

Basic Embryology



Embryology

- Definition: the study of the origin and development of an organism
- Prenatal period: before birth
 - 38 weeks from conception to birth (average) “fetal” age
 - Gynecologic timing has been from LMP therefore refers to 40 weeks “gestational” age
 - Date of conception has been difficult to time
 - LMP is on average two weeks before ovulation

Traditional (artificial) division:

- “Embryonic” period: first 8 weeks
 - All major organs formed
- “Fetal” period: remaining 30 weeks
 - Organs grow larger and become more complex

Embryonic Period

Duration: First 8 weeks after conception.

Major embryological events:
Organs form from three primary germ tissues.
Emergence of the basic body plan.



3.5 mm

25 days



10 mm

36 days



30 mm

56 days

Fetal Period

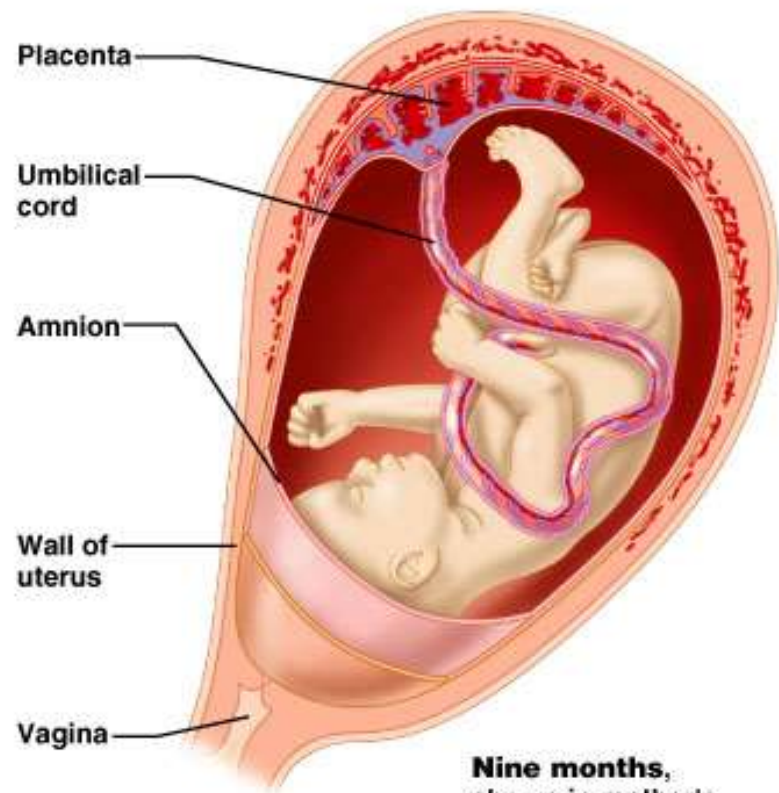
Duration: Weeks 9 to 38 after conception (or until birth).

Major fetal events: Organs grow in size and complexity.



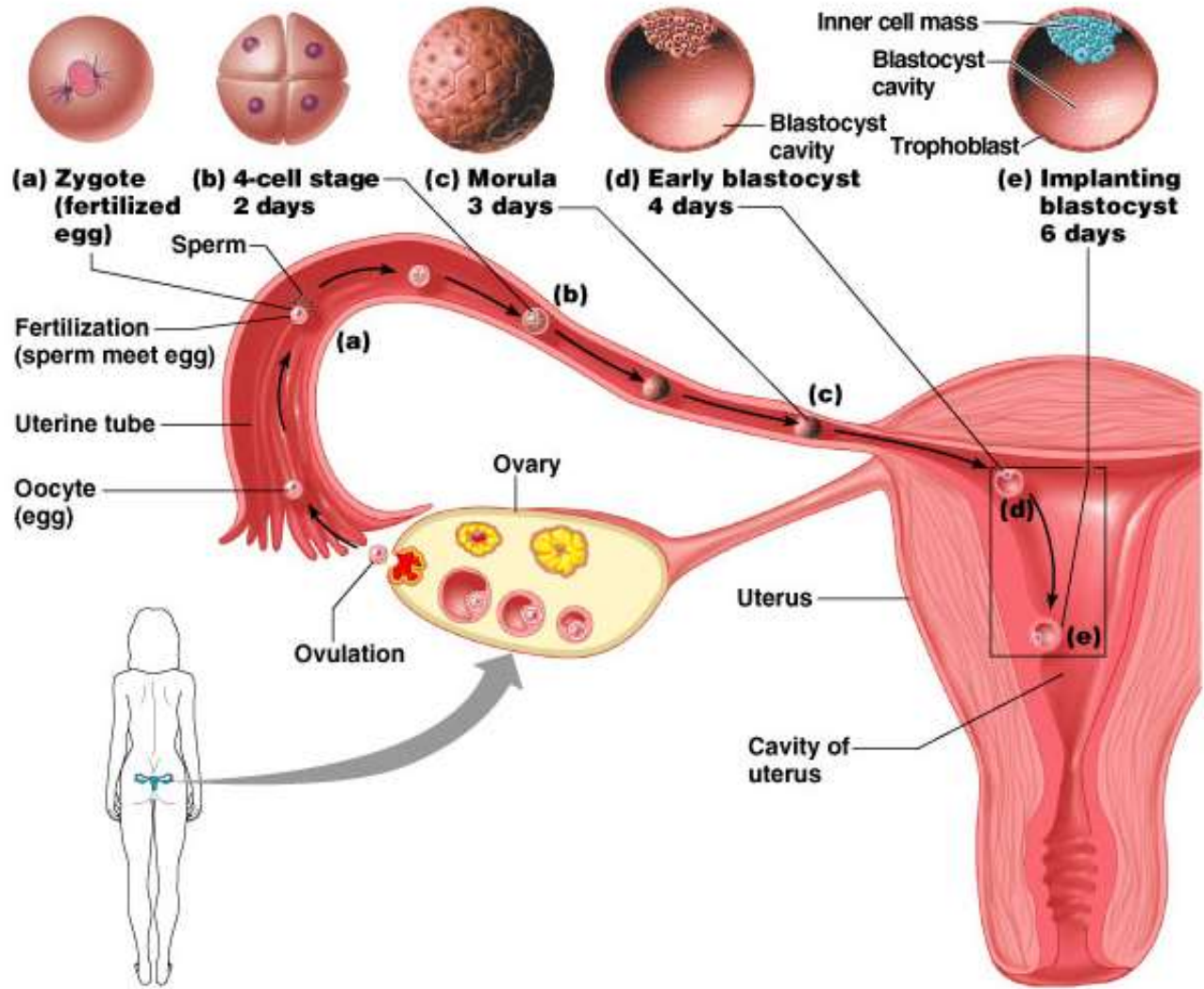
18.5 cm

20-week fetus



Nine months,
shown in mother's
womb (uterus)

