

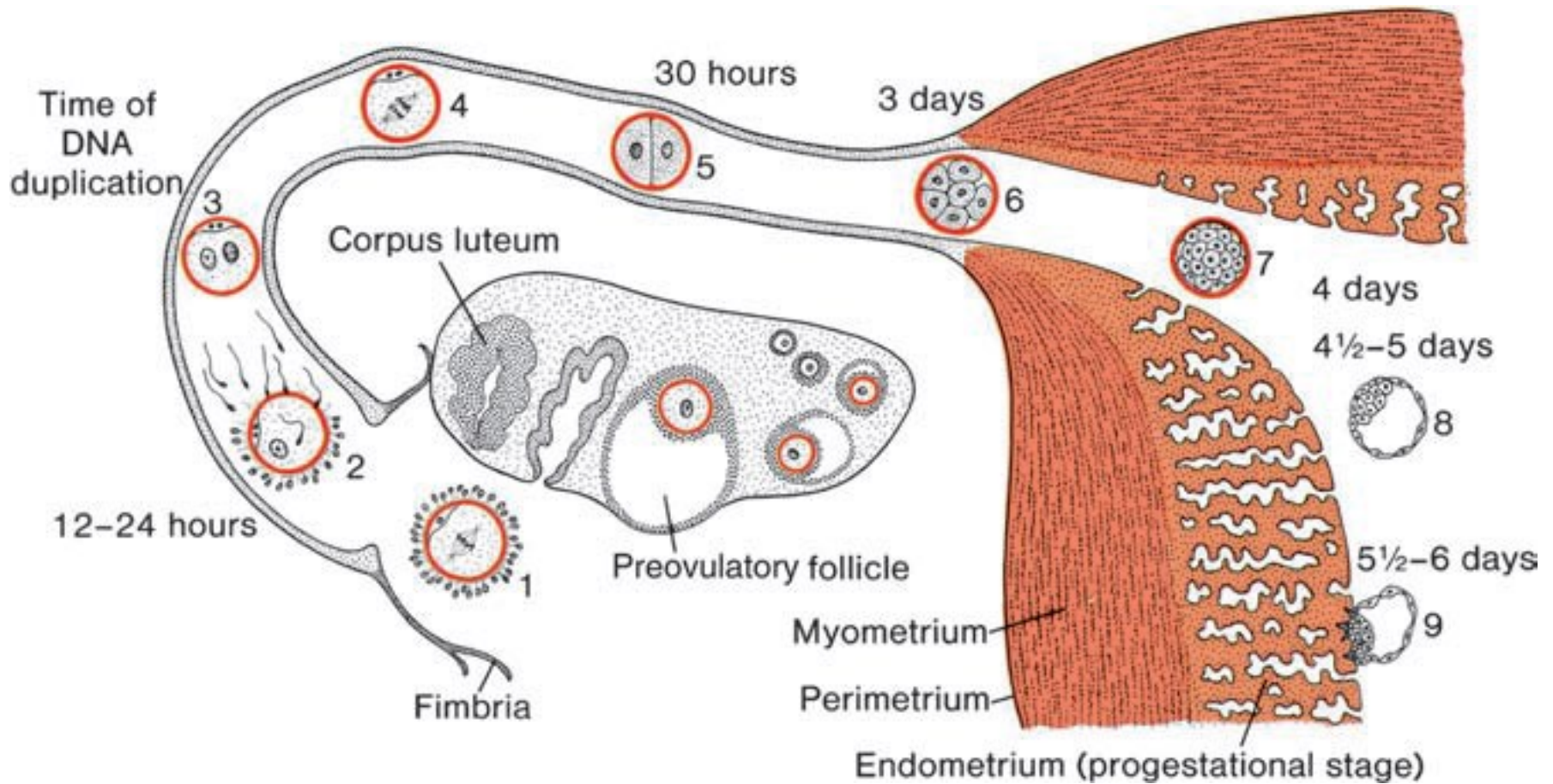
Fetal membranes, umbilical cord.
Structure of the placenta,
placental circulation.

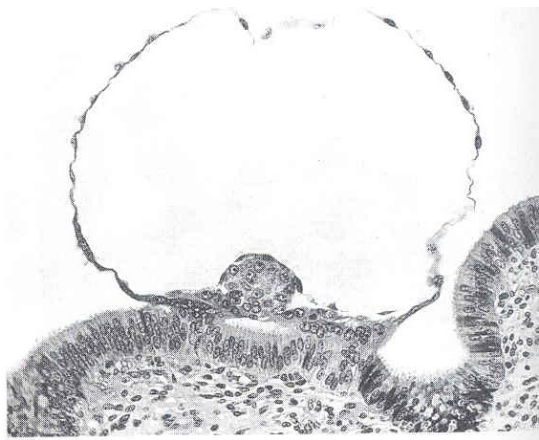
Emese Pálfi

Semmelweis University

Department of Anatomy, Histology and Embryology

1. week Fertilization → Implantation

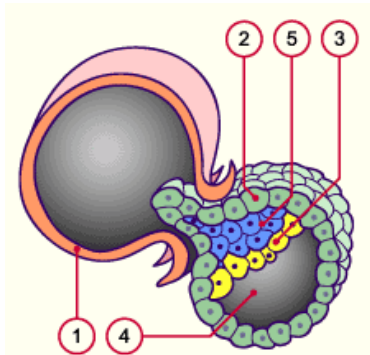




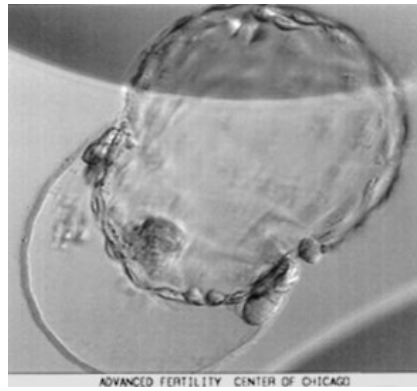
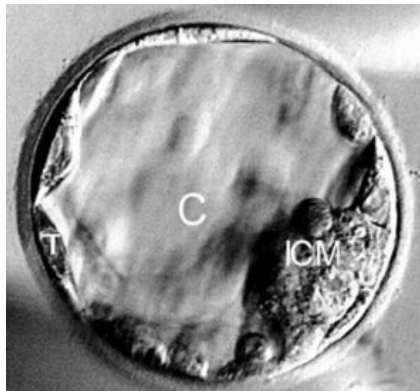
Criteria of implantation:

- Blastula (stage)
- Uterus (endometrium: 19-24. day, „window“)

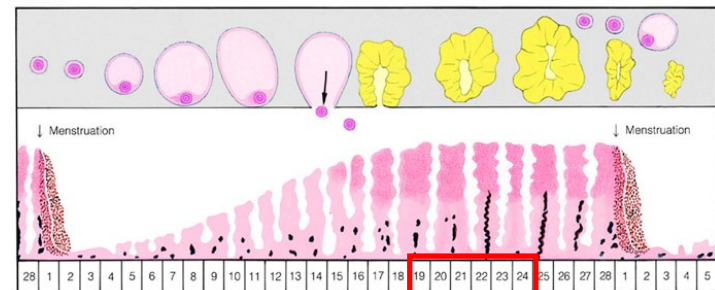
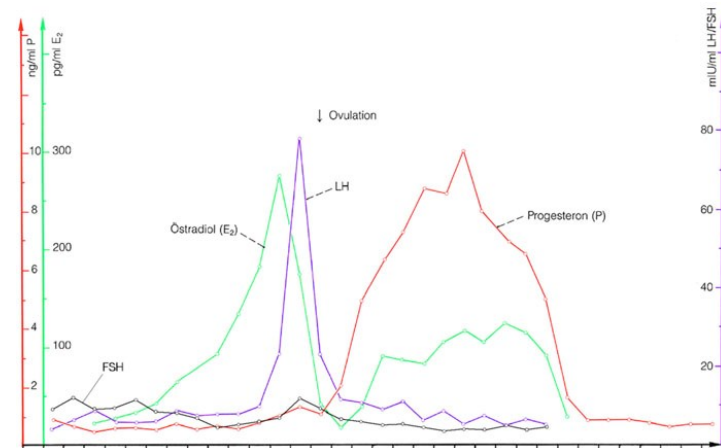
Blastocyst



