Placenta and Fetal Membranes

Amnion - Epiblast / Extraembryonic Mesoderm

Yolk Sac - Hypoblast / Extraembryonic Mesoderm

Allantois - Embryonic Hindgut

Chorion - Trophoblasts / Extraembryonic Mesoderm

Placenta - Chorion / Maternal Decidua

Amnion

Amnionic membrane is two cell layers

1) epiblast derived extraembryonic ectodermal layer
2) thin non-vascular extraembryonic mesoderm

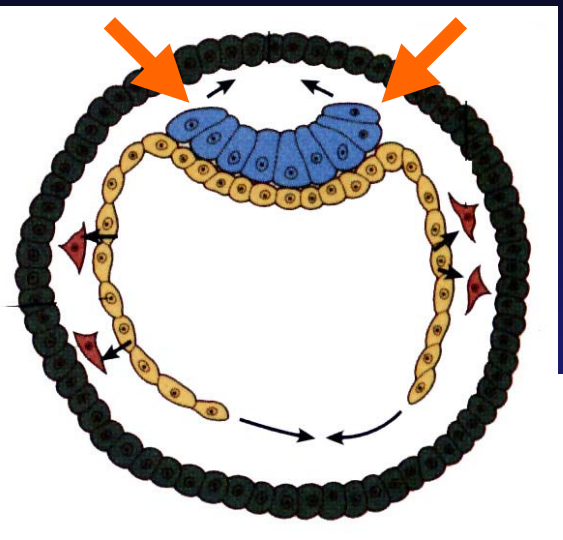
As the amnion enlarges it encompasses the embryo on the ventral side, merging around the umbilical cord.

Amnion forms the epithelial layer of the umbilical cord

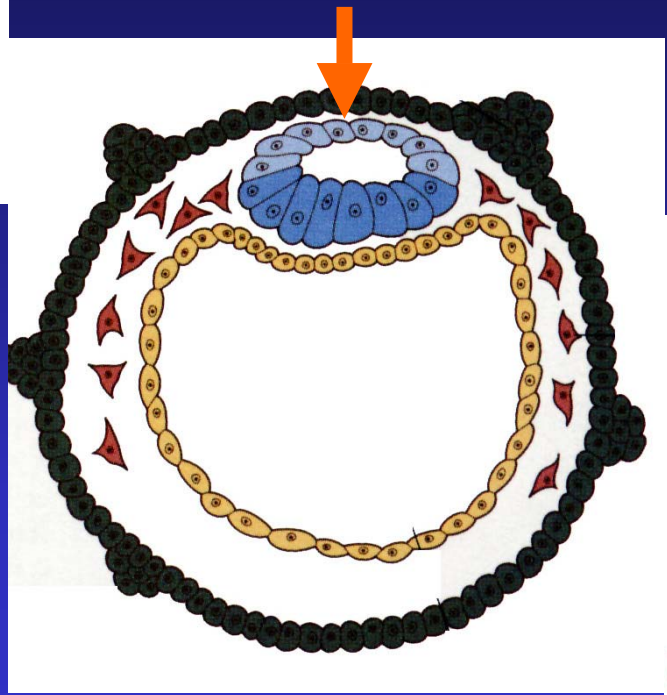
With embryo growth the amnion obliterates the chorionic cavity

Amnionic sac is fluid filled called amnionic fluid: the embryo is bathed in the fluid

