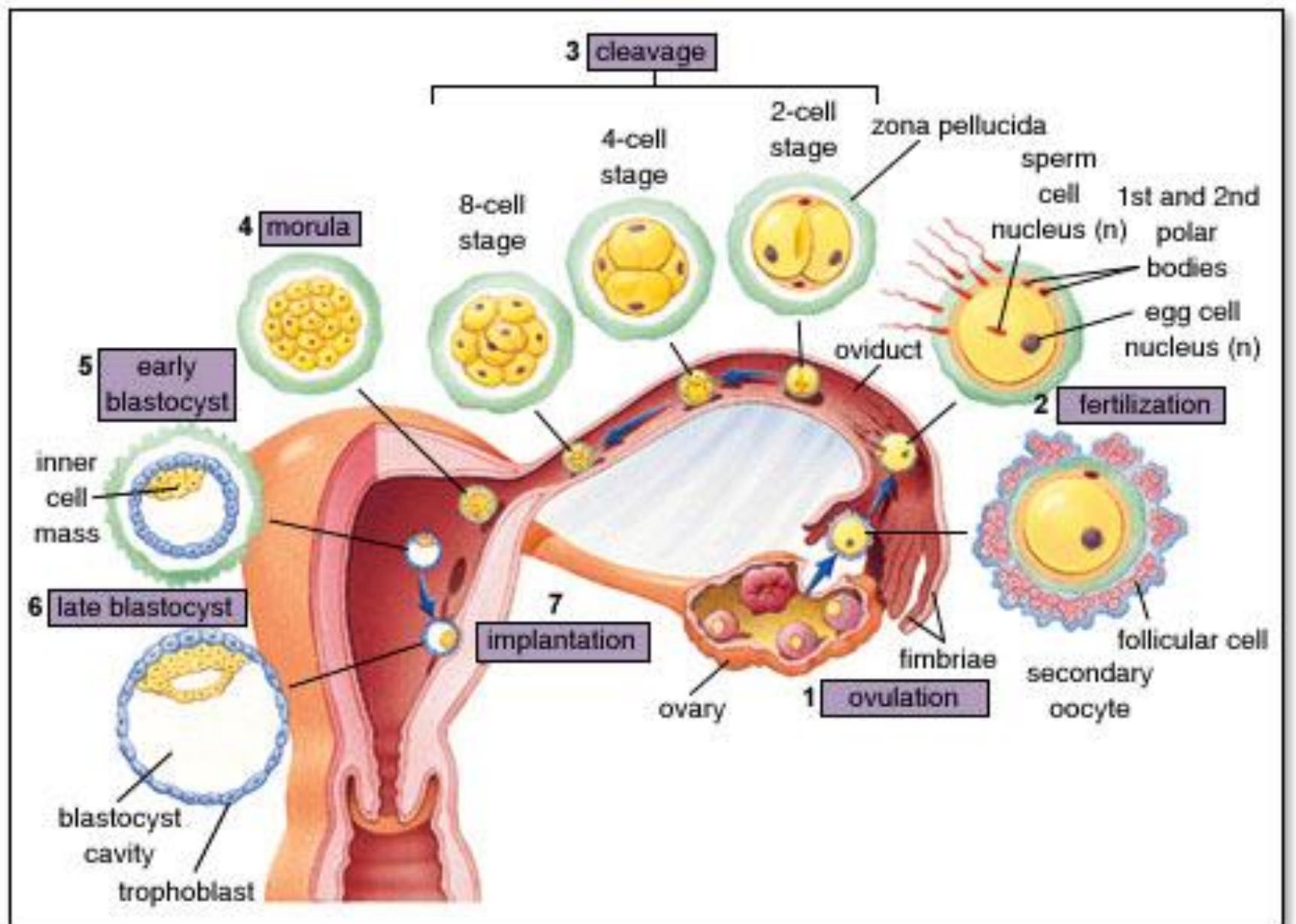


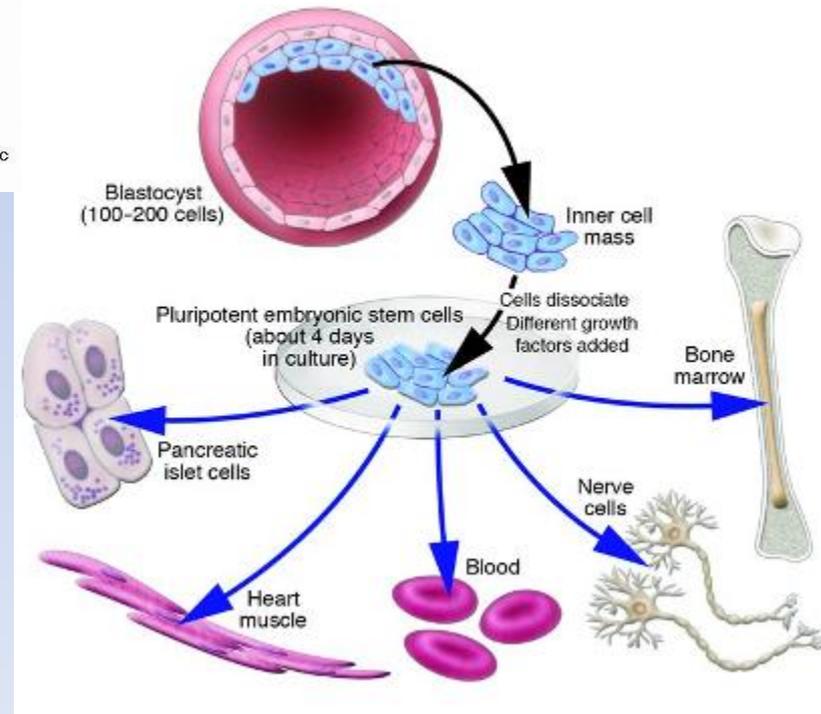
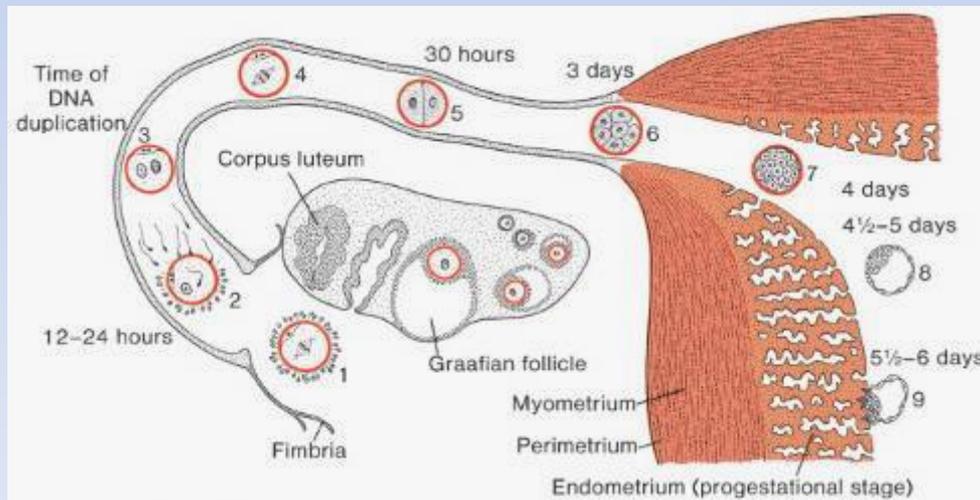
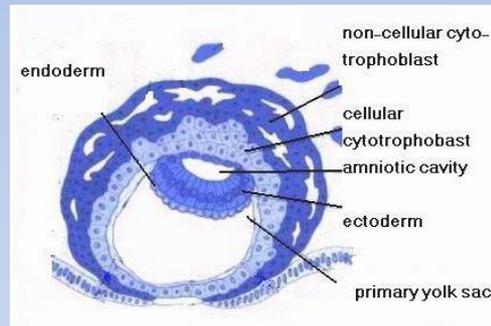
Events in the female genital tract (1st week)



BLASTULATION

Within the BLASTOCYST an inner cell mass (ICM) is separated, this contains the EMBRYOBLASTS

The surrounding cells form TROPHOBLASTS, they are responsible for the formation of the chorion.



HATCHING OF THE BLASTOCYST

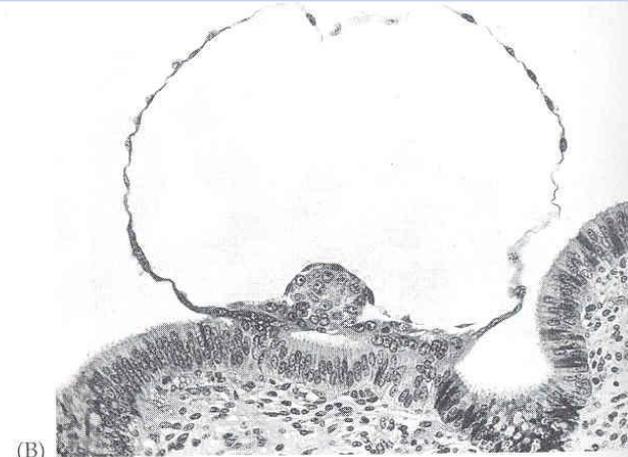
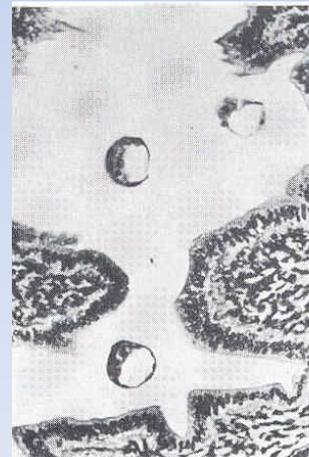
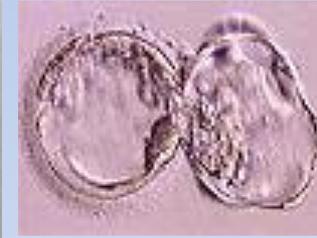
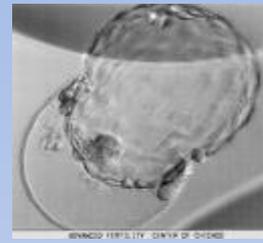
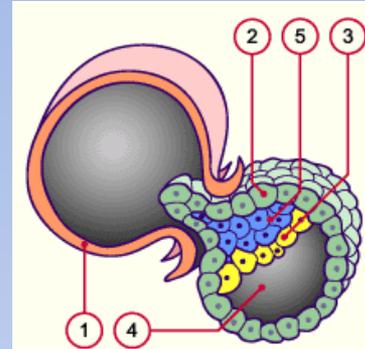
- enters the uterus 0.1 - 0.2 mm
- „**hatches**“ from the zona pellucida

The implantation starts 5 - 6 days after the ovulation, the blastula descends into the uterine cavity, then adheres to the endometrium (*the trophoblasts produce enzymes which pierce the endometrium*)

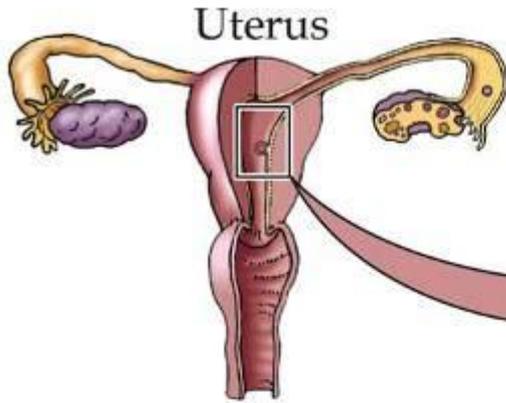
APPOSITION (the embryo turns towards the endometrium with the ICM being deep)

- The superficial proteoglycans bind to the cells
 - hCG, progesterone release grows
- Pregnancy test!!*

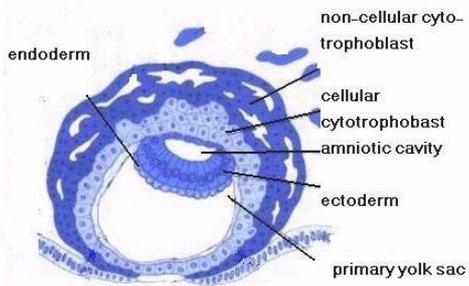
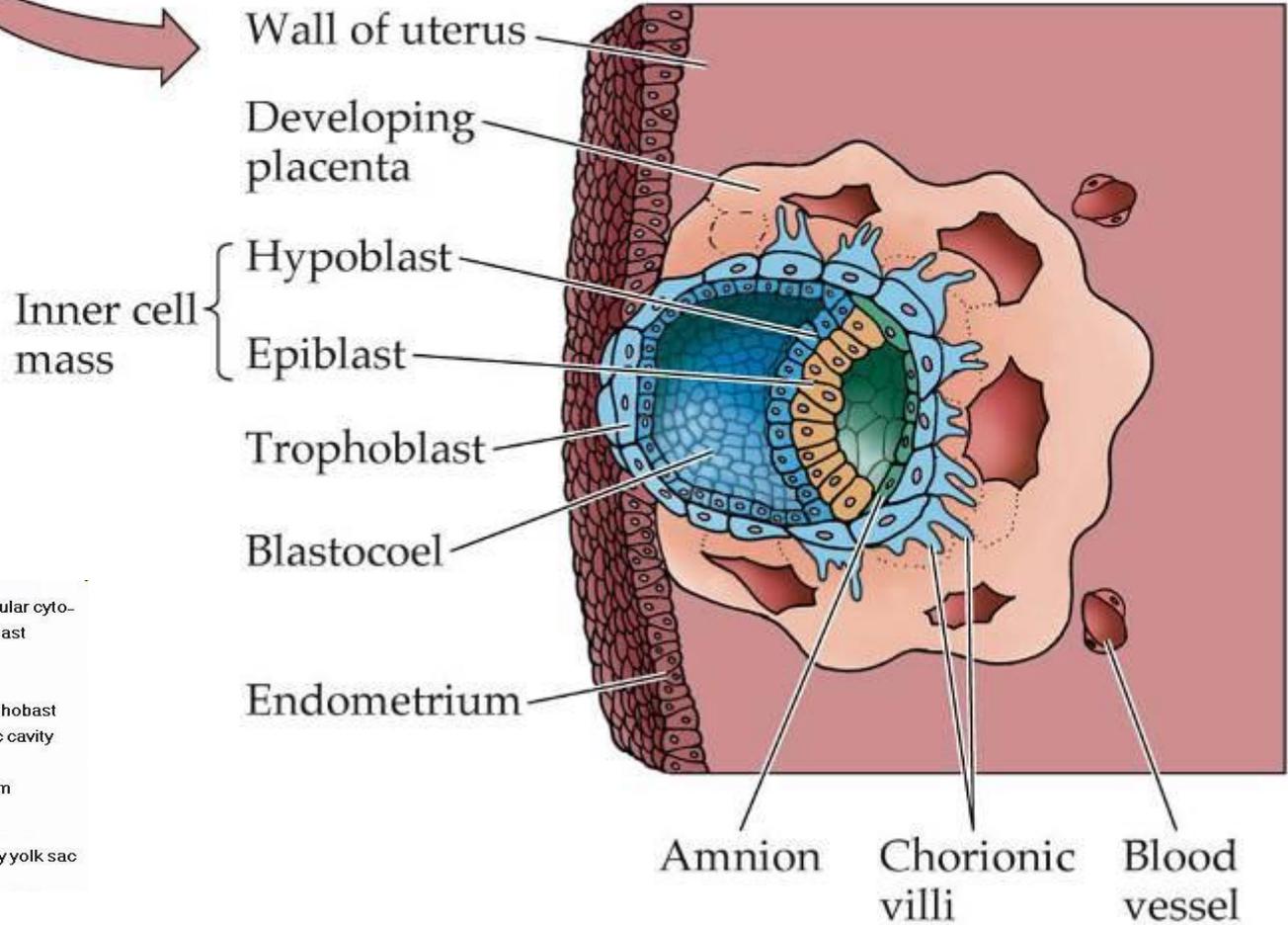
The glands enlarge
The endometrium thickens
A richer vascular network grows



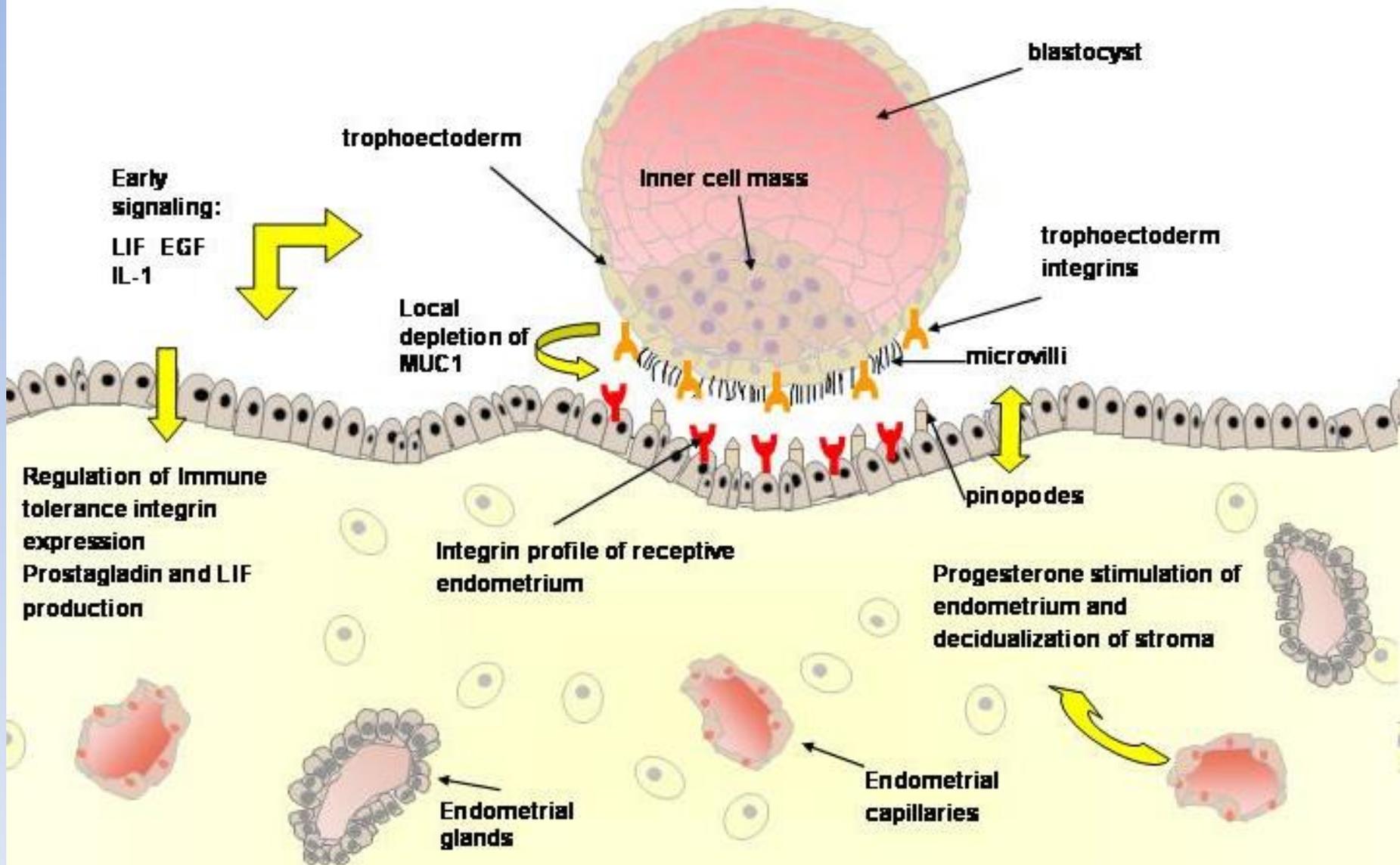
IMPLANTATION



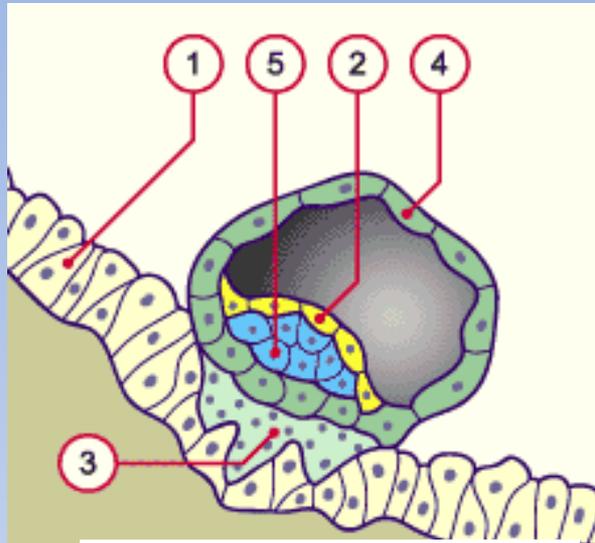
Human embryo at 9 days



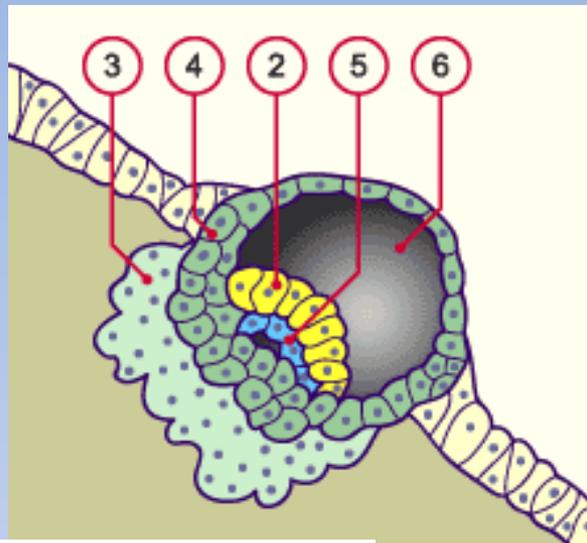
MOLECULAR FACTORS OF IMPLANTATION



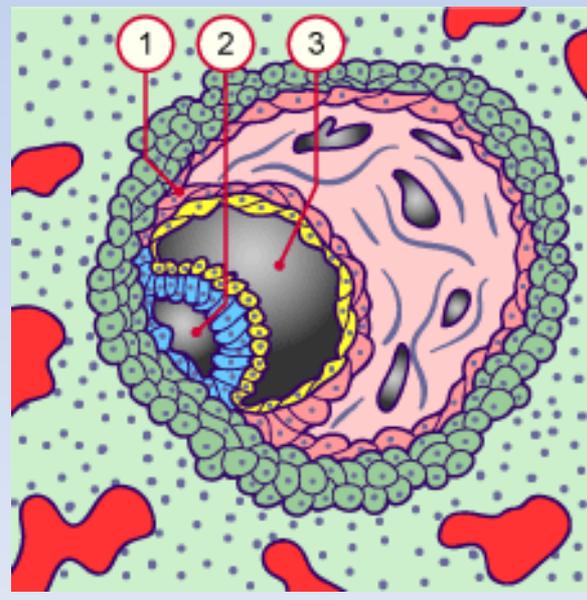
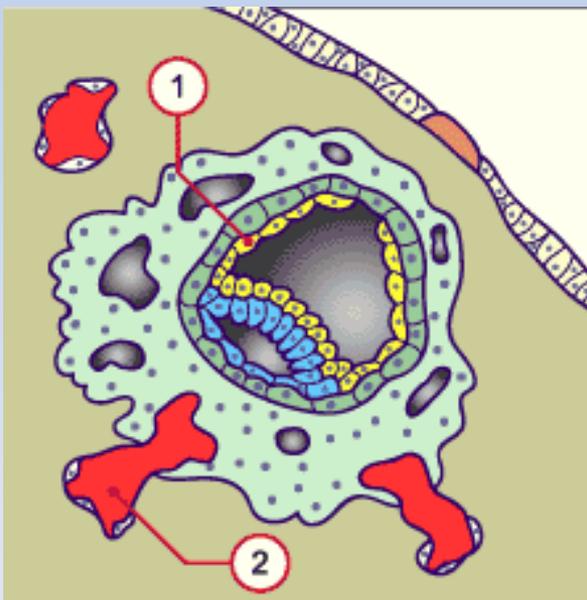
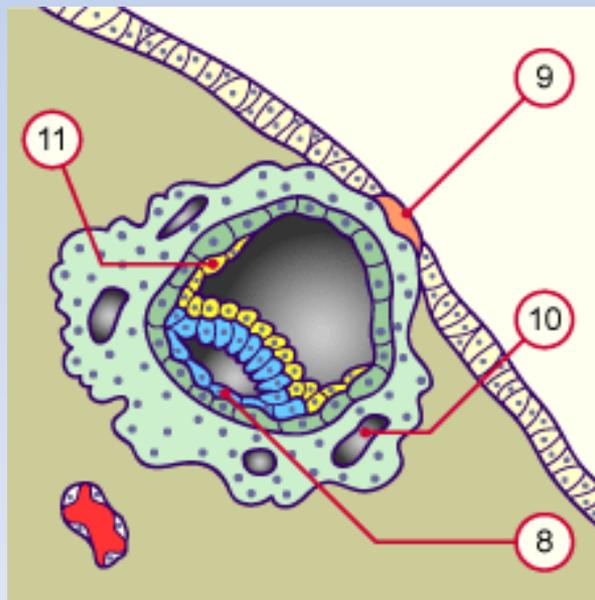
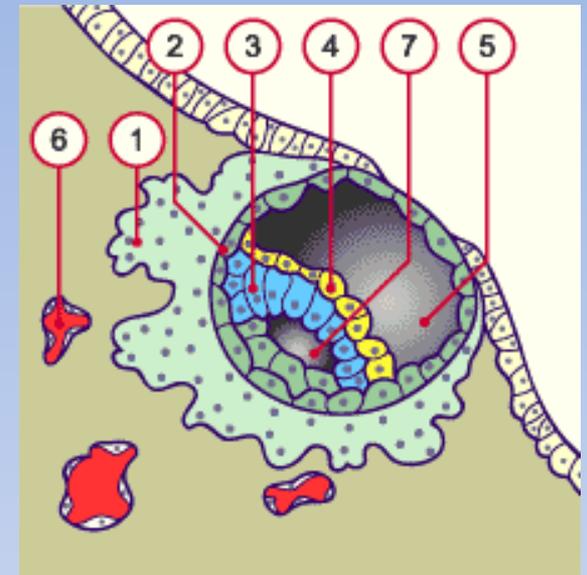
Events in the wall of the uterus in 2nd week