1. ZP
2. Trophoblast
3. Hypoblast
4. Blastocyst cavity
5. ICM

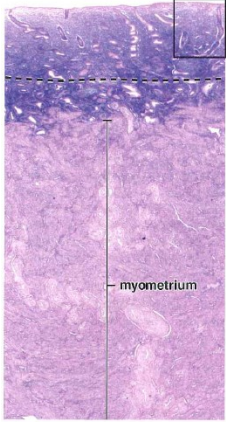


Endometrium

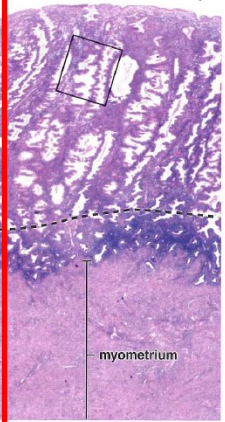


Endometrium – secretory phase

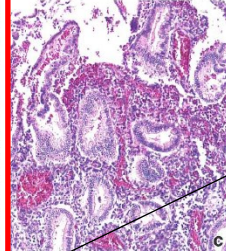
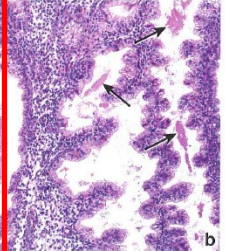
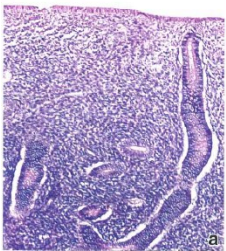
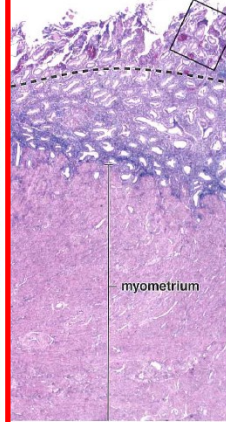
1. Proliferative



2. Secretory

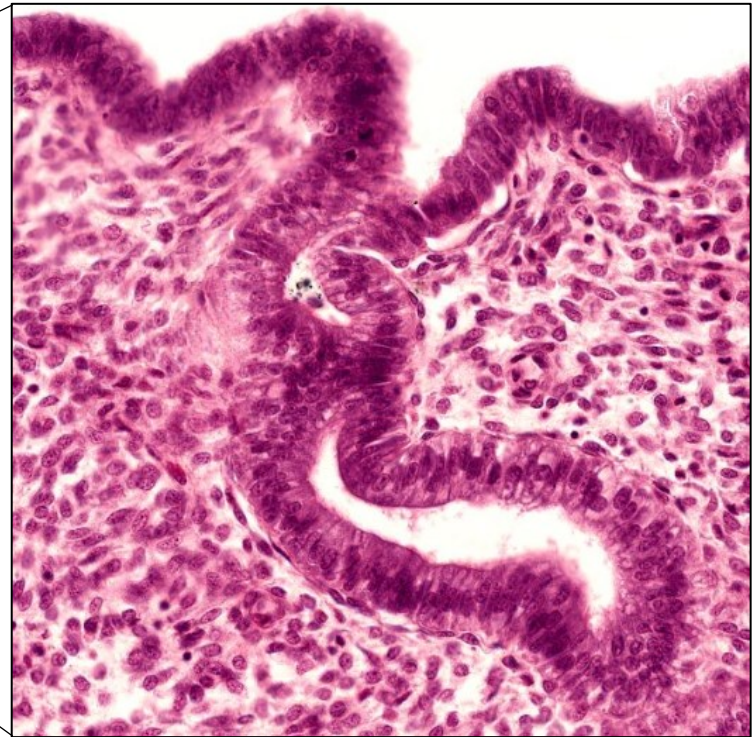
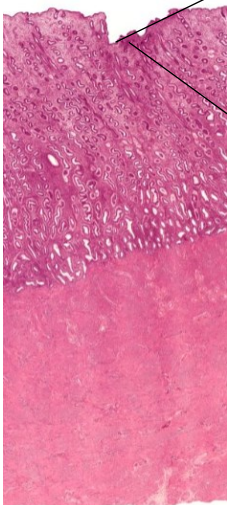


3. Menstrual



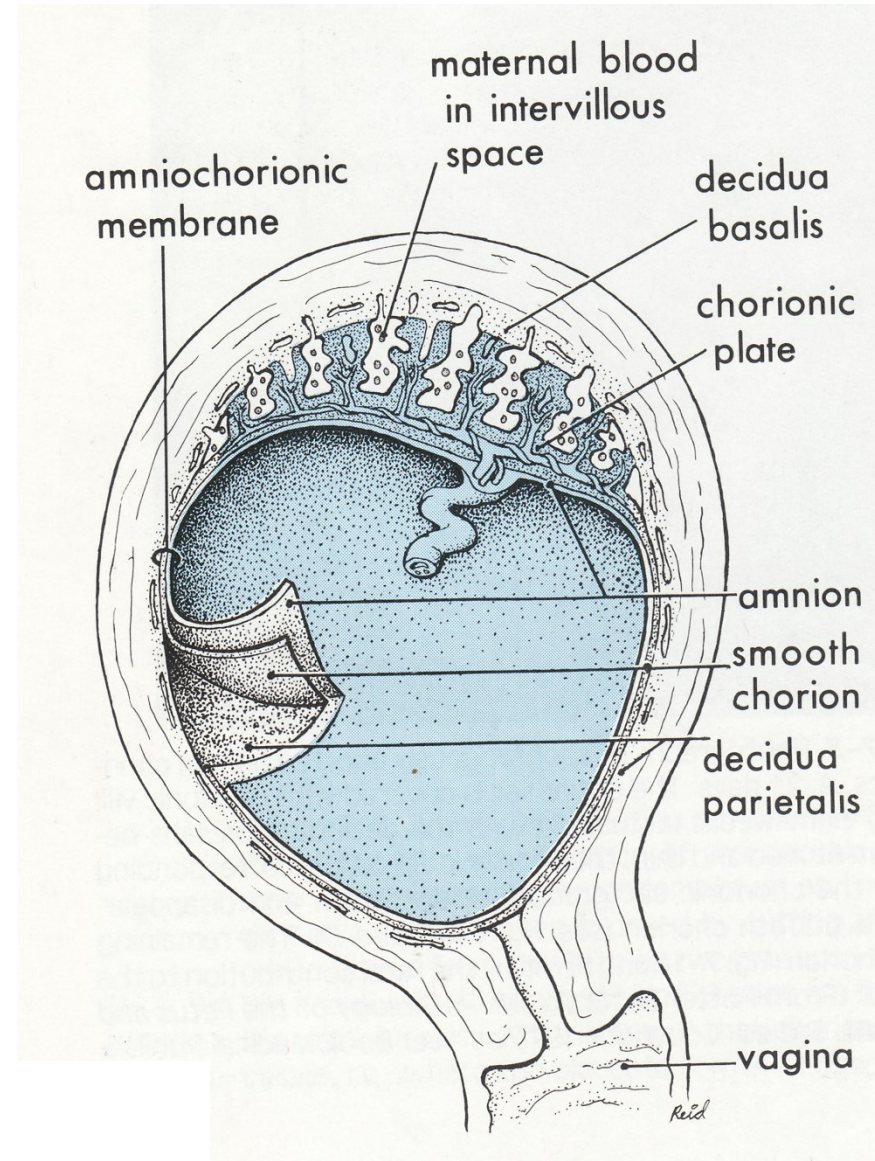
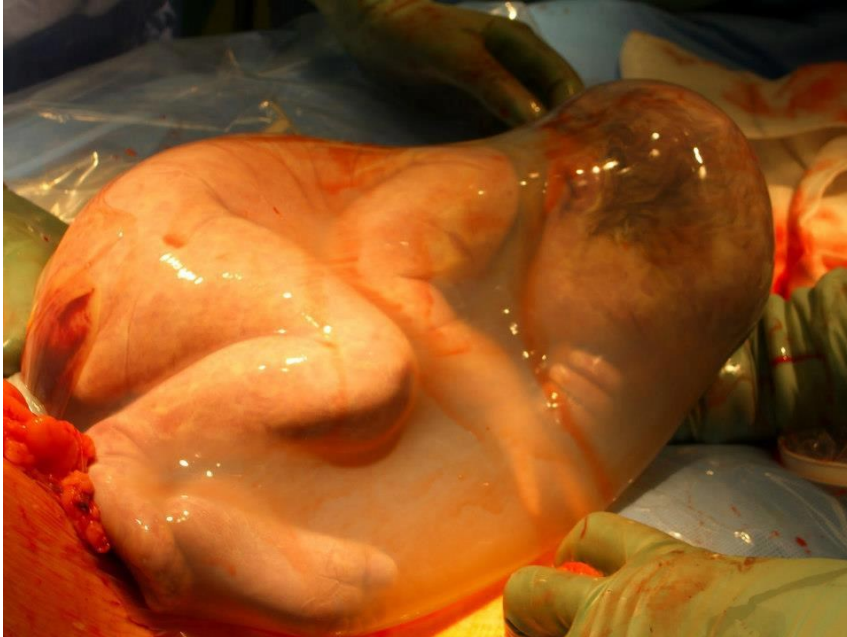
Stratum functionale:

