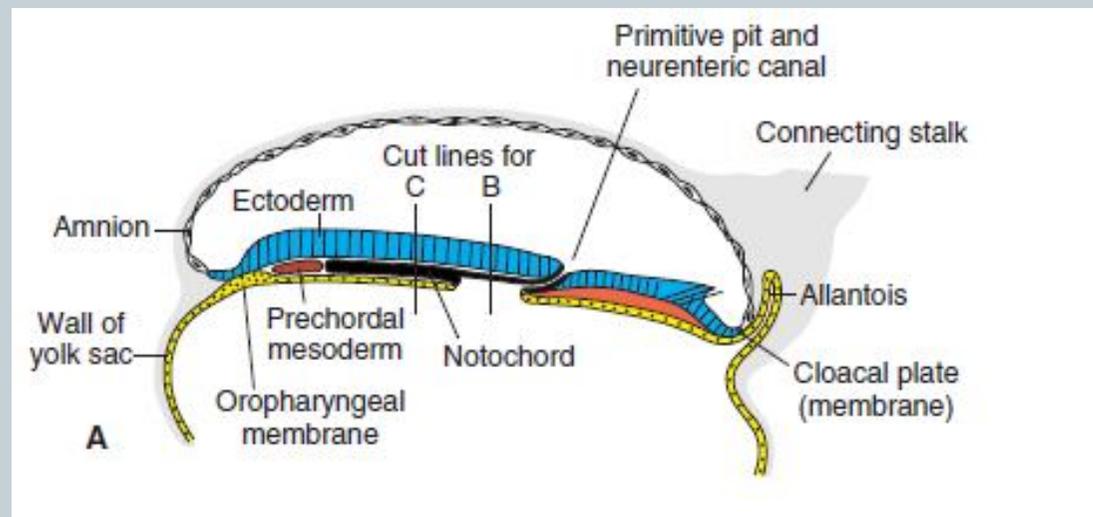
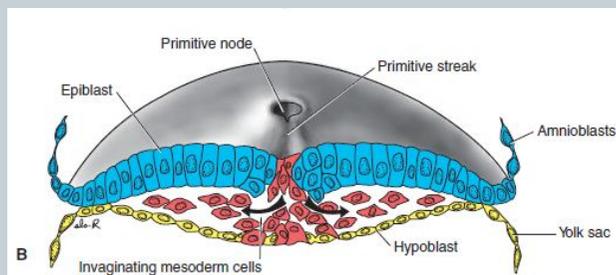
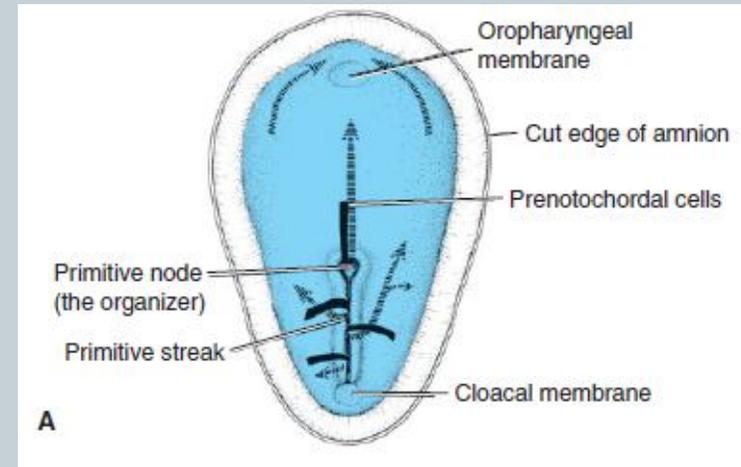
GASTRULATION

- epiblast Cells migration (**Invagination**)
- Cell migration & specification by FGF8 (streak cells)
Cell migration by E-cadherin downregulating
Cell specification by regulation of *Brachyury (T) expression*
- cells displace the hypoblast (**endoderm**)
- Cells lie between epiblast & endoderm (**mesoderm**)
- Cells remaining in the epiblast (**ectoderm**)



GASTRULATION

- cell movement between epiblast & hypoblast layers
- Cells spread laterally & cranially
- Cells migrate beyond the margin of the disc
- Cells contact with the extraembryonic mesoderm
- Cells pass the **prechordal plate**
- prechordal plate (induction of the forebrain)
- The oropharyngeal membrane