3-syncytiotrophoblast



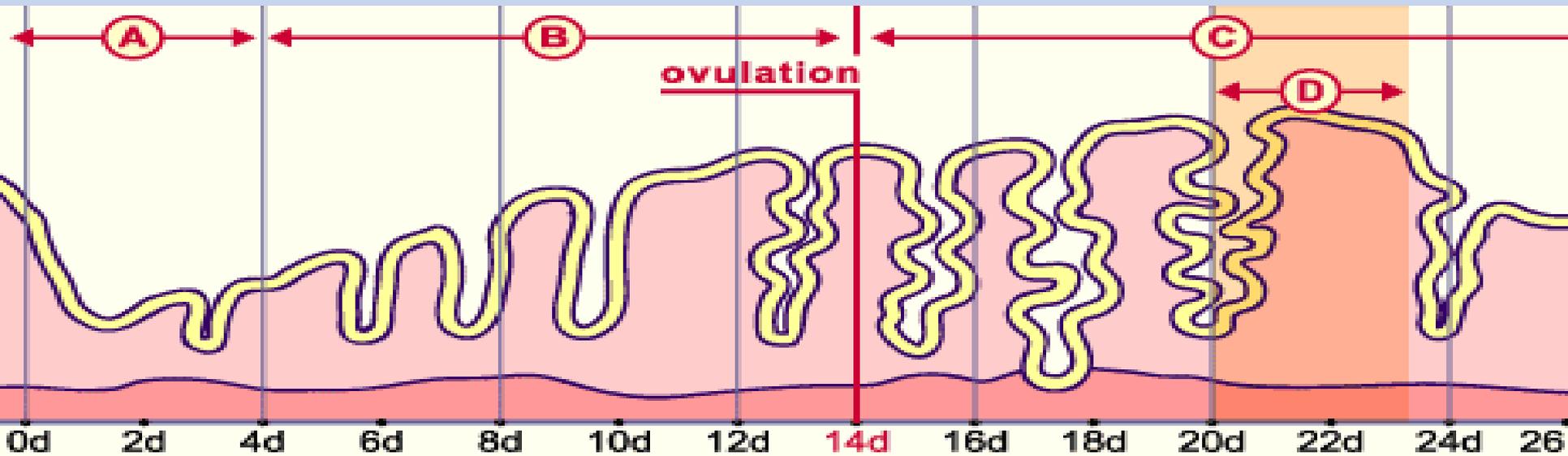
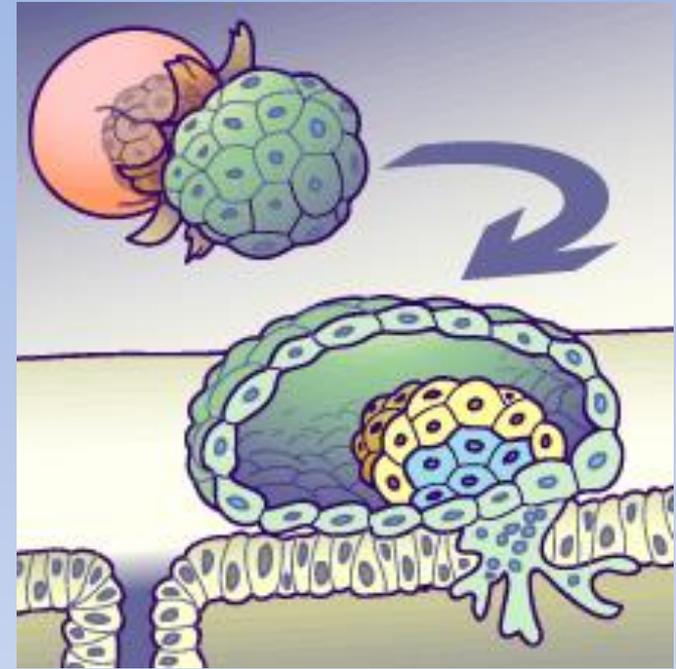
4-cytotrophoblast



Implantation (embedding)

Criteria:

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



**Endometrium,
Secretory phase**

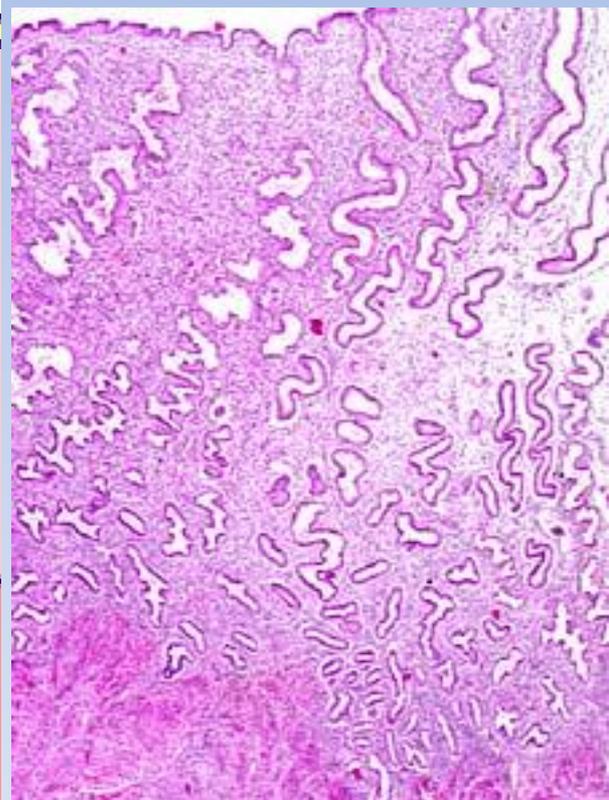
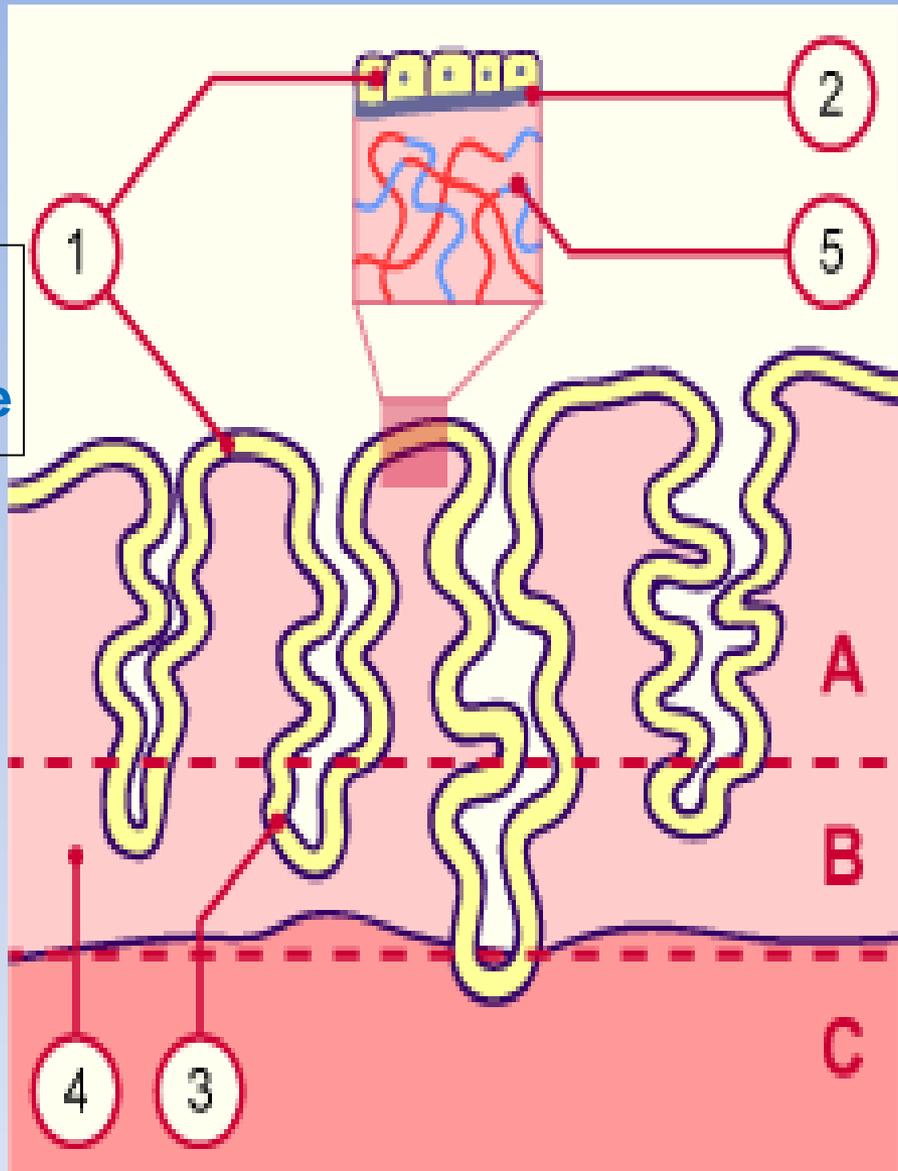
• Str. compactum

• Str. spongiosum

• Str. basale

Myometrium

Perimetrium



Uterus, endometrium → decidual transformation!!!

STEPS OF IMPLANTATION

APPOSITION – the ICM faces the endometrium

ADPLANTATION – the endometrial cells grow processes
(*they swell and catch the blastocyst - reversible binding*)

ADHESION – the microvilli of the trophoblasta interact with the cells of the endometrium (proteoglycans) *irreversible binding*

DIFFERENTIATION - trophoblast derivatives - *syncytiotrophoblast*
- *cytotrophoblast*

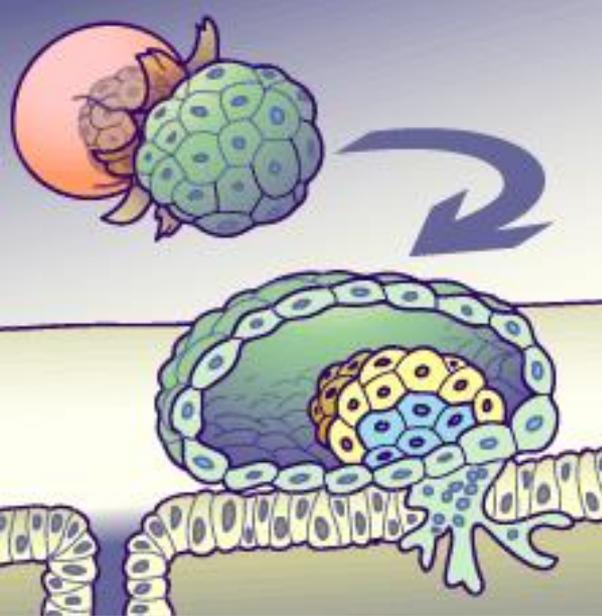
IMPLANTATION – the syncytiotrophoblasts form a syncytium and penetrate the membrana basalis as well as the endometrium

DECIDUAL REACTION – apoptosis within the endometrial cells, then the stroma cells undergo an epitheloid transformation.

The extracellular vacuoles will be filled with blood and merge to form the
LACUNAE

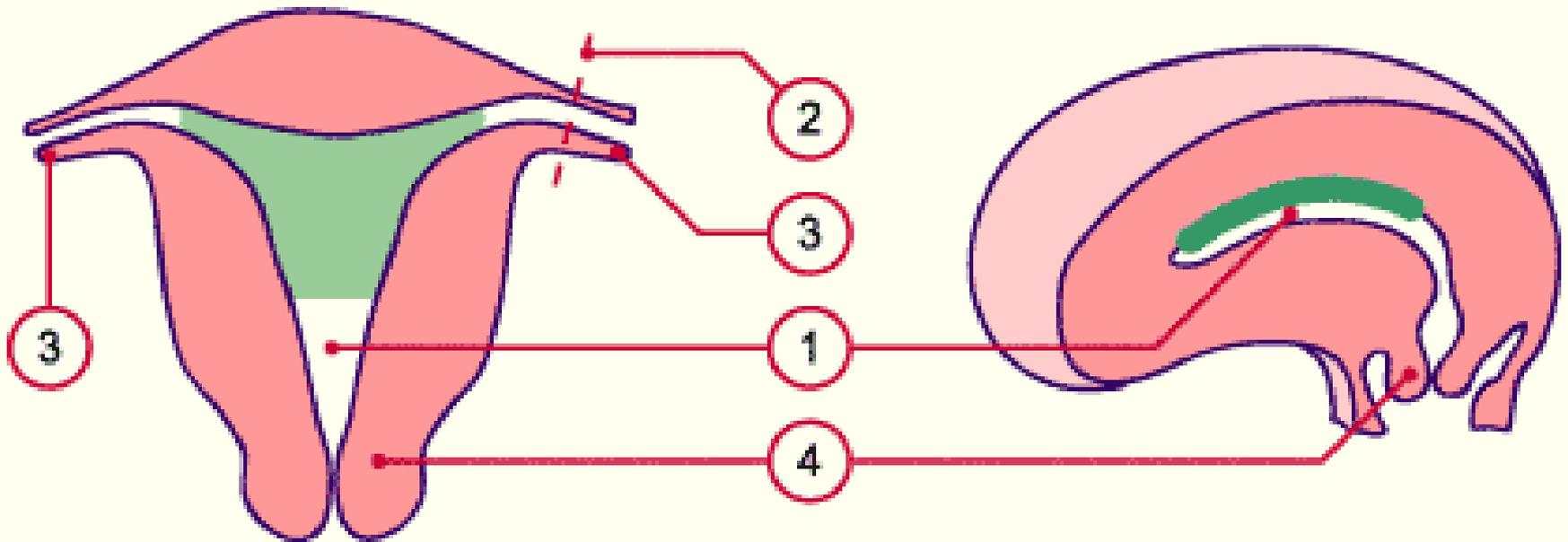
the invasive growth will be stopped by the **zona compacta**

By week 2. the pregnancy can be tested from urine too.

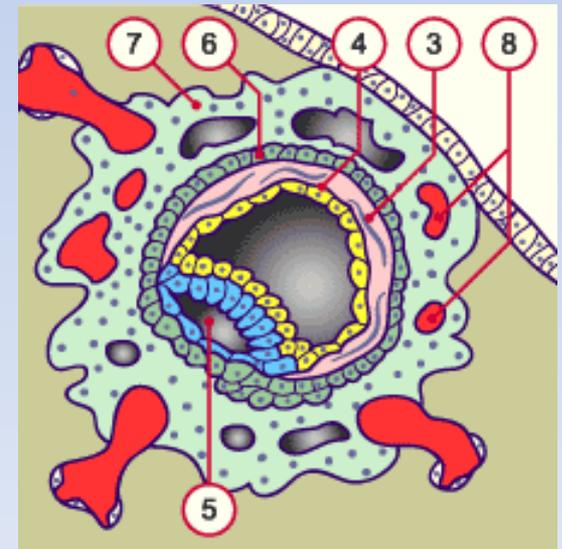
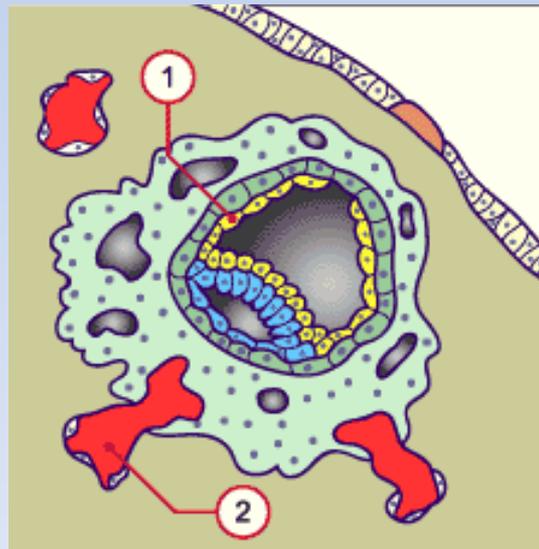
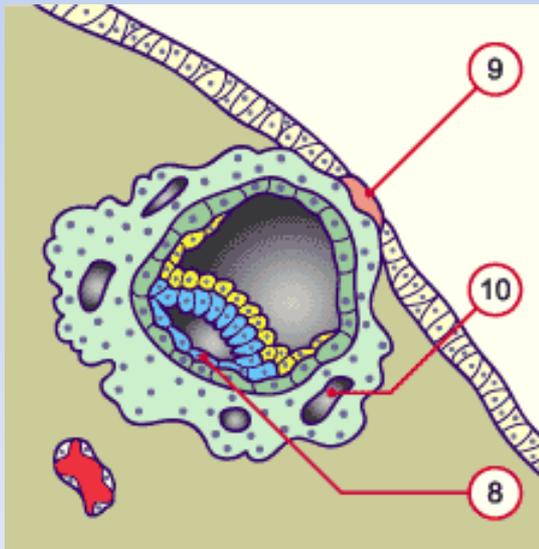
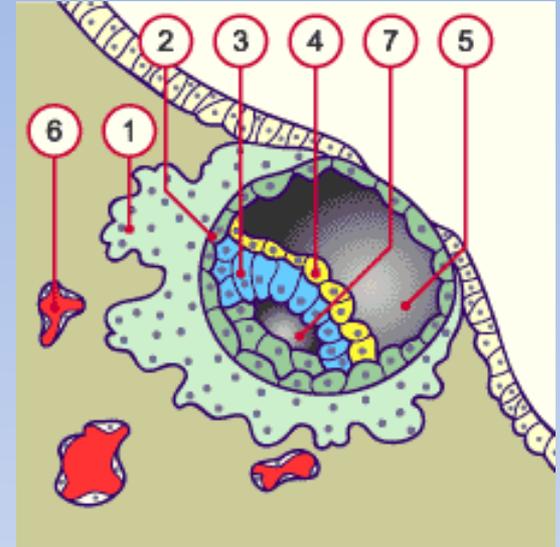
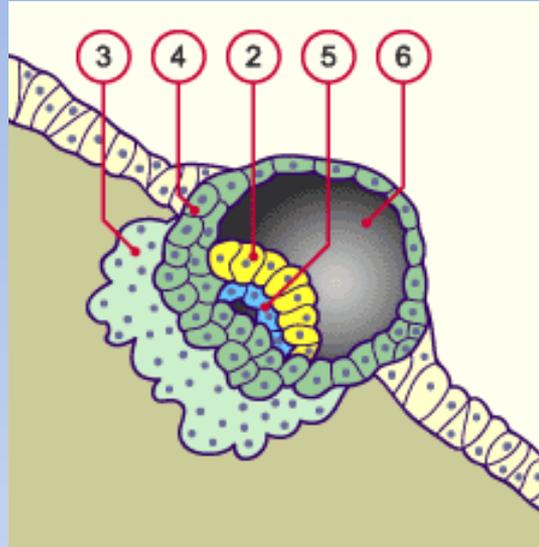
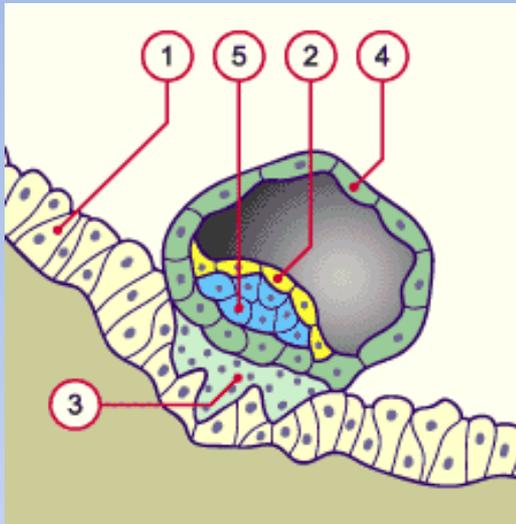


Implantation

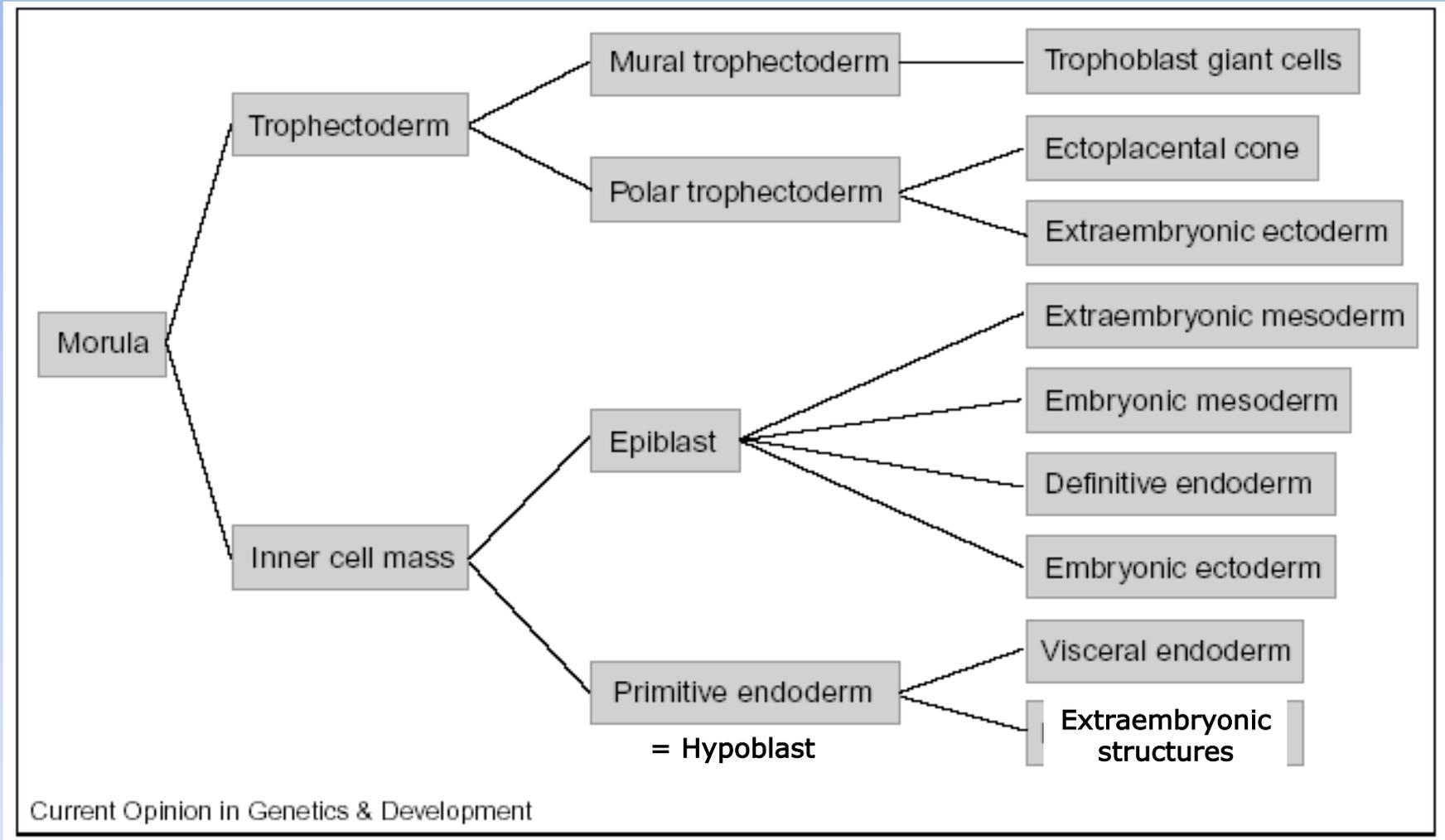
- **Place:** uterus post. (ant.) wall
- **Time:** end of 1. week → end of 2. week