- decidual transformation (enlargement of the stroma cells → pseudodecidua cells)



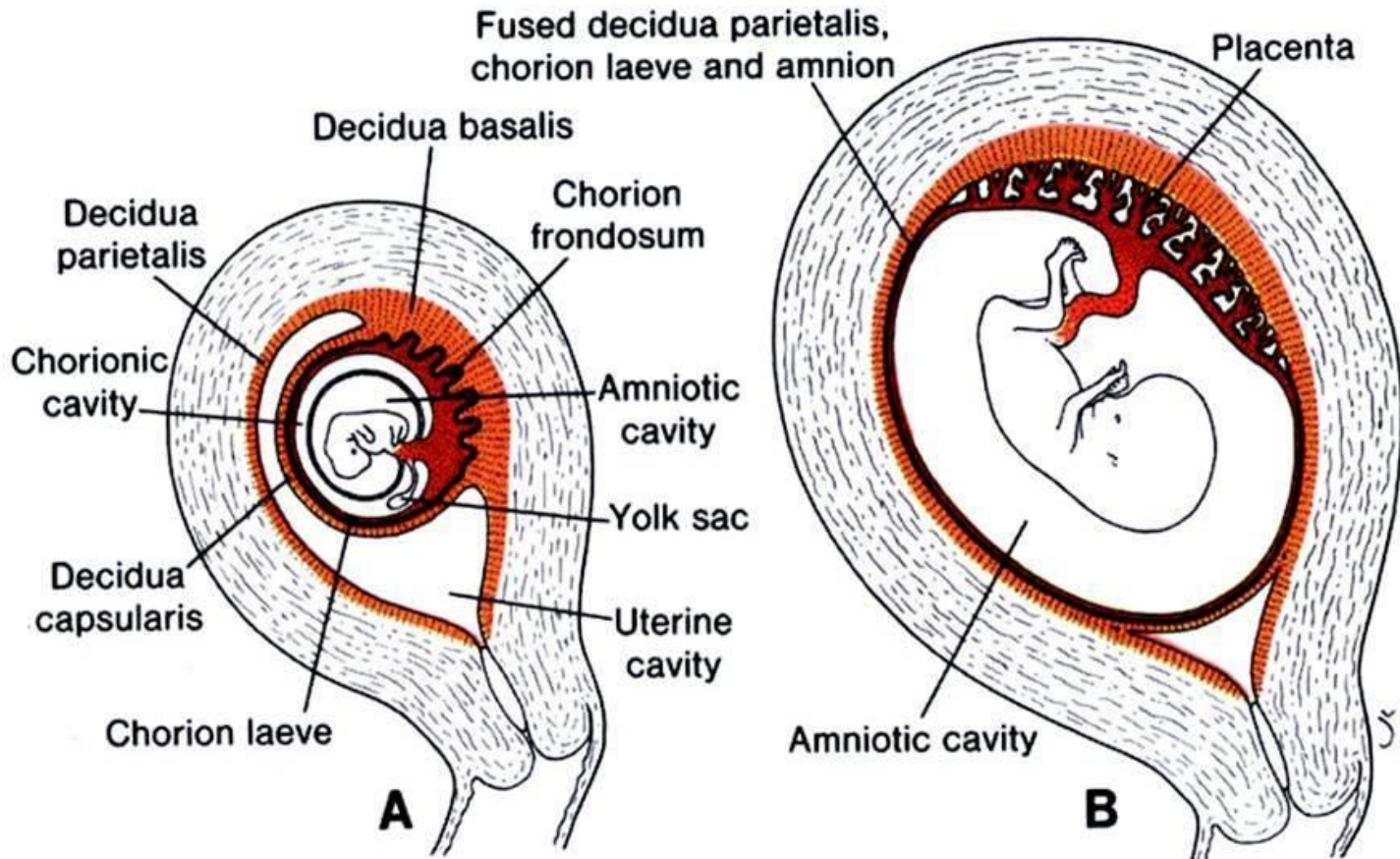
Fetal membranes

- Decidua
- Chorion
- Amnion
- Yolk sac
- Allantois

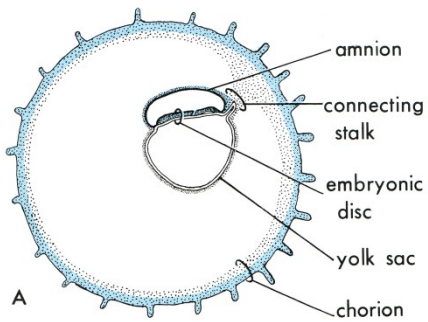


Decidua

- decidua basalis
- decidua capsularis
- decidua parietalis



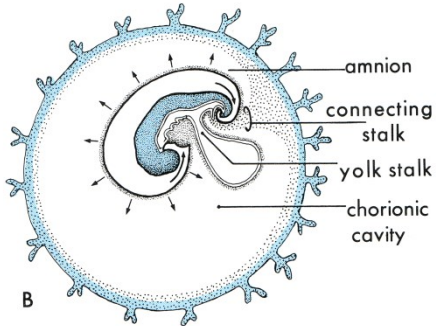
Amnion and amniotic fluid



- Amnion is attached to the embryonic disc

→ obliterates the chorionic cavity

→ enfolds the umbilical cord



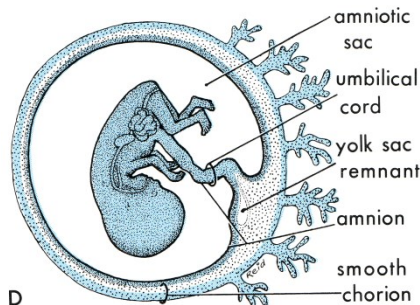
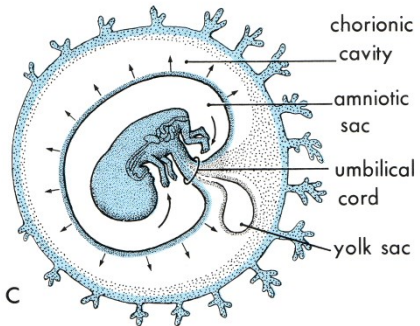
- Amniotic fluid

- secreted by the amniotic cells, maternal interstitial fluid, fetal respiratory tract, urine of the fetus

- exchange in every 3 hours (also swallowed by the fetus)

- clinical relevance: *oligohydraminos*, *polyhydraminos*

amniocentesis



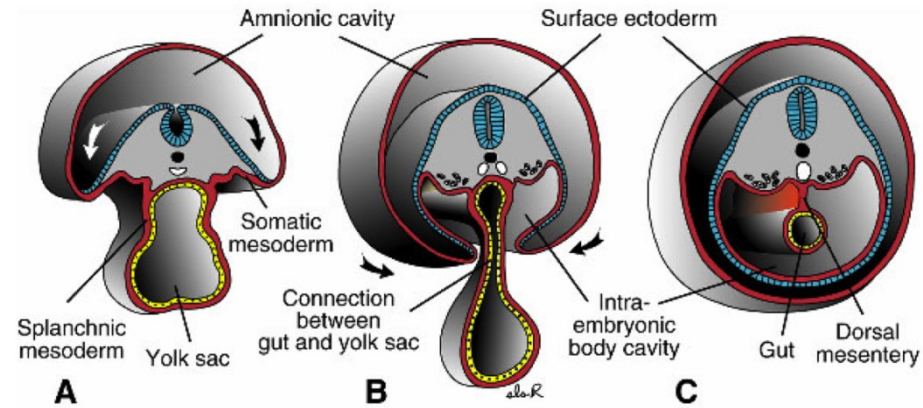
1. Permits symmetrical external growth
2. Enables free movement
3. Permits normal fetal lung development
4. Acts as barrier to infections
5. Cushions embryo against injuries
6. Control the embryo's body temperature
7. Prevents adherence of amnion