Fertilization to Implantation

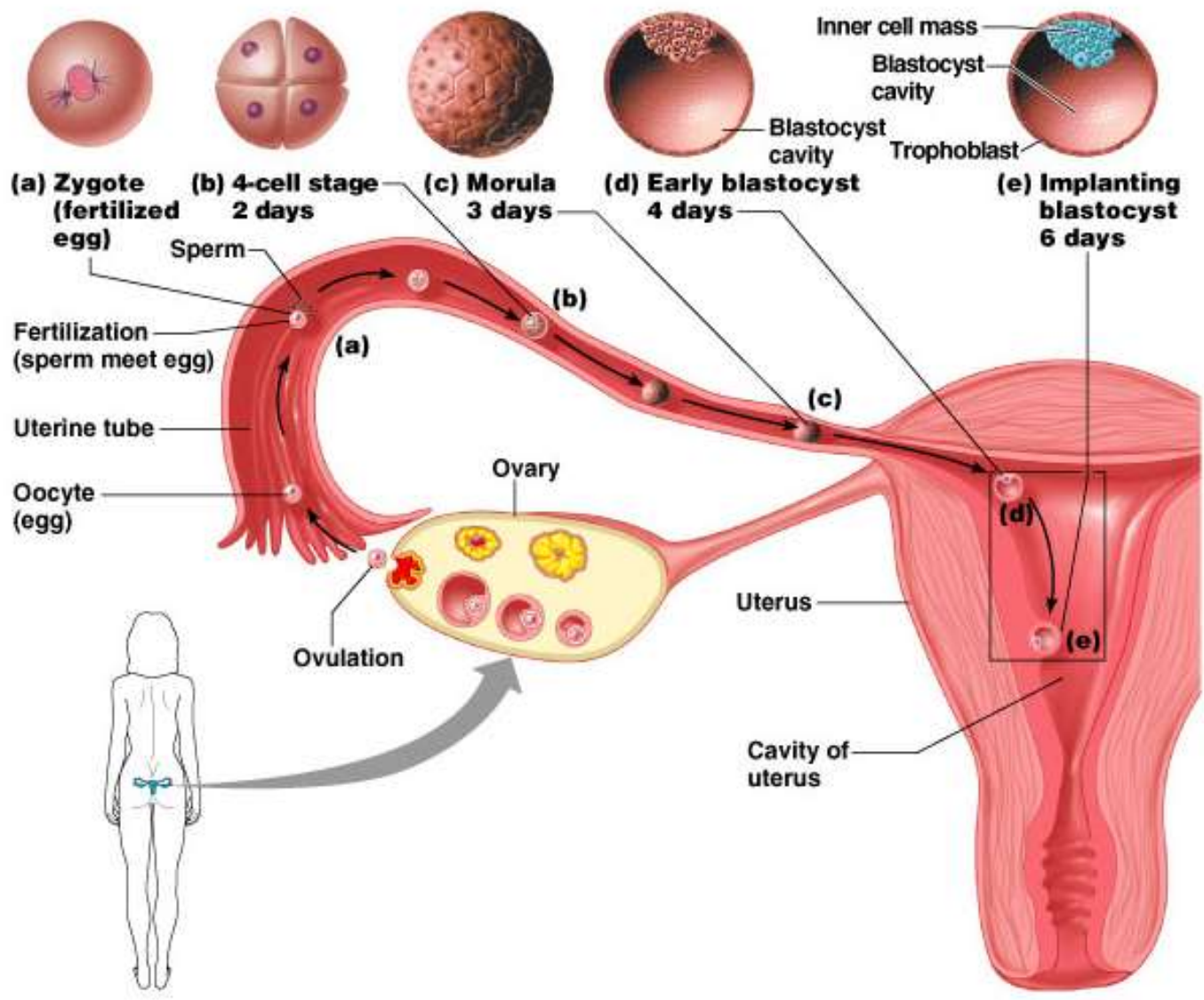


- Ovulation: egg released into the peritoneal cavity
- Travels down fallopian tube in which fertilization occurs
- At conception in fallopian tube, maternal and paternal genetic material join to form a new human life (zygote)
- Cell division occurs with travel down the tube and into the uterus

[Conception \(biology\)](#) or fertilisation, the fusion of gametes to produce a new organism of the same species (Wikipedia)

Week 1 post conception

- **Zygote** divides repeatedly moving down tube toward uterus (cleavage)
- The daughter cells are called **blastomeres**
- **Morula**: the solid cluster of 12-16 blastomeres at about 72 hours
- Day 4: late 60 cell morula enters uterus, taking up fluid becoming **blastocyst**