Extraembryonic Tissues

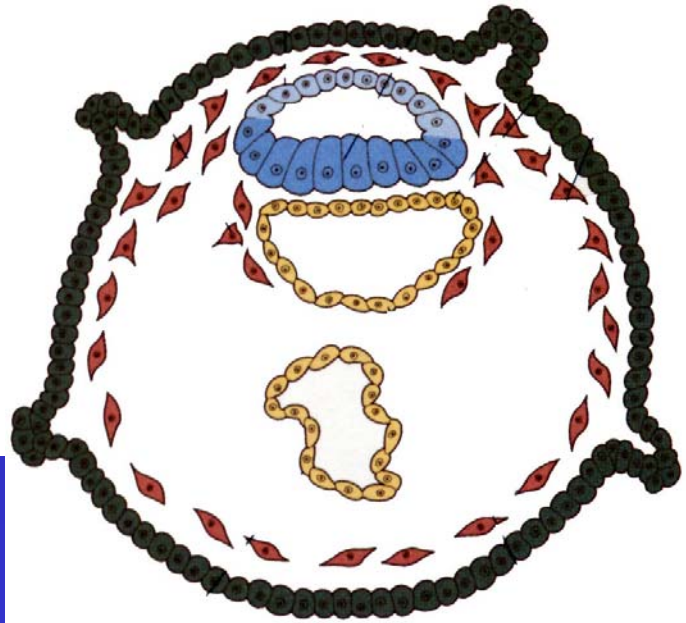


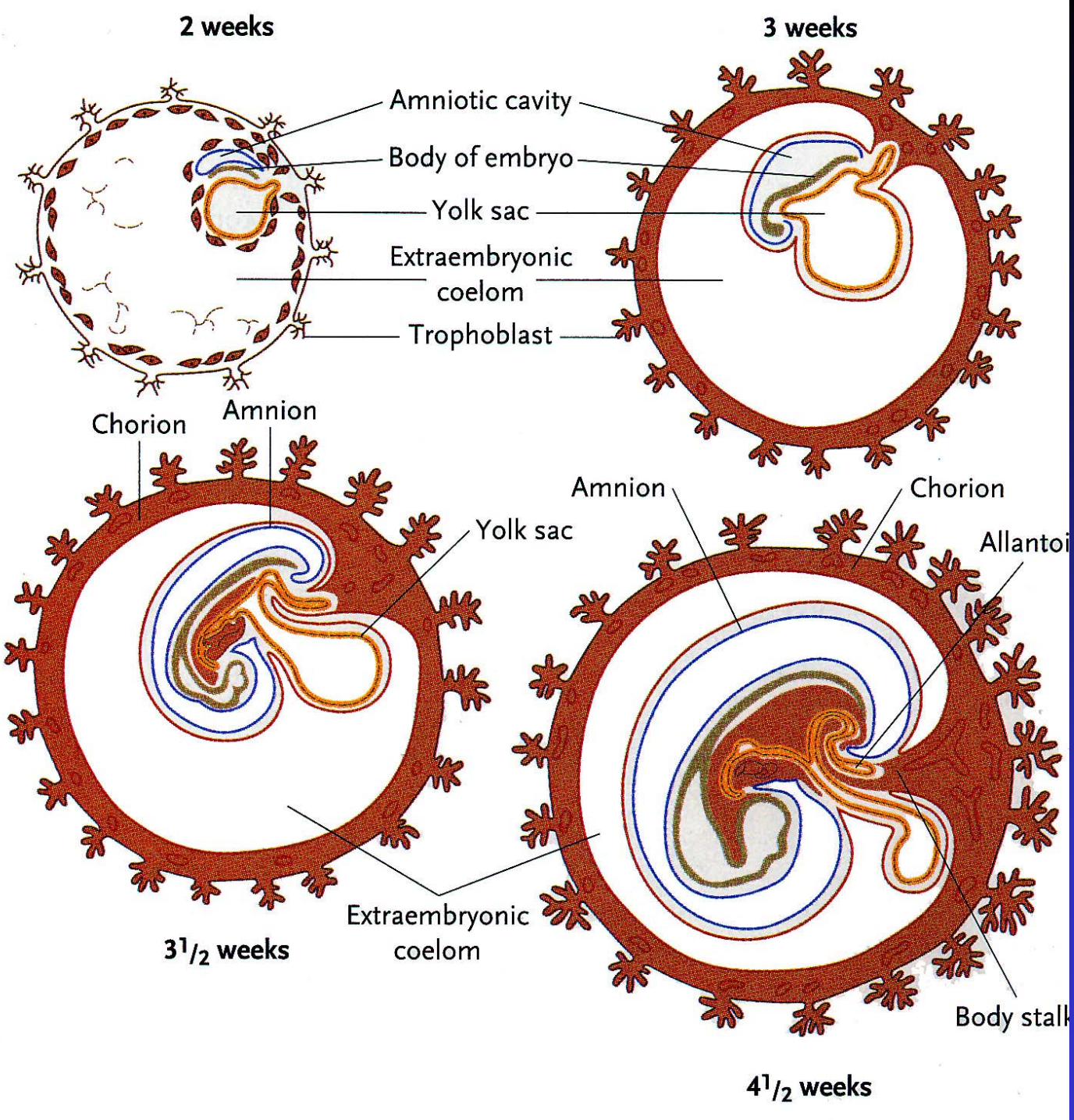
8 days

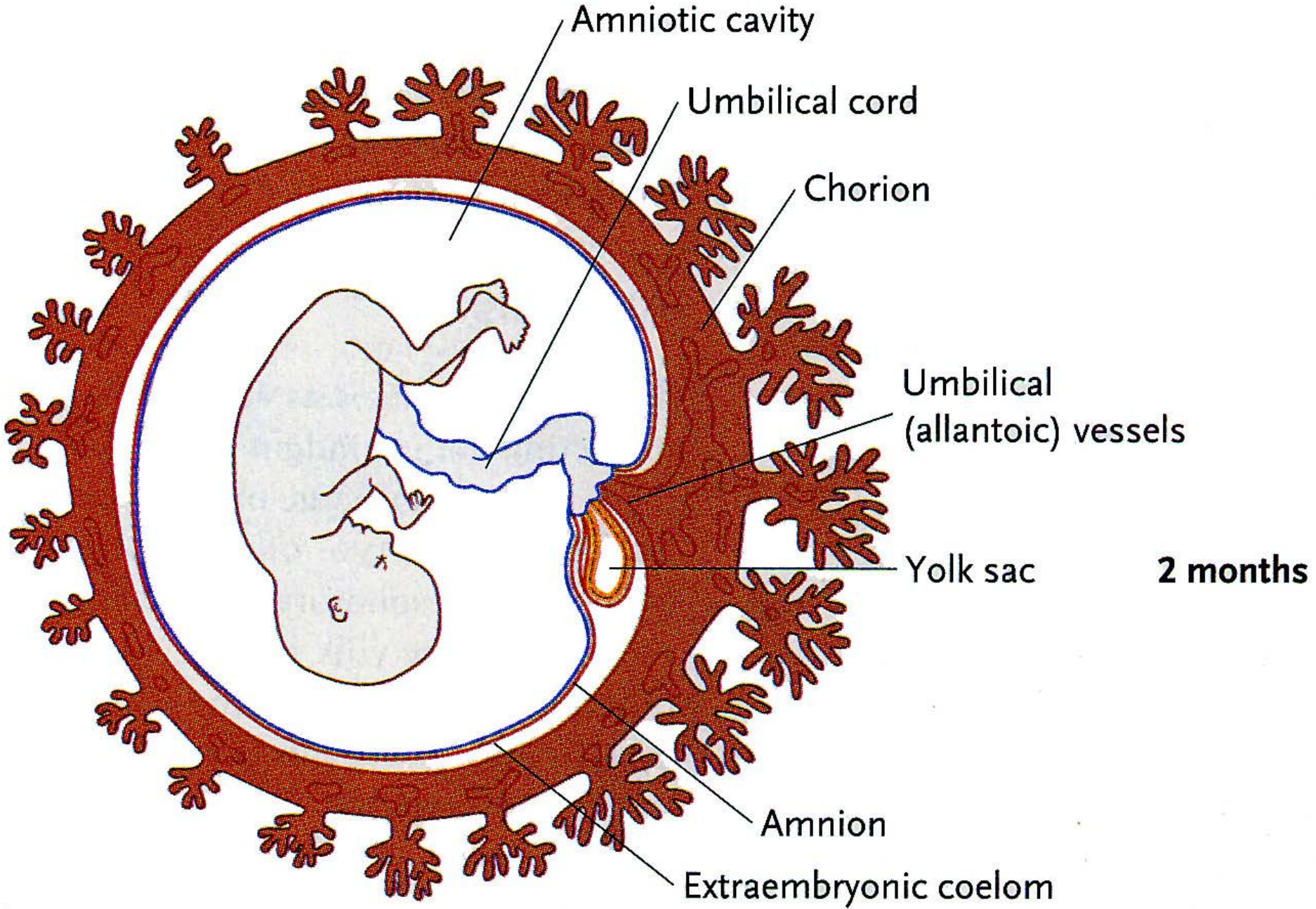


9 days

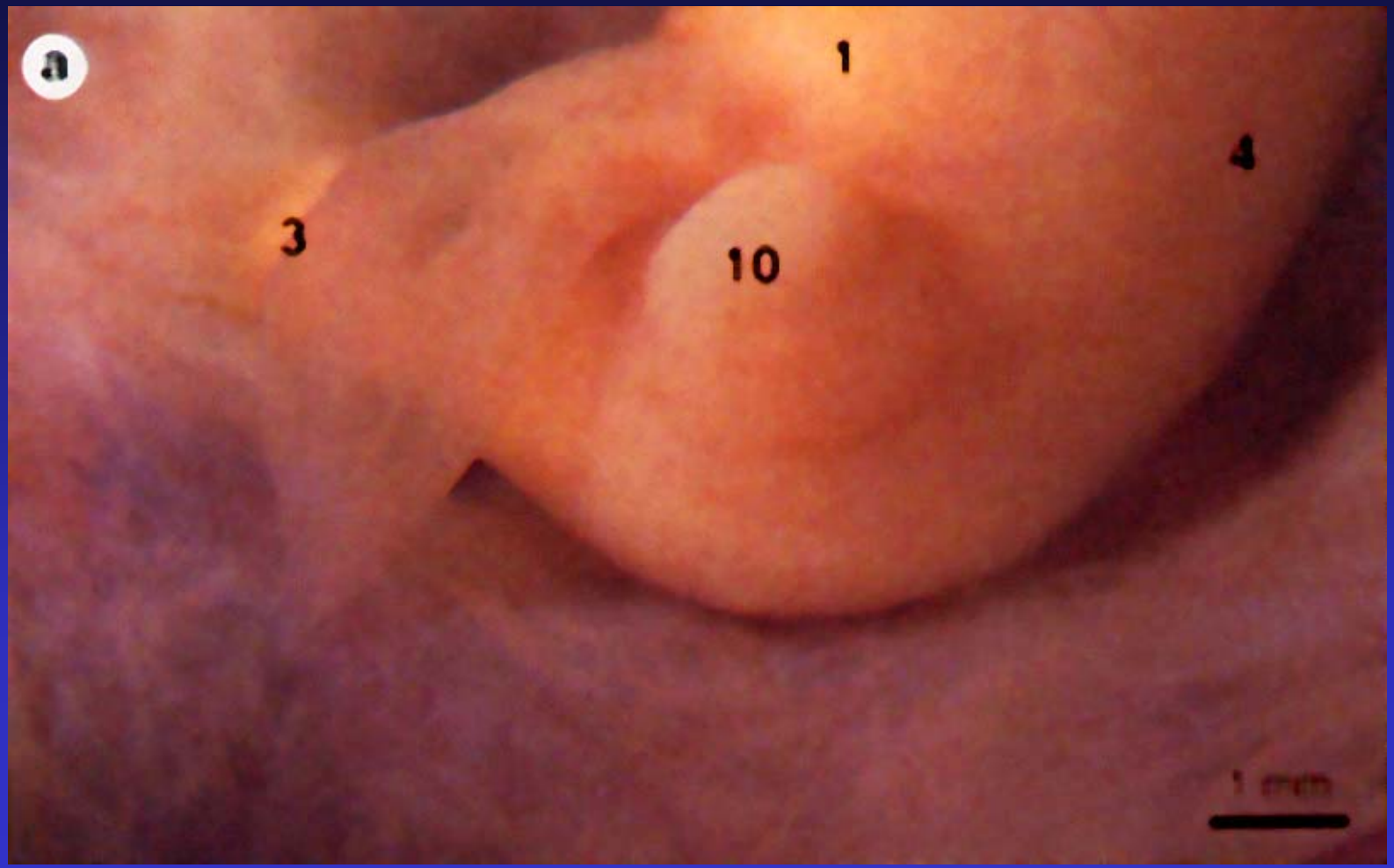
14 days



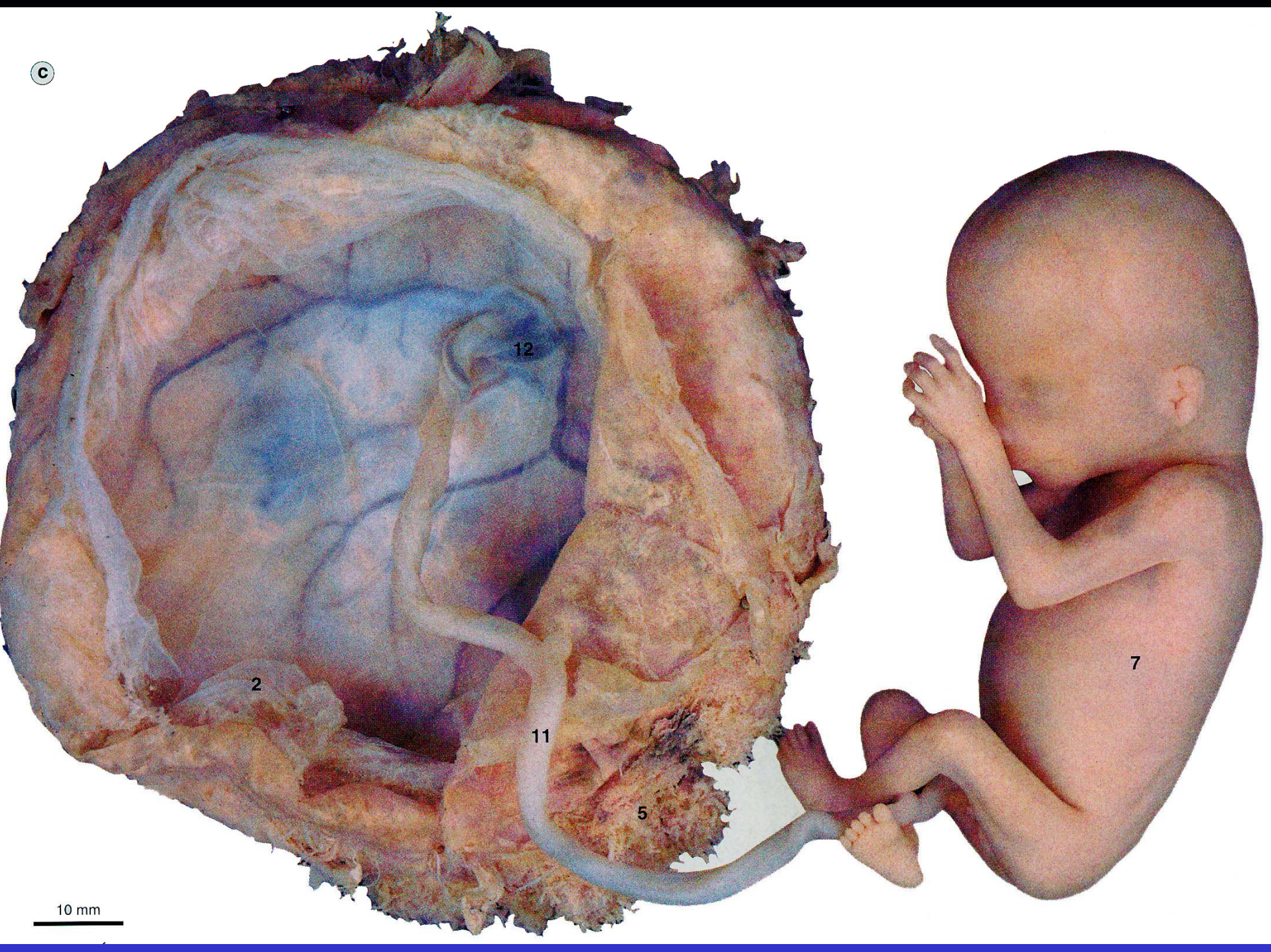

2 weeks
3 weeks
Amniotic cavity
Body of embryo
Yolk sac
Extraembryonic coelom
Trophoblast
Chorion
Amnion
Yolk sac
Amnion
Chorion
Allantoi
Extraembryonic coelom
Body stalk
3 1/2 weeks
4 1/2 weeks


Amniotic cavity
Umbilical cord
Chorion
Umbilical
(allantoic) vessels
Yolk sac
2 months
Amnion
Extraembryonic coelom

Amnion



Amnion


c
12
2
11
5
7
10 mm

Amnionic Fluid

Up to week 20 - fluid is similar to fetal serum (keratinization)

After 20 weeks – Contribution from urine, maternal serum filtered thru endothelium of nearby vessels, filtration from fetal vessels in cord

Near birth - can contain fetal feces called meconium

Near birth – amnionic fluid (500-1000 ml) exchanges every 3 hrs

1) across the amnion – exchange with maternal fluids.
2) fetal swallowing (20 ml/hour) – to gut – adsorption by fetus – out the umbilical cord to placenta.