Yolk sac

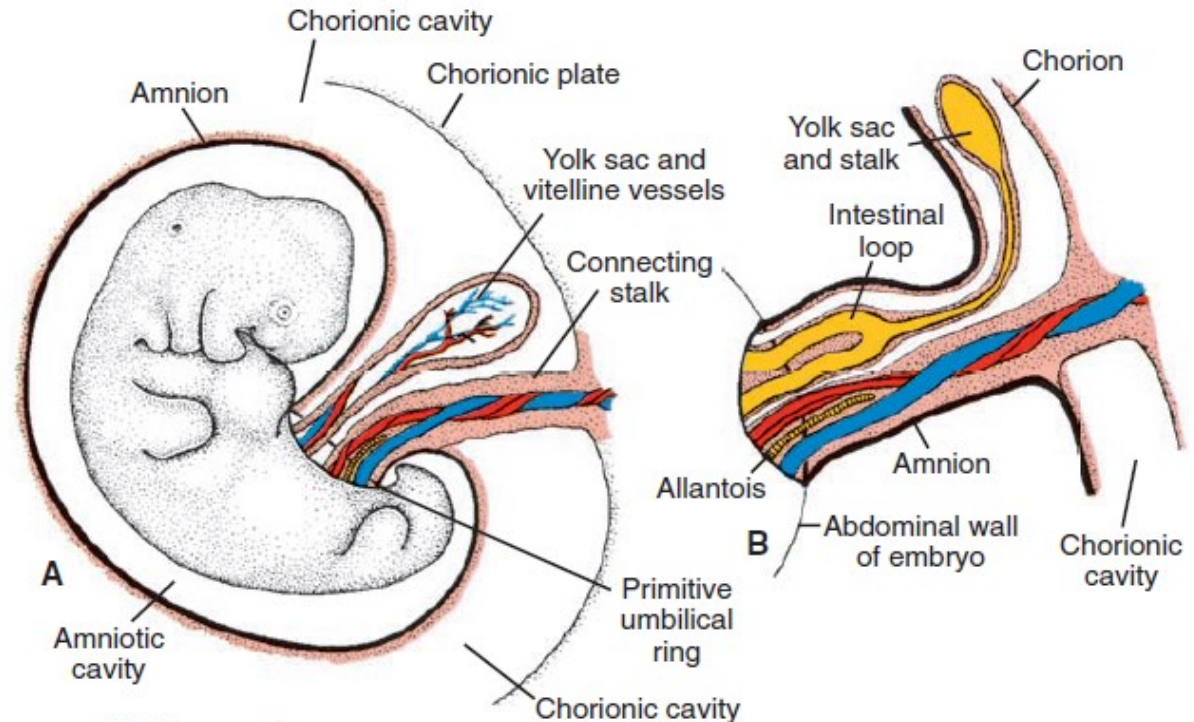
- Nonfunctional in human
- Atrophies during pregnancy

detaches from the midgut loop
in the 6. week

ileal diverticulum/Meckel's
diverticulum (2% of adults)

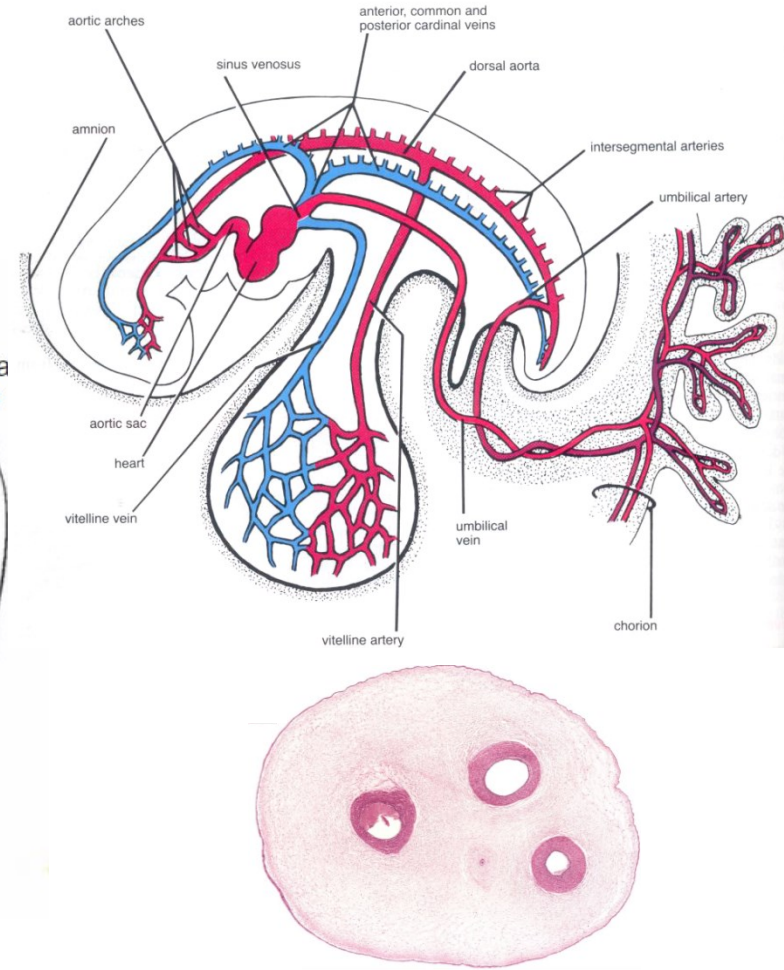
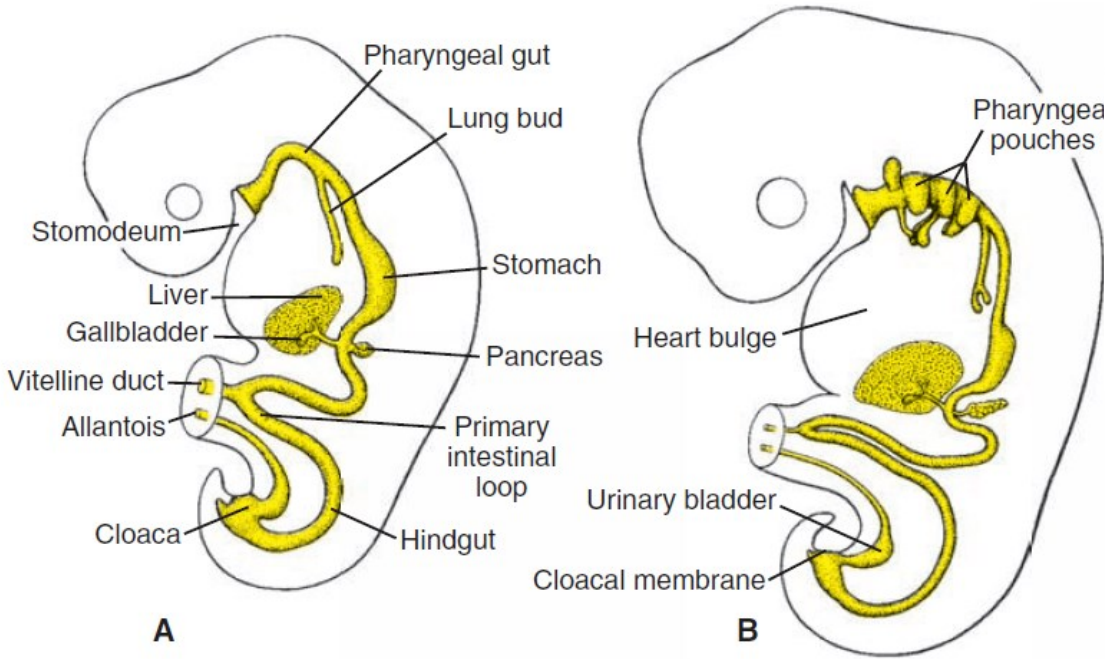


1. Transfer of nutrients to the embryo (2-3 weeks)
2. Blood development
3. Dorsal part is incorporated → GI tract
4. Primordial germ cells appearing in the wall



Allantois

- Nonfunctional in human
- Extraembryonic umbilical portion degenerates in the 2. month