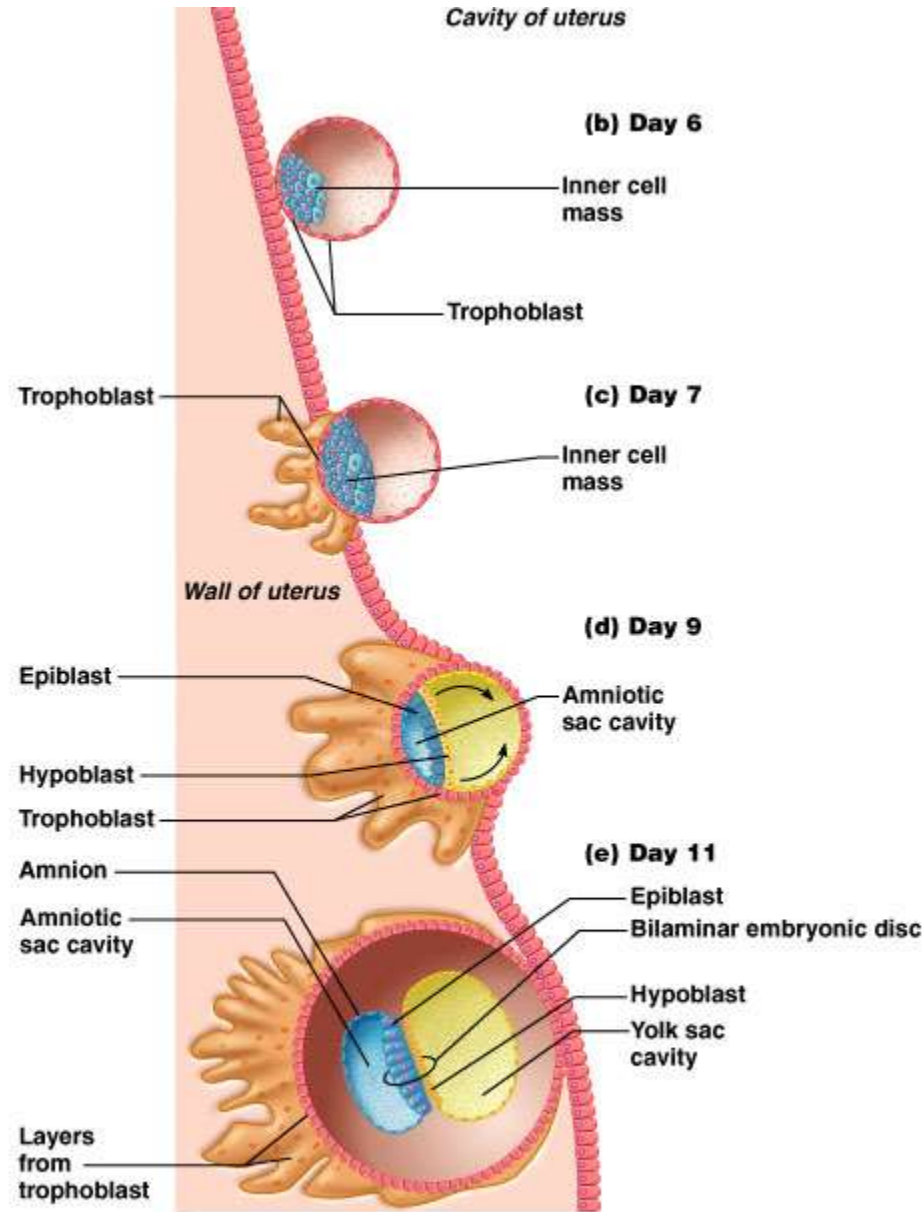
Blastocyst stage



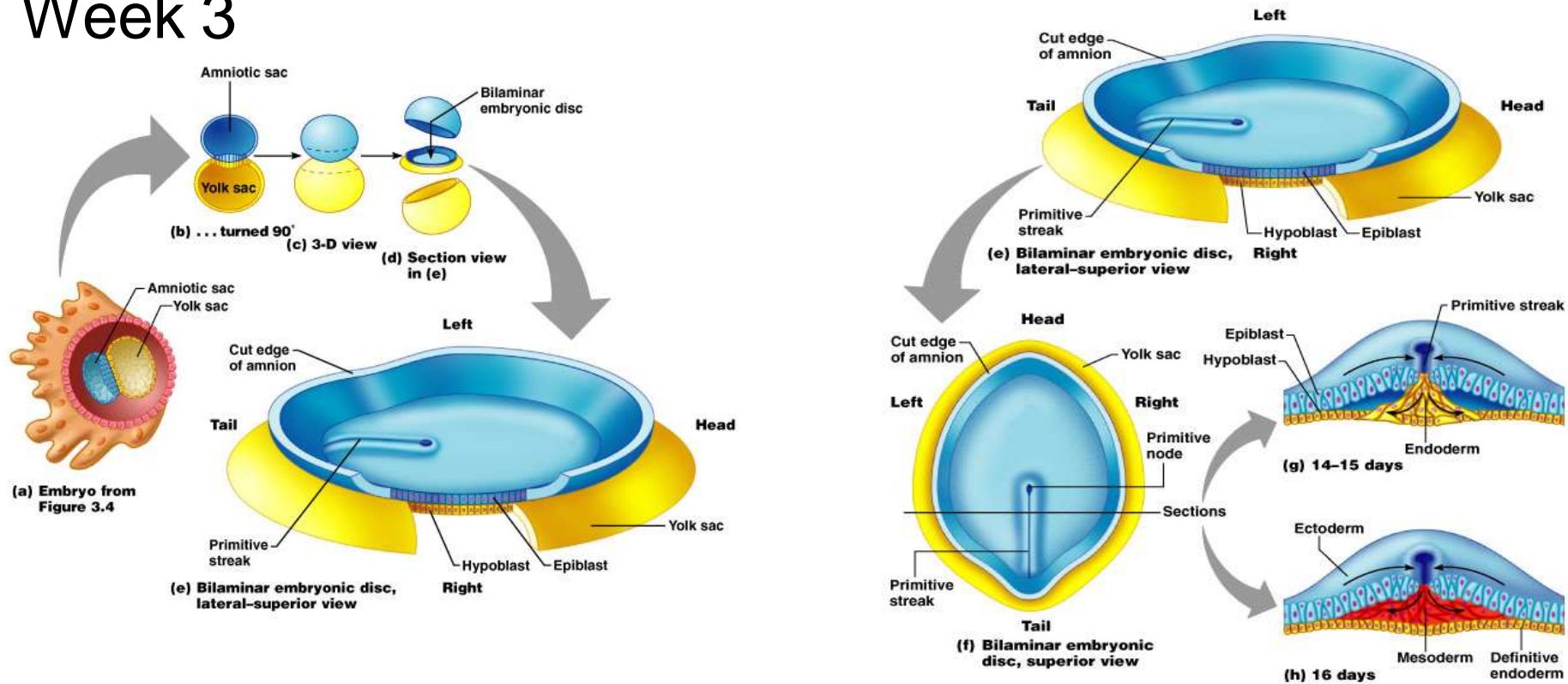
- Two distinct types of cells
 - **Inner cell mass:** forms the embryo
 - **Trophoblast:** layer of cells surrounding the cavity which helps form the placenta
- Floats for about 3 days
- **Implantation** on about day 6 post conception
 - Trophoblast erodes uterine wall
 - Takes 1 week to complete
- If inner cell mass of a single blastocyst divides: monozygotic (identical) twins

Week 2

- Inner cell mass divides into epiblast and hypoblast
- 2 fluid filled sacs
 - **Amniotic sac** from epiblast
 - **Yolk sac** from hypoblast
- Bilaminar **embryonic disc**: area of contact
(gives rise to the whole body)



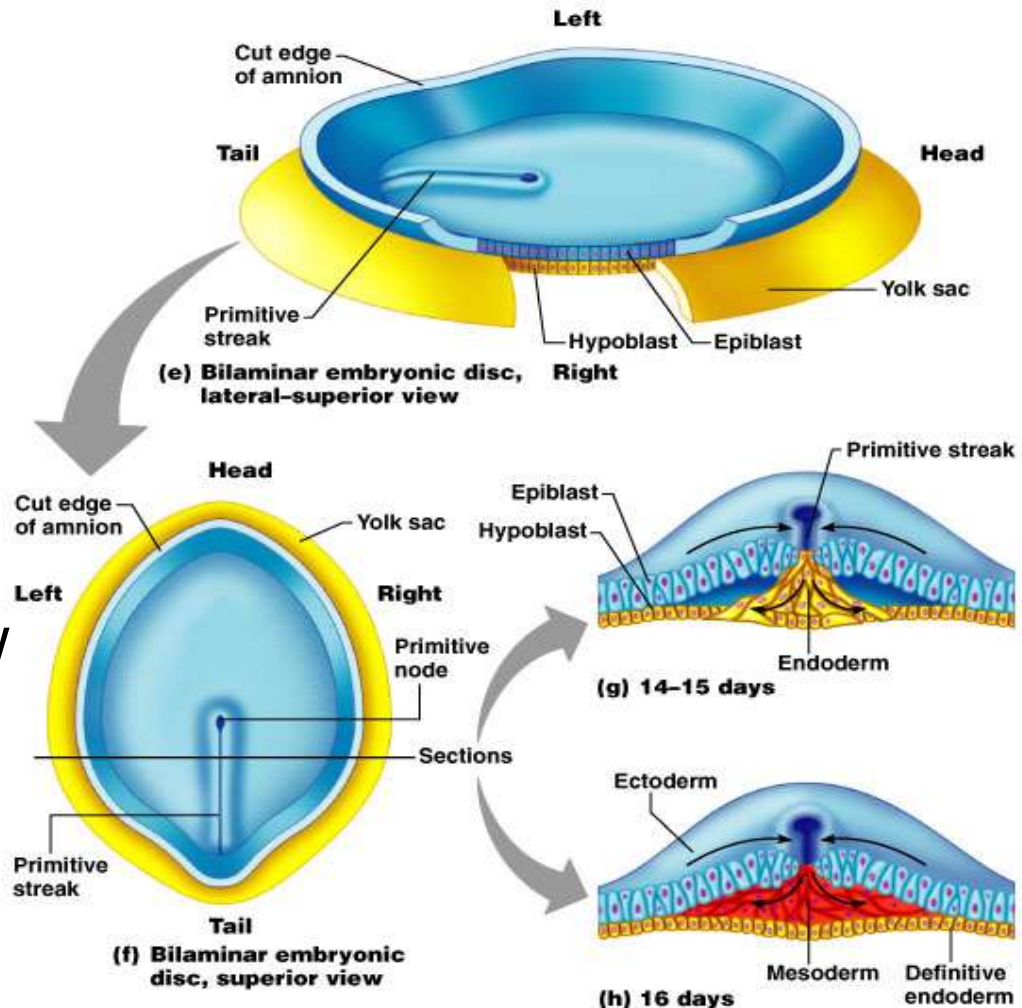
Week 3



- Bilaminar to trilaminar disc
- Three primary “germ” layers: all body tissues develop from these
 - Ectoderm
 - Endoderm
 - Mesoderm

Formation of the 3 “germ” layers

- Primitive streak (groove) on dorsal surface of epiblast
- Gastrulation: invagination of epiblast cells
- Days 14-15: they replace hypoblast becoming **endoderm**
- Day 16: **mesoderm** (a new third layer) formed in between
- Epiblast cells remaining on surface: **ectoderm**