BILAMINAR EMBRYO



EMBRYOGENESIS (3rd-8th weeks)



EMBRYONIC DISK, HYPOBLAST – EPIBLAST

2. week

- the blastocyst partially is implanted,
- the primitive yolk sac is formed from the blastocoel

EMBRYOBLASTS: FORM THE EMBRYONIC DISK

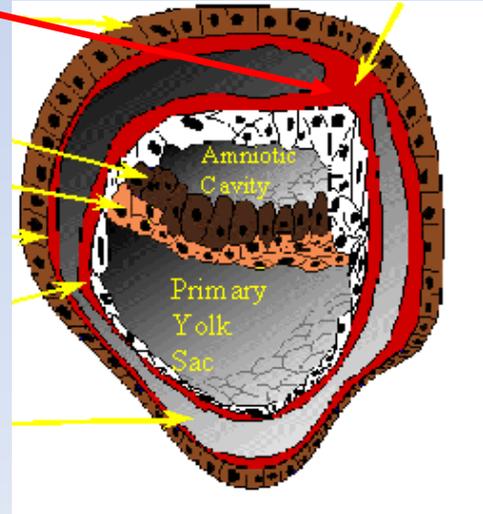
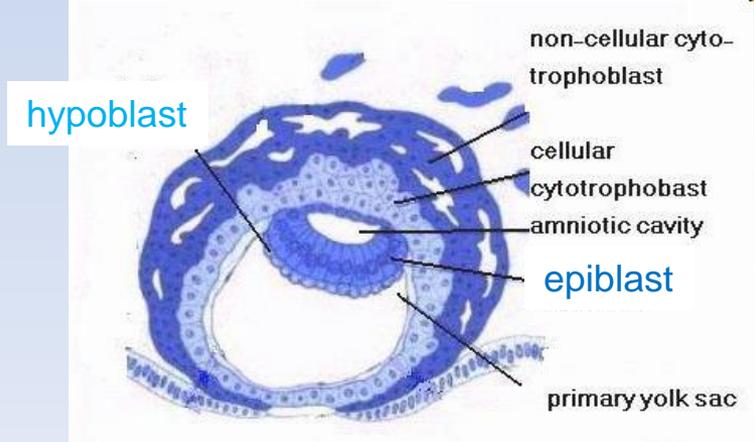
- epiblast** - tall cylindrical cells lining the amnion cavity
- hypoblast** - cuboidal cells, line the primary yolk sac

D 11-12. a minimal enlargement of the implanted embryo – bulges into the uterine cavity

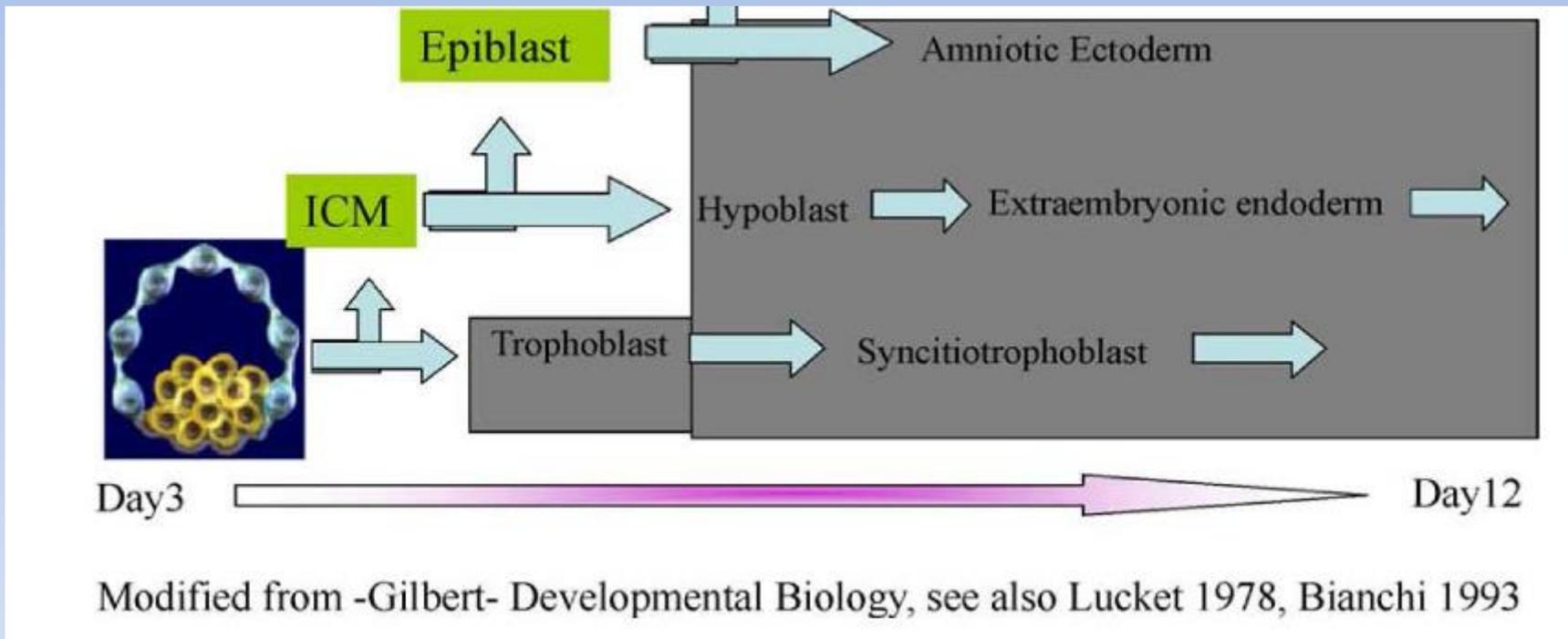
extraembryonic mesoderm – formed between the trophoblasts and amnion, or yolk sac – the cavities here merge to form the **extraembryonic coelom** which surrounds the embryonic disk (except for the site of the **body stalk** „allantois” – later umbilical cord)

D 13. the endometrium is completely sealed

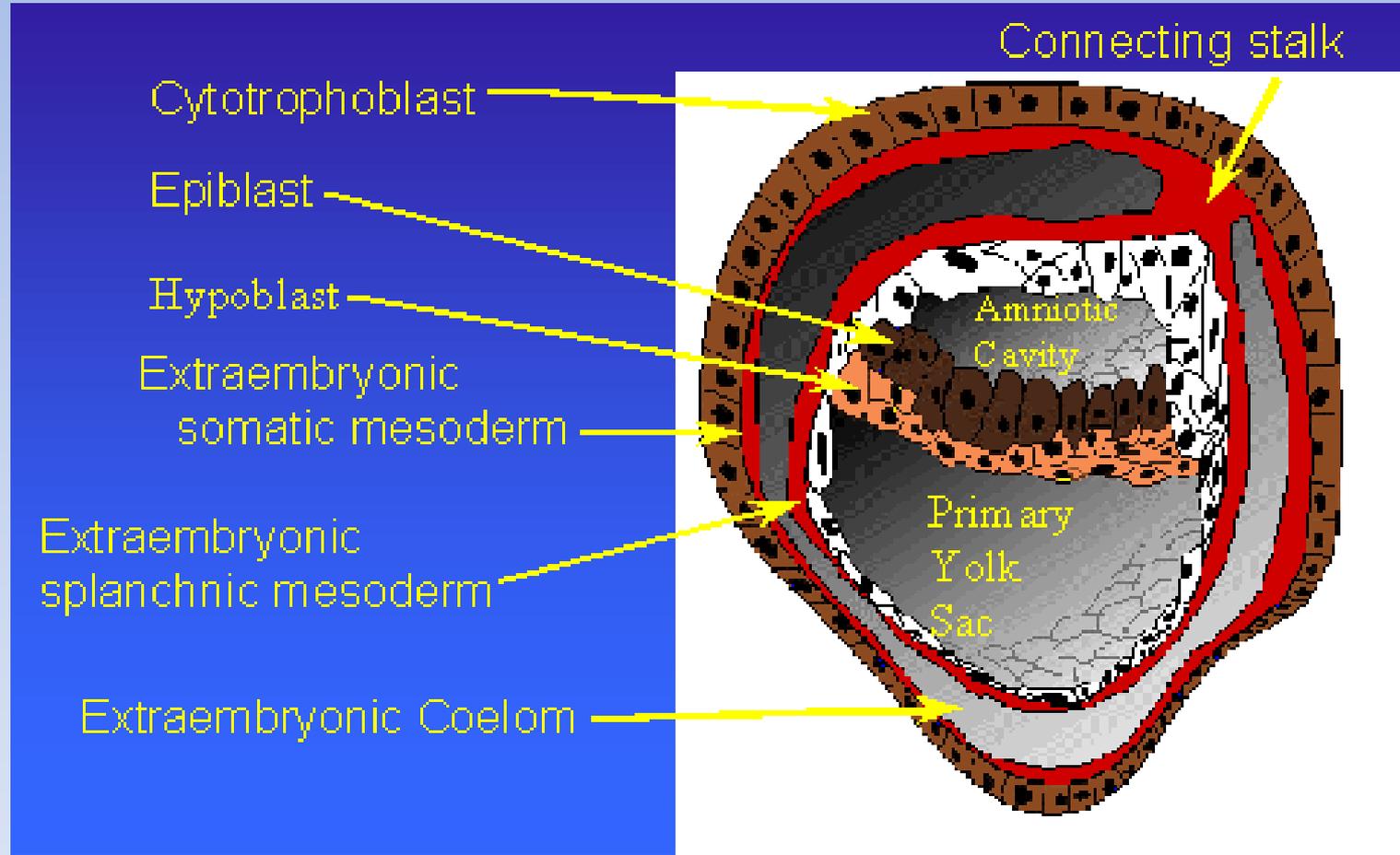
Hypoblasts form the secondary or **definitive yolk sac**
So the **extraembryonic coelom** will turn to the cavity of the chorion



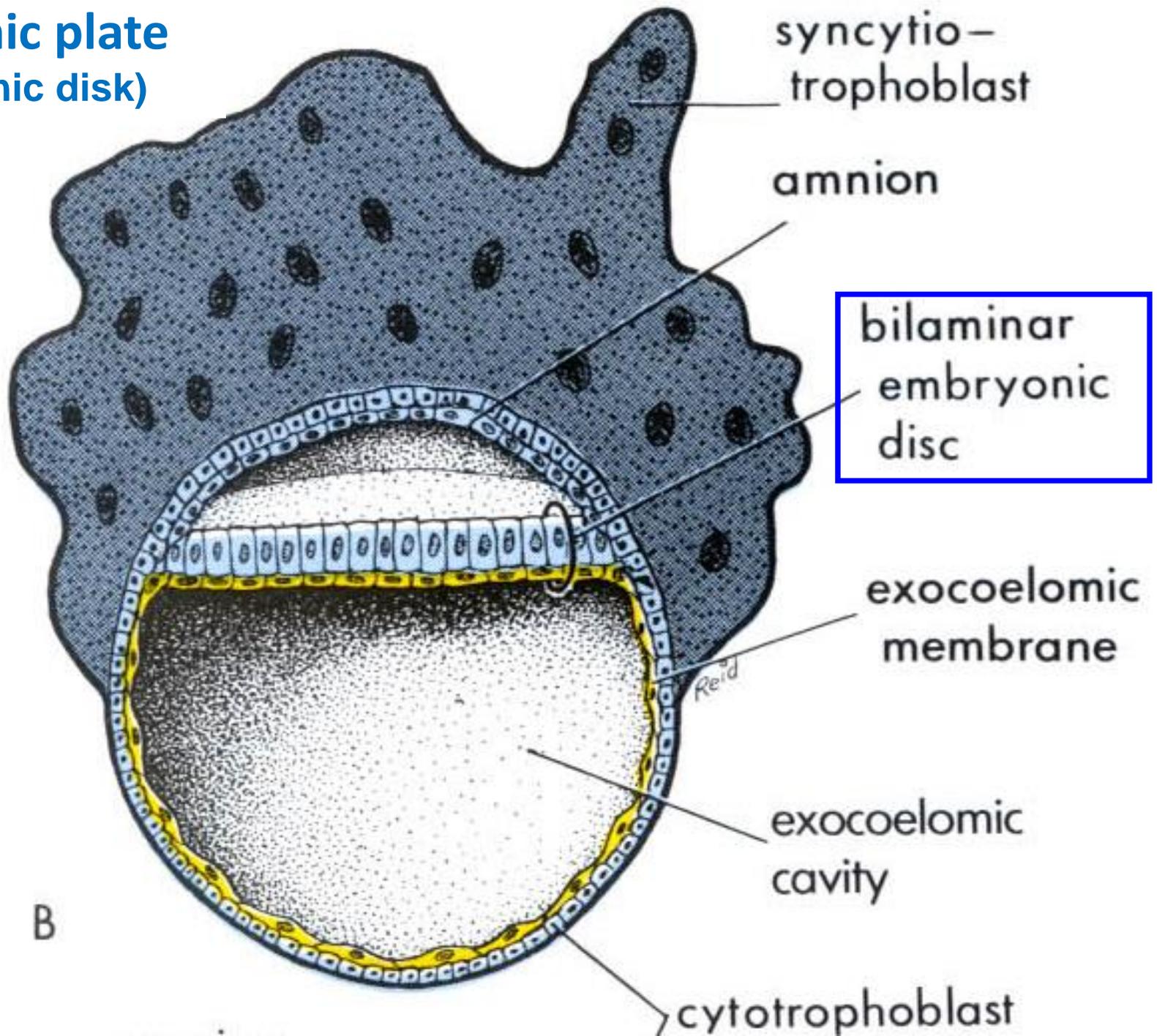
Segregation of EPIBLAST

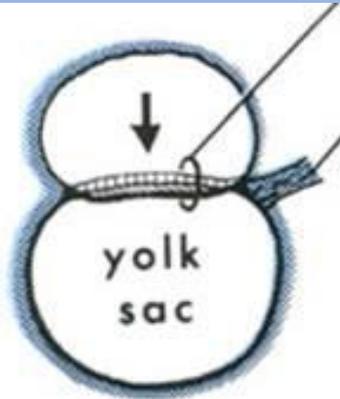


Segregation of the embryonic and extraembryonic areas.



Embryonic plate (= embryonic disk)



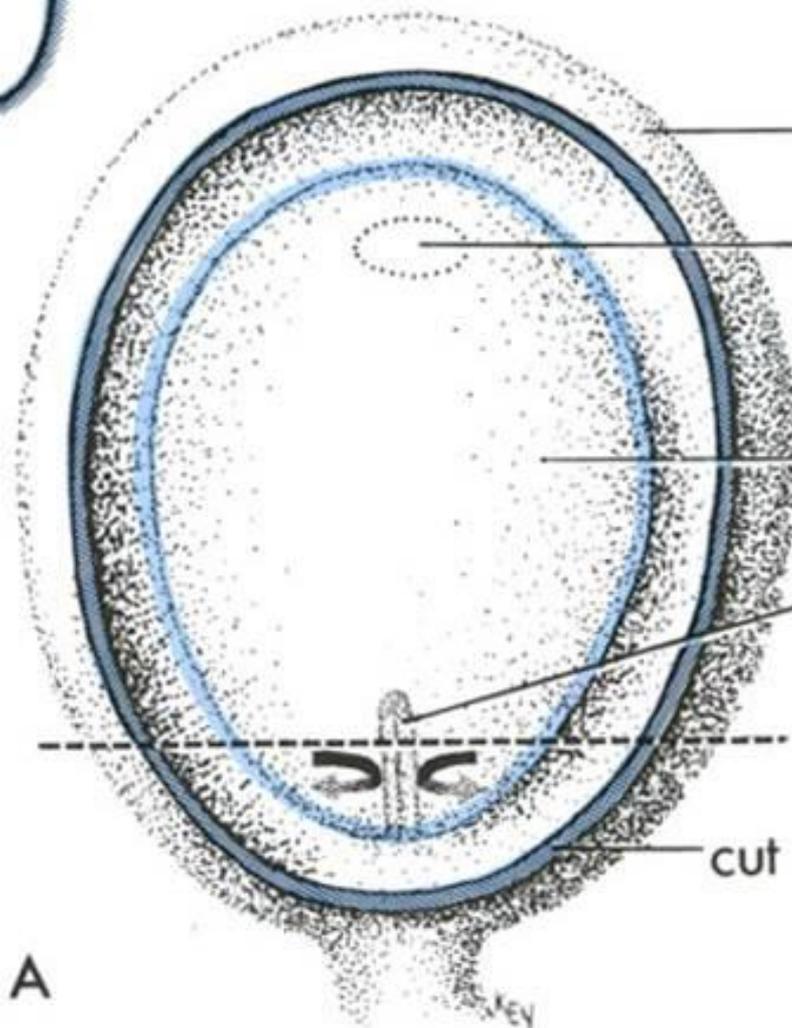


connecting stalk

yolk sac

Embryonic disc

cranial end



yolk sac

prochordal plate

Epiblast → all the 3 germ layers!

ectoderm

primitive streak

level of section B

cut edge of amnion

A

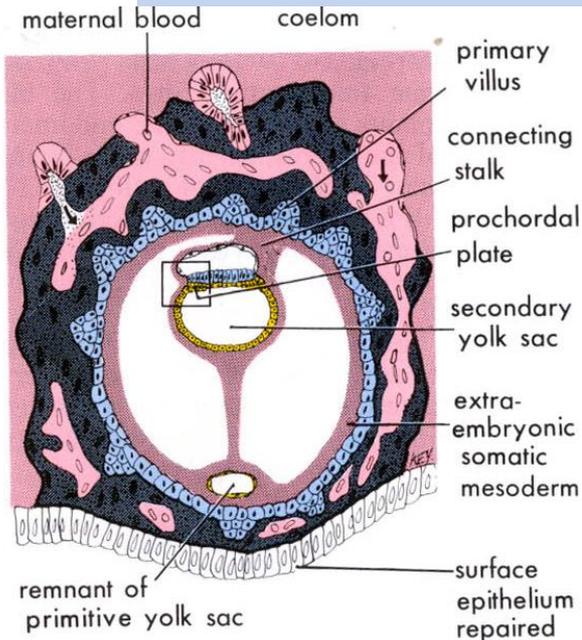
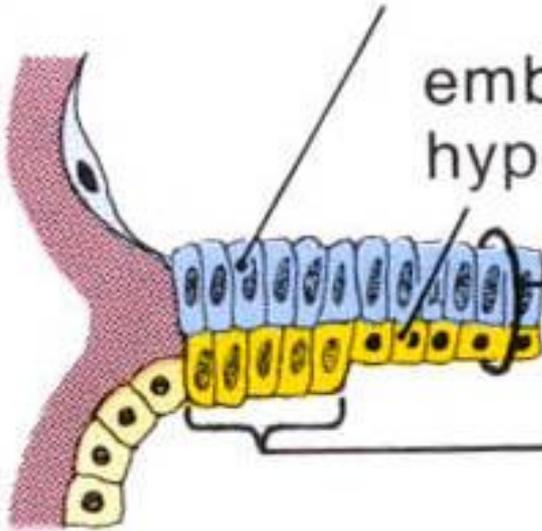
caudal end