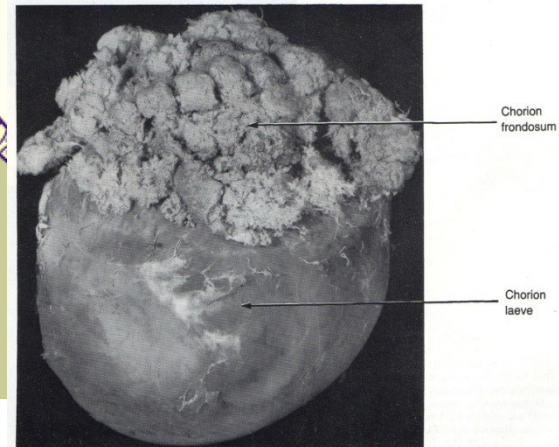
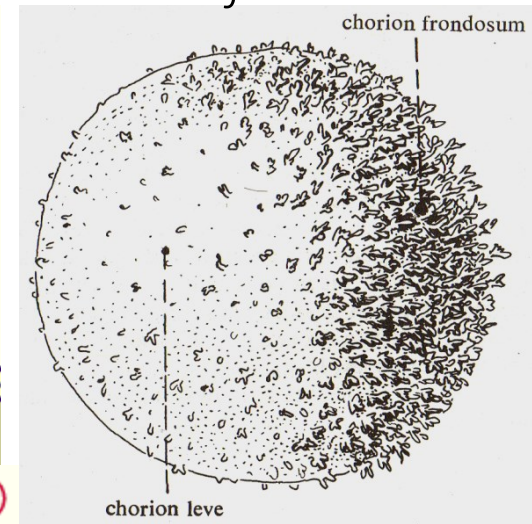
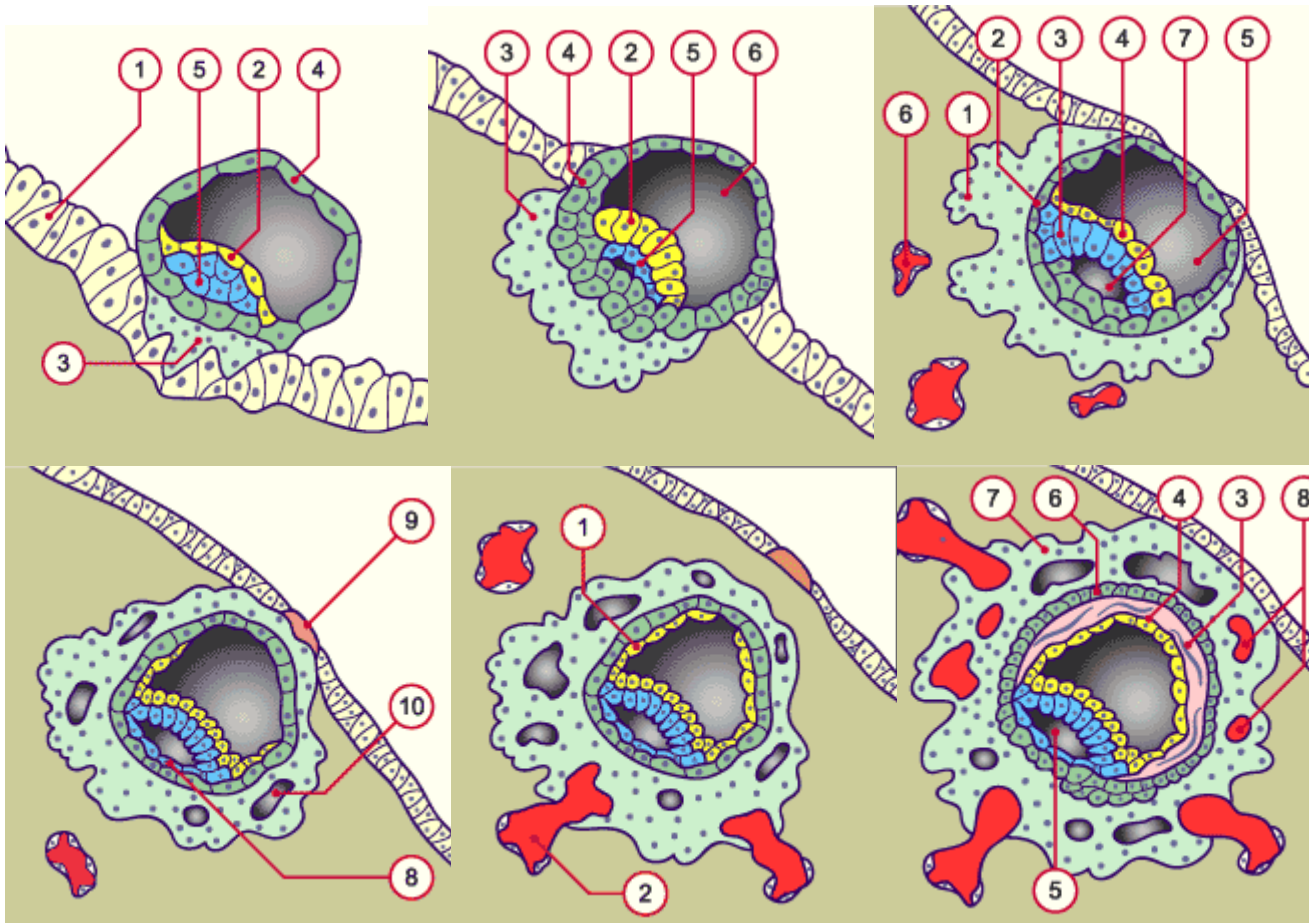


1. Blood formation during the 3-5. week
2. Its vessels become the umbilical vessels
3. Fluid from the amniotic cavity diffuses into the umbilical vein
4. The intraembryonic portion runs from the umbilicus to the urinary bladder
→ urachus

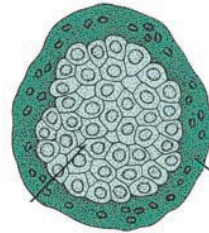
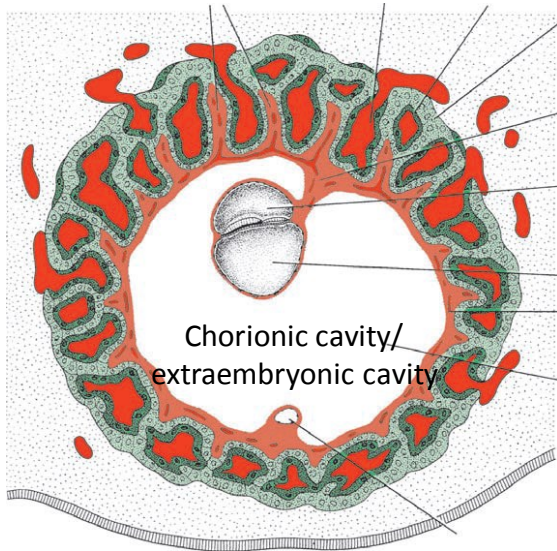
Chorion

2. week

8. week
 smooth chorion/
chorion laeve
 villous chorion/
chorion frondosum

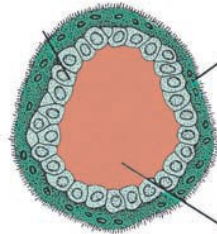


Development of the trophoblast

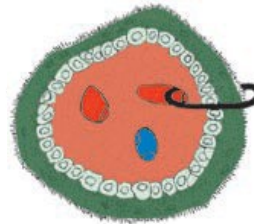


Primary villus

12-14. day

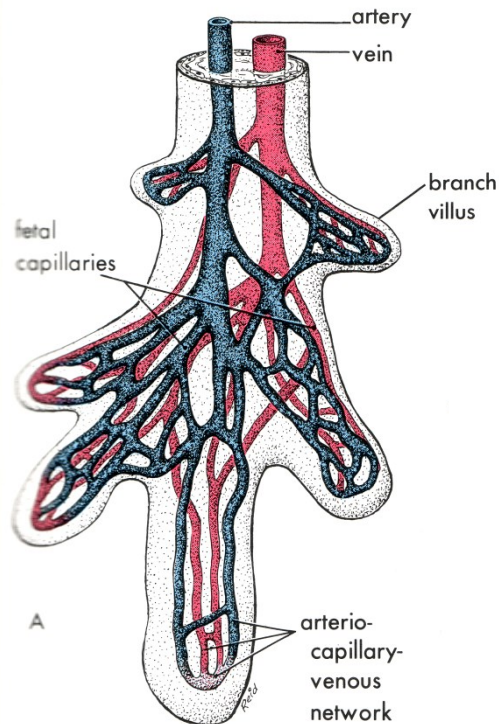
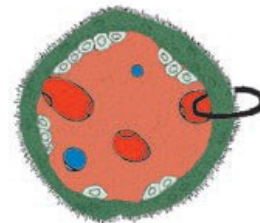