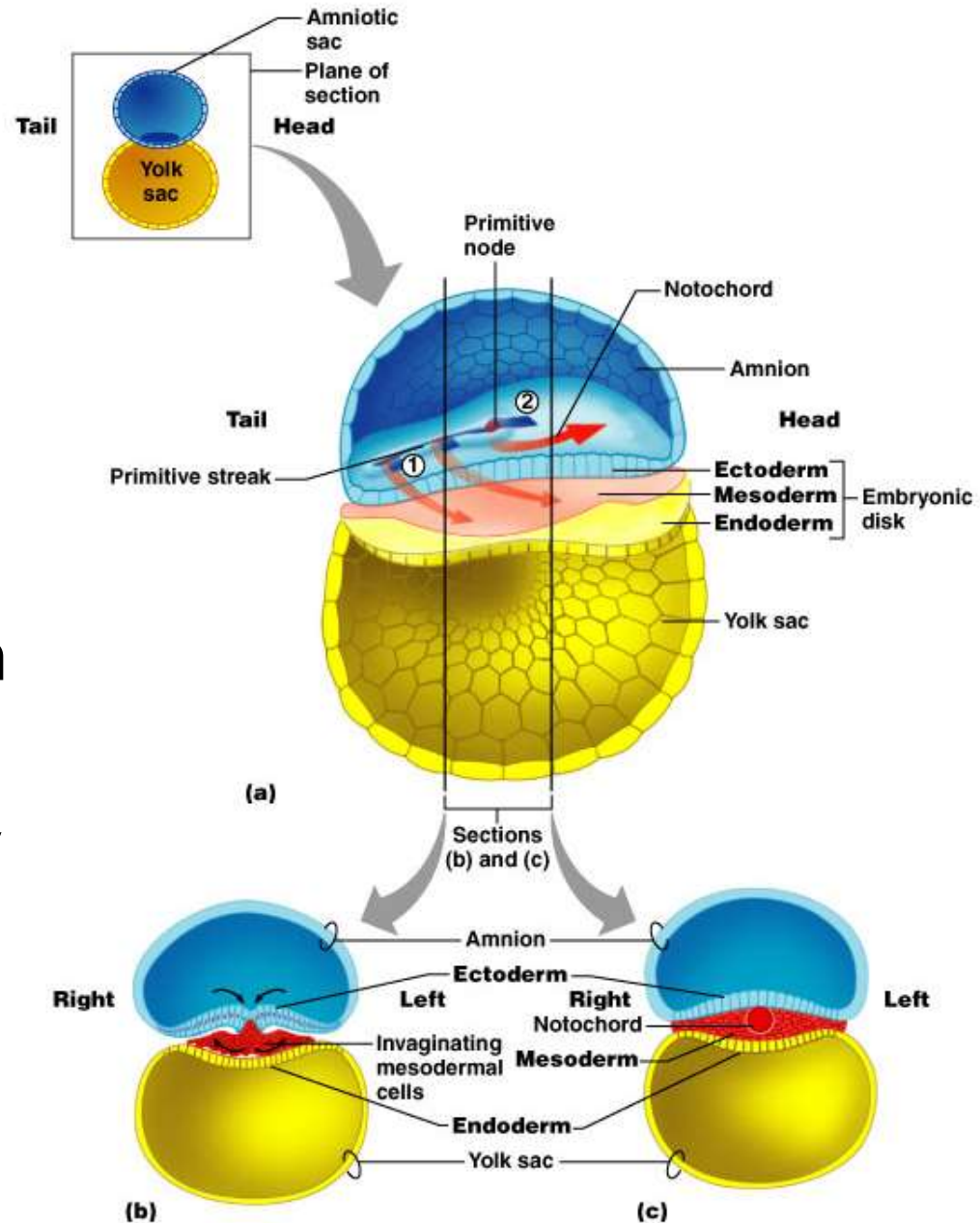


The three “germ” tissues

- “Germ” as in germinate, not germs
- Early specialization of cells
- Are precursors
- Ectoderm and endoderm are epithelial tissue (form sheets of tissue)
- Mesoderm is a mesenchyme tissue
 - Mesenchyme cells are star shaped and do not attach to one another, therefore migrate freely

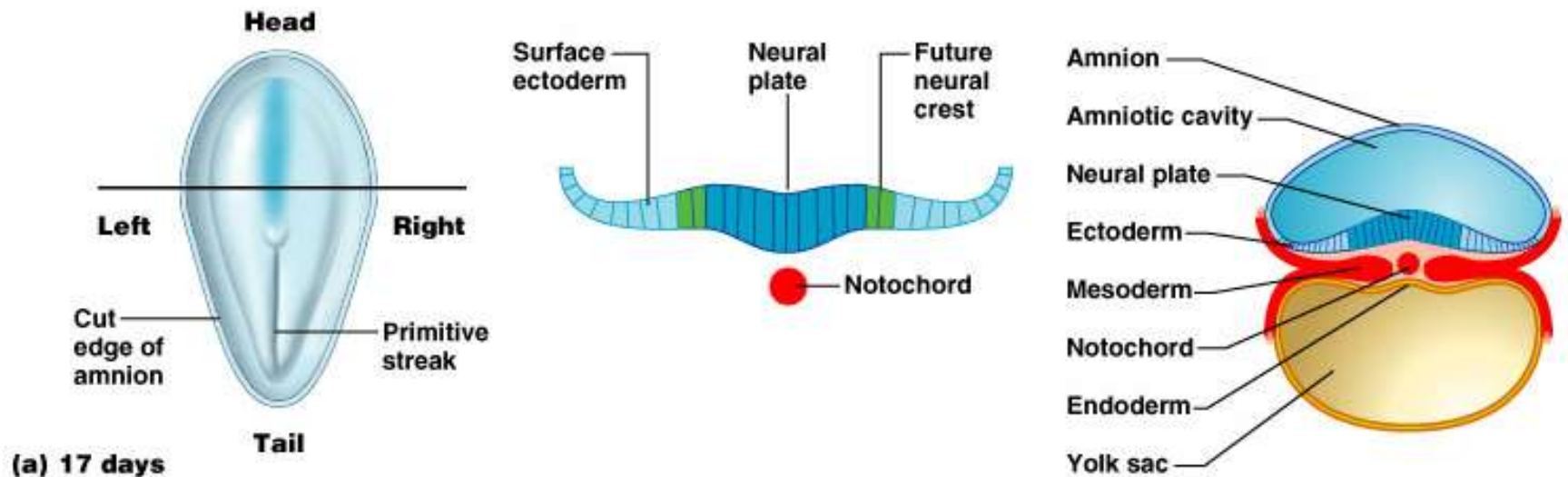
Notochord

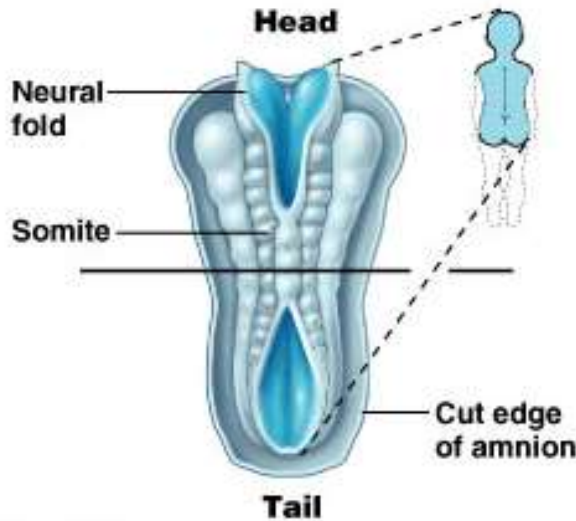
- Days 16-18
- Primitive node epiblast cells invaginate and migrate anteriorly with some endoderm cells
- Rod defining the body axis is formed
- Future site of the vertebral column



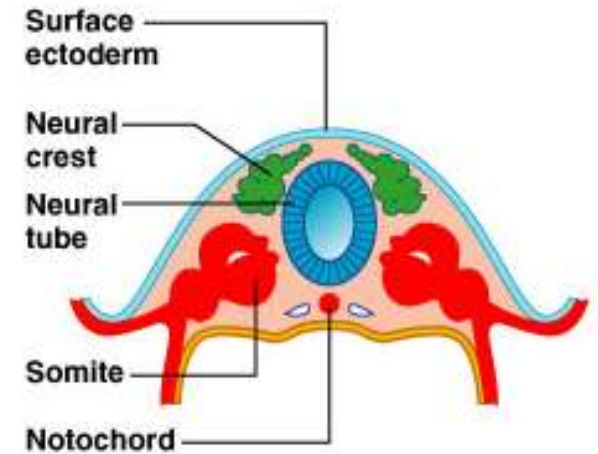
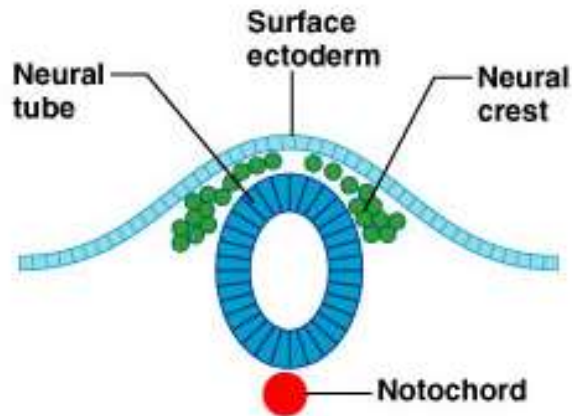
Neurulation