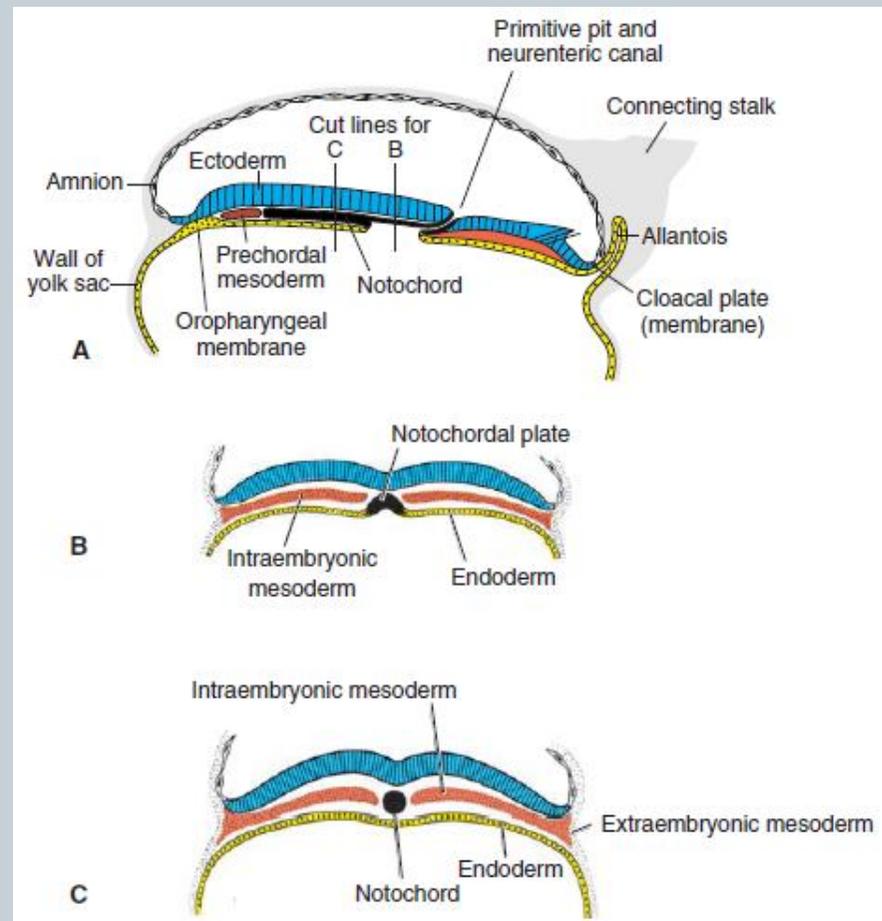
Notochord formation

- Prenotochordal cells move forward cranially in the midline & reach the prechordal plate
- notochordal plate (prenotochordal & hypoblast)

- definitive notochord formation
(prechordal plate to the primitive pit)

- Neurenteric canal

- cloacal membrane
- allantoenteric diverticulum, or allantois
(16th day of development)



Body axes establishment



Anteroposterior axis

- cells at the anterior (cranial) margin of the embryonic disc
- **anterior visceral endoderm (AVE) expresses** genes essential for head formation that inhibit nodal activity
- primitive streak initiated and maintained by expression of *Nodal* (**TGF- β**)
- **By BMP4** (TGF- β) & **FGF**, **mesoderm** ventralized to contribute to kidneys (intermediate mesoderm), blood, and body wall mesoderm (lateral plate mesoderm).
- other genes expressed in the node (**organizer**)

***Chordin* (*Goosecoid*)**

Noggin

Follistatin

cranial mesoderm is dorsalized into notochord, somites, and somitomeres these three genes are expressed in the notochord (neural induction in cranial region)

Anteroposterior axis



- anterior (cranial) margin ocell
anterior visceral endoderm (AVE) expresses head formation & nodal activity inhibition

- primitive streak initiated and maintained by *Nodal* expression (TGF- β)

- **By BMP4 (TGF- β) & FGF, mesoderm** ventralized kidneys (intermediate mesoderm)
Blood & body wall mesoderm (lateral plate mesoderm)

- other genes expressed in the node (**organizer**)

Chordin (Goosecoid)

Noggin

Follistatin

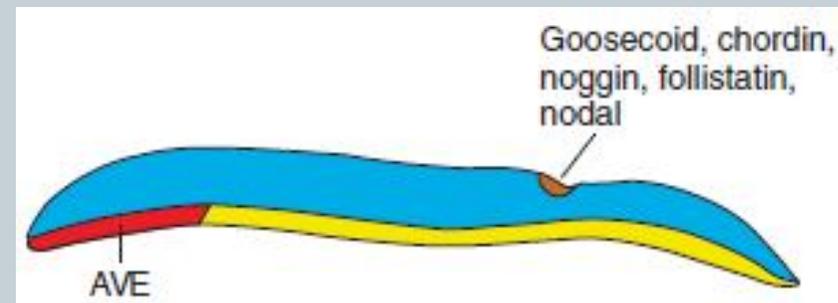
cranial mesoderm to somites, & somitomeres