Secondary villus



Tertiary villus

End of the 3. week - 20. week



Placental barrier

→ waste products

RBC antigens

← nutrients

antibodies, vitamins, IgG

harmful substances (drugs, alcohol)

nontransferable substances

(heparin, bacteria, IgS, IgM)

Placenta

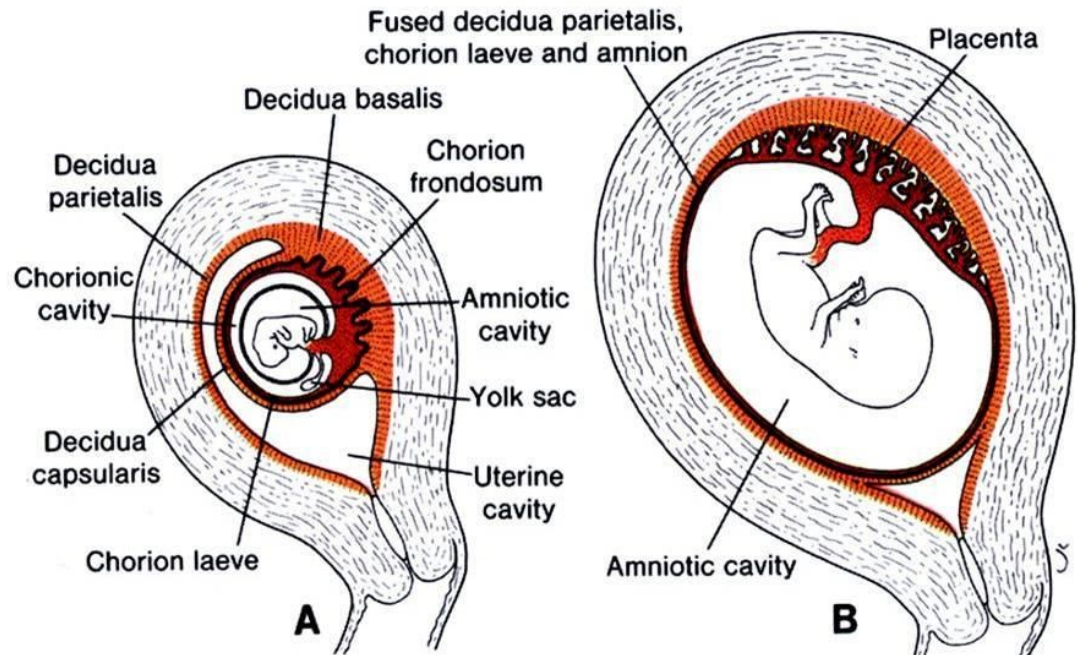
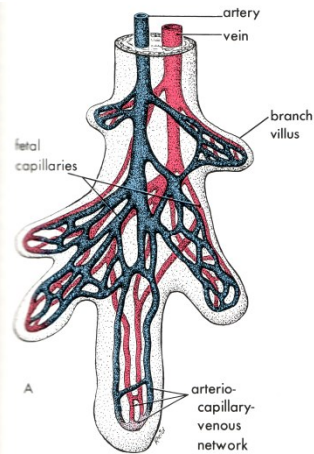
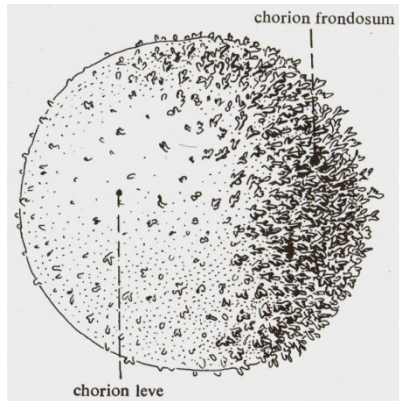
Fetal part

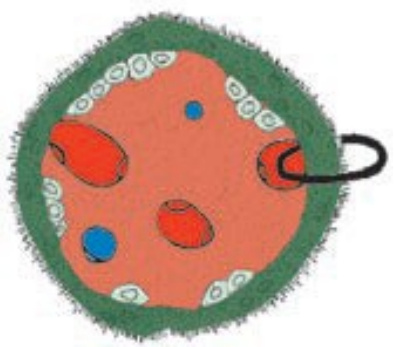
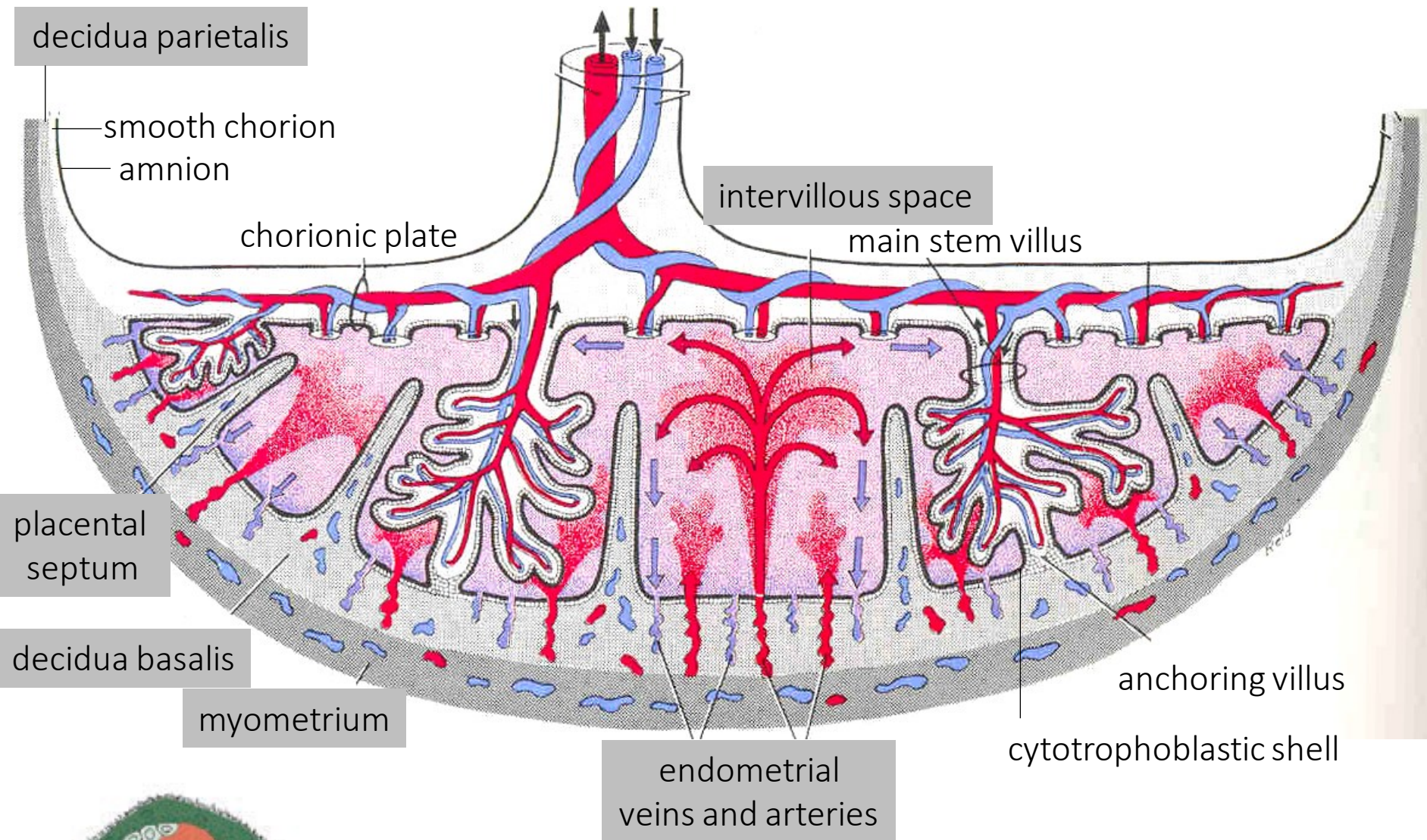
Amnion: covers the fetal part
simple cuboidal epithelium