- Notochord signals overlying ectoderm
- Formation begins of spinal cord and brain (neurulation)
- Neural plate to neural groove to neural tube: pinched off into body

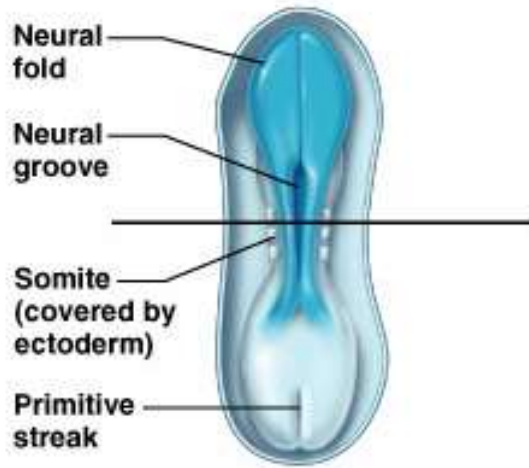




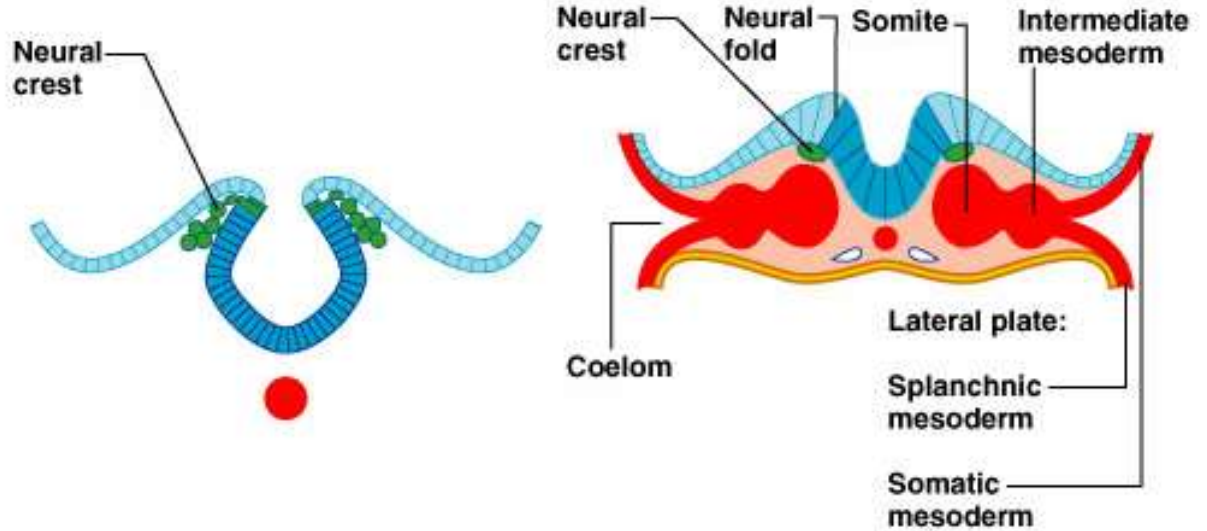
(d) 22 days



- Closure of neural tube: begins at end of week 3; complete by end of week 4 (folic acid important for this step)
- Extends cranially (eventually brain) and caudally (spinal cord)
- Neural crest, lateral ectodermal cells, pulled along and form sensory nerve cells and other structures



(c) 20 days



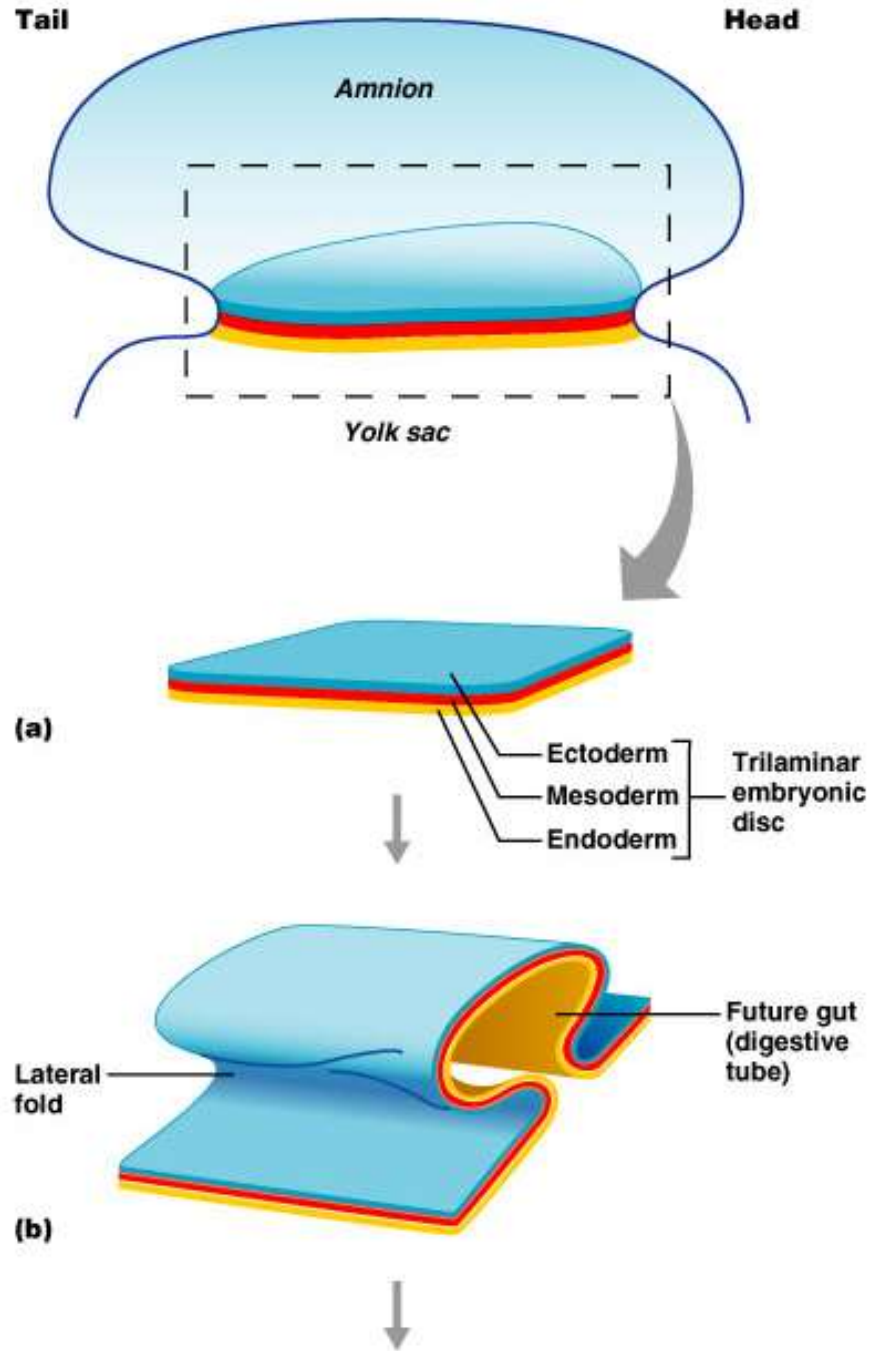
- Mesoderm begins to differentiate
 - Lateral to notochord, week 3
 - Extends cranially and caudally (from head to tail or crown to rump)
- Division of mesoderm into three regions
 - Somites: 40 pairs of body segments (repeating units, like building blocks) by end week 4
 - Intermediate mesoderm: just lateral to somites
 - Lateral plate: splits to form coelom (“cavity”)