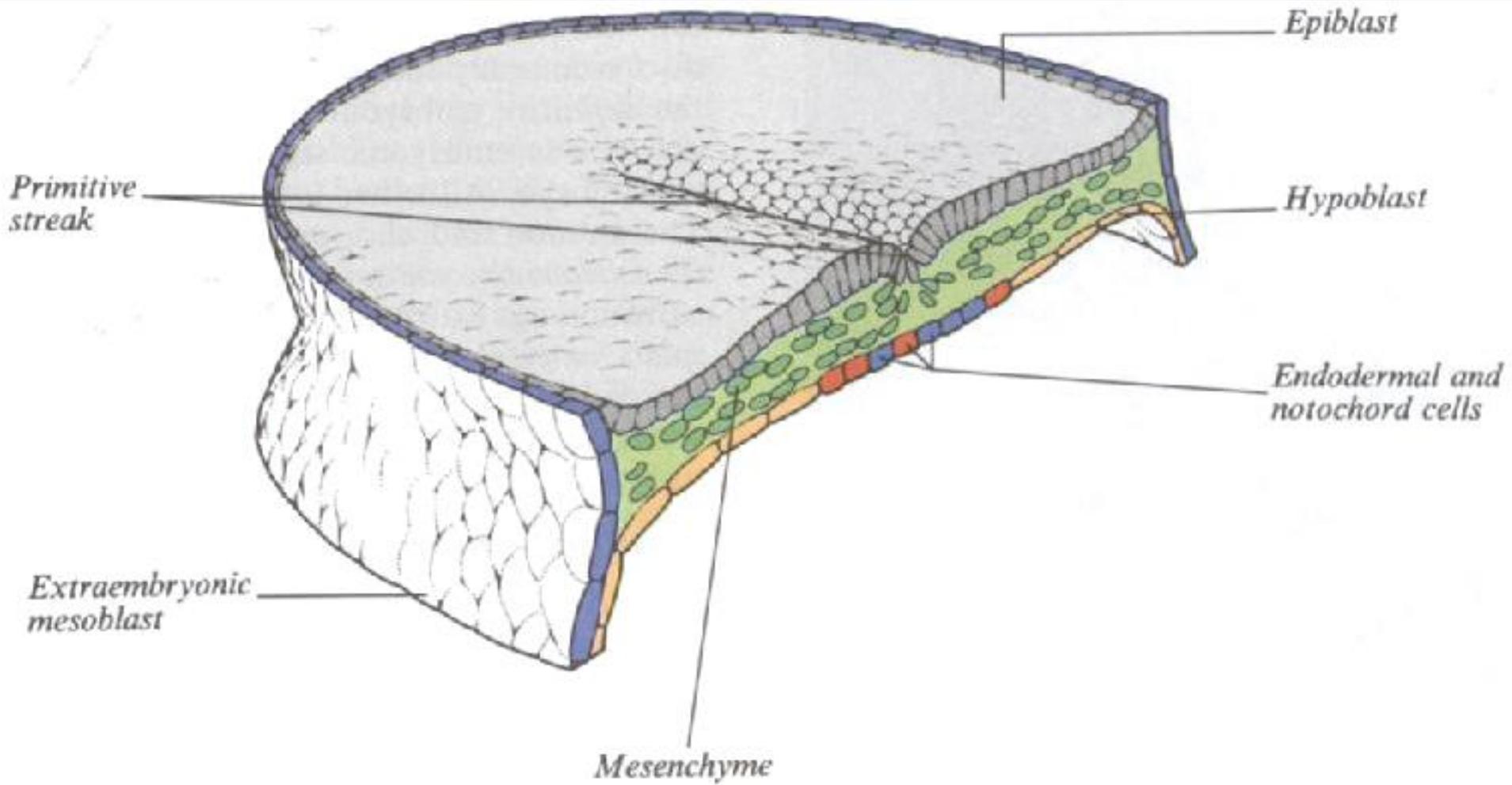
embryonic epiblast

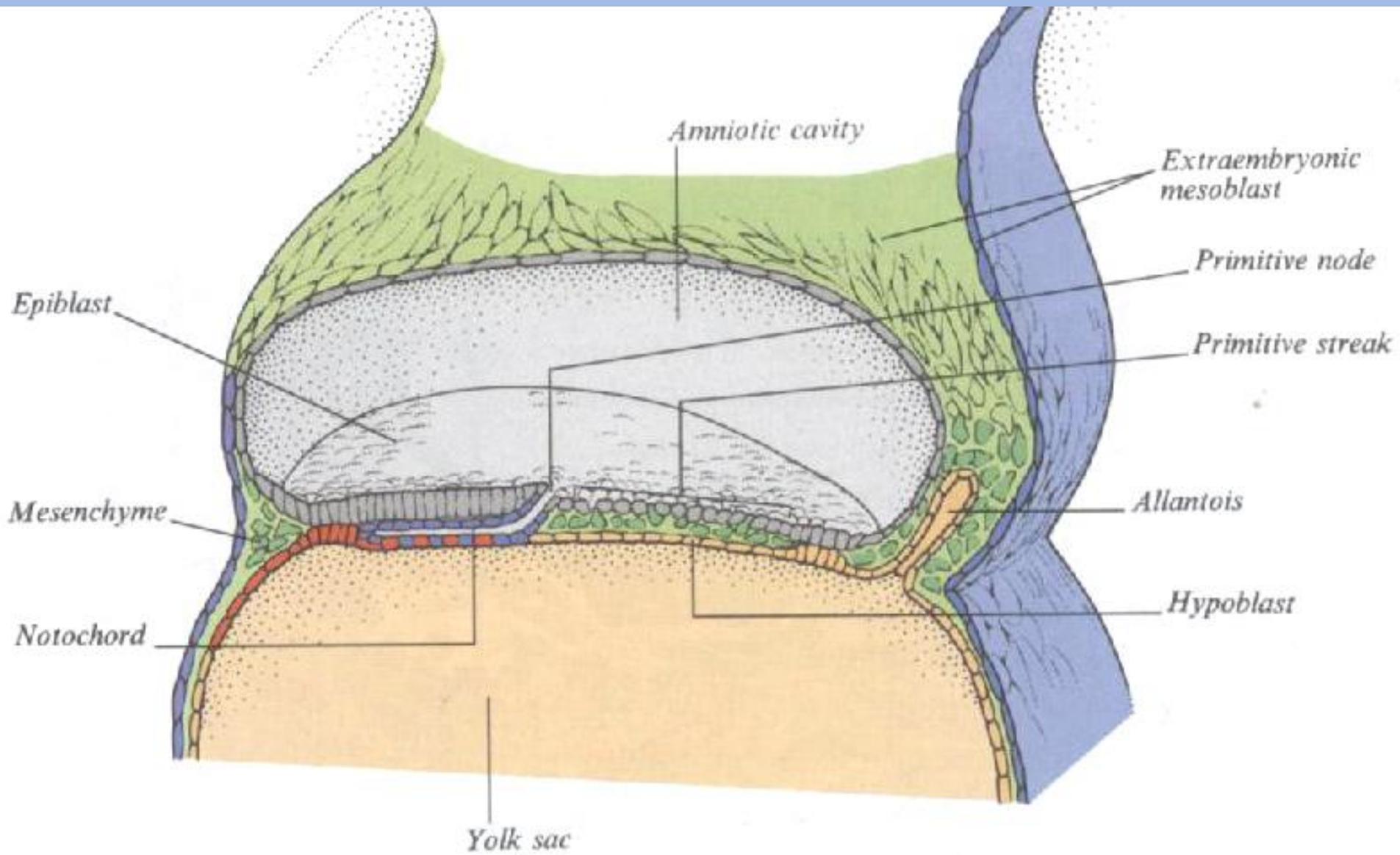
embryonic hypoblast

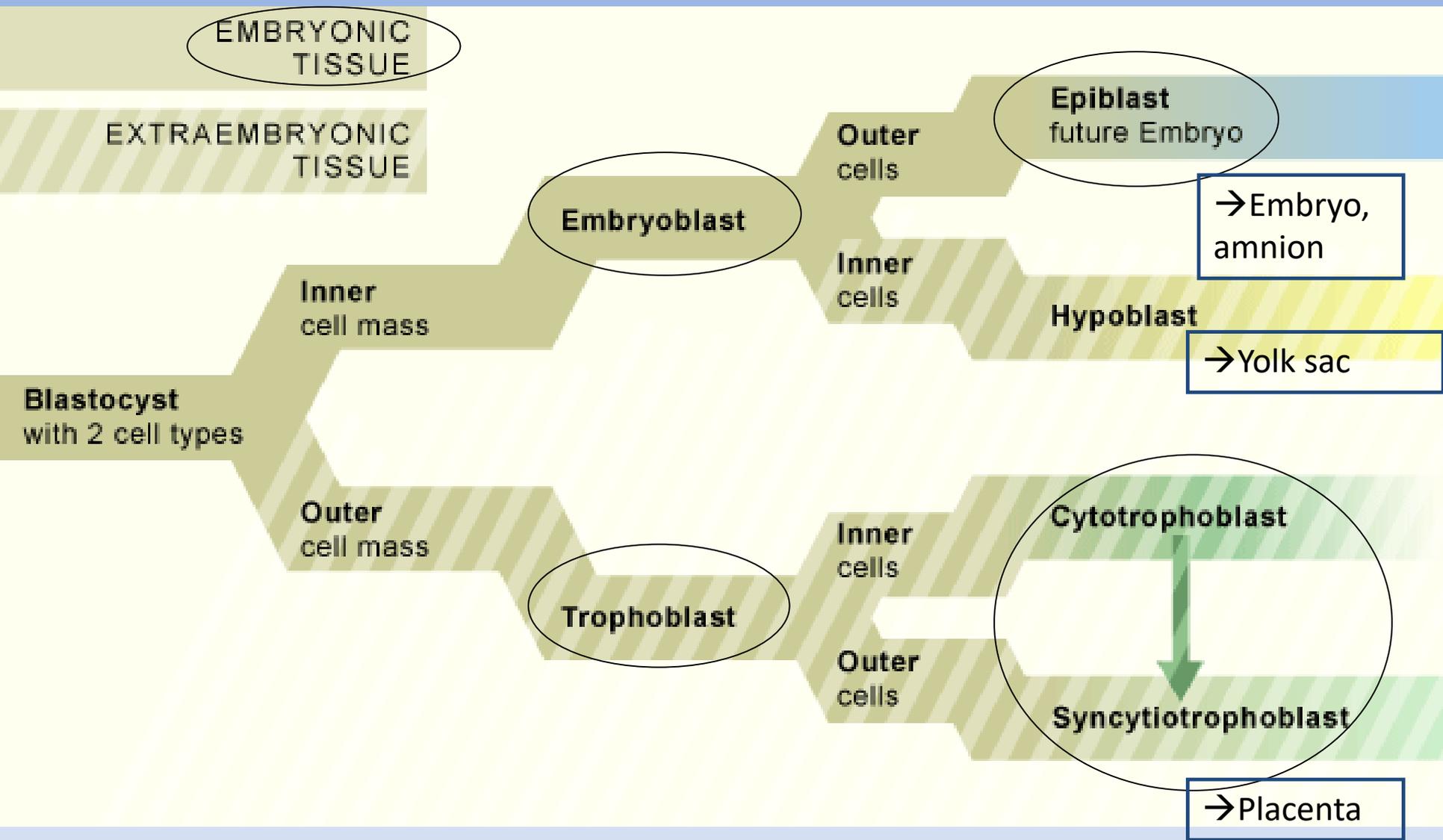
bilaminar embryonic disc

prochordal plate









EMBRYONIC TISSUE

EXTRAEMBRYONIC TISSUE

Embryoblast

Outer cells

Epiblast
future Embryo

→ Embryo,
amnion

Inner cells

Hypoblast

→ Yolk sac

Inner cell mass

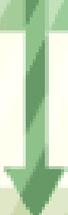
Blastocyst
with 2 cell types

Outer cell mass

Trophoblast

Inner cells

Cytotrophoblast



Outer cells

Syncytiotrophoblast

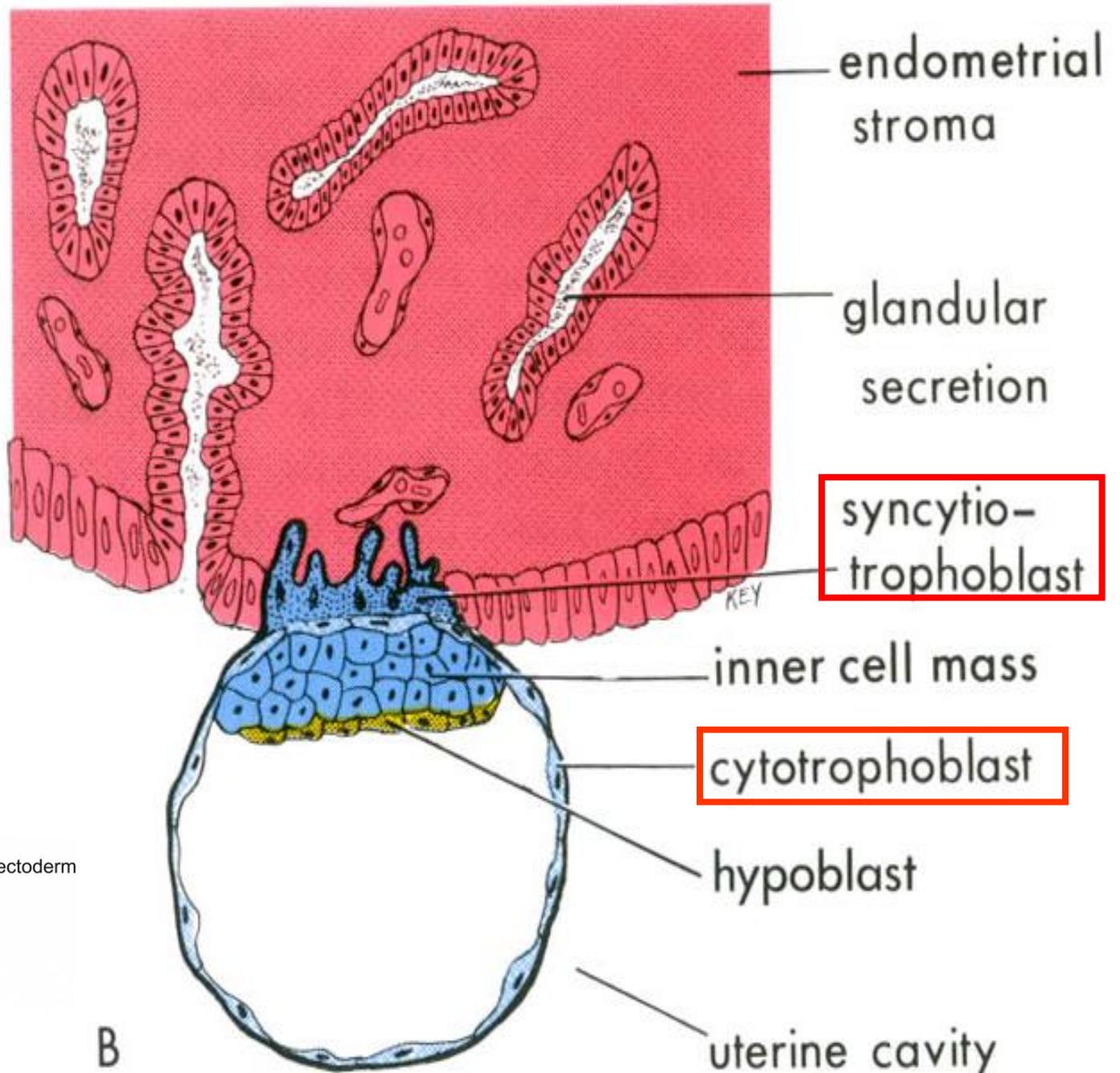
→ Placenta

Syncytium:

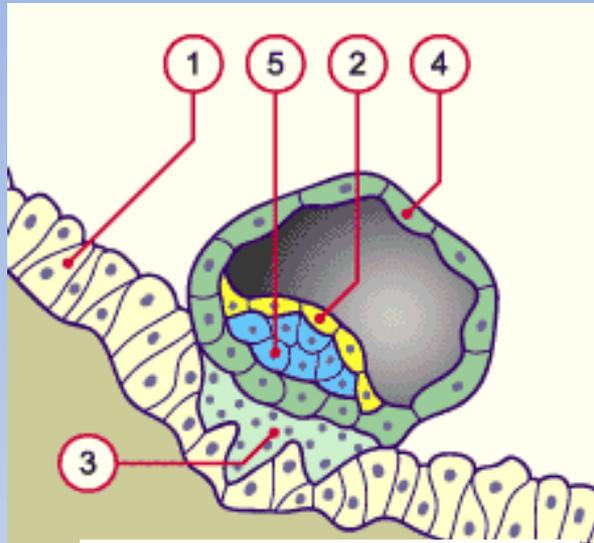
A mass of cytoplasm containing several nuclei and enclosed in a membrane but no internal cell boundaries

Trophoblast

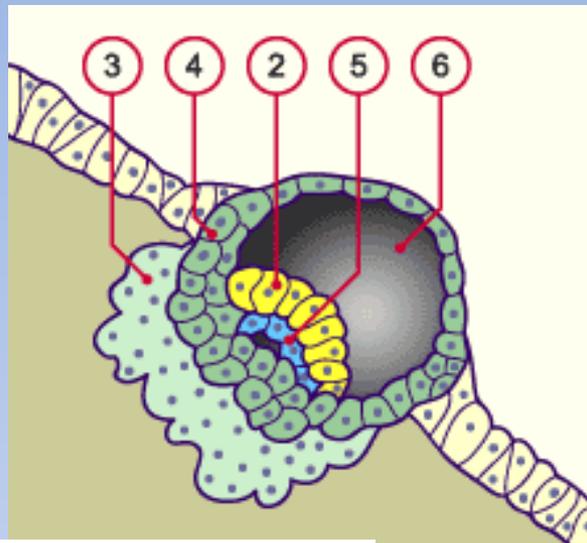
- polar
- mural



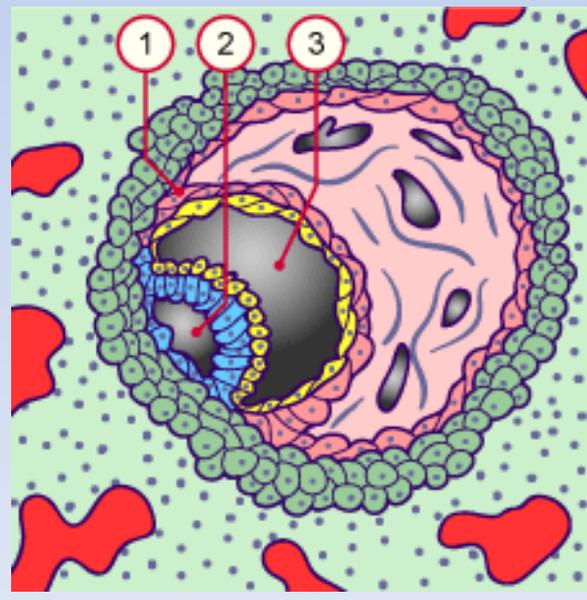
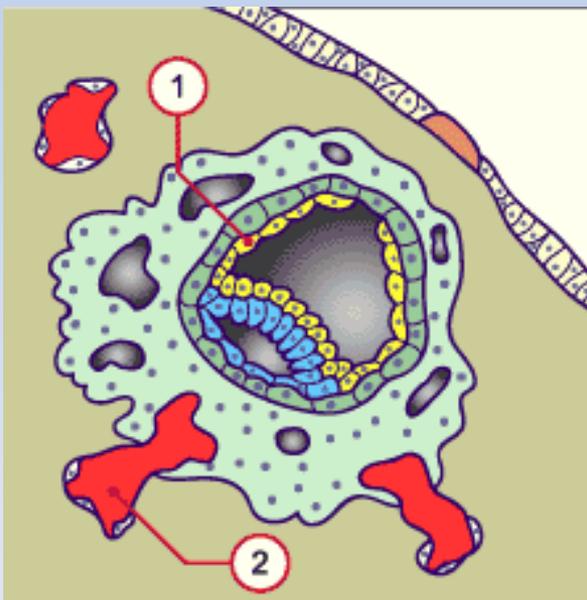
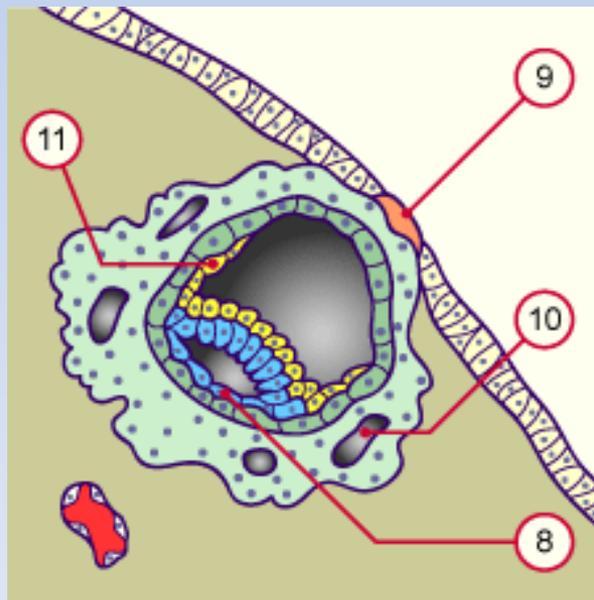
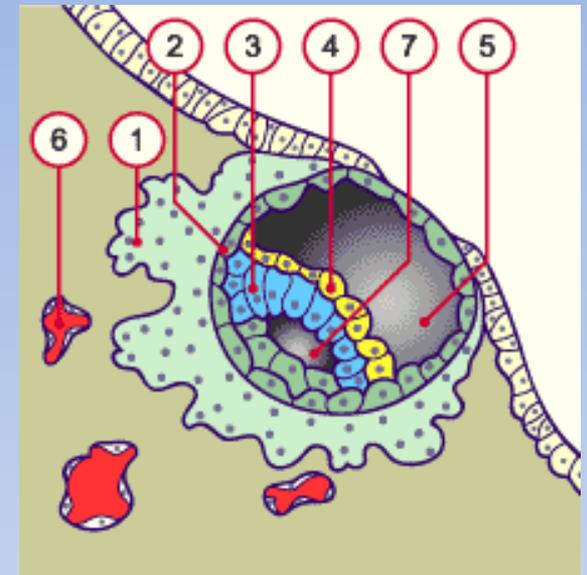
Events in the wall of the uterus in 2nd week



3-syncytiotrophoblast



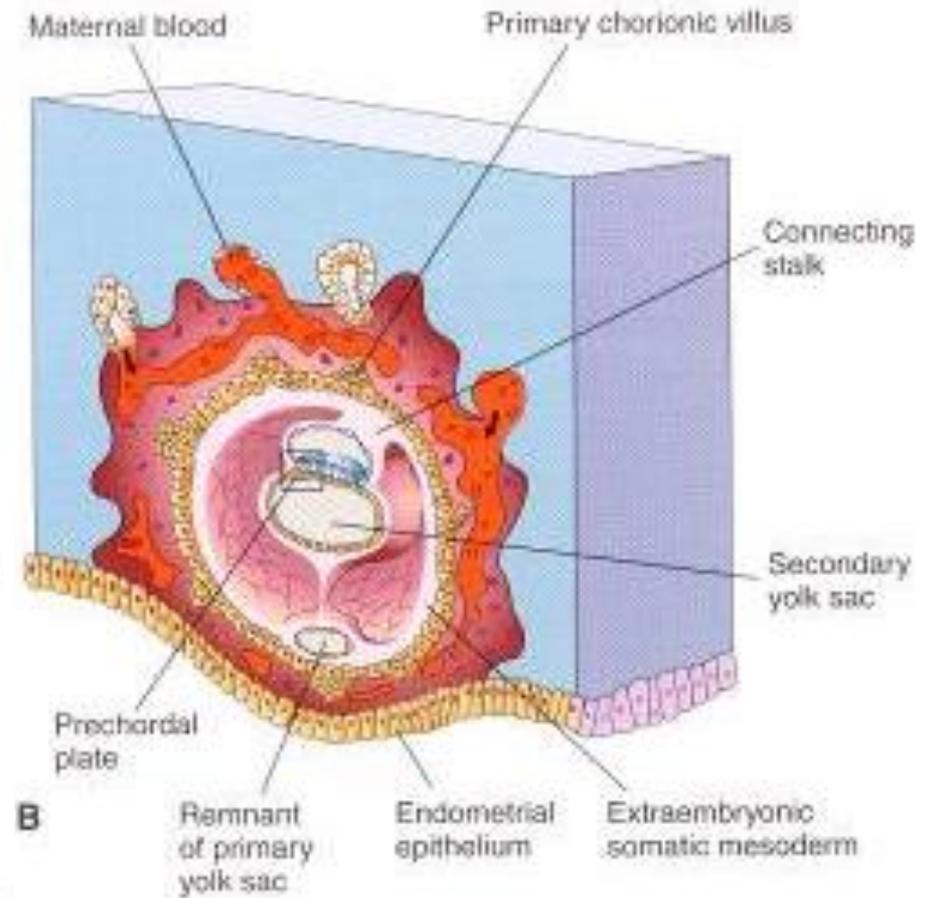
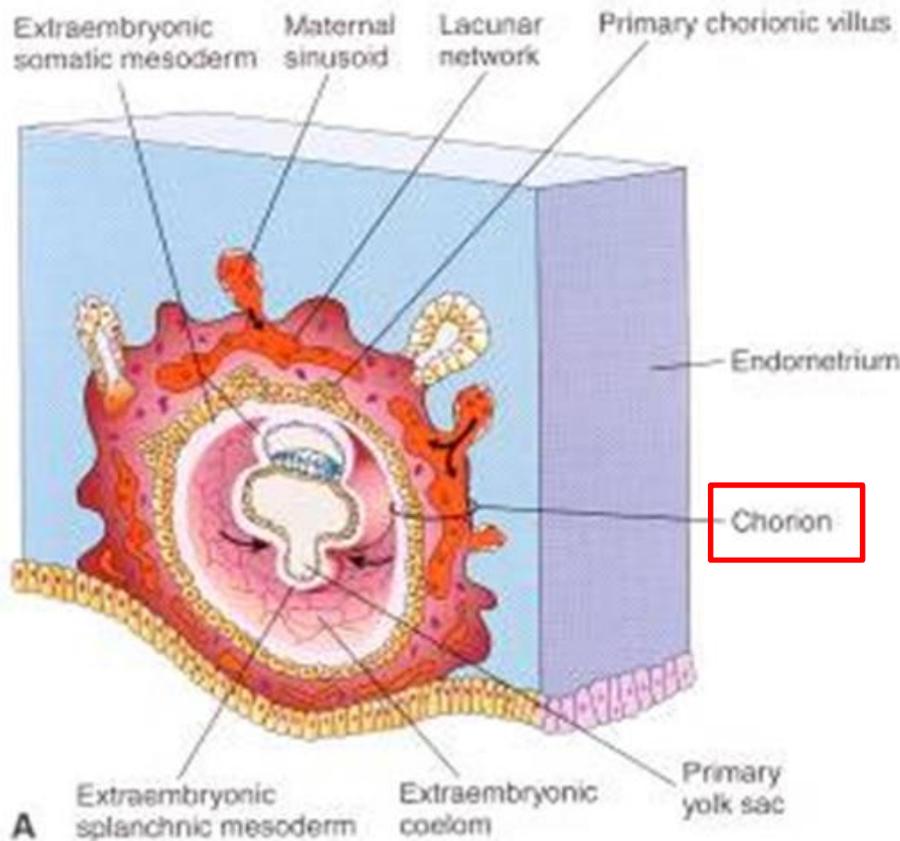
4-cytotrophoblast