Hydraminos – Excess fluid (>2000 ml), esophageal atresia

Oligohydramnios – Insufficient fluid (<500 ml), renal agenesis

Amnion Function

Mechanical protection: hydrostatic pressure

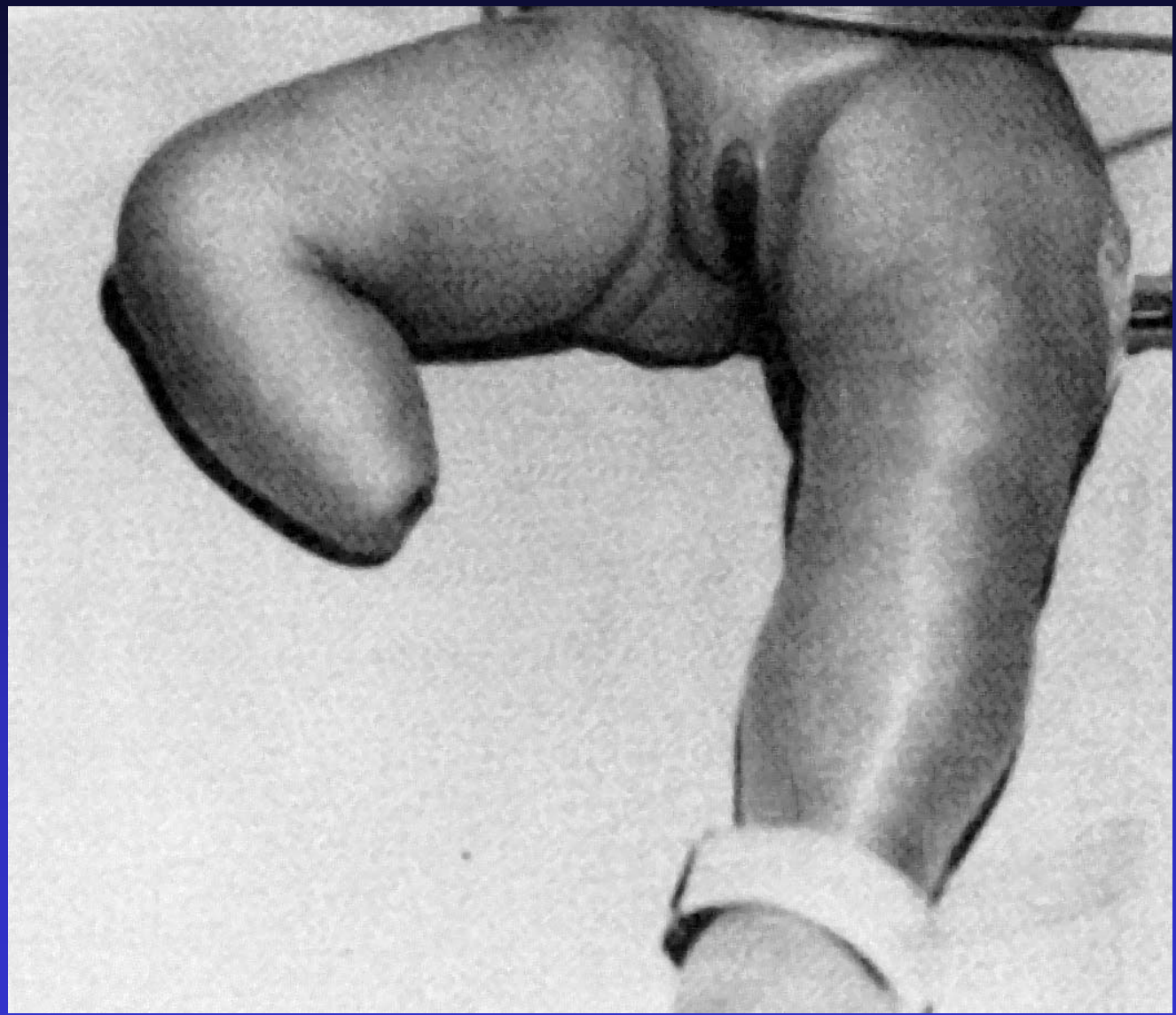
Allows free movement - which aids in neuromuscular development

Antibacterial

Allow for fetal growth

Protection from adhesions

Amnion Band Syndrome (ABS)



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Yolk Sac

Hypoblast - the primary yolk sac or Heuser's membrane.

Day 12 - Second wave of cell migration - forms definitive yolk sac

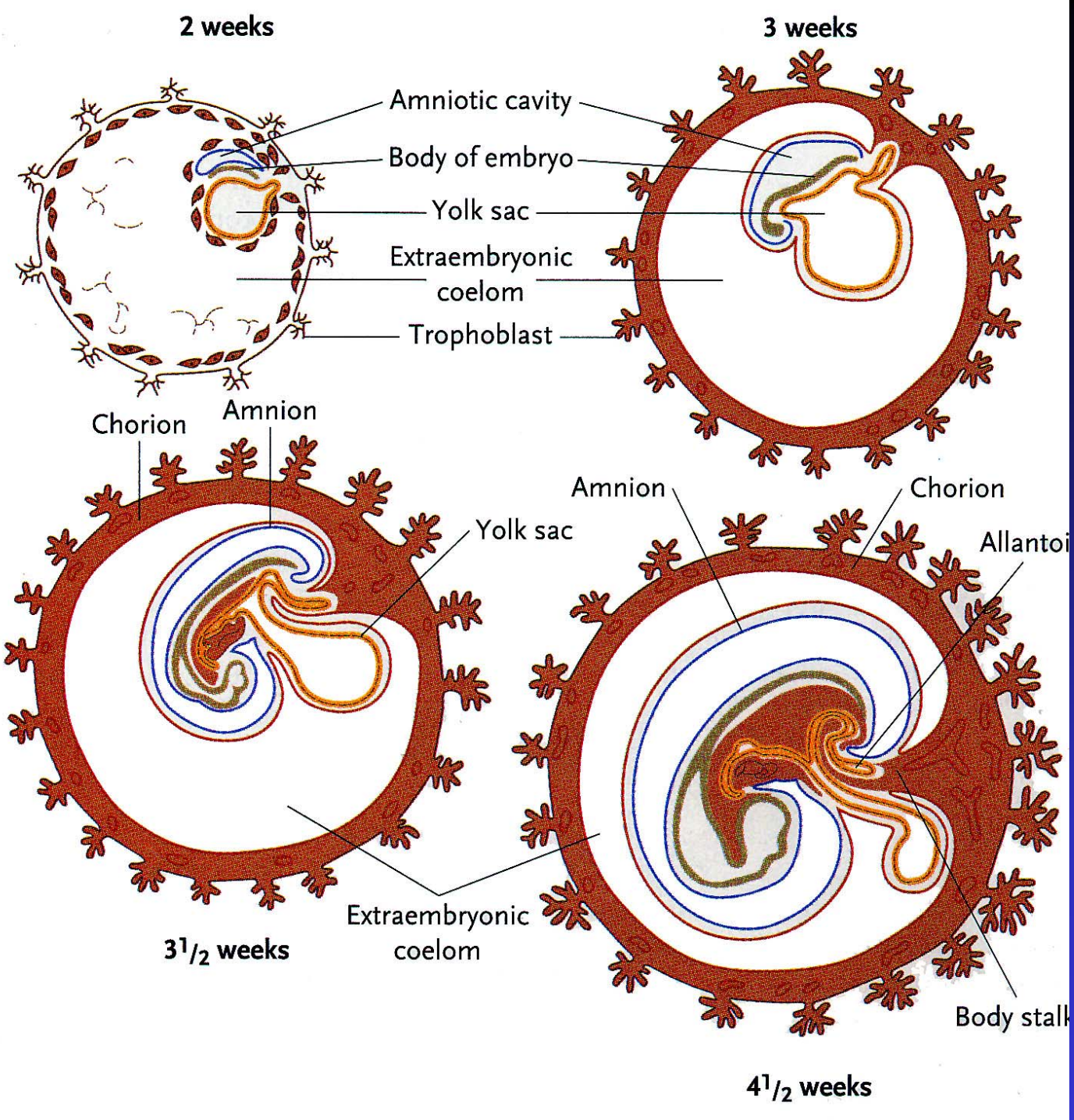
Composed of extrembryonic endoderm

Early nutrition (2-3 weeks) for the embryo - later shrinking - nonfunctional – Meckels diverticulum (outpocketing of small intestine)

Connects to midgut via the yolk sac stalk

Derivatives:

- Early blood cells forms from blood islands
- Primordial germ cells
- The early gut, epithelium of the respiratory and digestive tracts


2 weeks
3 weeks
Amniotic cavity
Body of embryo
Yolk sac
Extraembryonic coelom
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Allantois

Endodermal origin – caudal outpocketing of the yolk sac

Invades the connecting stalk (extraembryonic mesoderm) that suspends the embryo in the chorionic cavity

Involved in early hematopoiesis (up to 2 months)

The allantois blood vessels - artery and vein - becomes the umbilical vessels

Remnants of Allantois becomes the urachus ligament that connects the belly button to the bladder

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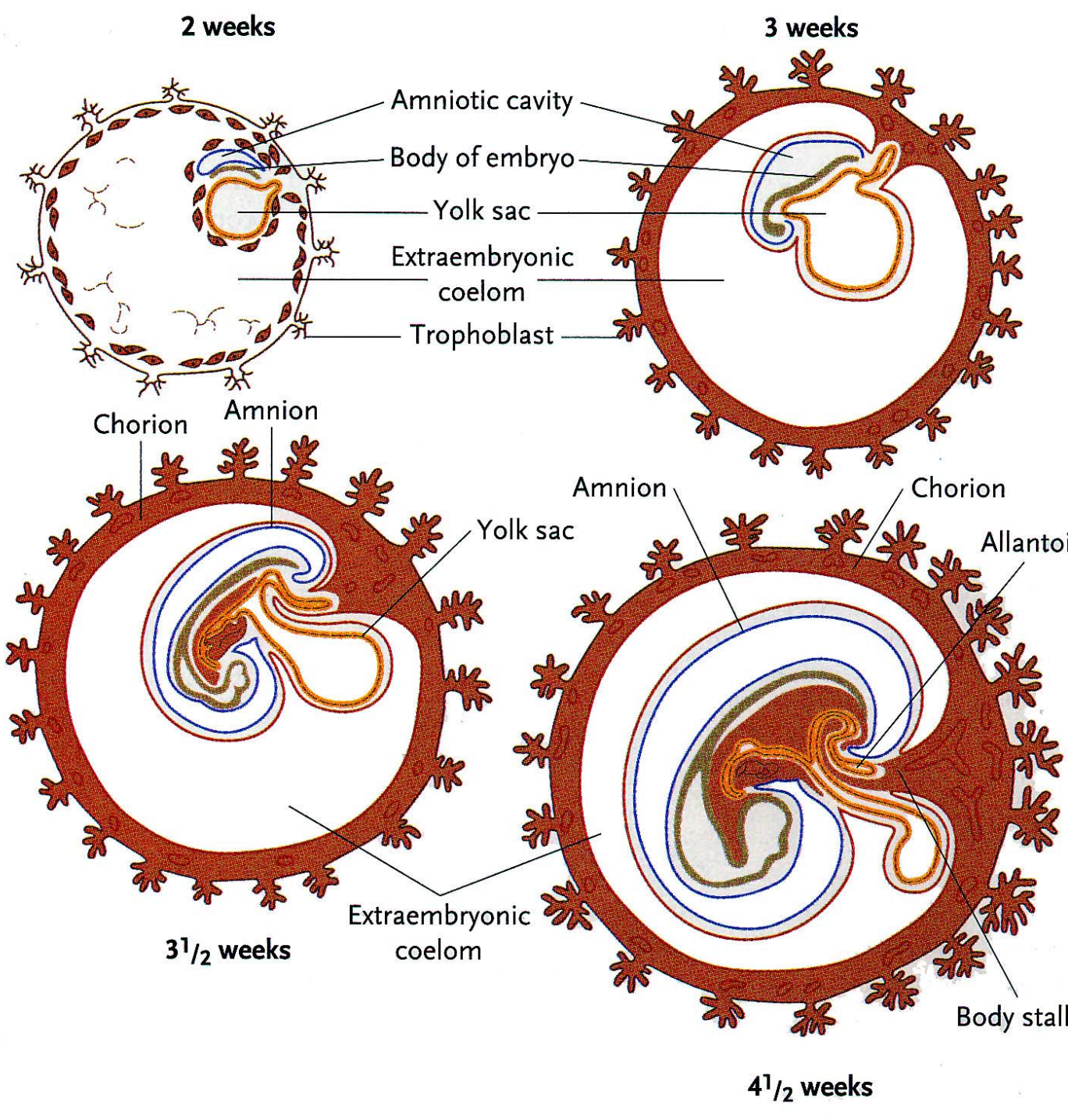
Chorion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Chorion
Amnion
Yolk sac
Amnion
Chorion
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Extraembryonic coelom
Body stall
3 1/2 weeks
4 1/2 weeks