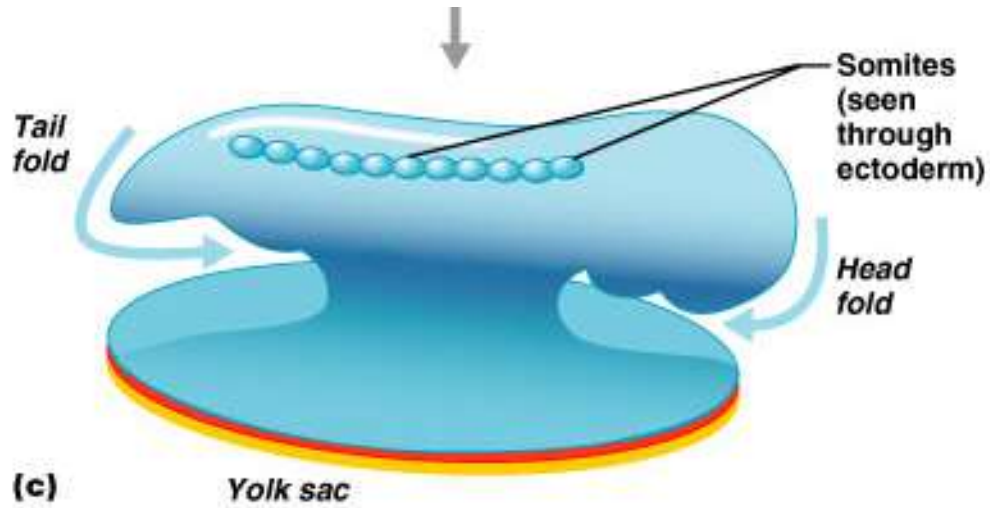
Divisions of the mesodermal lateral plate

- Somatic mesoderm: apposed to the ectoderm
- Splanchnic mesoderm: apposed to the endoderm
- Coelom in between will become the serous cavities of the ventral body cavity:
 - Peritoneal
 - Pericardial
 - Pleural

Folding begins at week 4

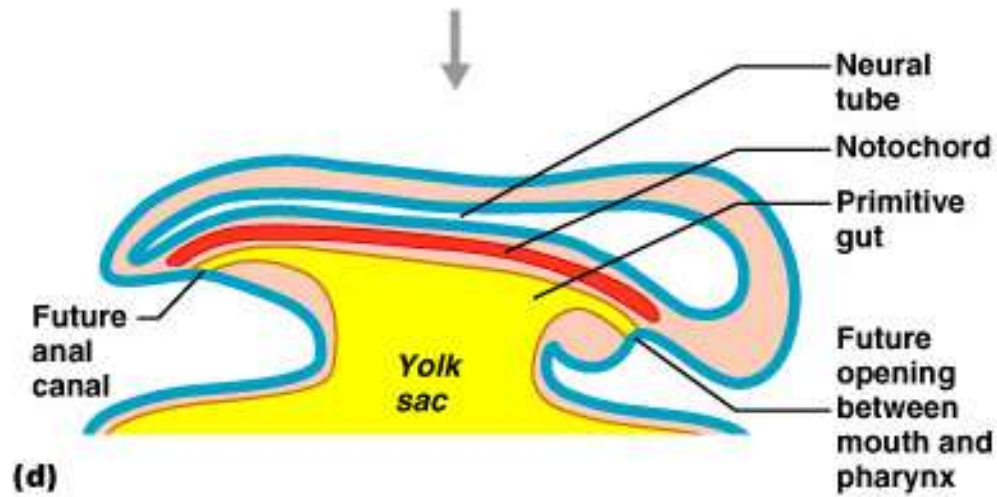
(main difference between the 3 week embryo and the adult body is that the embryo is still a flat disc)





(c)

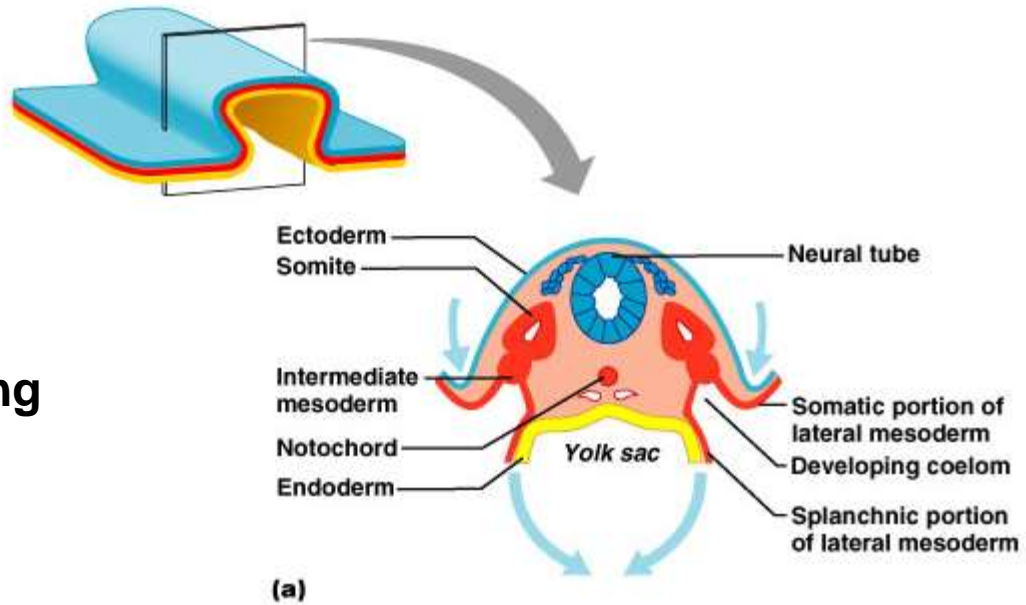
Yolk sac



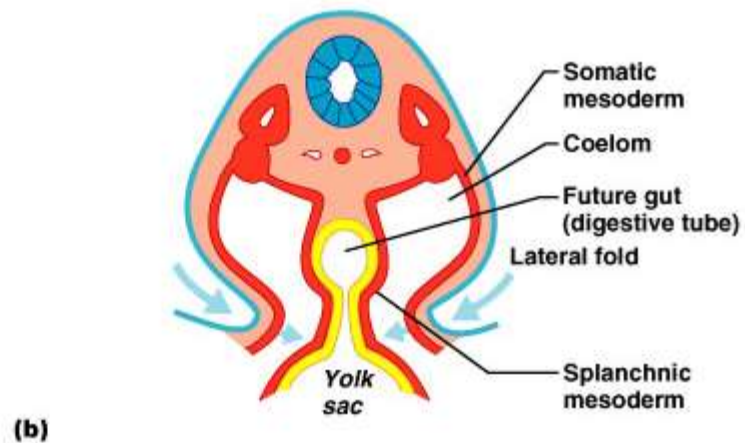
(d)