Chorion: chorionic plate
chorionic villi

Maternal part

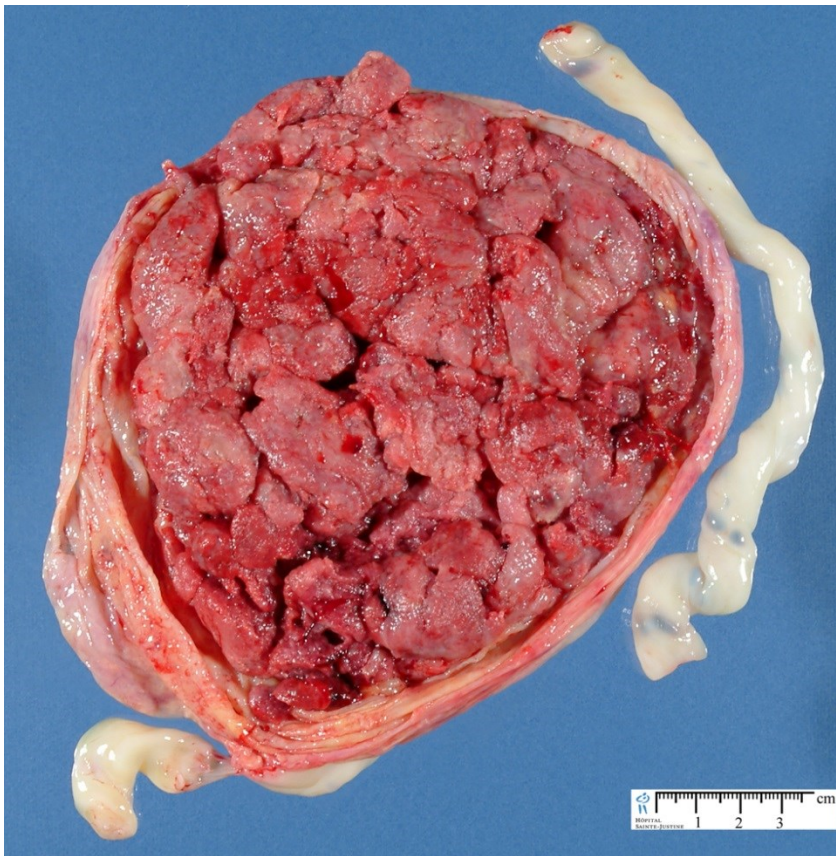
Decidua basalis
Placental septums





Haemochorial placenta

syncytiotrophoblast- fused basal membrane - endothel
 surface area of chorionic villi 4-14 m²



Transport

- passive diffusion:
 - O_2 , CO_2 , water, lipids, steroids
- facilitated diffusion:
 - glucose, aminoacids
- active transport:
 - proteins (Ig)
- pinocytosis

Metabolism

glycogen, cholesterol, fatty acids

Endocrine secretion

hCG (human chorion gonadotropin hormon)
 progestins
 estrogens
 somatomammotrop hormon

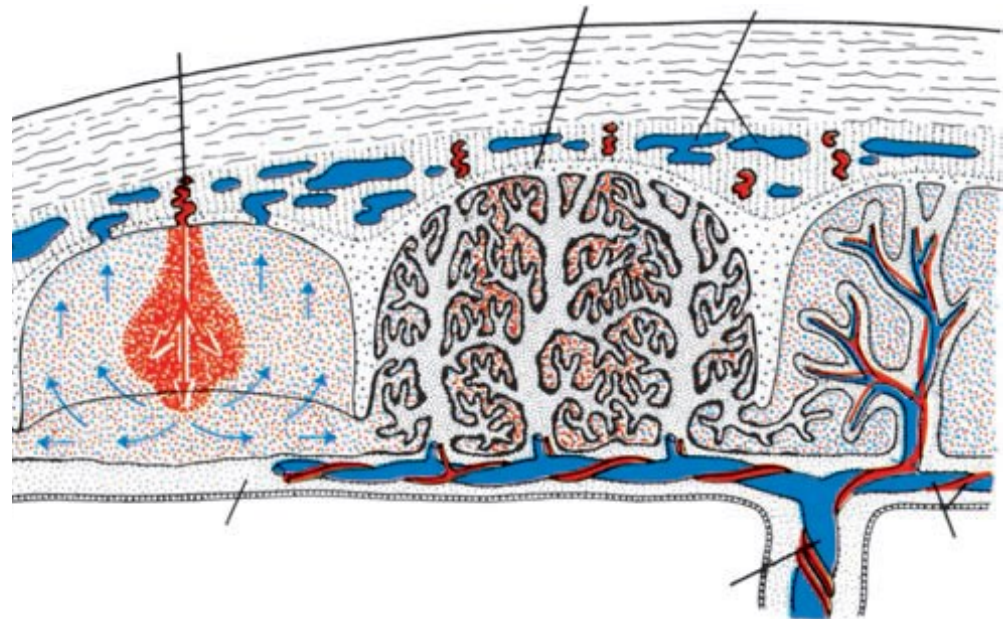
Placental circulation

Fetal placental circulation

- poorly oxygenated blood in the umbilical arteries
- branches in the chorionic plate
- arteriocapillary-venous system within the villi
- exchange of metabolic and gaseous products between maternal and fetal blood
NO INTERMINGLING OF FETAL AND MATERNAL BLOOD
- well-oxygenated blood passes into the veins
- umbilical vein carries the blood to the fetus

Maternal placental circulation

- 80-100 spiral arteries are opening in the intervillous space
 - endovascular invasion by cytotrophoblast cells
 - gaps on the cytotrophoblastic shell
- pulsatile flow
- the blood returns to the endometrial veins
- ~150 ml blood in the intervillous space, replenished 3-4 times/minute