Chorion

Chorionic cavity (extraembryonic coelom)- lined with extraembryonic mesoderm

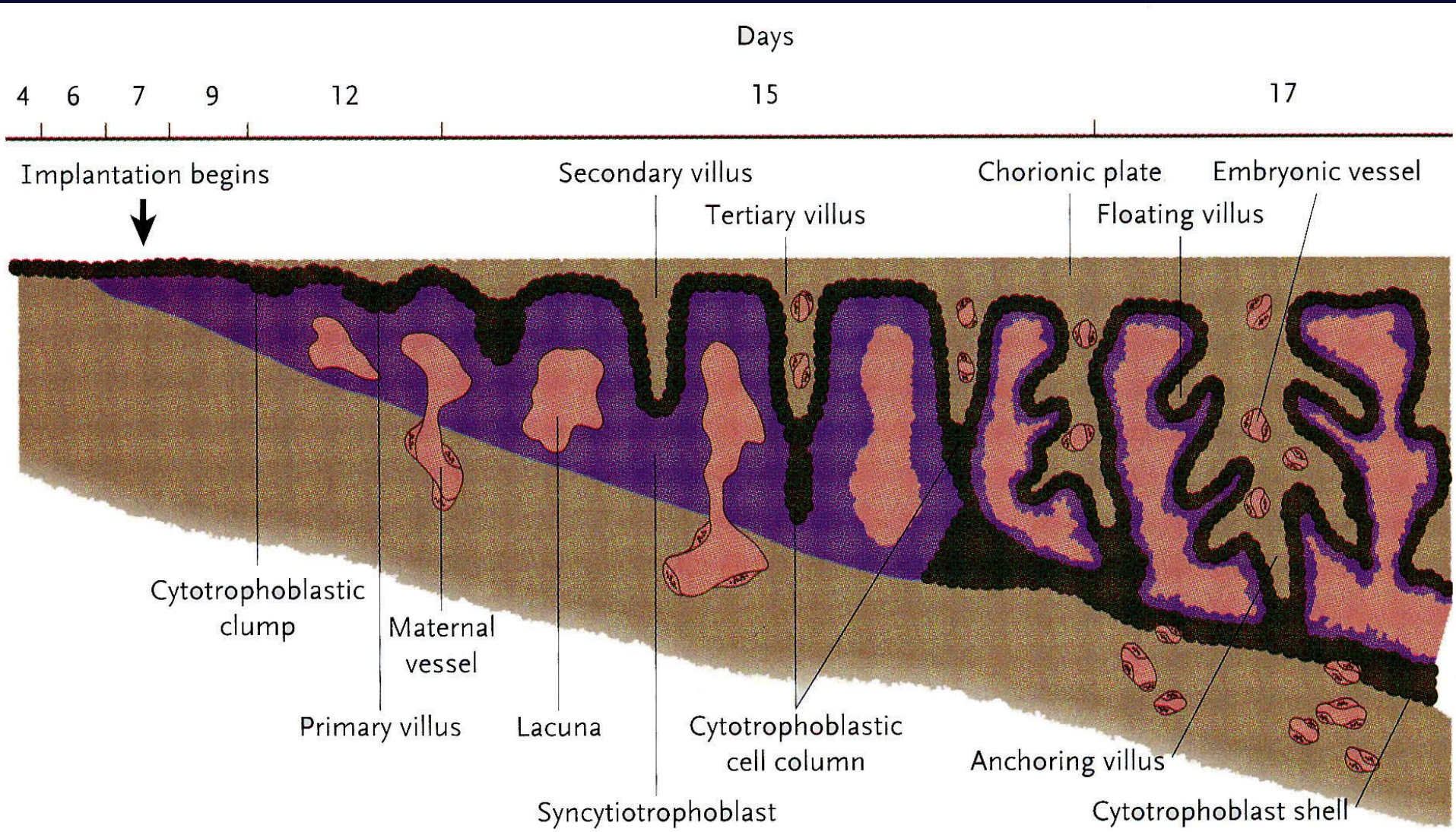
Chorionic cavity expands separating amnion from cytotrophoblast

Chorionic sac consist of:
- cytotrophoblastic layer
- syncytiotrophoblastic layer
- extraembryonic somatic mesoderm

The Chorion / maternal endometrium forms the placenta

Chorion forms stem villi

Stem Villi


Days
4
6
7
9
12
15
17
Implantation begins
Secondary villus
Tertiary villus
Chorionic plate
Floating villus
Embryonic vessel
Cytotrophoblastic clump
Maternal vessel
Primary villus
Lacuna
Syncytiotrophoblast
Cytotrophoblastic cell column
Anchoring villus
Cytotrophoblast shell

Stem Villi

Chorionic Plate – Stem villi extends from this tissue

Primary stem villi (day 11-13) - finger-like protrusions into endometrium - contains syncytiotrophoblast, cytotrophoblast.

Secondary stem villi (day 16) - extraembryonic mesoderm invasion into villi core.

Tertiary stem villus (21 day) - extraembryonic vessels - chorionic arteries and veins derived from extraembryonic mesoderm.

Hemichorial type placenta – maternal blood baths villi

Stem Villi

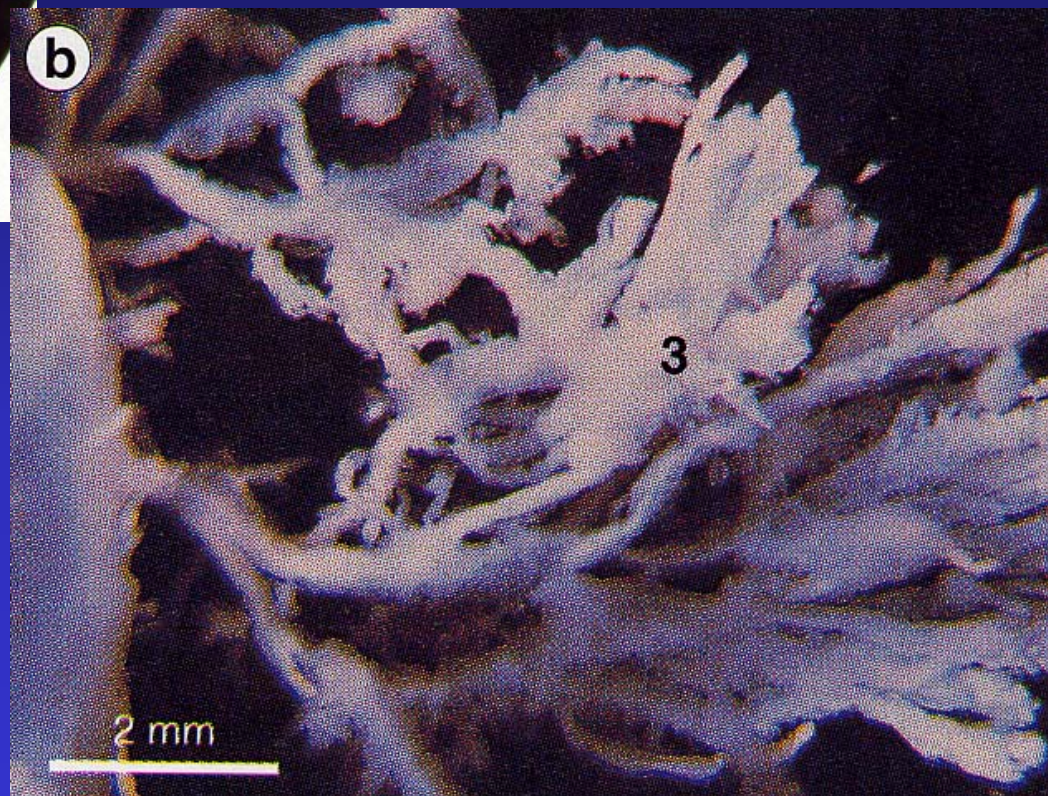
Cytotrophoblastic cell column – terminal villi, solid mass of trophoblast

Cytotrophoblastic shell – surrounds embryo; direct contact with maternal decidual cells

Anchoring Villi – give off cytotrophoblastic extensions - anchoring because they represent the real maternal-embryo link

Floating Villi – branches off anchoring villi – dangles freely in maternal blood


c
2
3


b
3
2 mm

Chorion

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Decidua

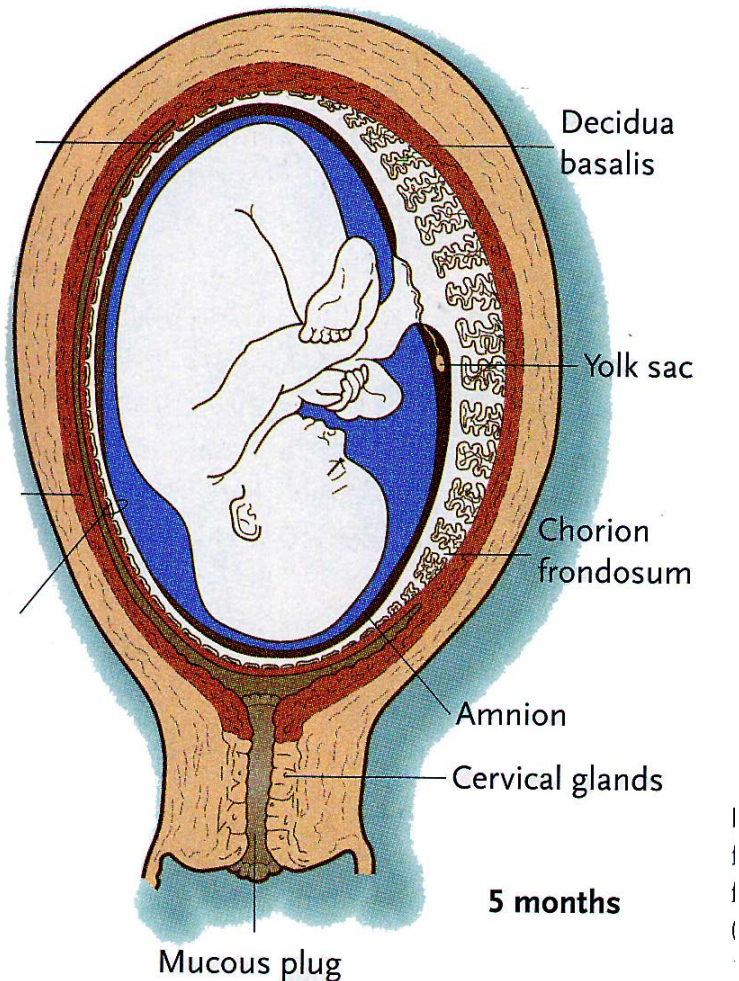
Decidual Reaction – stromal cells – accumulate glycogen and lipid, called **Decidual Cells**