24 day embryo; protrudes into amniotic cavity

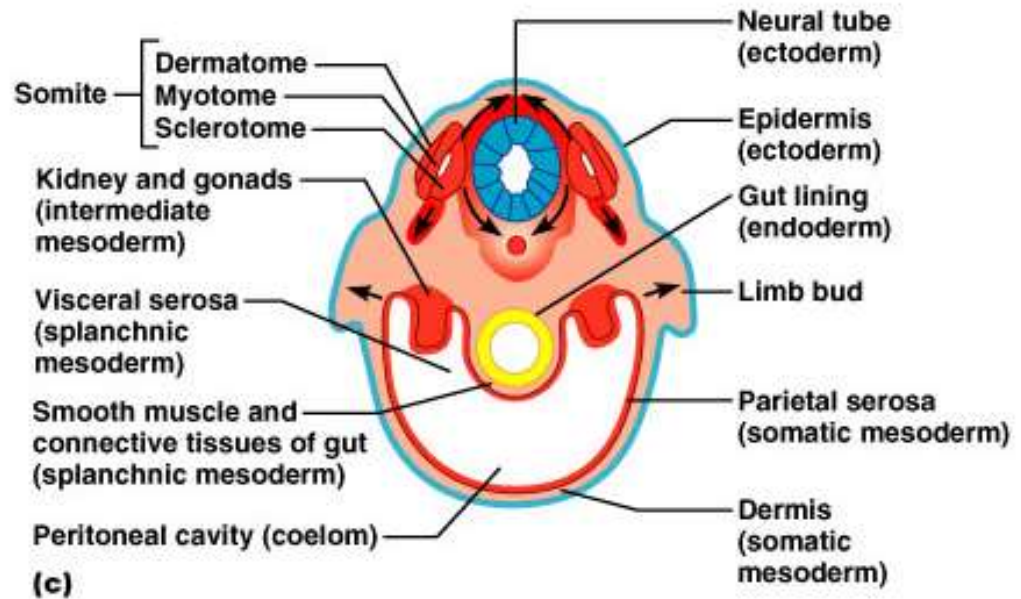
Day 23, beginning to fold



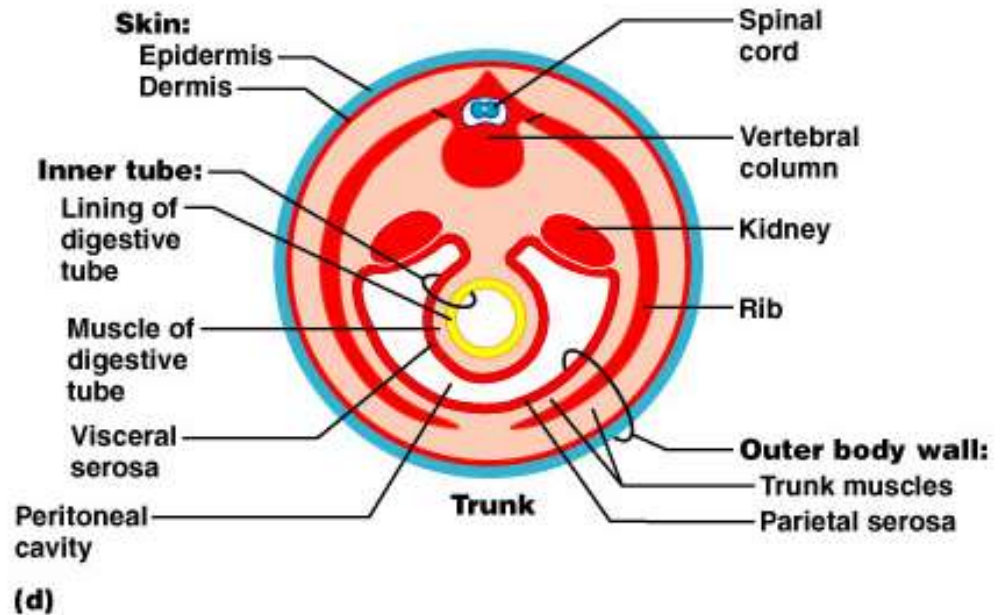
Lateral folds will join ventrally



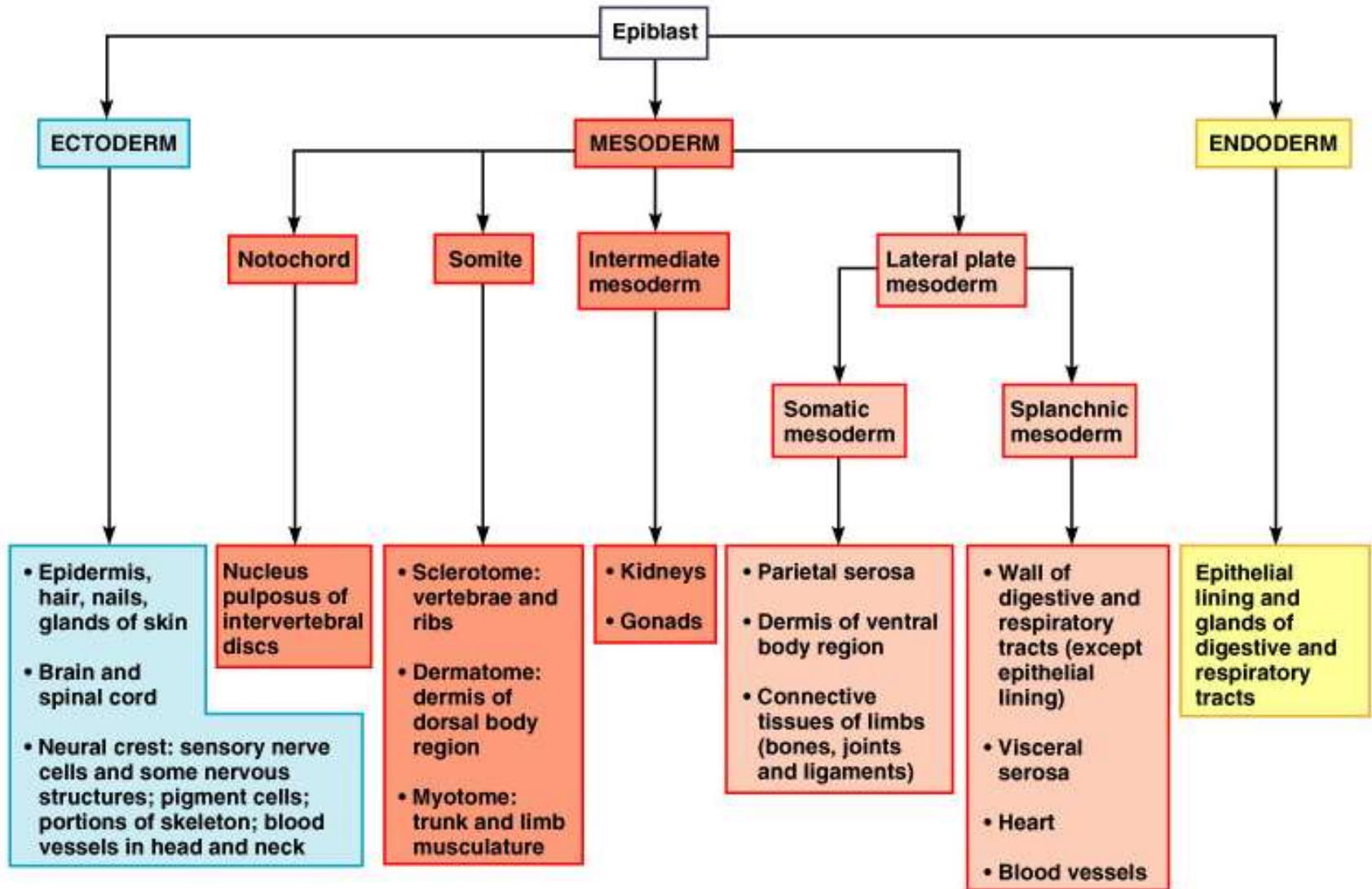
Cylindrical human body plan, day 28 (about 1/2 cm)



Simplified cross section through abdomen of an adult (essentially the same as above)