3 genes expression in the notochord (neural induction)

- ***HNF-3 β* maintains the node & induces** forebrain and midbrain formation

- dorsal mesoderm (middle & caudal regions by ***Brachyury (T) gene*** (node, notochord precursor cells, Notochord)

- caudal dysgenesis



Anteroposterior axis

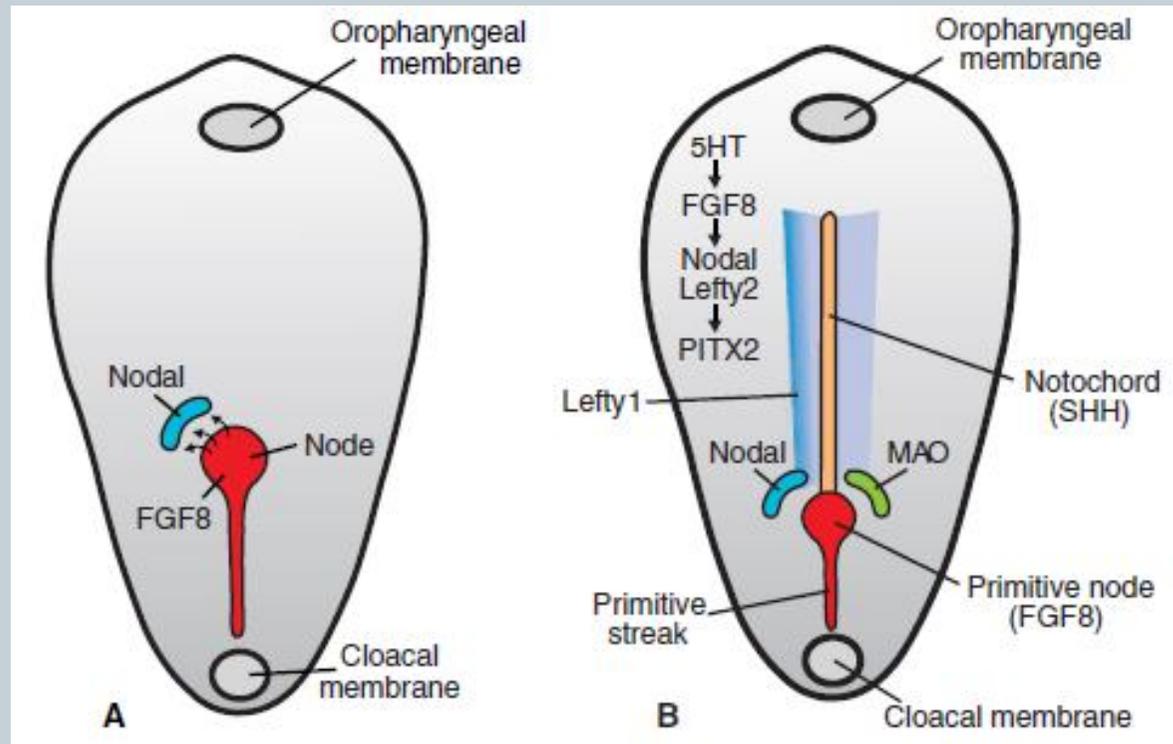


- anterior (cranial) margin ocell
anterior visceral endoderm (AVE) expresses
head formation & nodal activity inhibition
 - primitive streak initiated and maintained by *Nodal* expression (**TGF-b**)
 - **By BMP4 (TGF-b) & FGF, mesoderm** ventralized
kidneys (intermediate mesoderm)
Blood & body wall mesoderm (lateral plate mesoderm)
 - other genes expressed in the node (**organizer**)
Chordin (Gooseoid)
Noggin
Follistatin
cranial mesoderm to somites, & somitomeres
- 3 genes expression in the notochord (neural induction)
- ***HNF-3b* maintains the node & induces** forebrain and midbrain formation
 - dorsal mesoderm (middle & caudal regions by ***Brachyury (T) gene*** (node, notochord precursor cells, Notochord)
 - caudal dysgenesis



Laterality (left–right-sidedness)

- **FGF8** (node & primitive streak)
- *Nodal* Expression in *left side*
- **LEFTY**
- heart, stomach, gut primordia
- situs inversus and dextrocardia
- **Sonic hedgehog (SHH)**
- *Brachyury (T) gene*
- **serotonin (5HT)**
- **Cilia**
- **Gap j.**