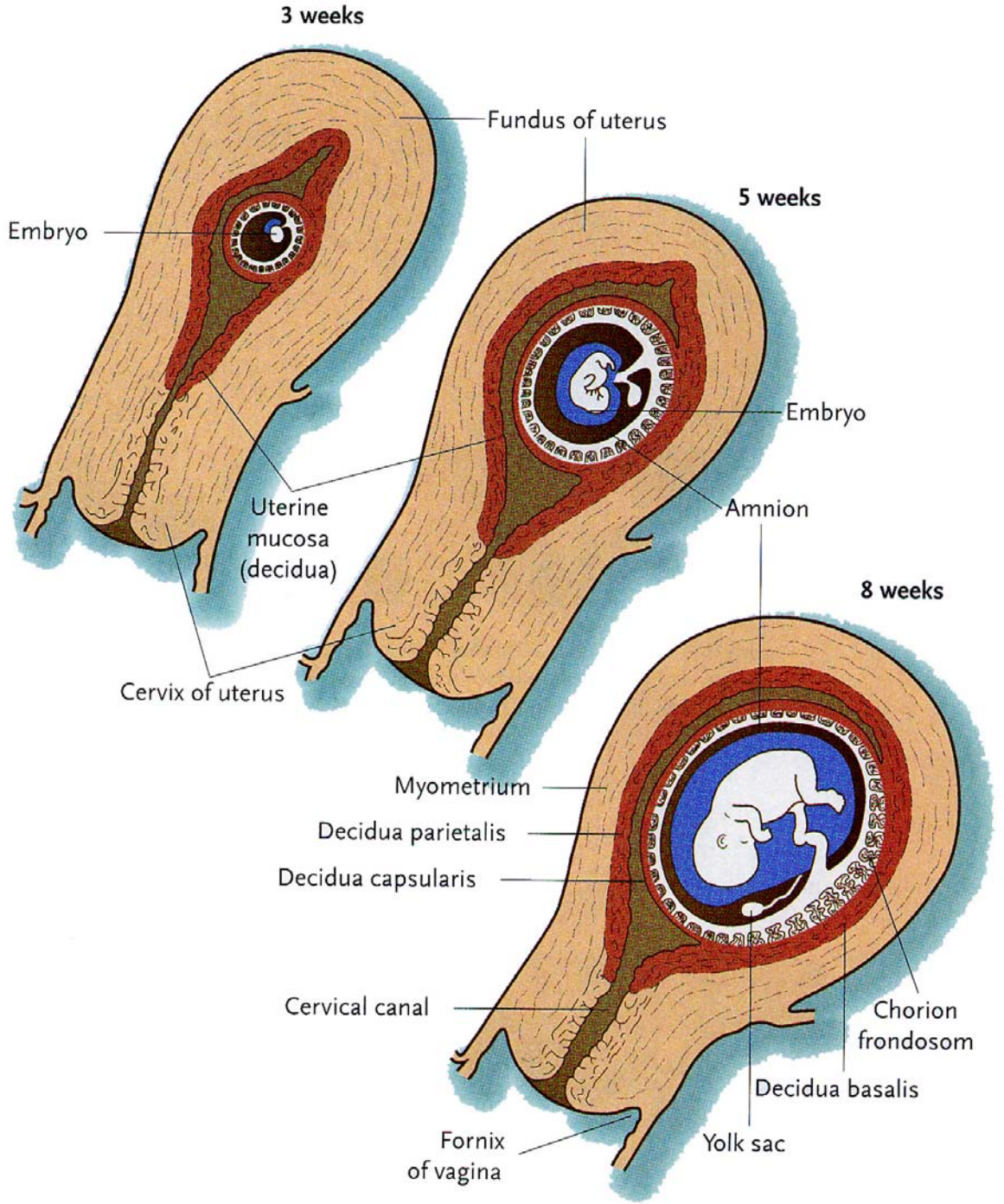
Decidua basalis - forms maternal component of the placenta; associates with the chorion frondosom

Decidua capsularis - superfical layer overlying the entire embryoblast - this layer eventually degenerates; associates with the chorion laeve

Decidua parietalis - all remaining parts of the endometrium - not associated with the embryo

Deciduas


Decidua basalis
Yolk sac
Chorion frondosum
Amnion
Cervical glands
5 months
Mucous plug


3 weeks
Fundus of uterus
Embryo
5 weeks
Embryo
Amnion
Uterine mucosa (decidua)
Cervix of uterus
8 weeks
Myometrium
Decidua parietalis
Decidua capsularis
Cervical canal
Chorion frondosom
Decidua basalis
Yolk sac
Fornix of vagina

Making the Placenta

By 8 weeks - chorionic stem villi over the entire surface of the chorionic sac

Those villi associated with the decidua basalis increase in size and more villi form.

Enlargement includes further branching of the anchoring villus - chorion frondosum.

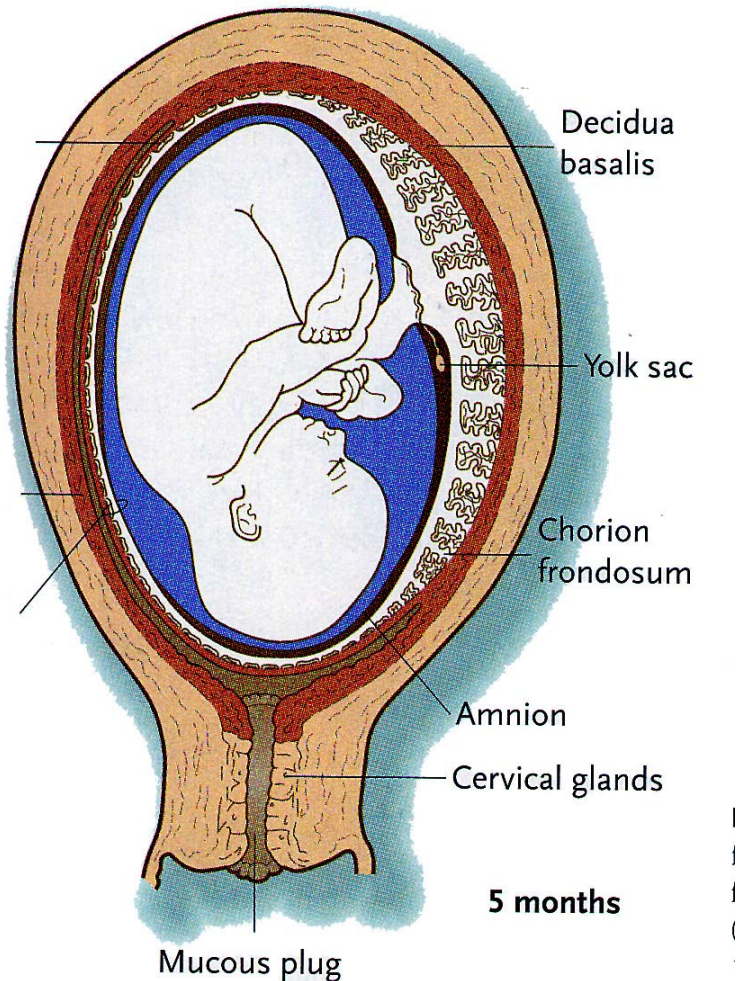
The villi continue to enlarge during most of gestation.

The villi project into a blood filled intervillous space resulting from the erosion of the decidua basalis.

Endometrial vessels - spiral arteries and endometrial veins

Villi associated with the decidua capsularis degenerate - this region is called the chorion laeve

Deciduas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Yolk sac
Chorion frondosum
Amnion
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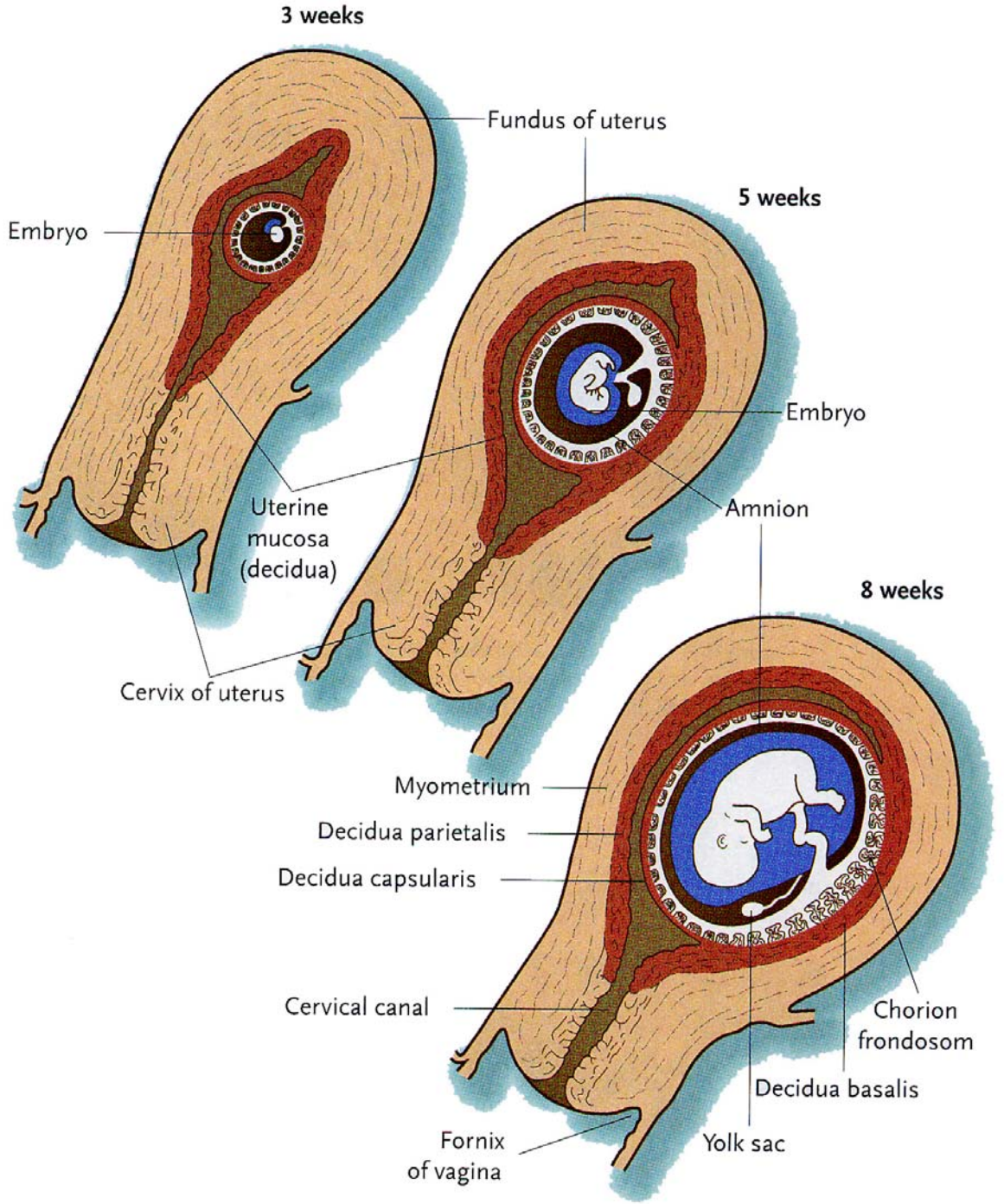
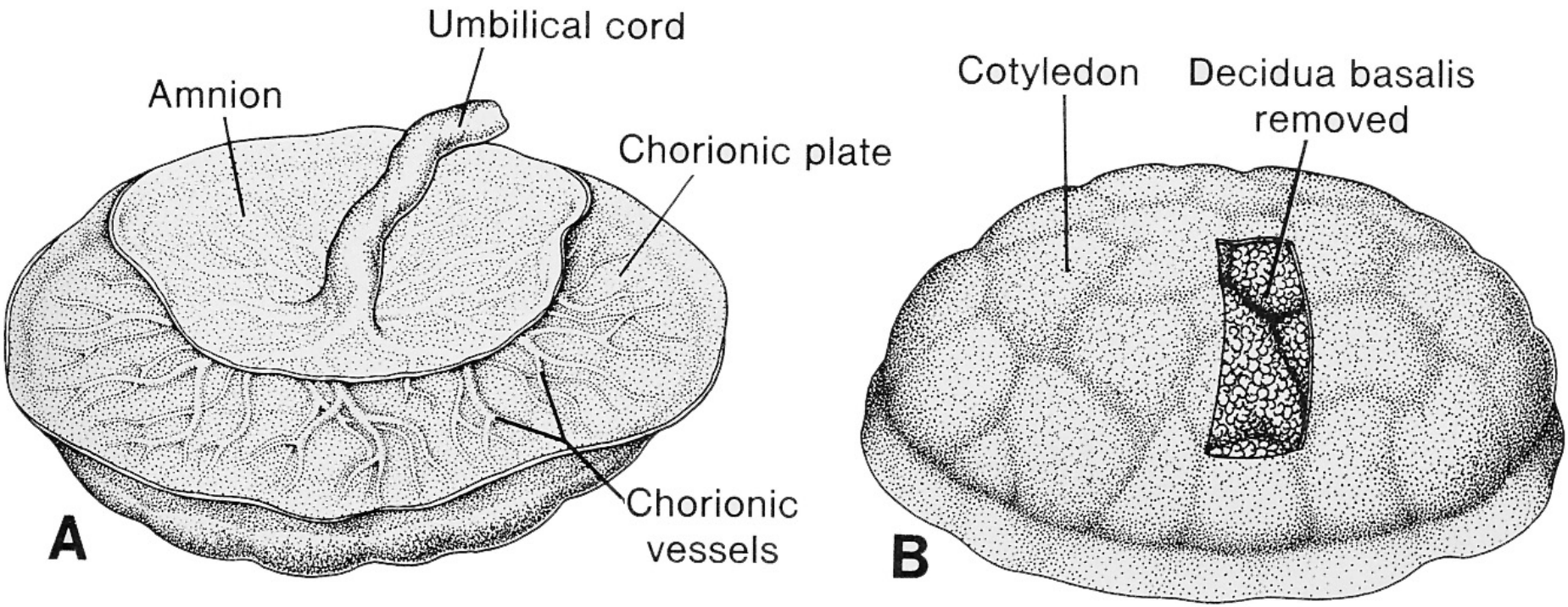
5 months
Mucous plug