Histology of the placenta



amnionepithel



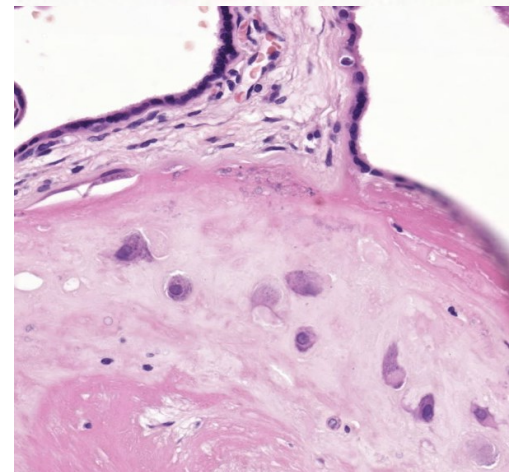
chorionic plate with umbilical vessels

tercier villi

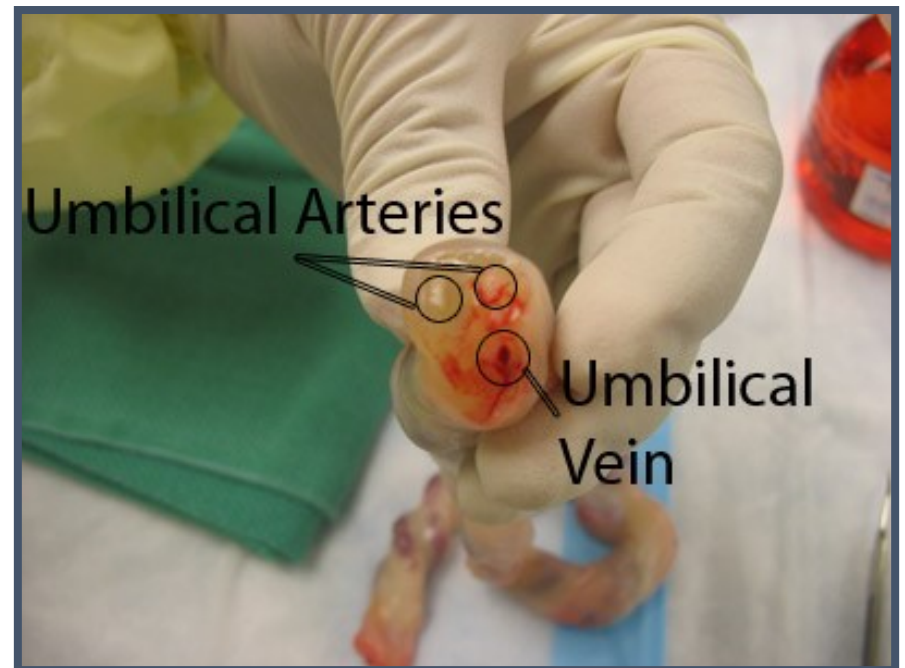


maternal septum

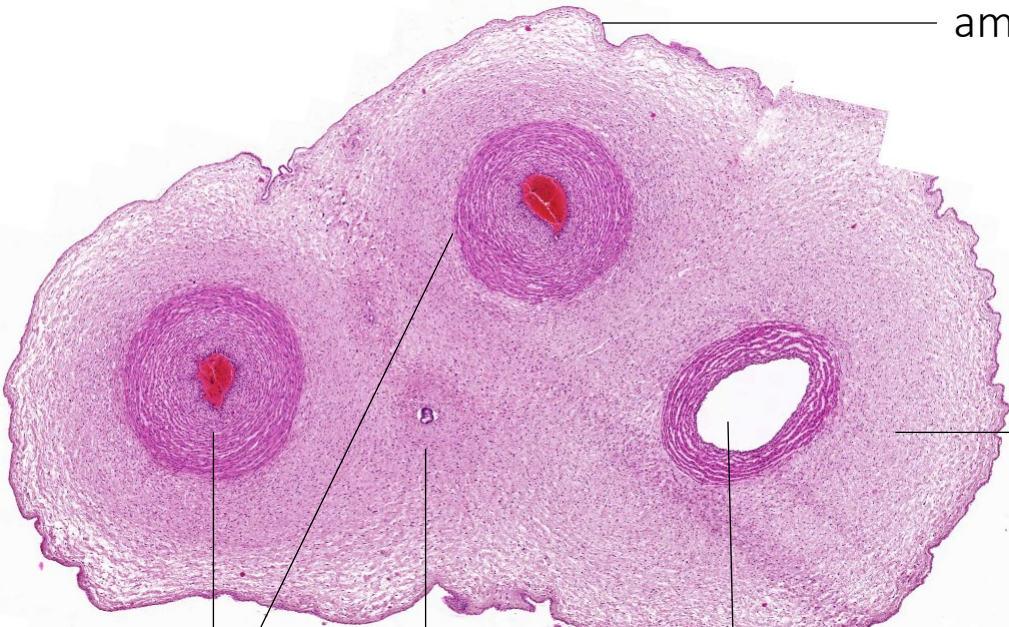
decidua basalis



Umbilical cord



Histology of the umbilical cord



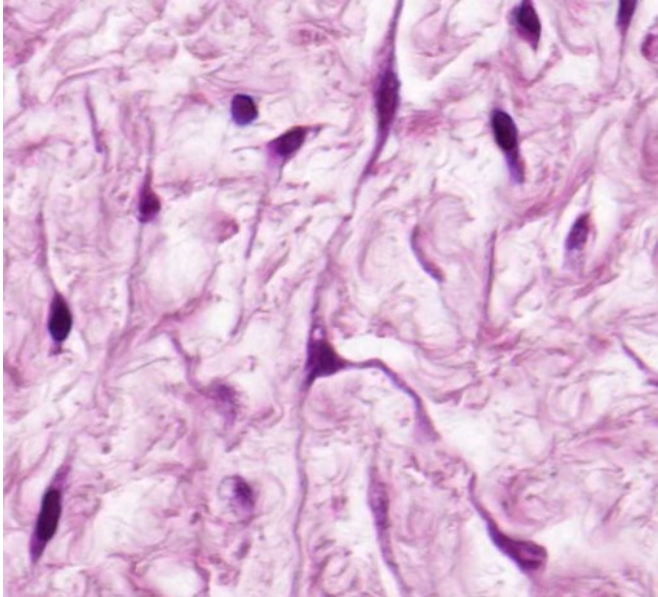
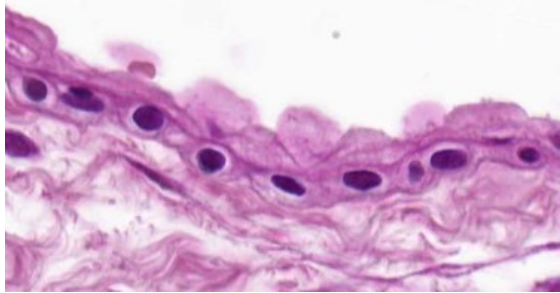
amnionepithel

arteries

urachus

vein

Wharton's jelly

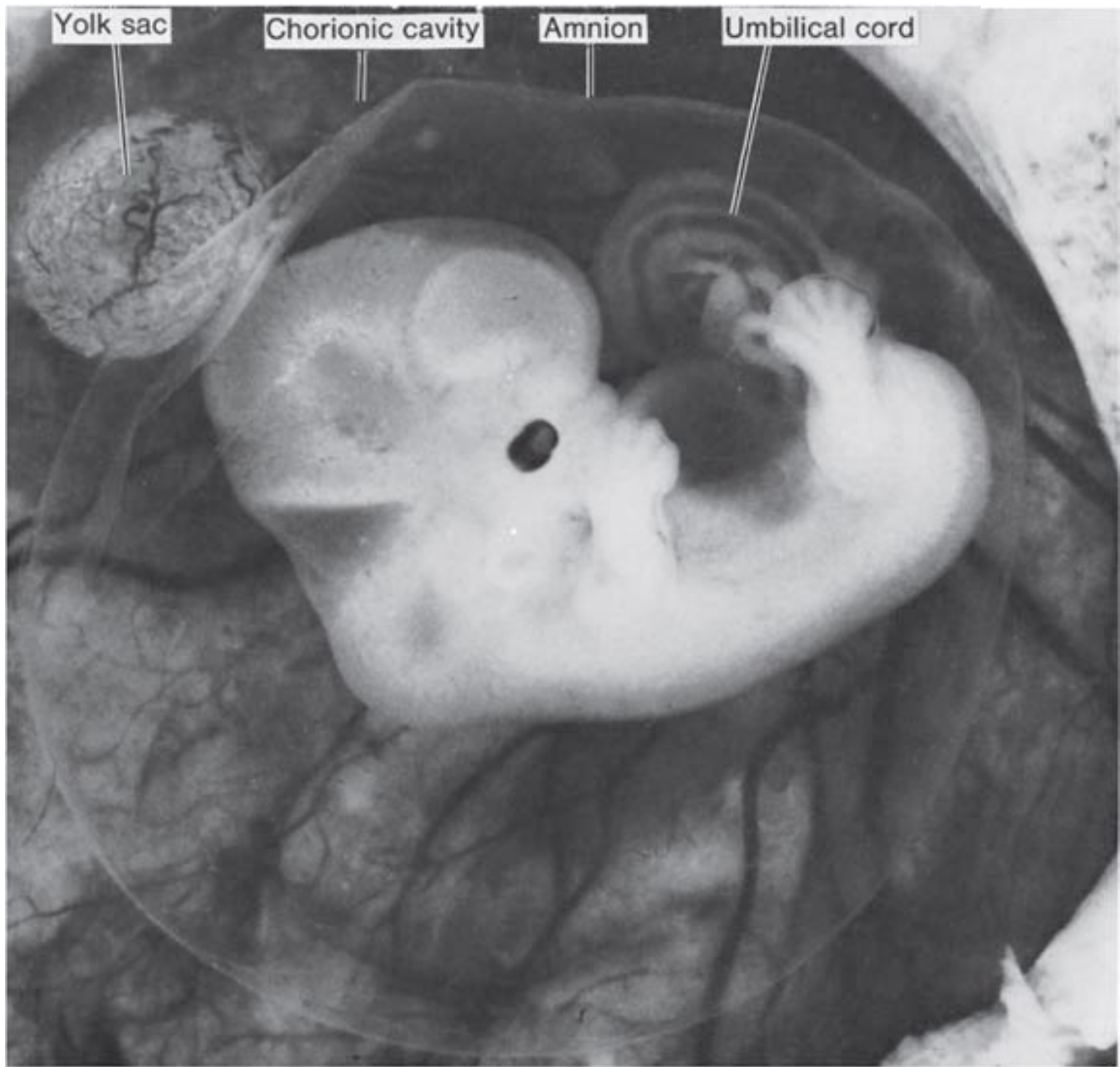


Yolk sac

Chorionic cavity

Amnion

Umbilical cord



János Hanics: Fetal membranes, Placenta

Andrea Székely: Placenta

Langman: Medical embryology (12th edition)

Moore and Persaud: The developing human (5th edition)