12-14 DAYS

(the end of 2nd week)

Formation of primary chorionic villi



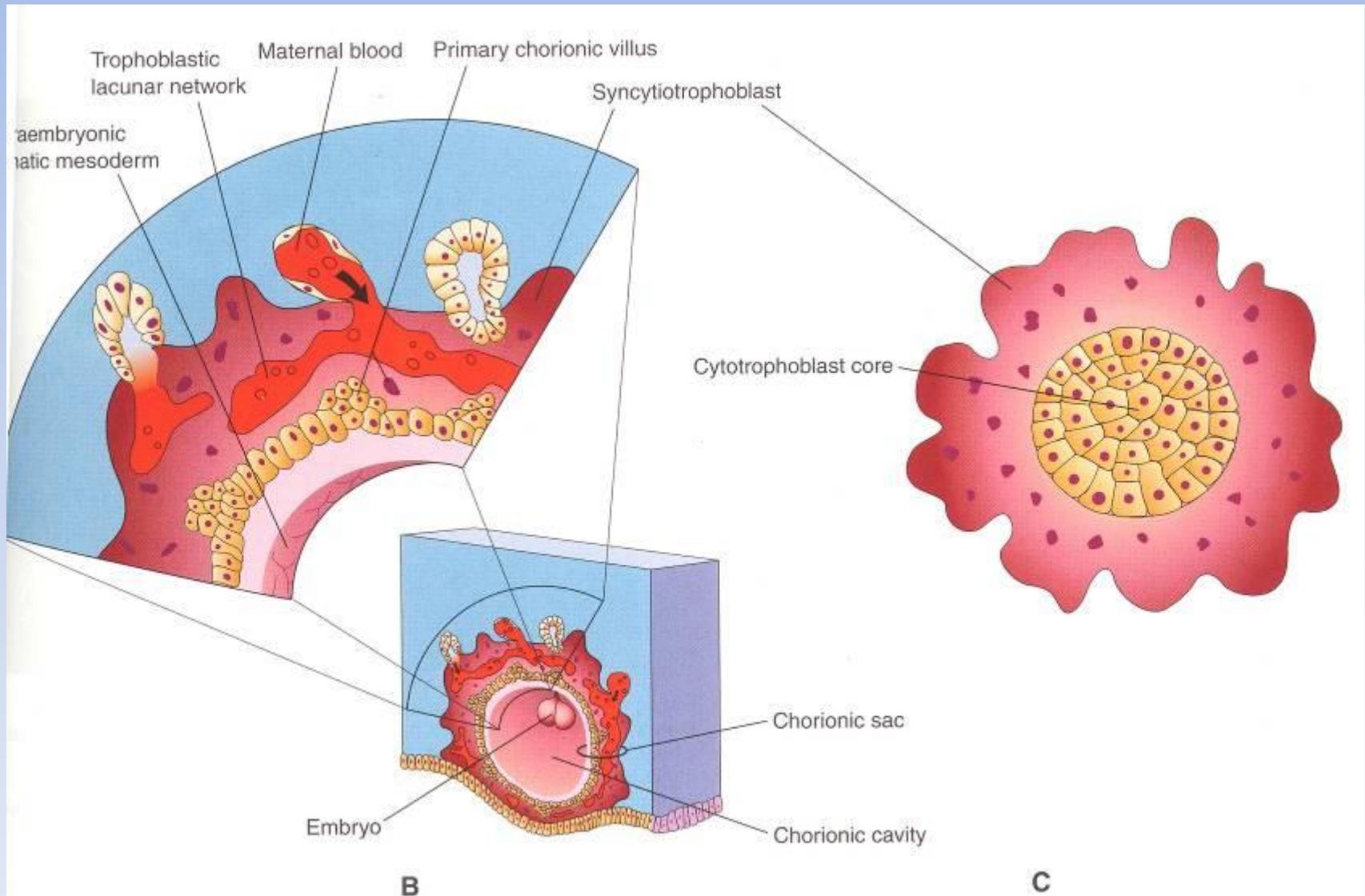
The outer fetal membrane = **chorion**:
Extraembryonic mesoderm +
trophoblast layers

Chorionic cavity (extraembryonic
cavity)

Primary chorionic villus

Formed by trophoblasts
inner: cytotrophoblast

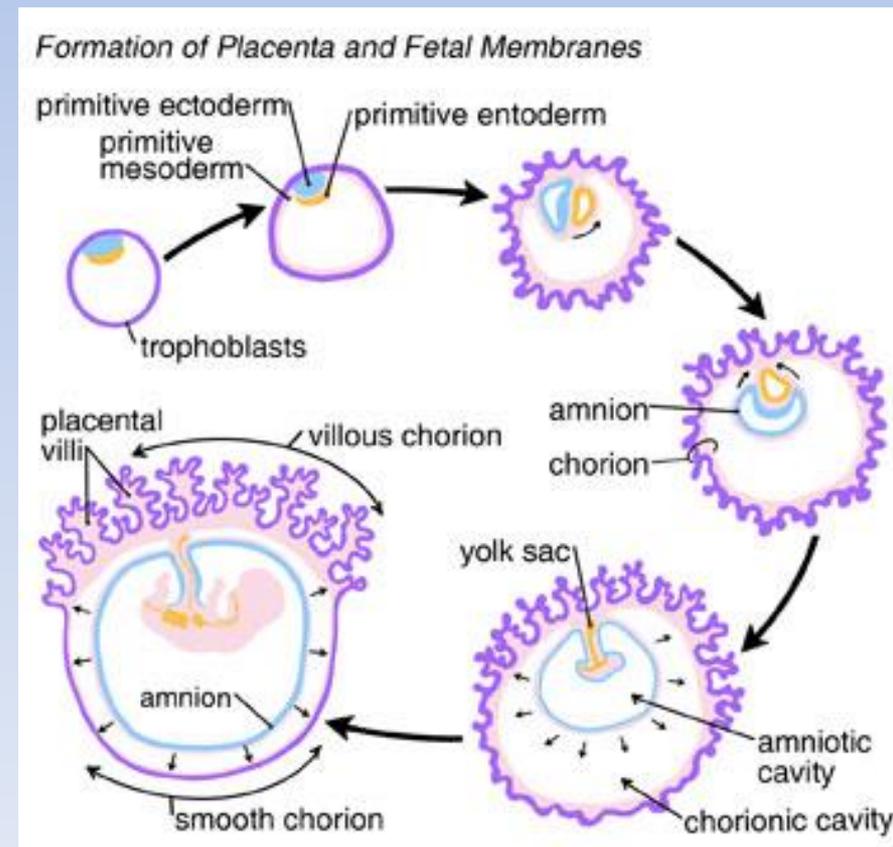
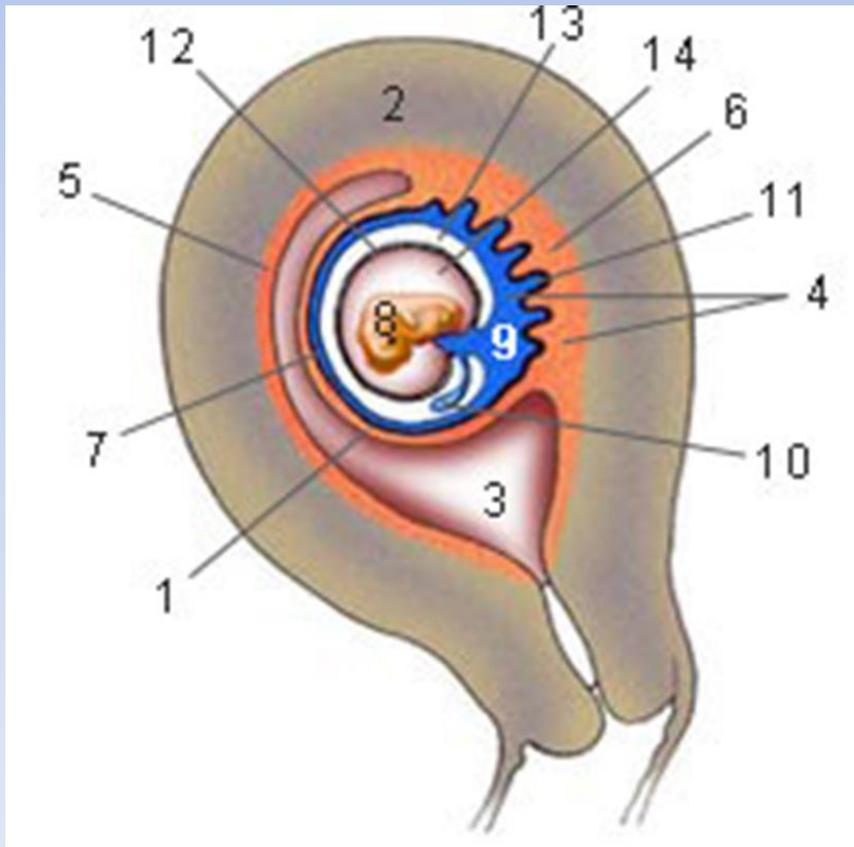
outer: syncytiotrophoblast



Polarisation of chorion and decidua

1. Decidua capsularis
2. Uterine wall
3. Uterine cavity
4. Placenta
5. Decidua parietalis
6. Decidua basalis
7. Chorion leave (smooth chorion)

8. Embryo
 9. Connecting stalk
 10. Yolk sac
 11. Chorion frondosum (villous chorion)
 12. Amnion
 13. Chorionic cavity
 14. Amniotic cavity
- Decidua marginalis



CAVITIES and MEMBRANES

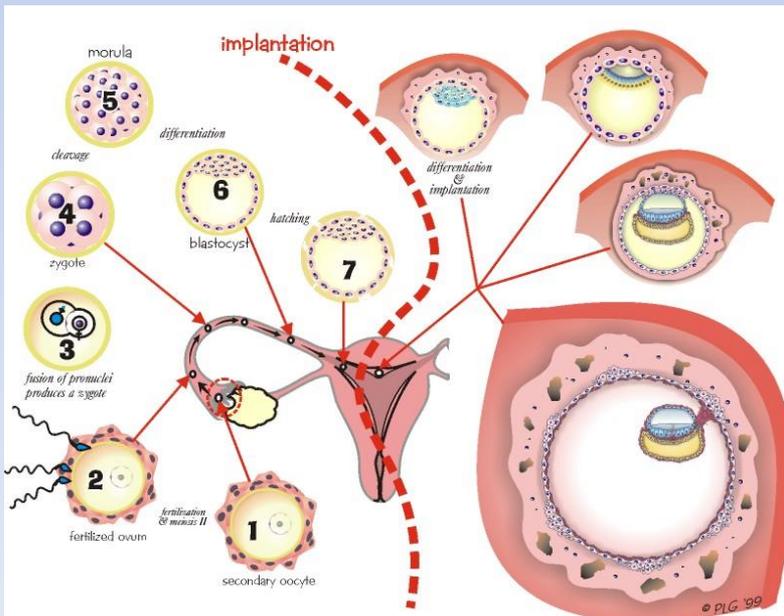
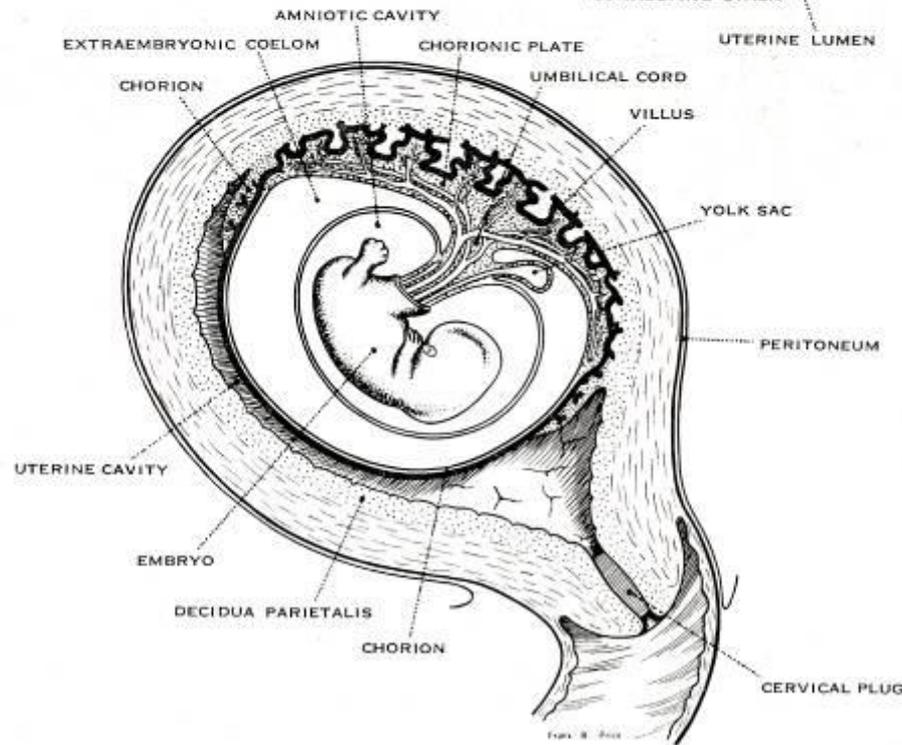
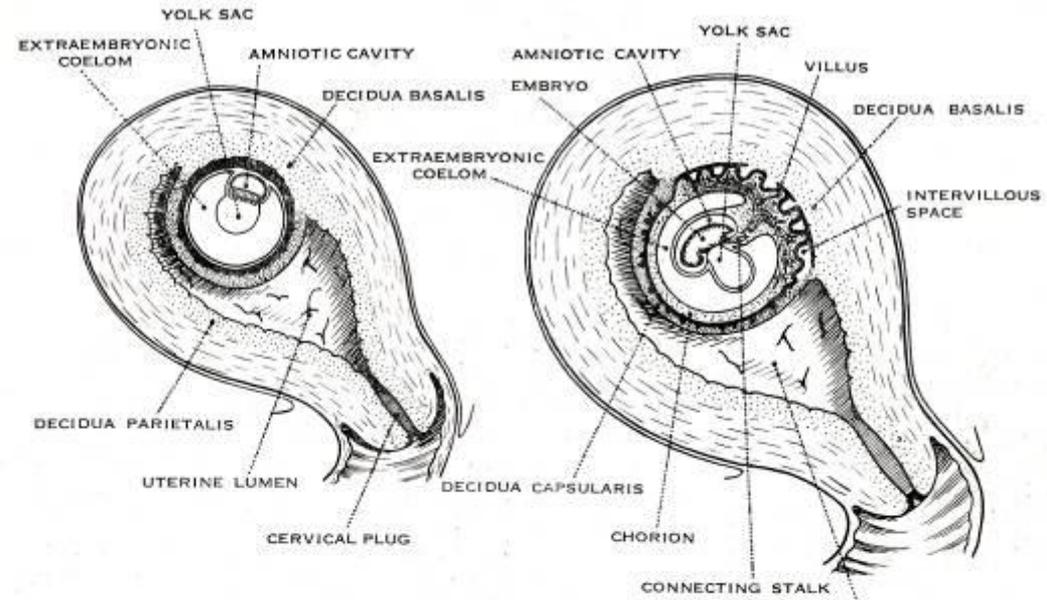
Uterine cavity

Chorionic cavity
(extraembryonic coelom)

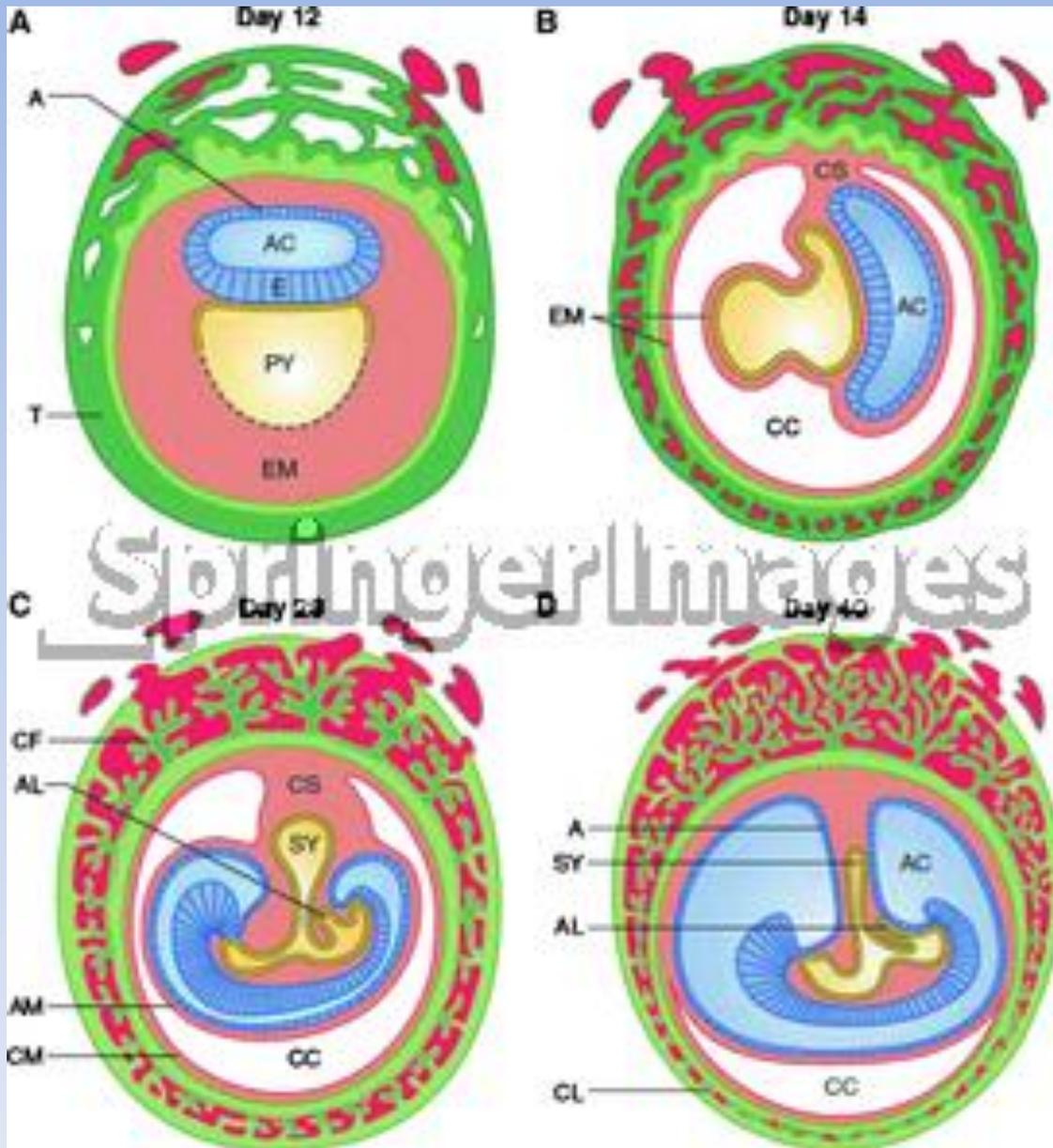
Chorion

Amniotic cavity

Amnion



Formation of the amniotic cavity



amnio-ectodermal junction

Amniotic fluid:

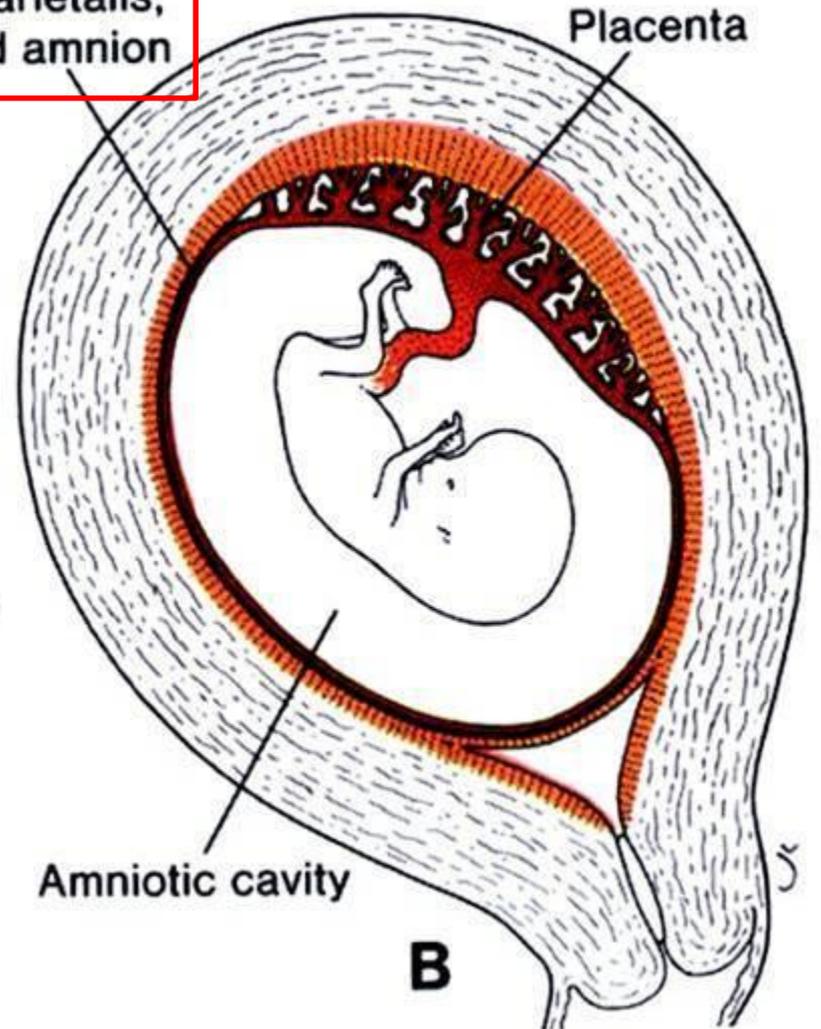
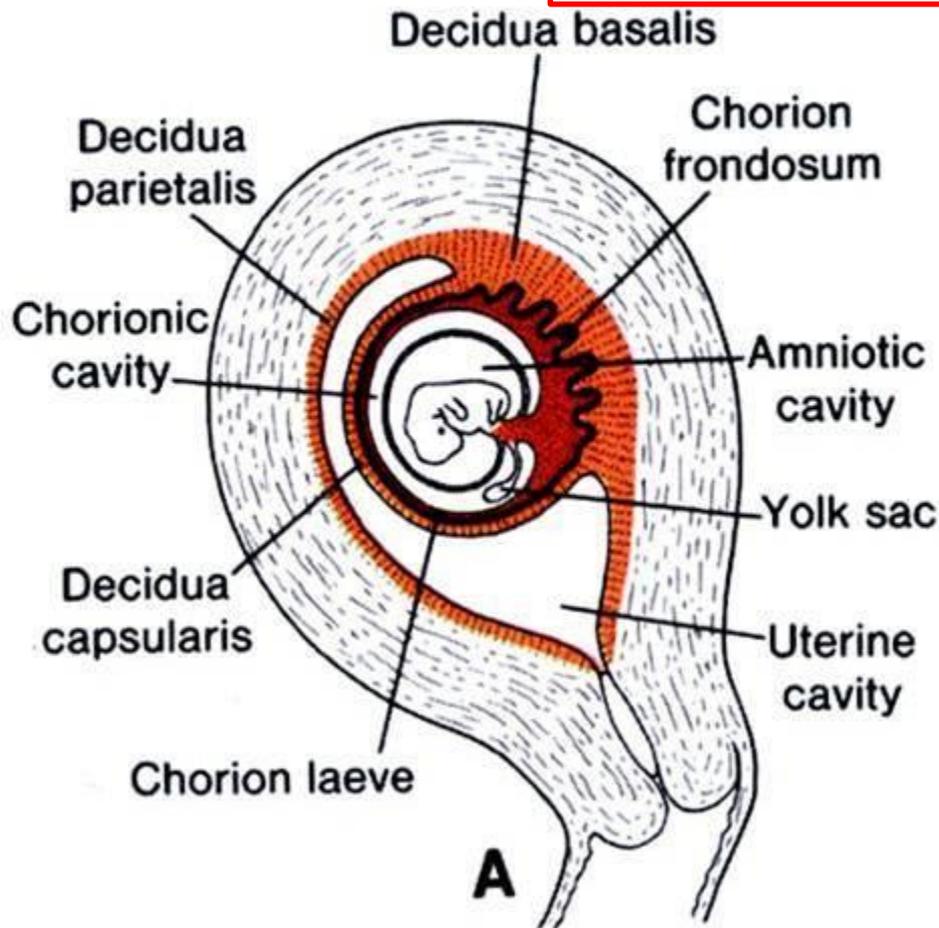
- clear, watery fluid
- derived 1) amniotic cells
- 2) fetal urine (from 5th month)
- 10th week: 30 ml
- 20th week: 800 ml
- 37th week: 1000ml
- Replace every 3 hours
- Fetus swallows 400ml/day
- (from 5th month)