Fate map established during gastrulation

- Node cranial region

Prechordal plate

Notochord

- Node lateral edge

Paraxial mesoderm

- Midstreak region

Intermediate mesoderm

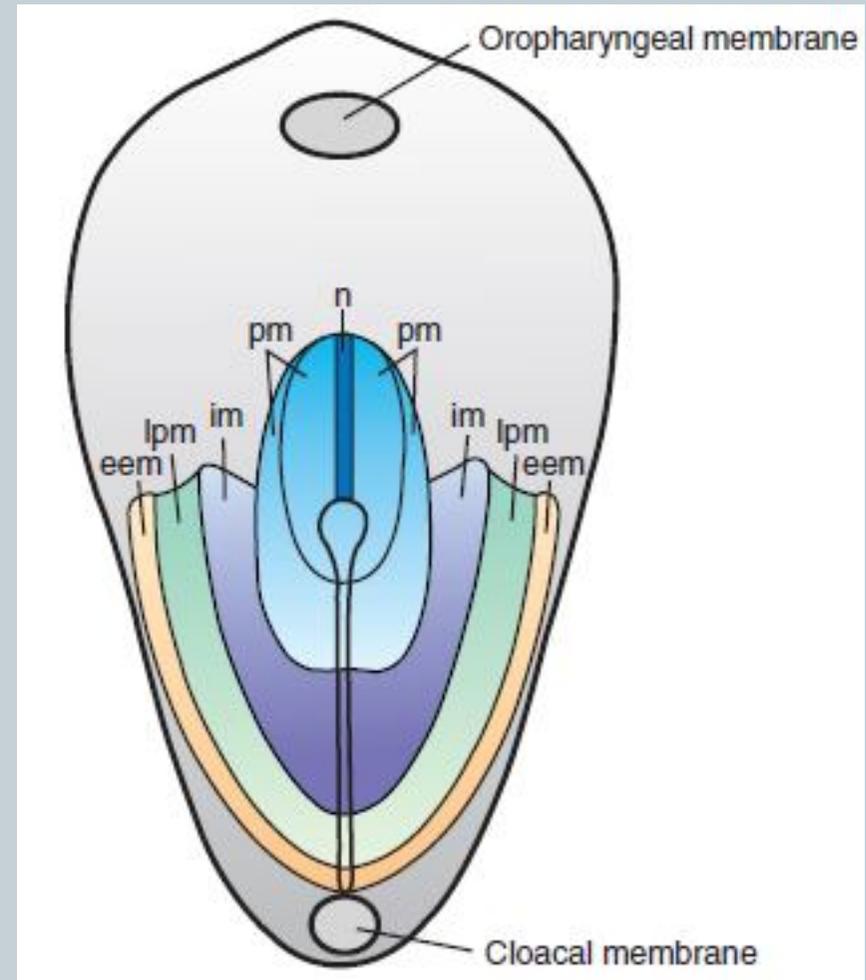
- Caudal part of streak

Lateral plate mesoderm

- The caudal most region of streak

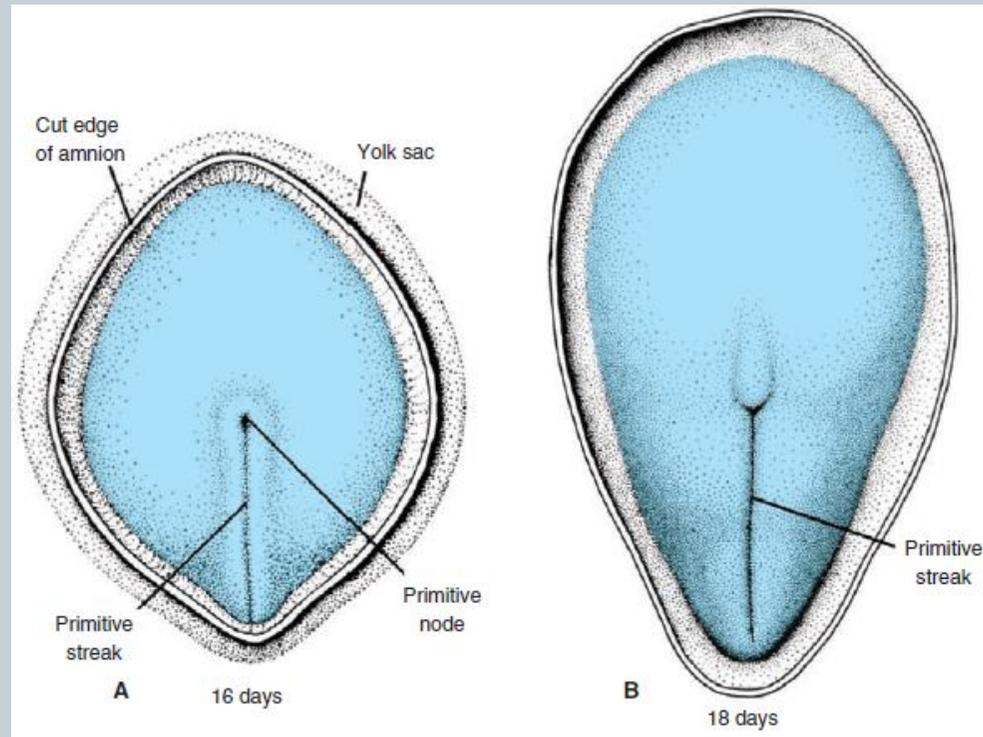
Extraembryonic mesoderm

(primitive yolk sac, hypoblast)



Growth of Embryonic disc

- Flat & round disc
- Broad cephalic & narrow caudal disc
- Cell migration up to end of 4th week
- Primitive streak disappears
- Cephalocaudal growth & differentiation



Clinical correlation