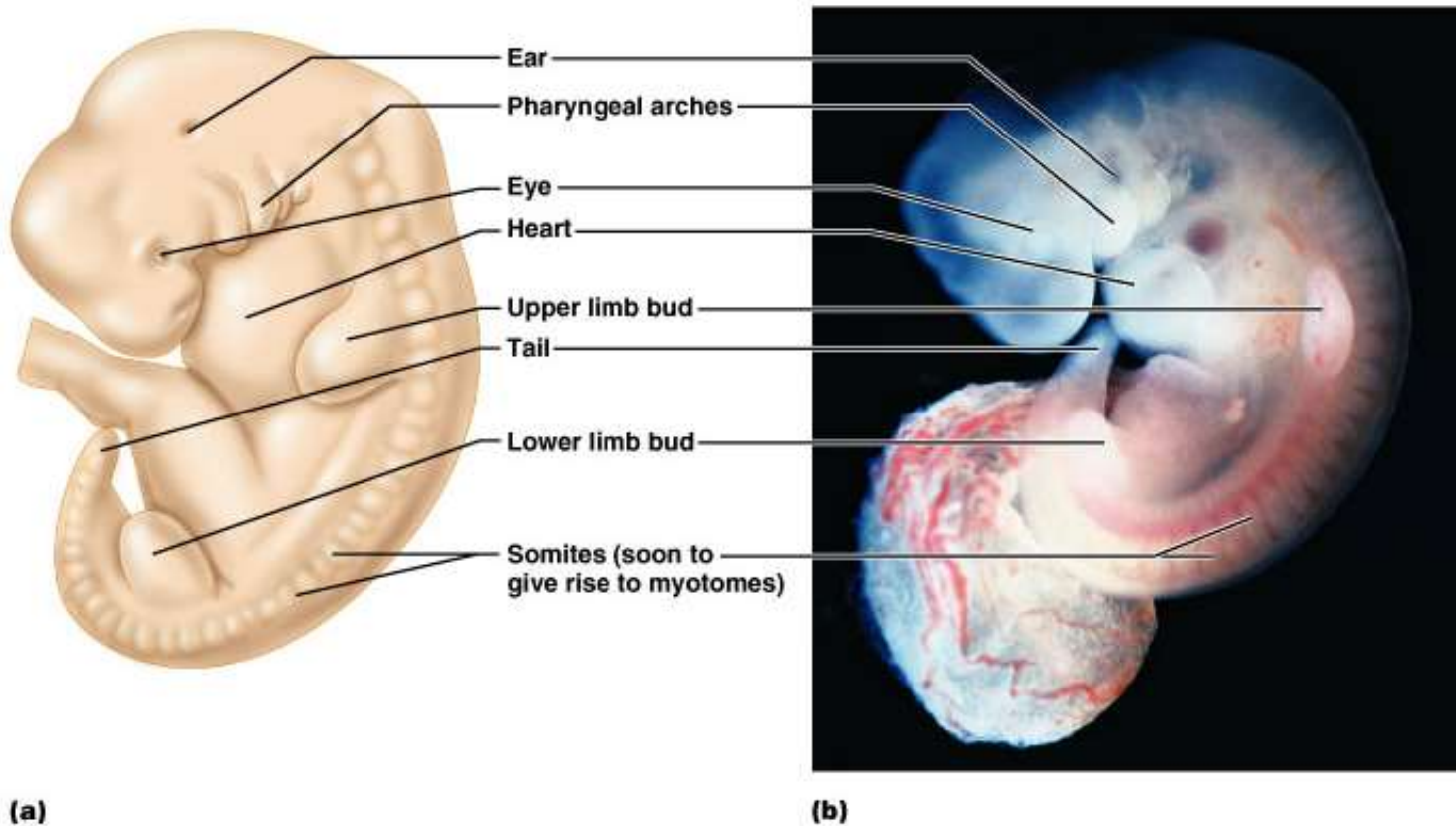


Major derivatives of the embryonic germ layers



29 day embryo

(this is when the heart starts pumping, about 4 weeks or 1 month, 1/2 cm size)



**3 month fetus
(6 cm)**



(a)

**late 5th month
(about 19 cm)**

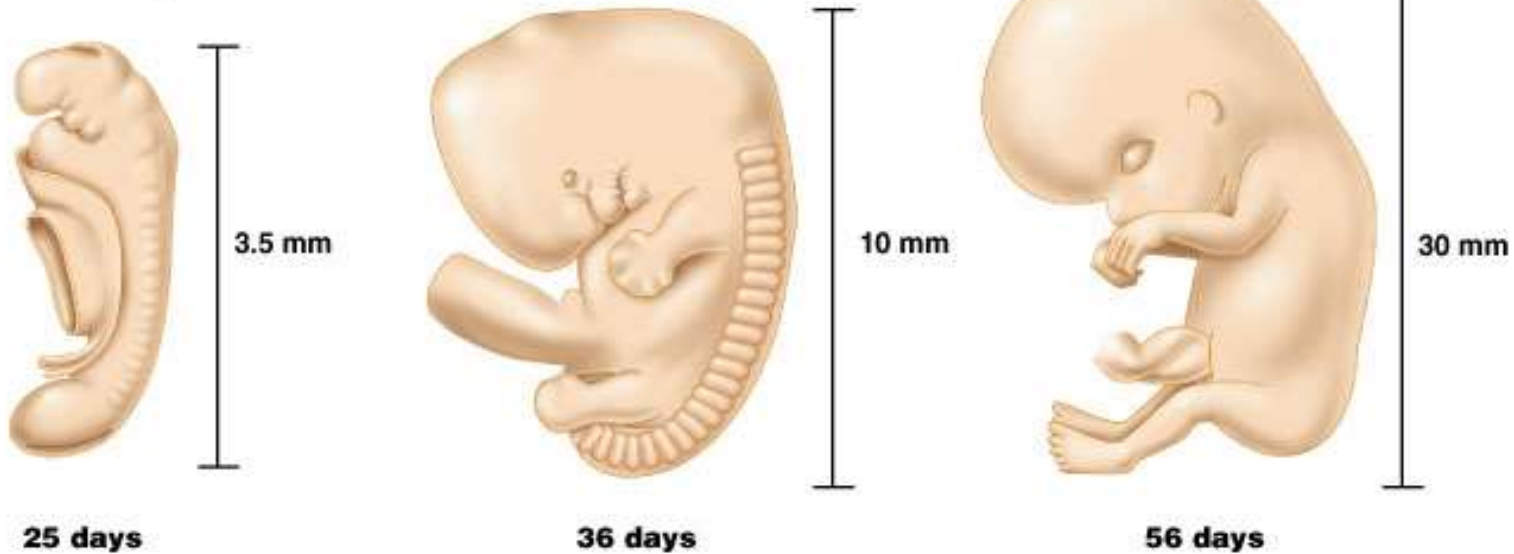


(b)

Embryonic Period

Duration: First 8 weeks after conception.

Major embryological events:
Organs form from three primary germ tissues.
Emergence of the basic body plan.



By 8 weeks, about 2 months, all major organs are in place in at least a rudimentary form; this is why drugs early in pregnancy are so important to avoid – many cause birth defects; baby is a little over 1" long (below right)

Fetal Period

Duration: Weeks 9 to 38 after conception (or until birth).

Major fetal events: Organs grow in size and complexity.



20-week fetus



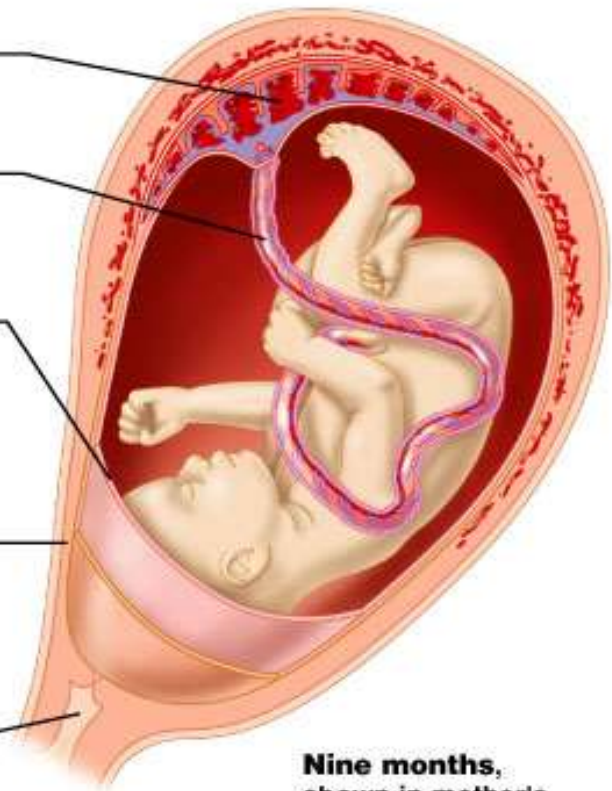
Placenta

Umbilical cord

Amnion

Wall of uterus

Vagina



Nine months,
shown in mother's
womb (uterus)