Function:

- absorbs jolts
- prevents adherence
- allows fetal movements

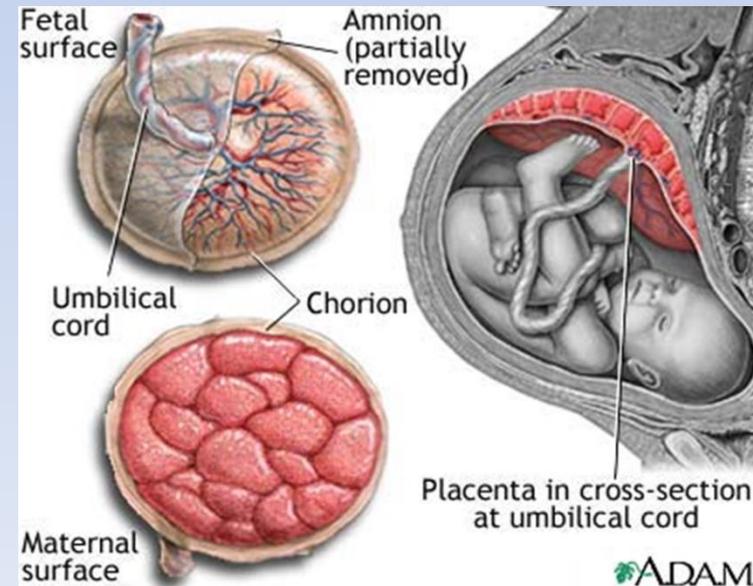
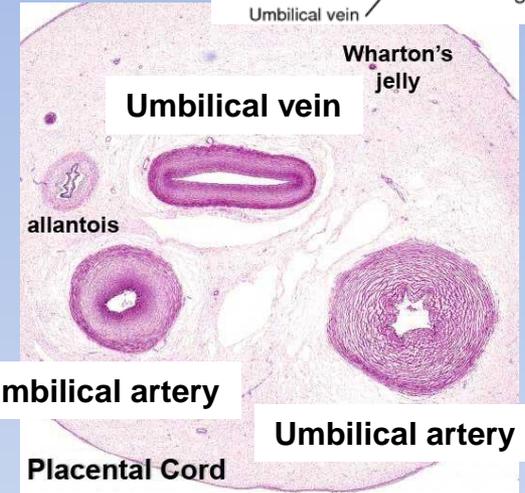
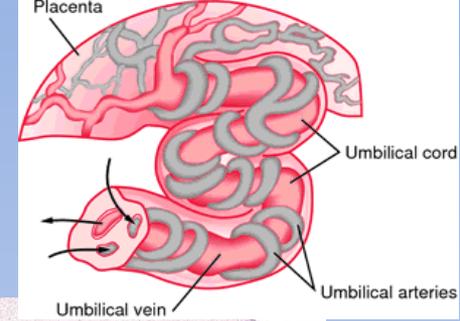
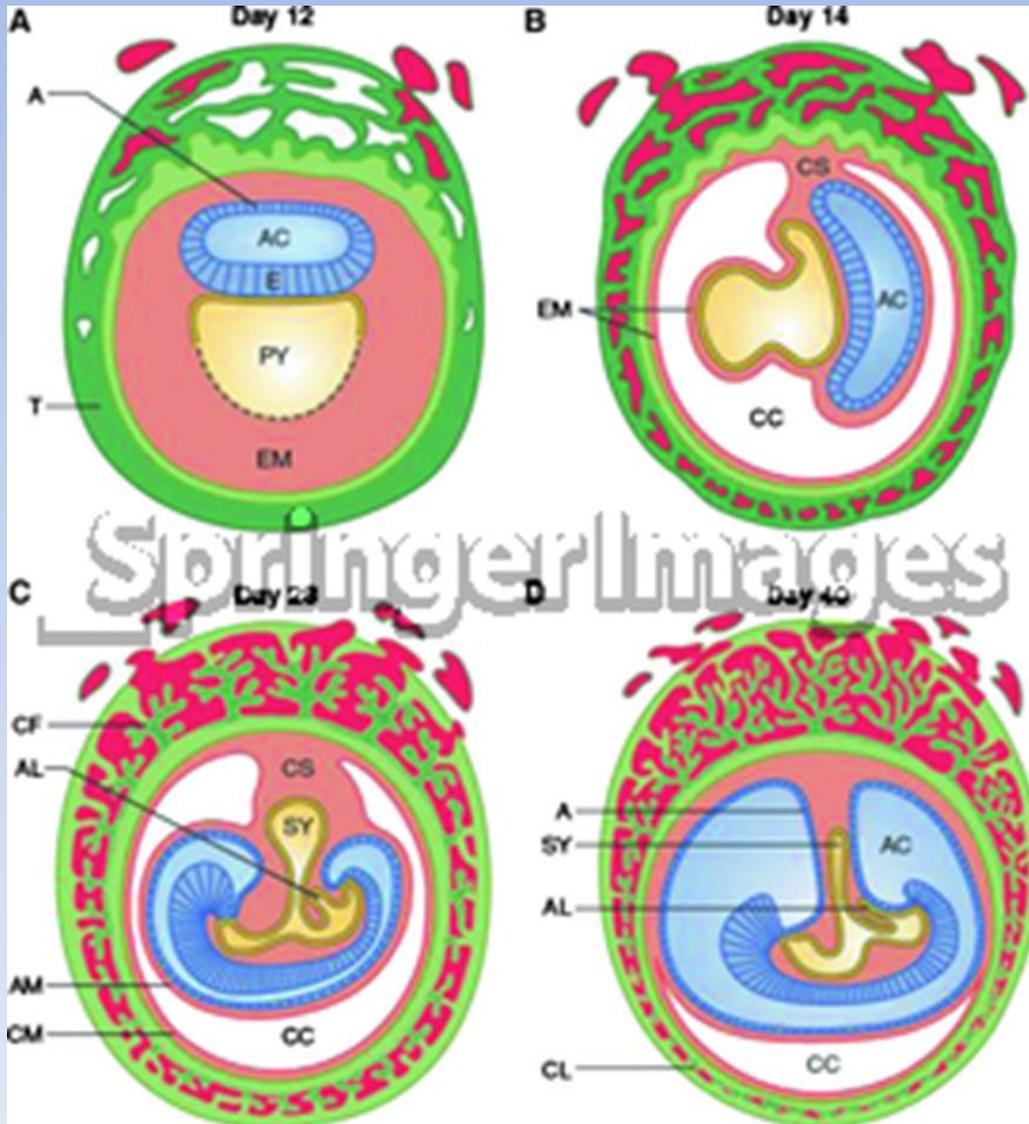


Fused decidua parietalis, chorion laeve and amnion



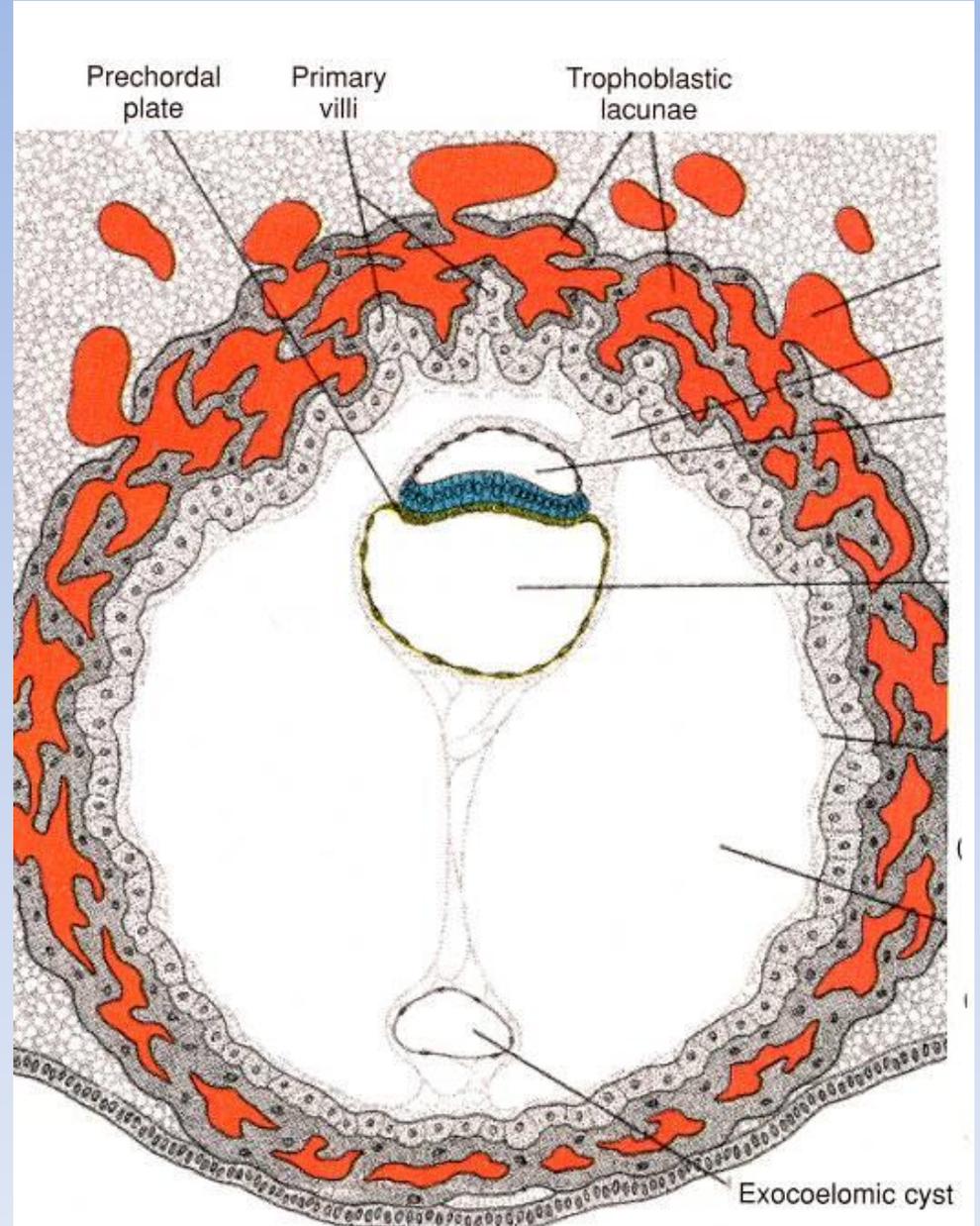
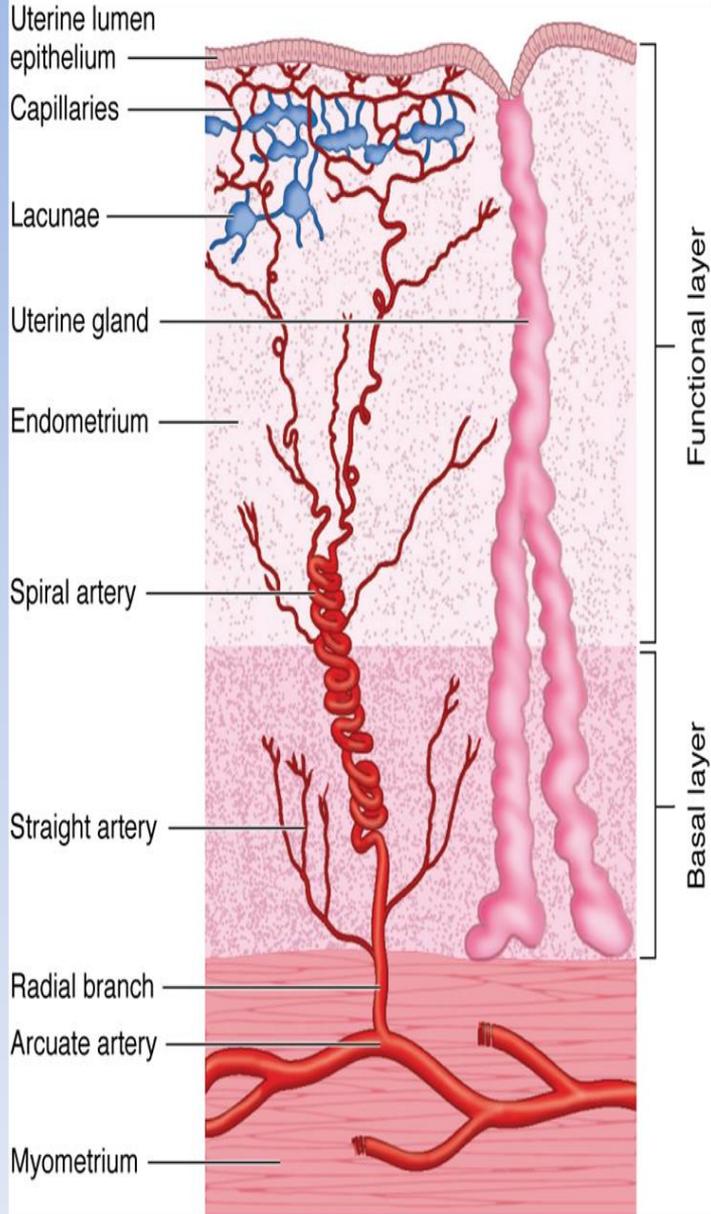
Formation of the umbilical cord