3 weeks
Fundus of uterus
Embryo
5 weeks
Embryo
Amnion
Uterine mucosa (decidua)
Cervix of uterus
8 weeks
Myometrium
Decidua parietalis
Decidua capsularis
Cervical canal
Chorion frondosom
Decidua basalis
Yolk sac
Fornix of vagina

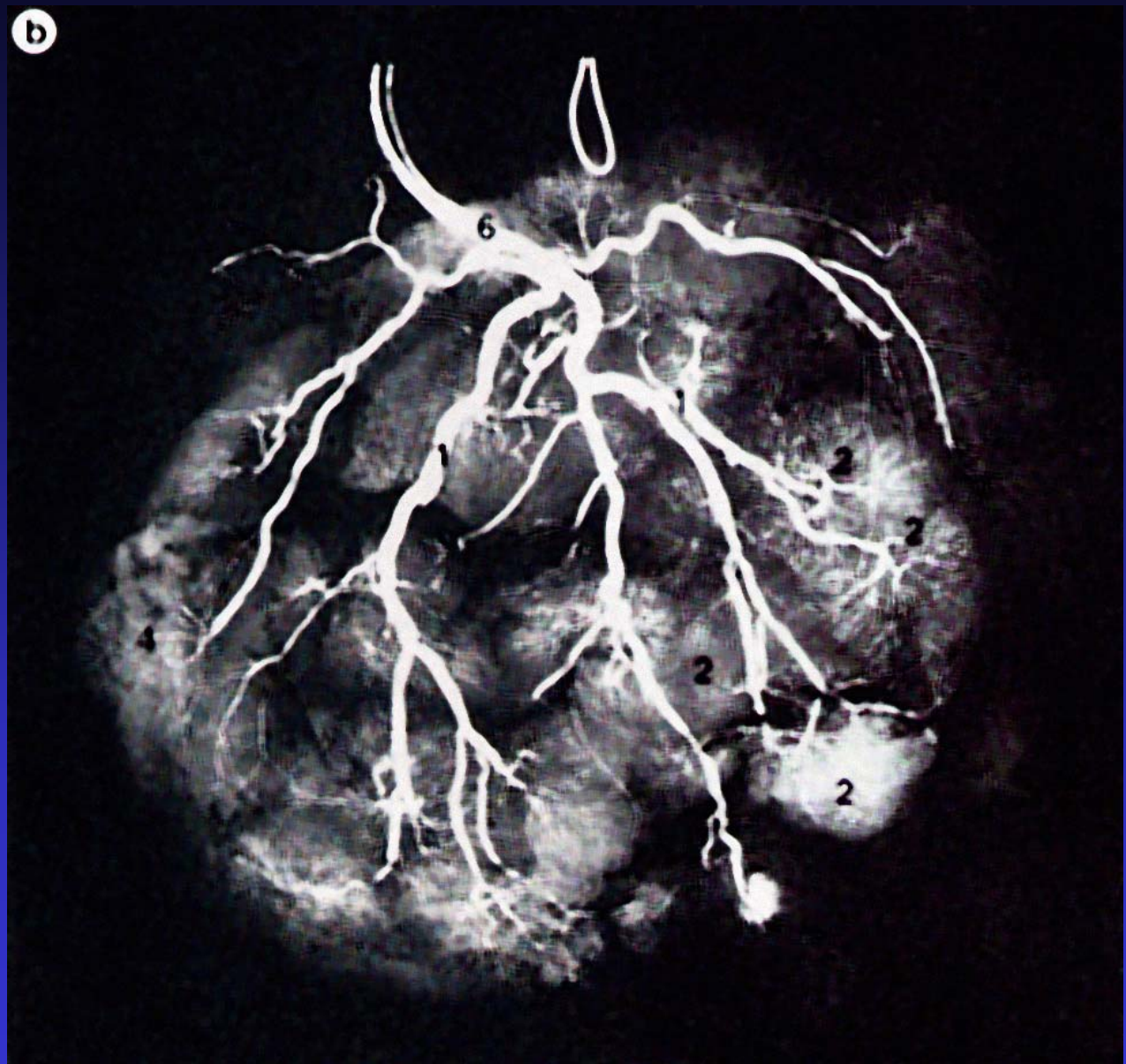
Placenta



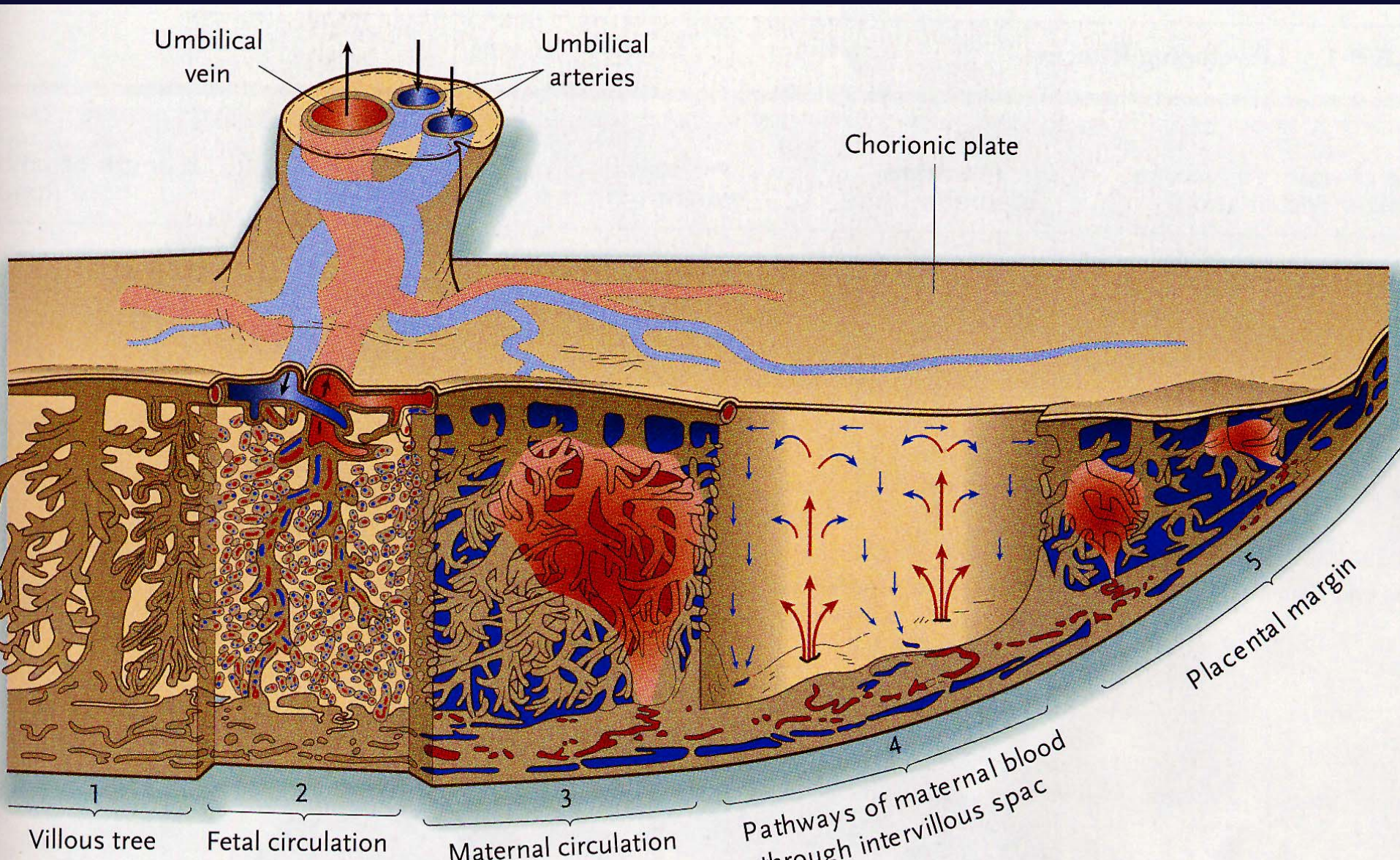
The erosion of the decidua basalis is incomplete - uneroded regions called decidual septa.

The decidual septa define regions of the placenta called cotyledon.