- Teratogenes

Alcohol

Holoprosencephaly

Hypotelorism

Caudal disgenesis (sirenomelia)



Clinical correlation



- Situs inversus
- Kartageners syndrome
- Laterality sequence

- Serotonin (5HT)

- Sacrococcygeal teratomas
- 1 in 37,000

- Primitive streak
- Primordial germ cell



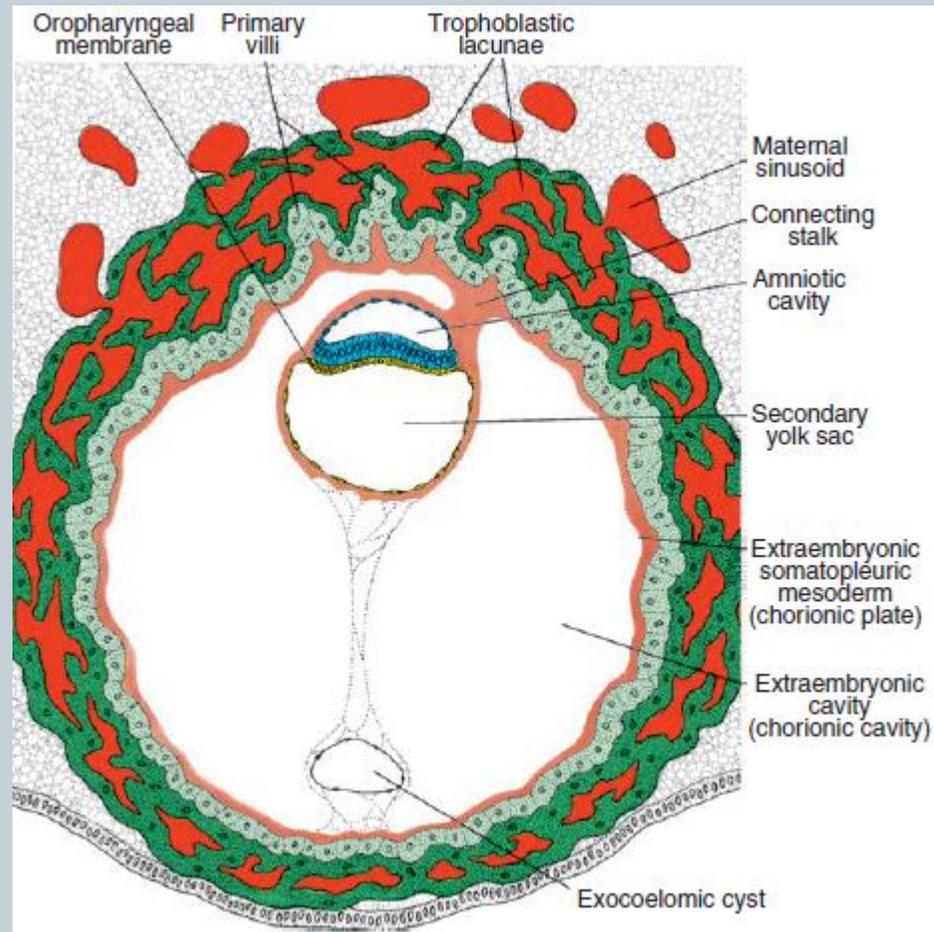
Further development of trophoblast

- Third week
- **Primary villi**

Column:

Cytotrophoblastic core

Syncytial layer



Further development of trophoblast

- **Secondary villi**

Mesodermal cells
penetration to column

- **Tertiary villi**

Definitive villi

Mesoderm to blood cells & small blood vessel