amnio-ectodermal junction



14 DAY

Formation of the placenta – early moments



maternal sinusoid

lacunar network

extra-embryonic somatic mesoderm

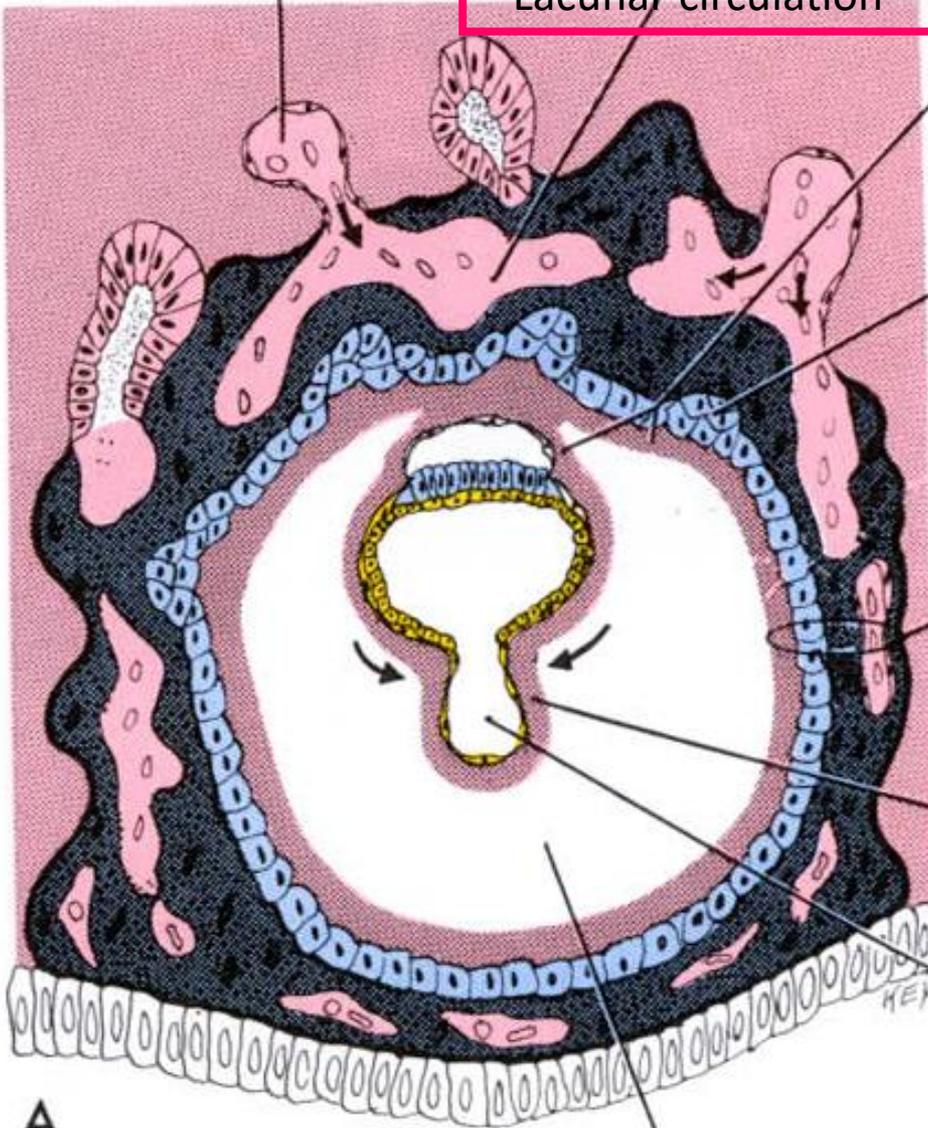
Lacunar circulation

primary chorionic villus

chorion --> Chorionic plate

extra-embryonic splanchnic mesoderm

primitive yolk sac



A

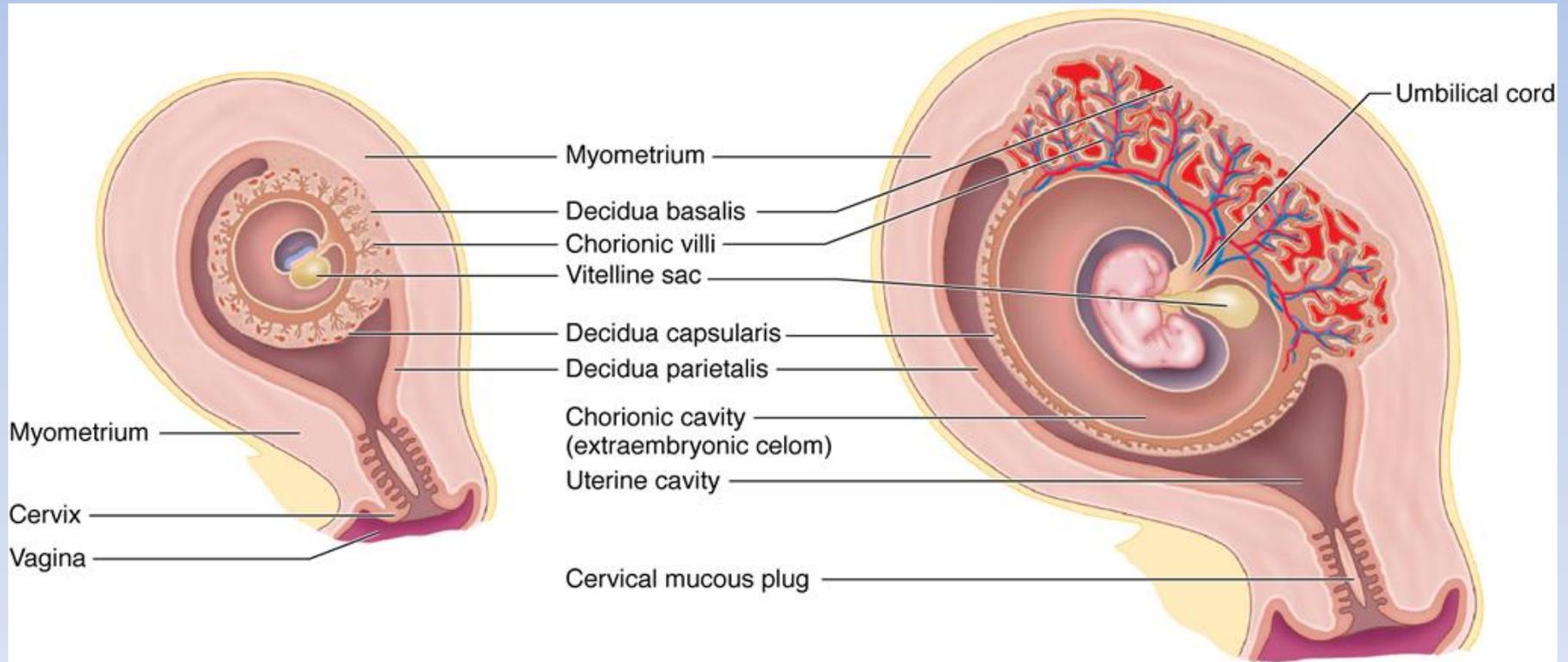
maternal blood

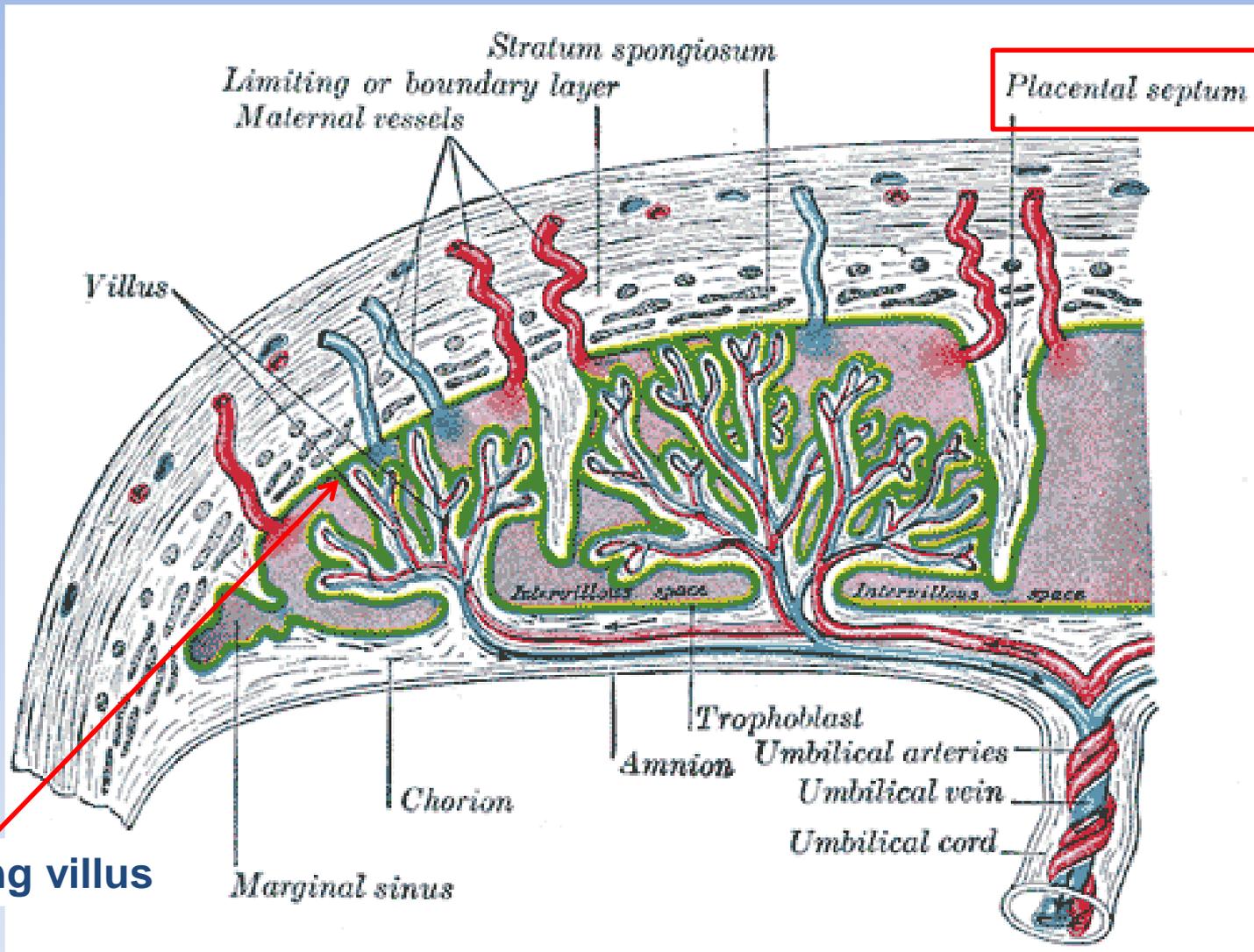
extraembryonic coelom

Formation of the placenta

Maternal part – decidua basalis

Fetal part – chorion frondosum





Stratum spongiosum
Limiting or boundary layer
Maternal vessels

Placental septum

Villus

Intervillous space

Intervillous space

Trophoblast

Amnion

Umbilical arteries

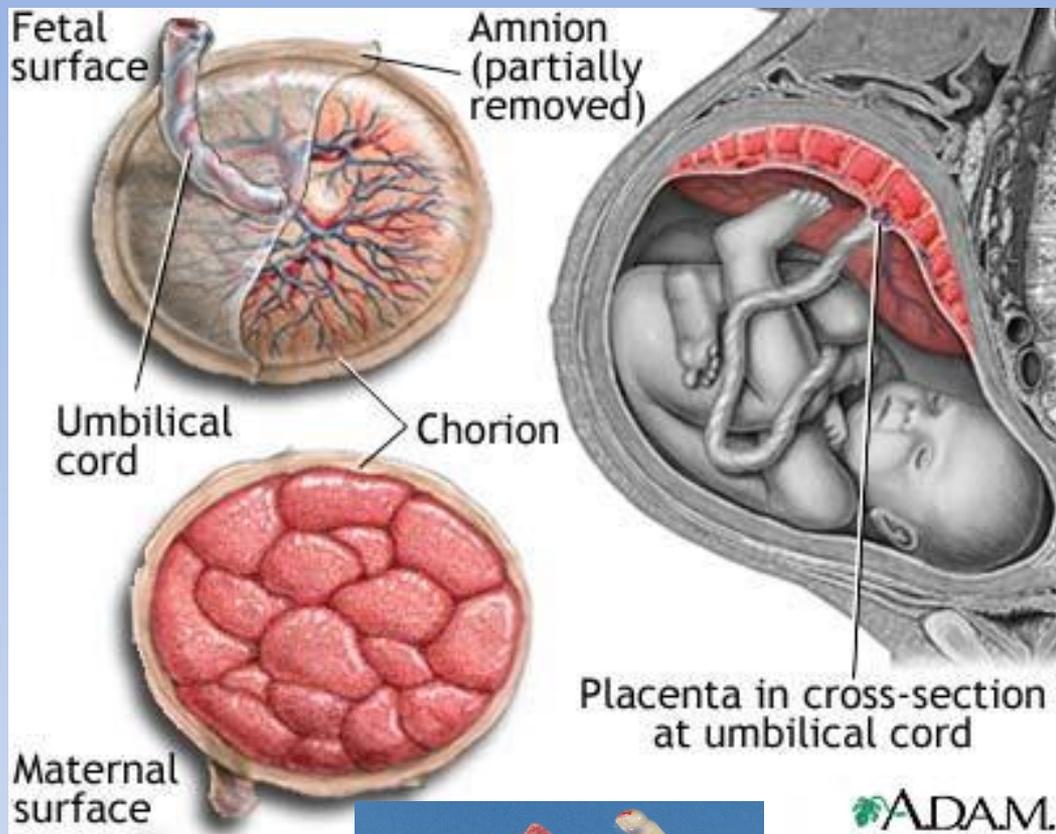
Umbilical vein

Umbilical cord

Chorion

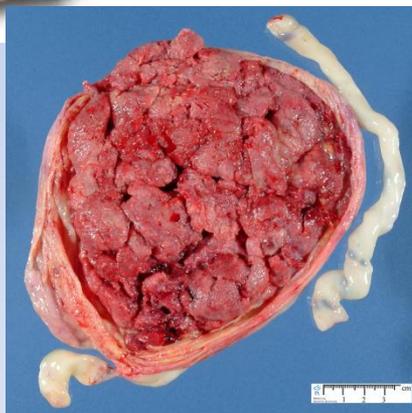
Marginal sinus

Anchoring villus



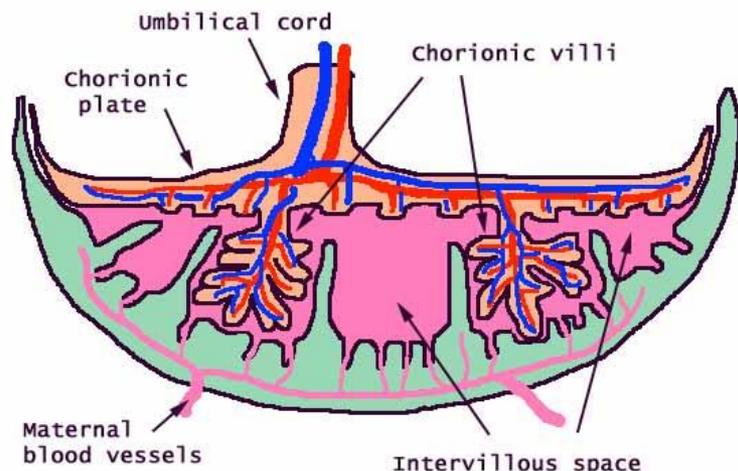
Full-Term Placenta

- discoid (diameter of 15-25cm)
- 3cm thick
- 500-600g

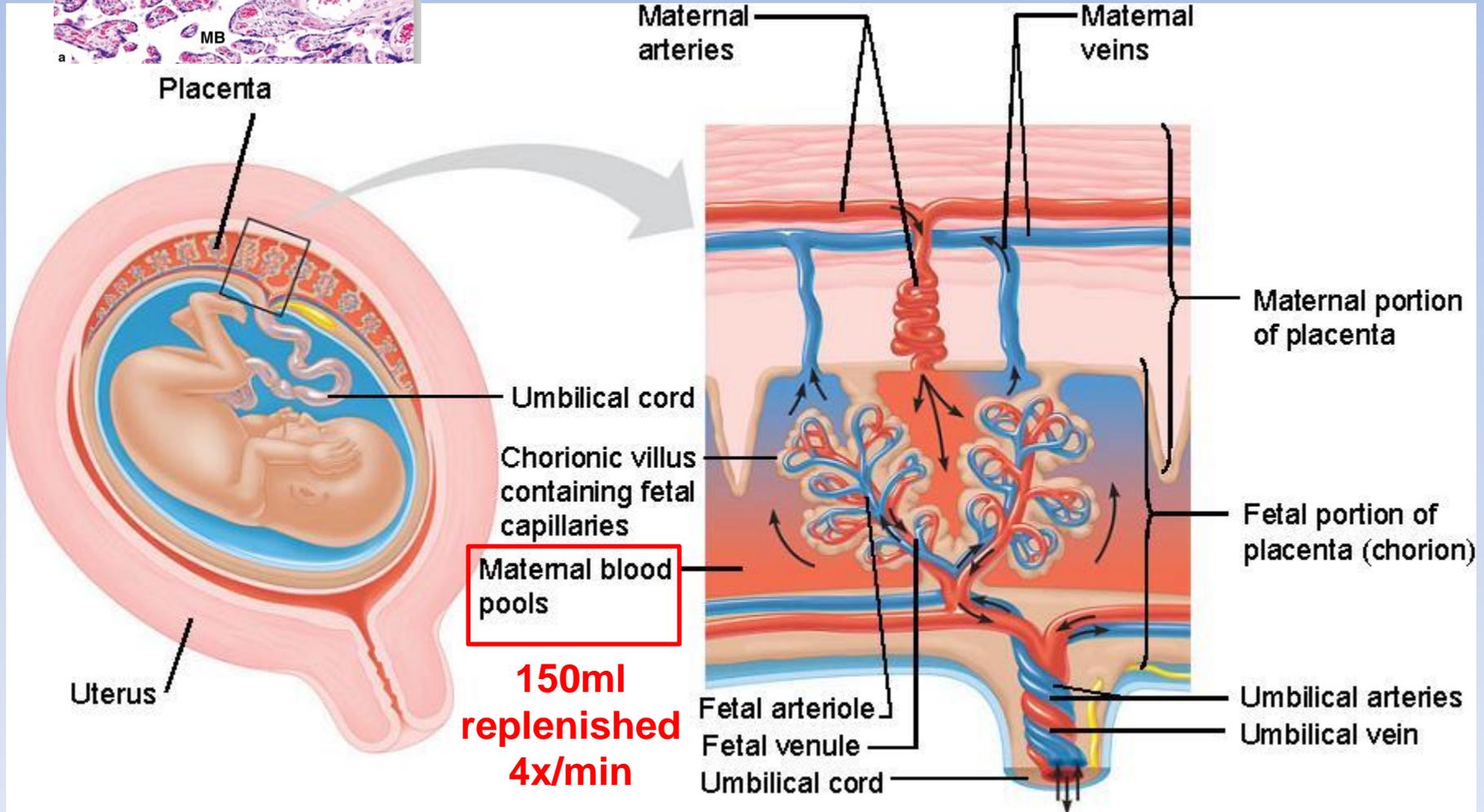
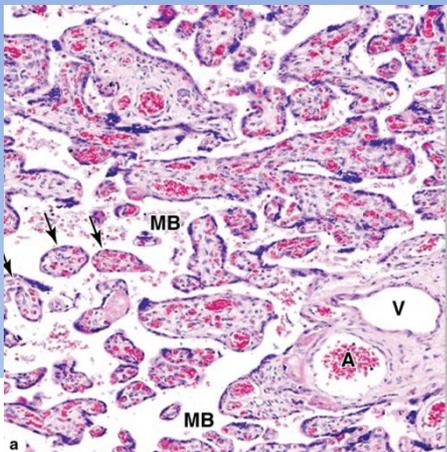


Cotyledon (15-20)

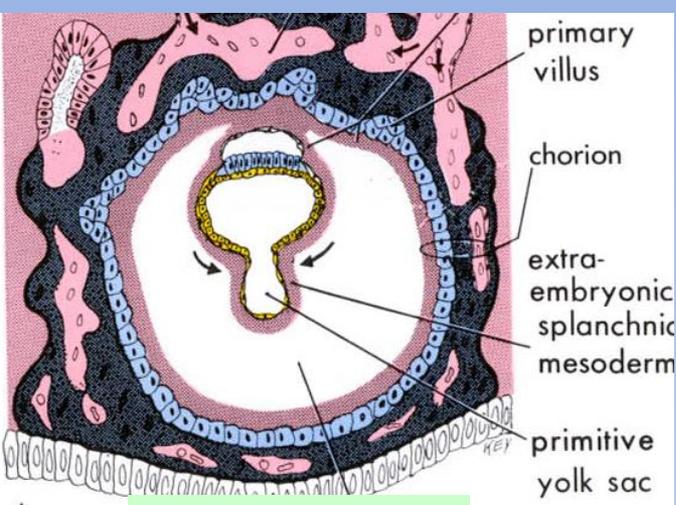
Divide by decidual (placental) septum



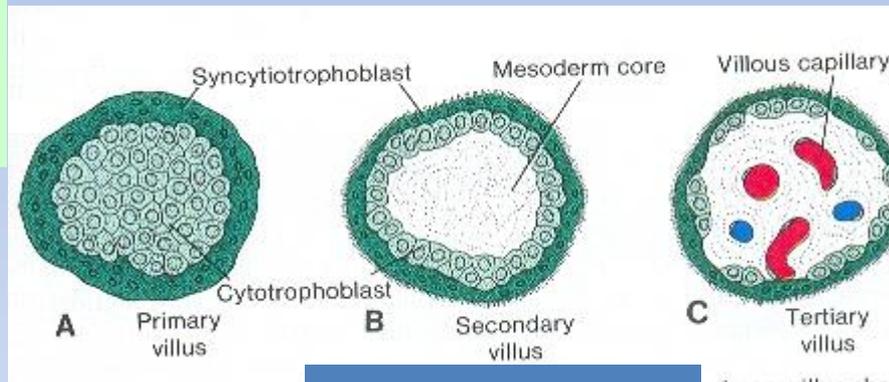
What can be found within the intervillous space?



Development of chorionic villi

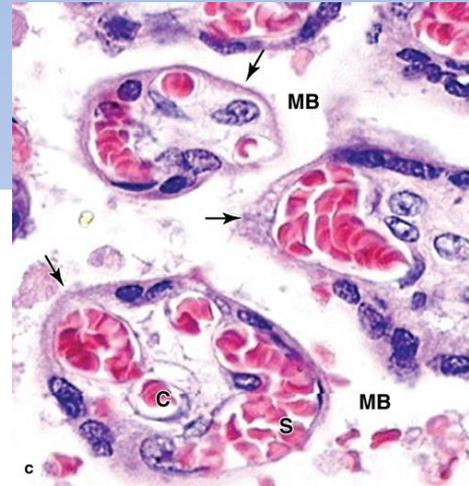


Primary villi:
- throphoblast



Secondary villi:
- throphoblast
- mesenchyme

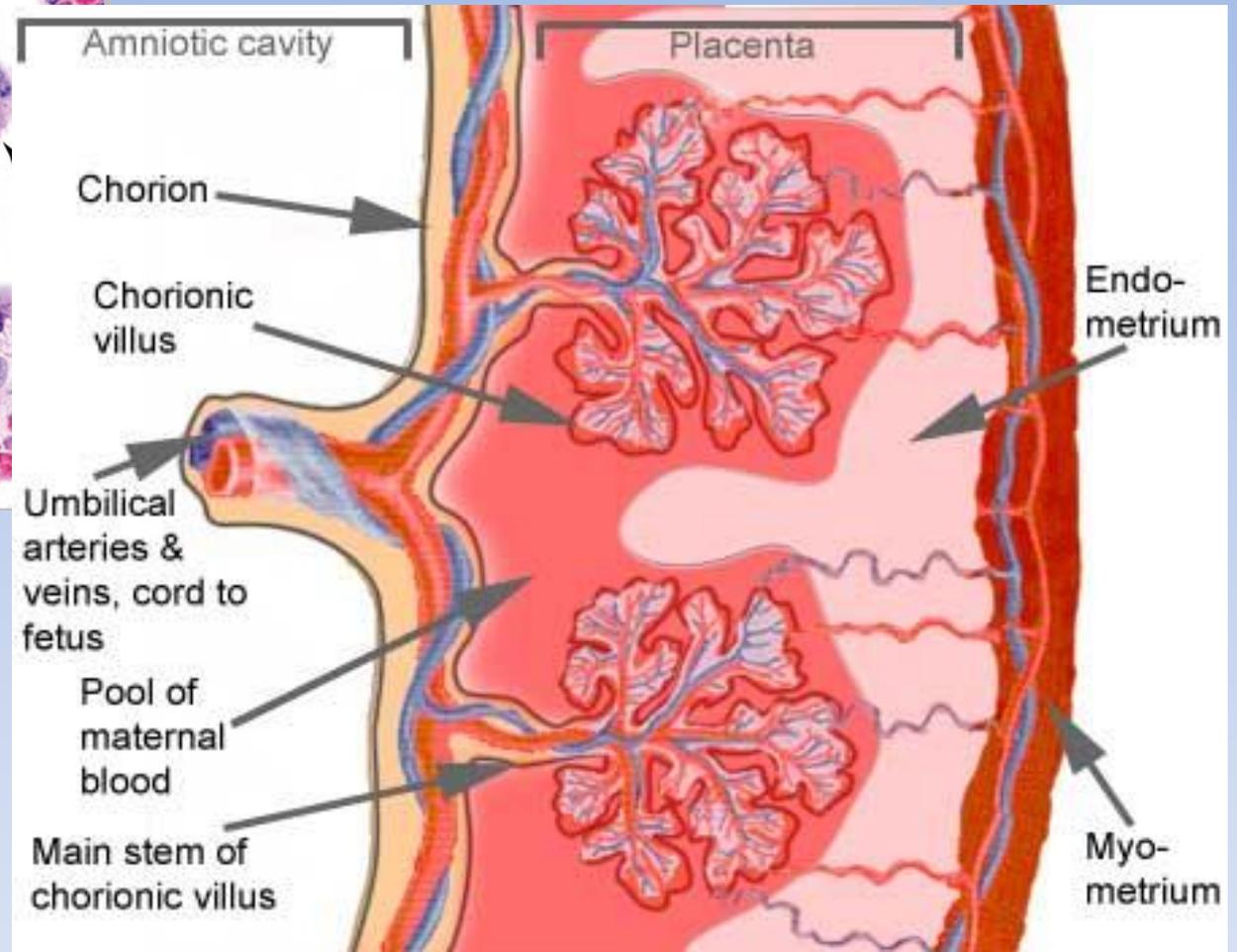
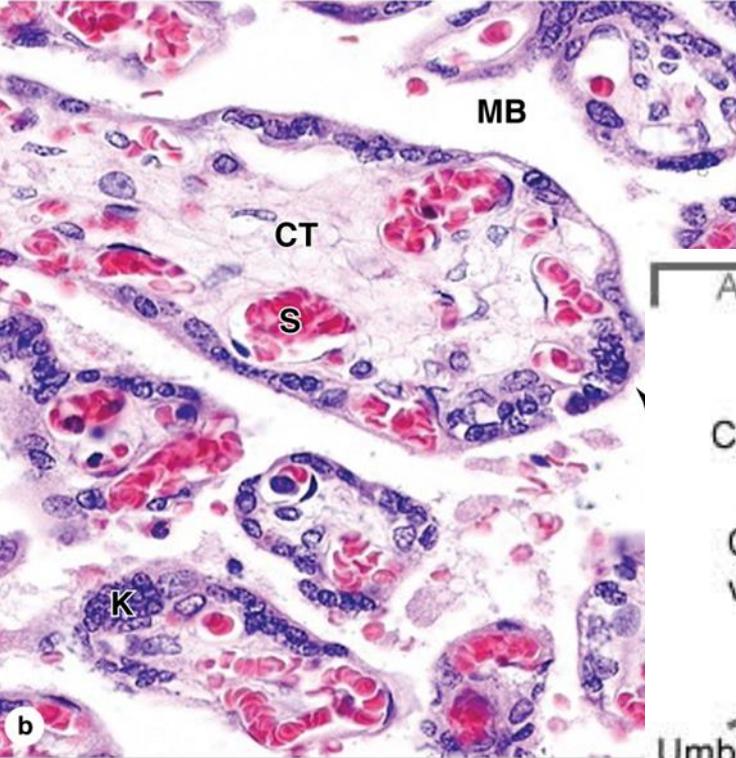
Tertiary villi:
- throphoblast
- mesenchyme
- fetal blood vessels



Placental barrier

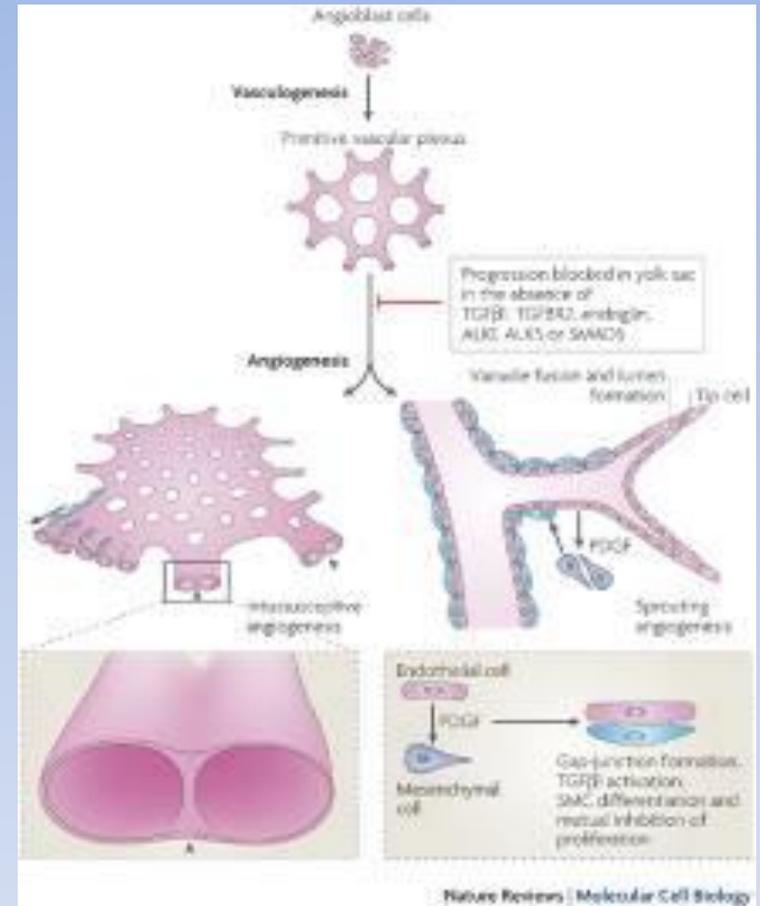
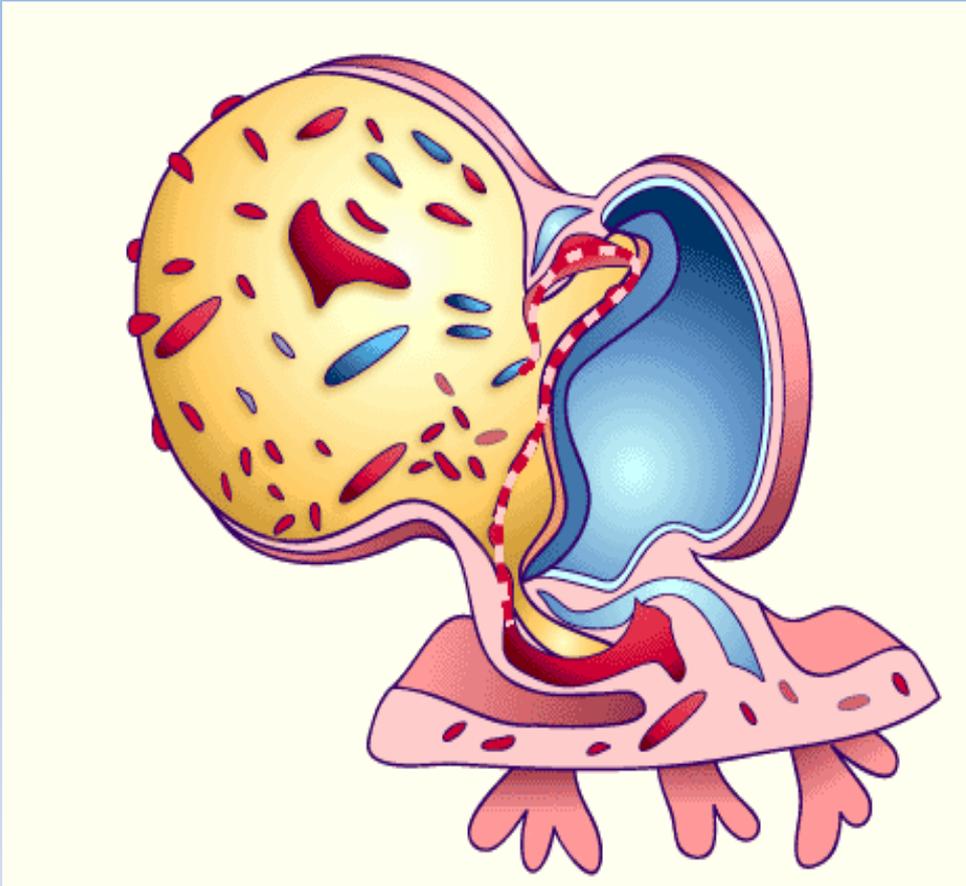
Human placenta is hemochorial