Placental Blood Flow



Placental Anatomy



Umbilical Cord

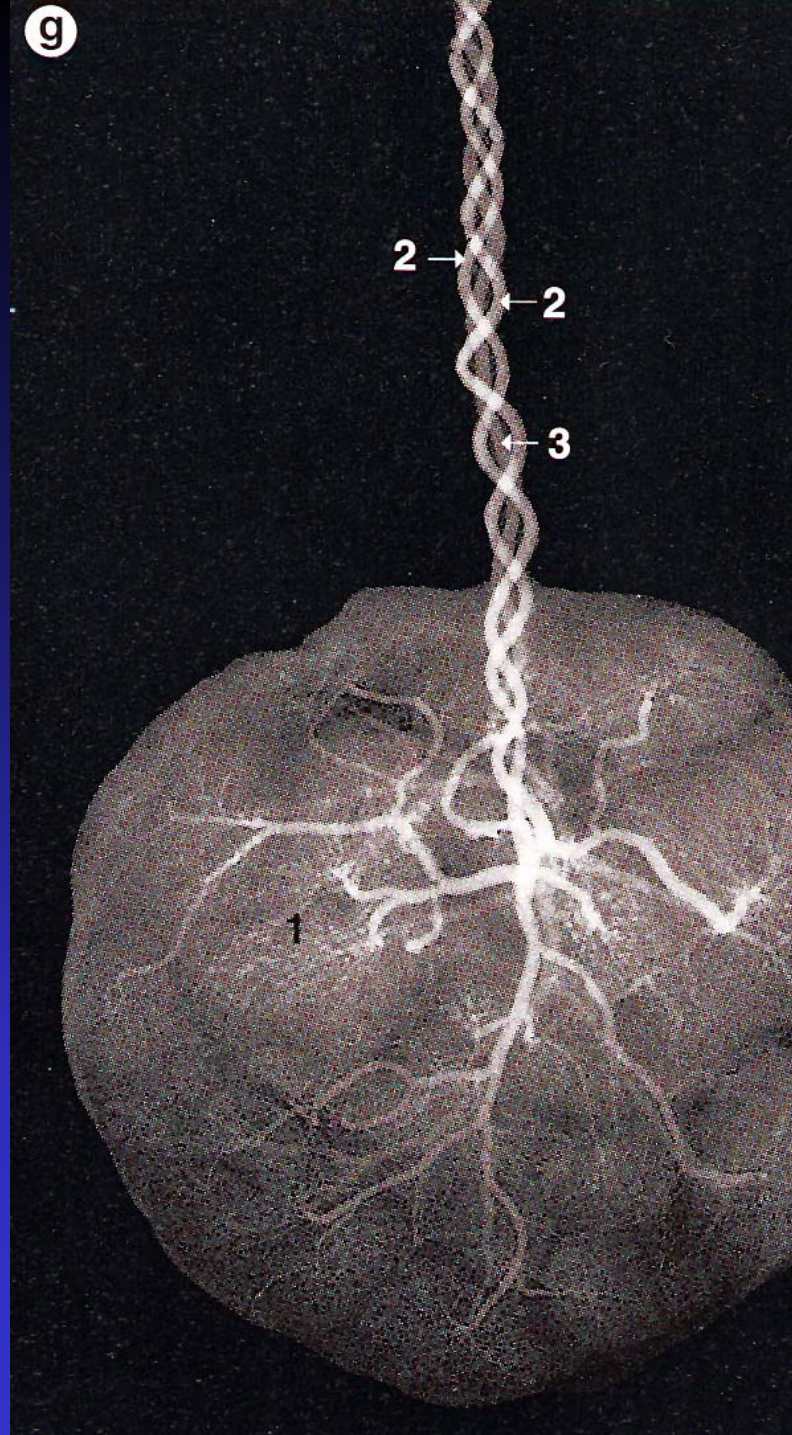
One umbilical vein, two umbilical arteries

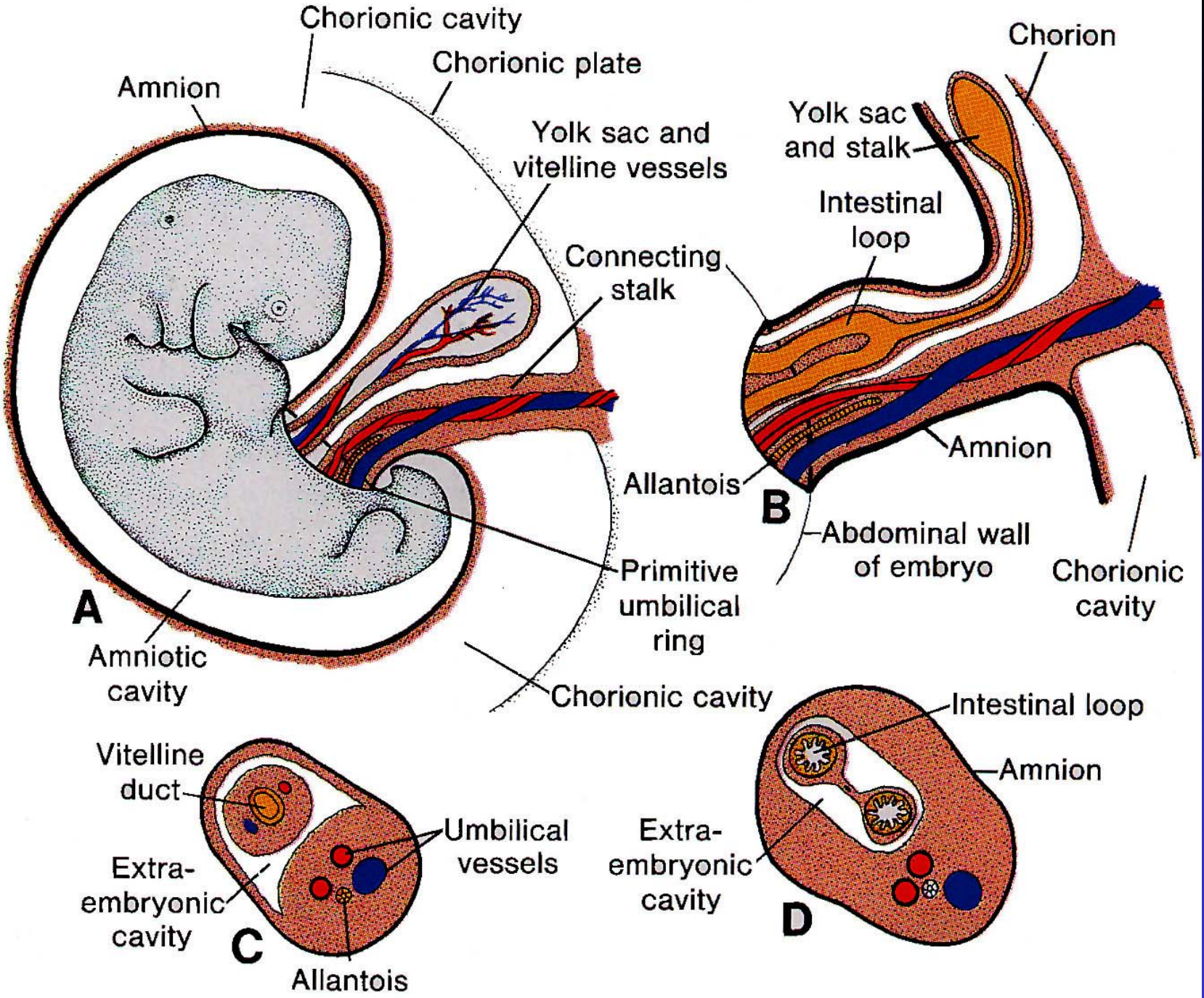
Wharton's jelly – mucoid connective tissue surrounding vessels

Allantois

Yolk Stalk (vitelline duct) and vitelline vessels (early)

Intestinal loop – umbilical hernia (late)




Chorionic cavity
Chorionic plate
Amnion
Yolk sac and vitelline vessels
Connecting stalk
Primitive umbilical ring
A
Amniotic cavity
Chorionic cavity
Chorion
Yolk sac and stalk
Intestinal loop
Amnion
Allantois
B
Abdominal wall of embryo
Chorionic cavity
Vitelline duct
Umbilical vessels
Extra-embryonic cavity
C
Allantois
Intestinal loop
Amnion
Extra-embryonic cavity
D

Placental Circulation

Fetal – Contained within vessels

Umbilical Arteries – chorionic plate – branches to stem villi – capillaries in terminal villi – return via umbilical vein