(3 layer between the maternal and fetal blood)



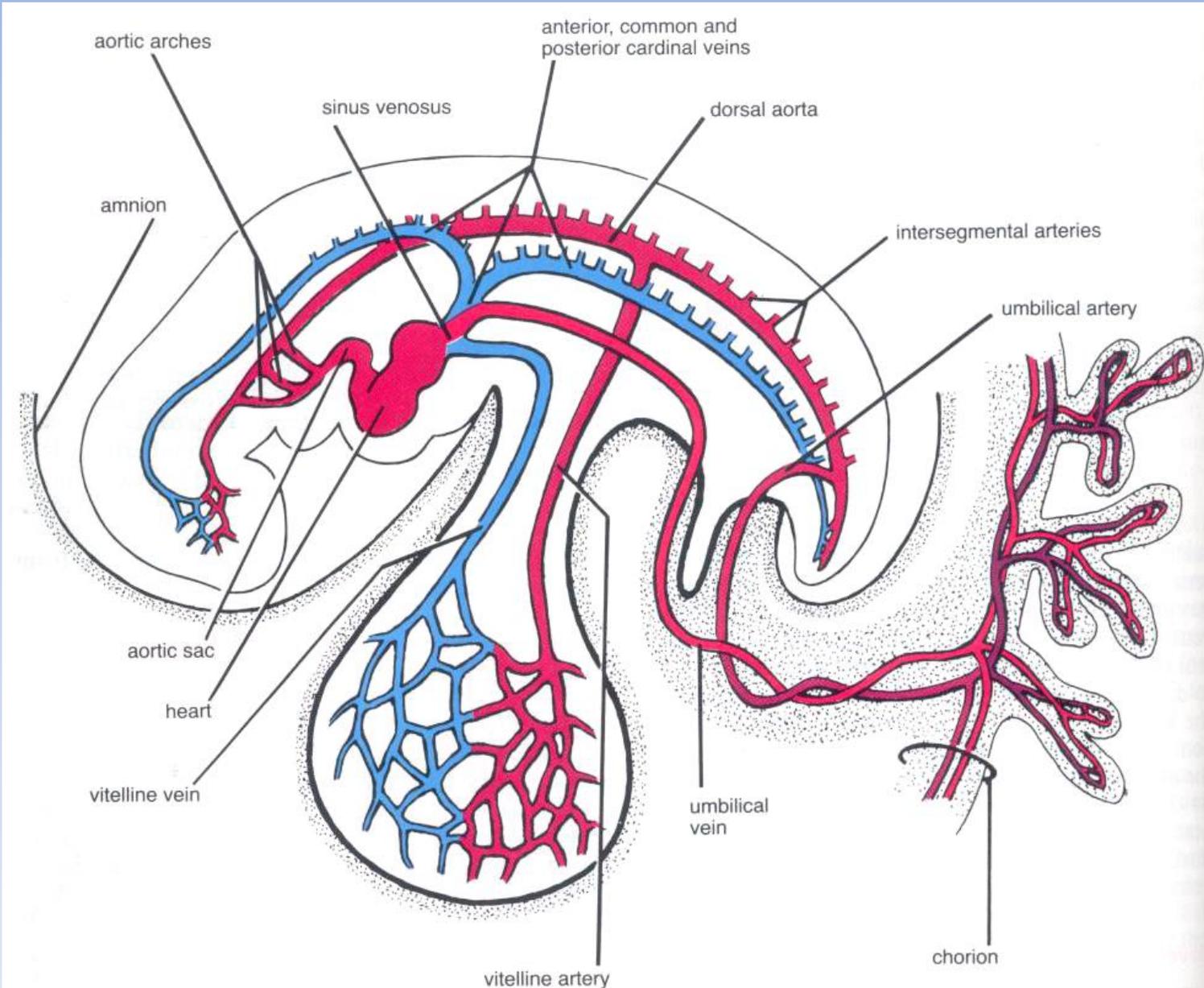
Surface area of chorionic villi 4-14 m²

Development of blood vessels and cells.

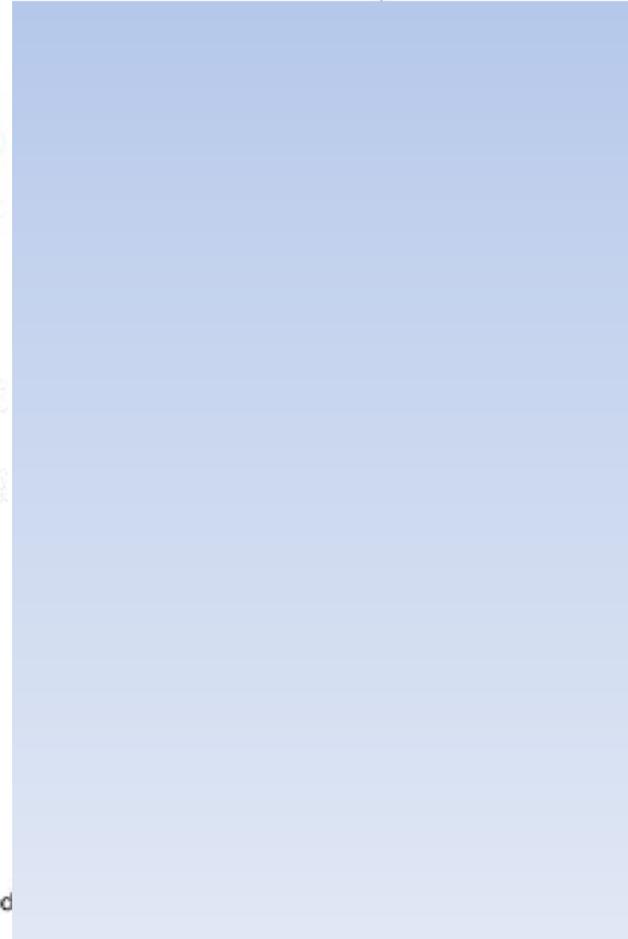
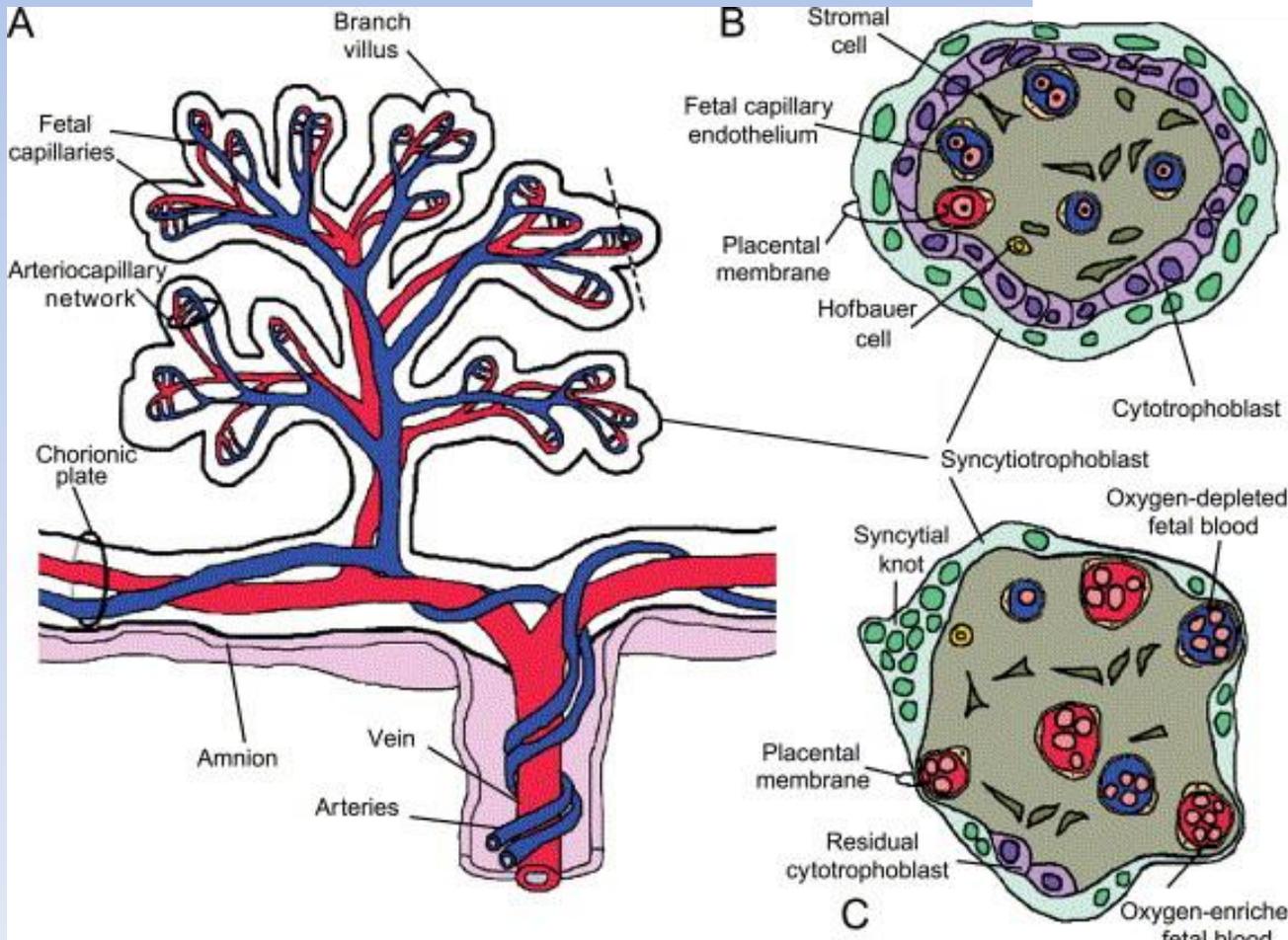
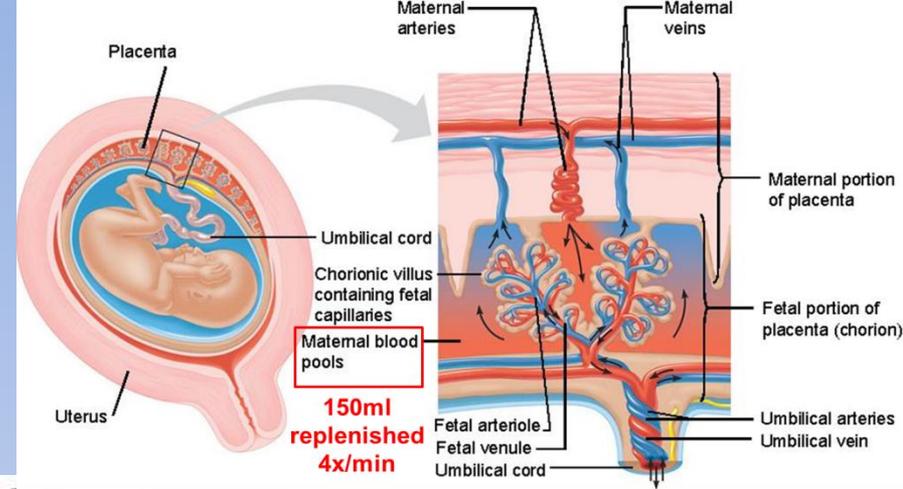


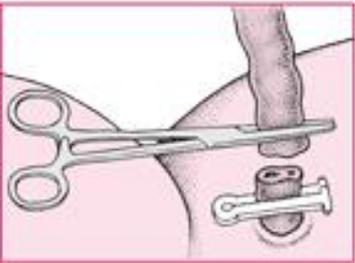
In the beginning of the 3rd week the cell groups of **splanchnopleura** (which are covered the yolk sac) differentiated like **vessels and blood cells (angioblasts)**, then form cords with lumen. The central cells form blood cells, while the peripheral cells form endothelial cells. On this way will form the vessel system of placenta (extraembryonal), and the cardiovascular system (intraembryonal).

Fetal circulation



Circulation of placenta





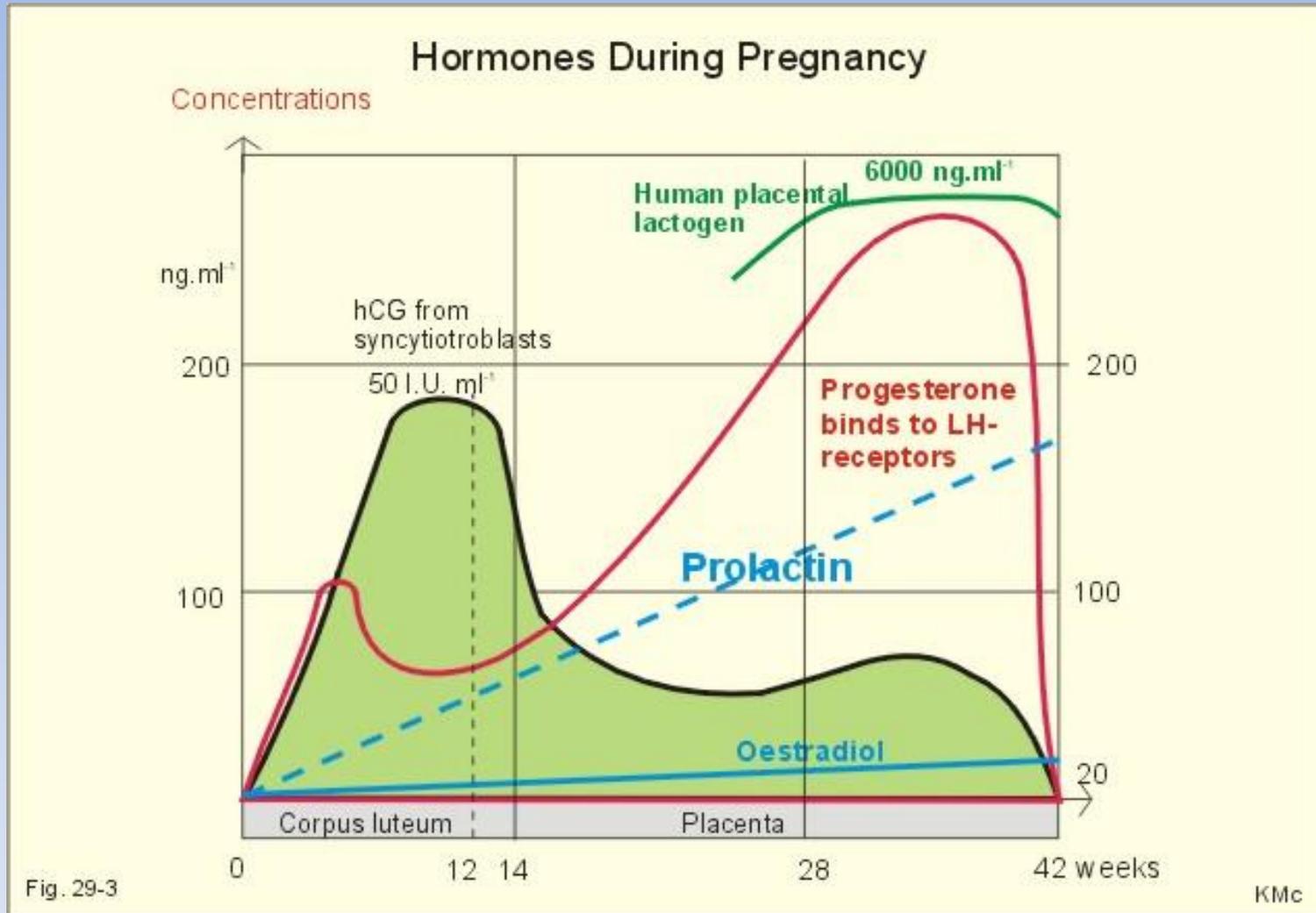
Cord Is Cut



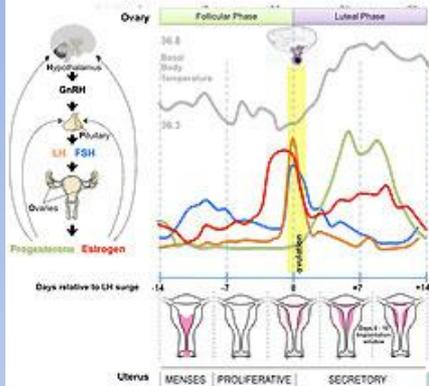
Cord Is Clamped



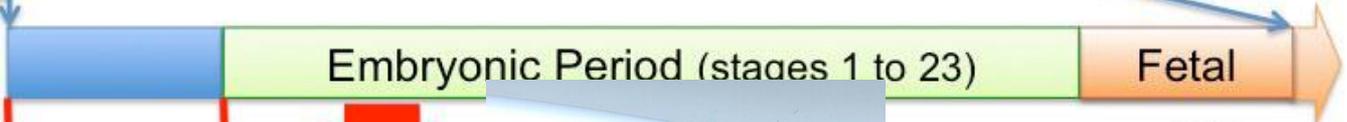
Placenta and hormones



Human Development Timeline

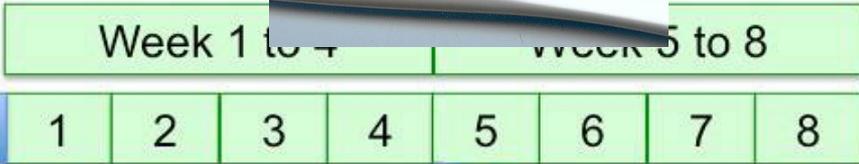


Menstrual cycle

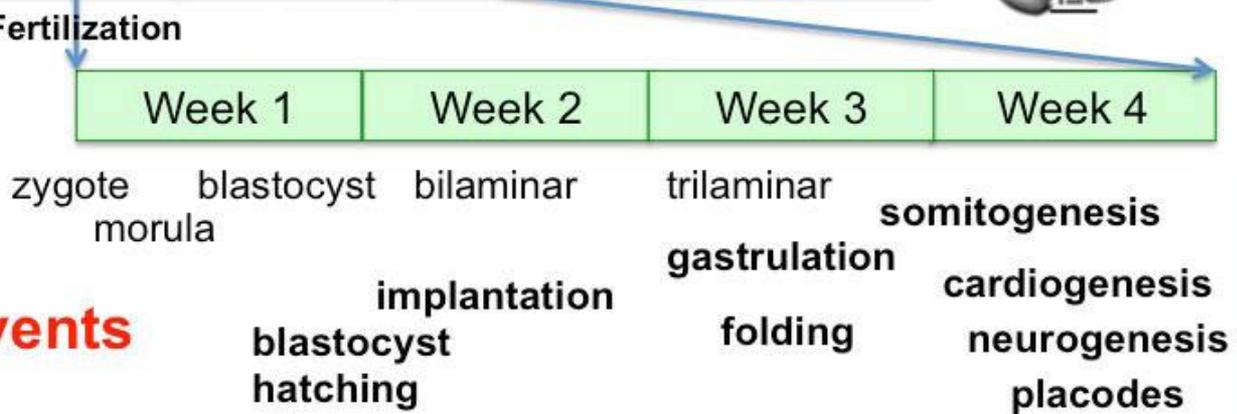


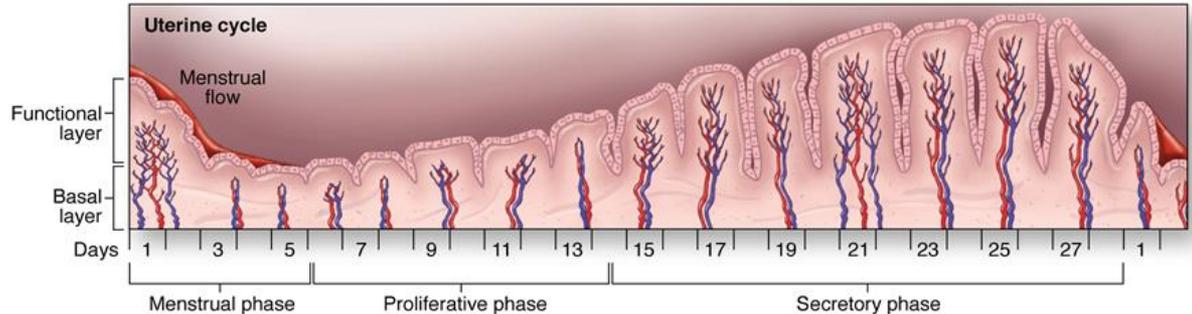
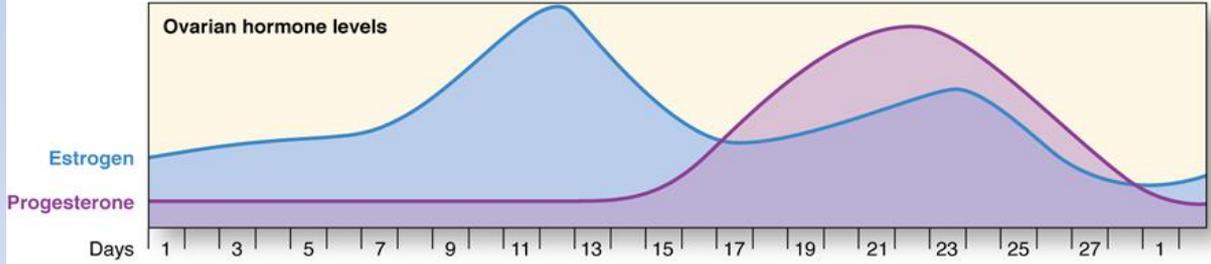
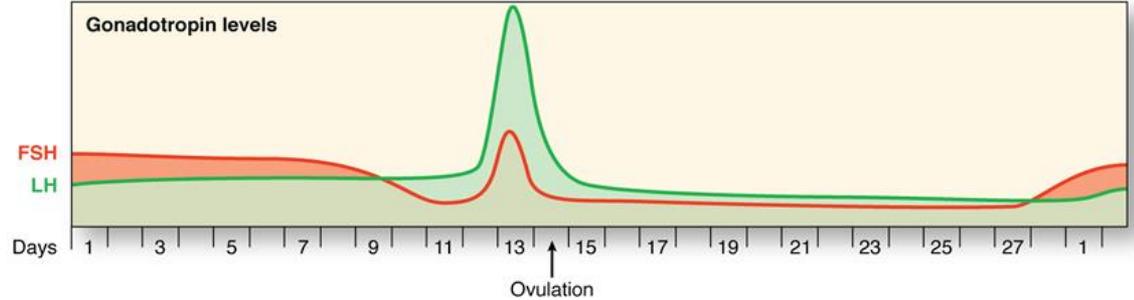
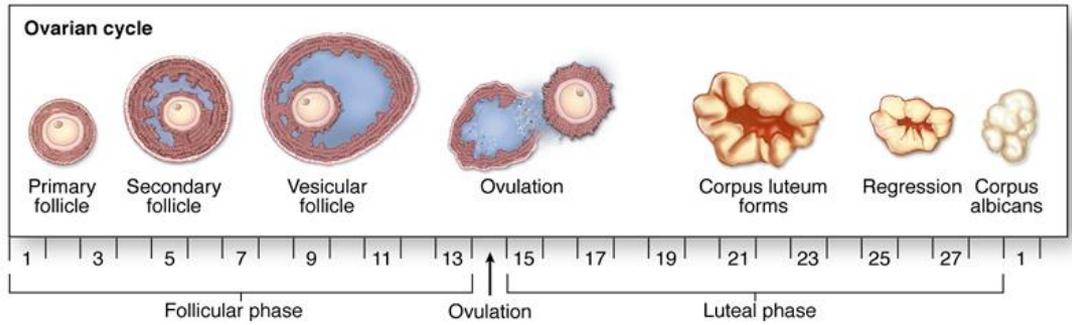
Last Menstrual Period

Fertilization



Events





Human development timeline