Maternal – Free-flowing lake

Spiral arteries open into intervillous space and bath the villi

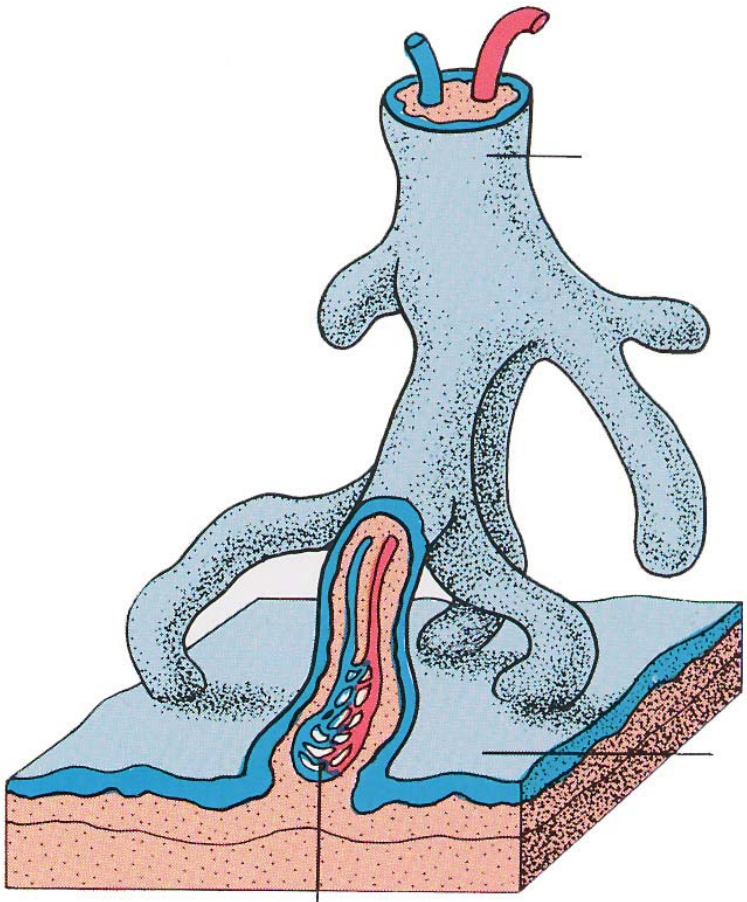
150 ml of maternal blood

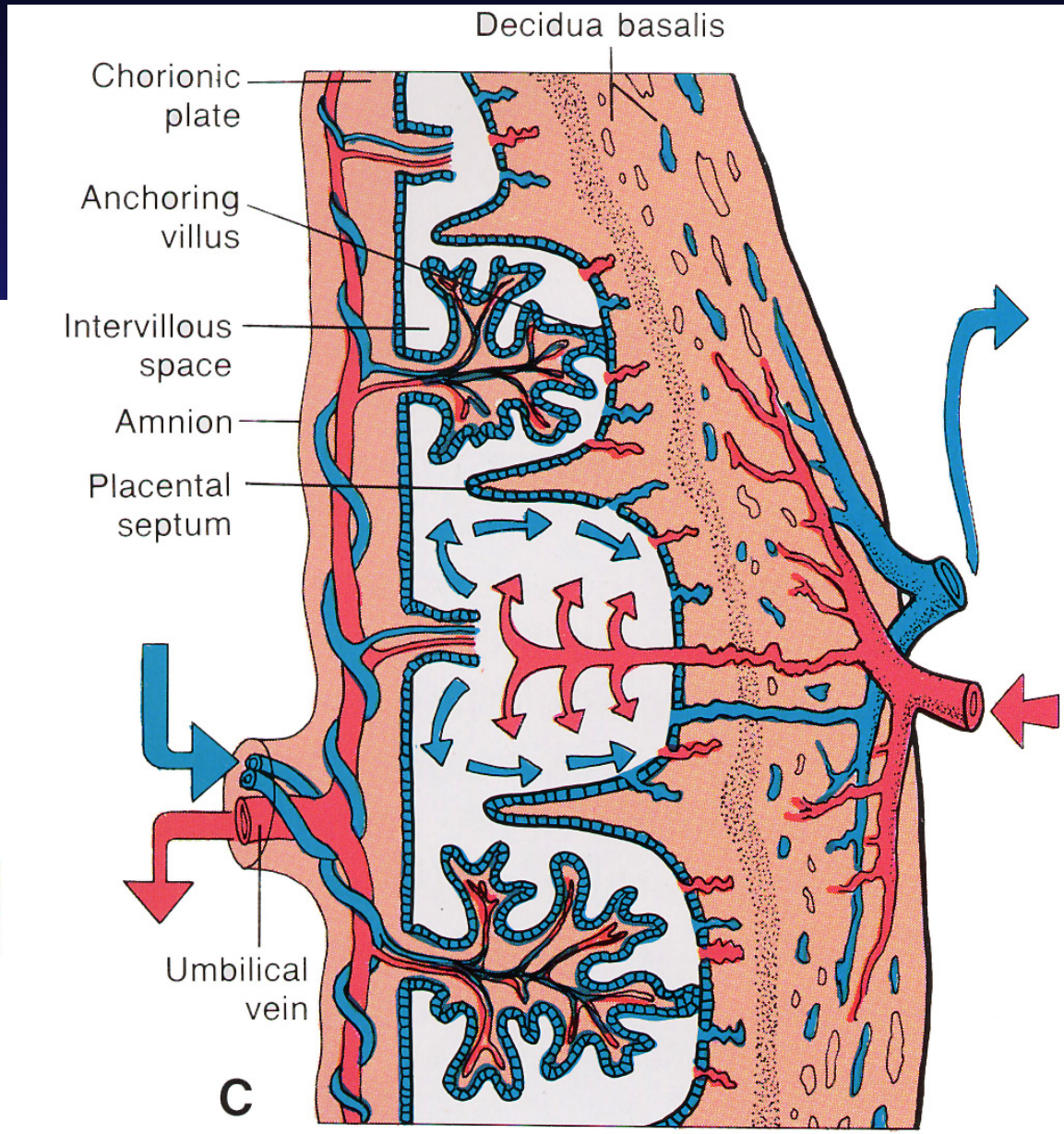
Exchanged - 3-4 times/minute

Reduced blood pressure in intervillous space

Oxygenated blood to the chorionic plate, return baths the villi

Placental Anatomy





Placental barrier decreases with gestation

Placental Barrier – syncytiotrophoblast + basal lamina, basal lamin
+ fetal capillary endothelium

Syncytiotrophoblasts – many microvilli, no major
histocompatibility antigens

O_2

H_2O

Fe

salts

CO2

H2O

salts

carbohydrates, amino acids, lipids

vitamins, hormones, antibodies

drugs, alcohol

viruses (rubella, varicella-zoster, HIV)

urea, uric acid

creatinine

bilirubin, hormones,

RBC antigens

Placenta as an Endocrine Organ

Human Chorionic Gonadotropin – Corpus Luteum (declines after 8 weeks)

Progesterone – High levels by the end of first trimester

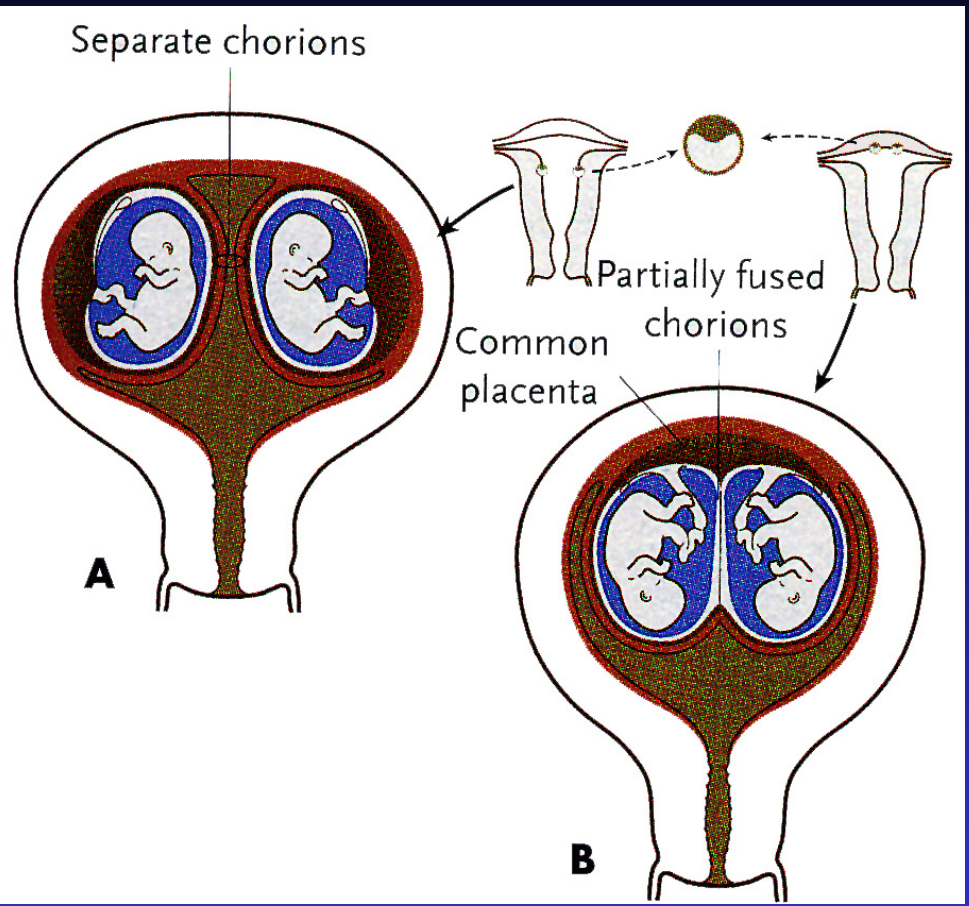
Estrogen – Synthesis involves enzymatic activity of fetal adrenal gland and liver

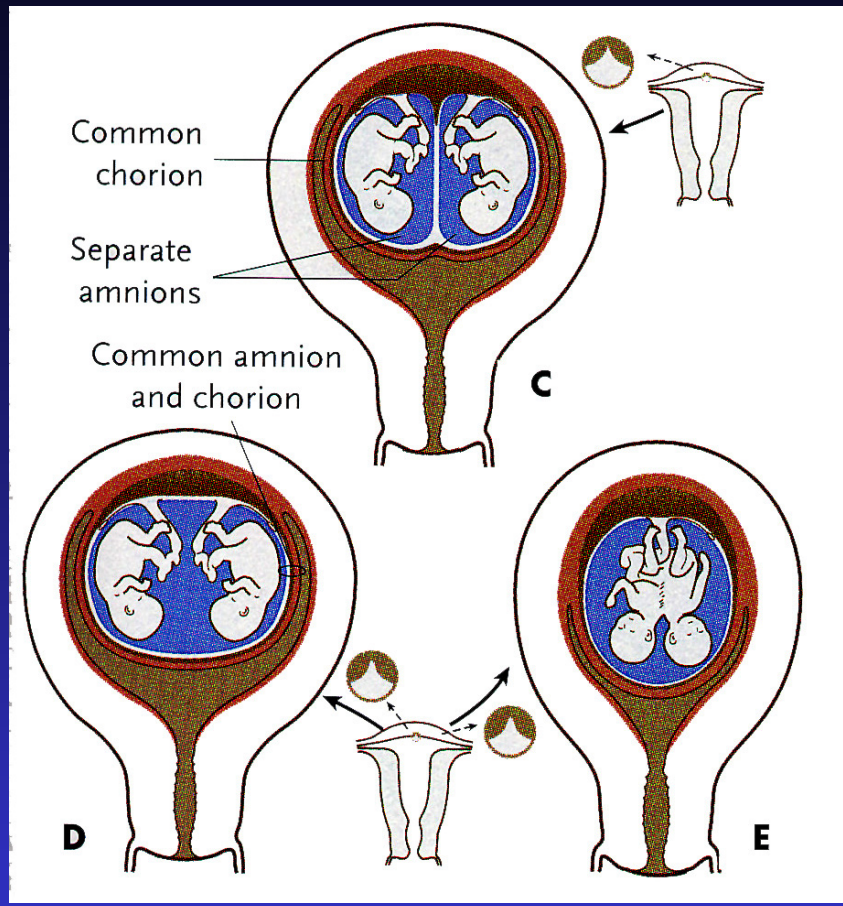
Chorionic Somatomammotropin – Human Placental Lactogen – similar to GH (growth, lactation, lipid and carbohydrate metabolism)

Placental Growth Hormone – similar to GH – Replaces materrnal GH by 15 wks – enhances blood glucose levels

Chorionic Thyrotropin, Chorionic Corticotropin

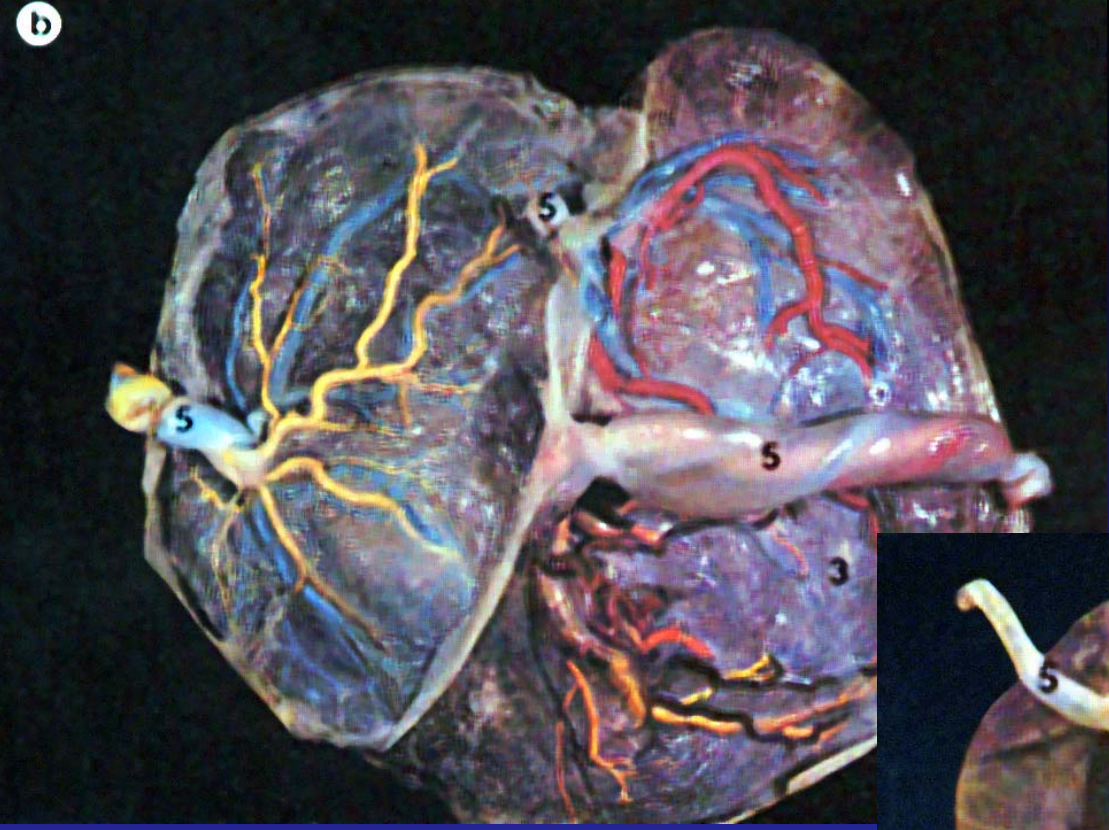
Multiple Pregnancies





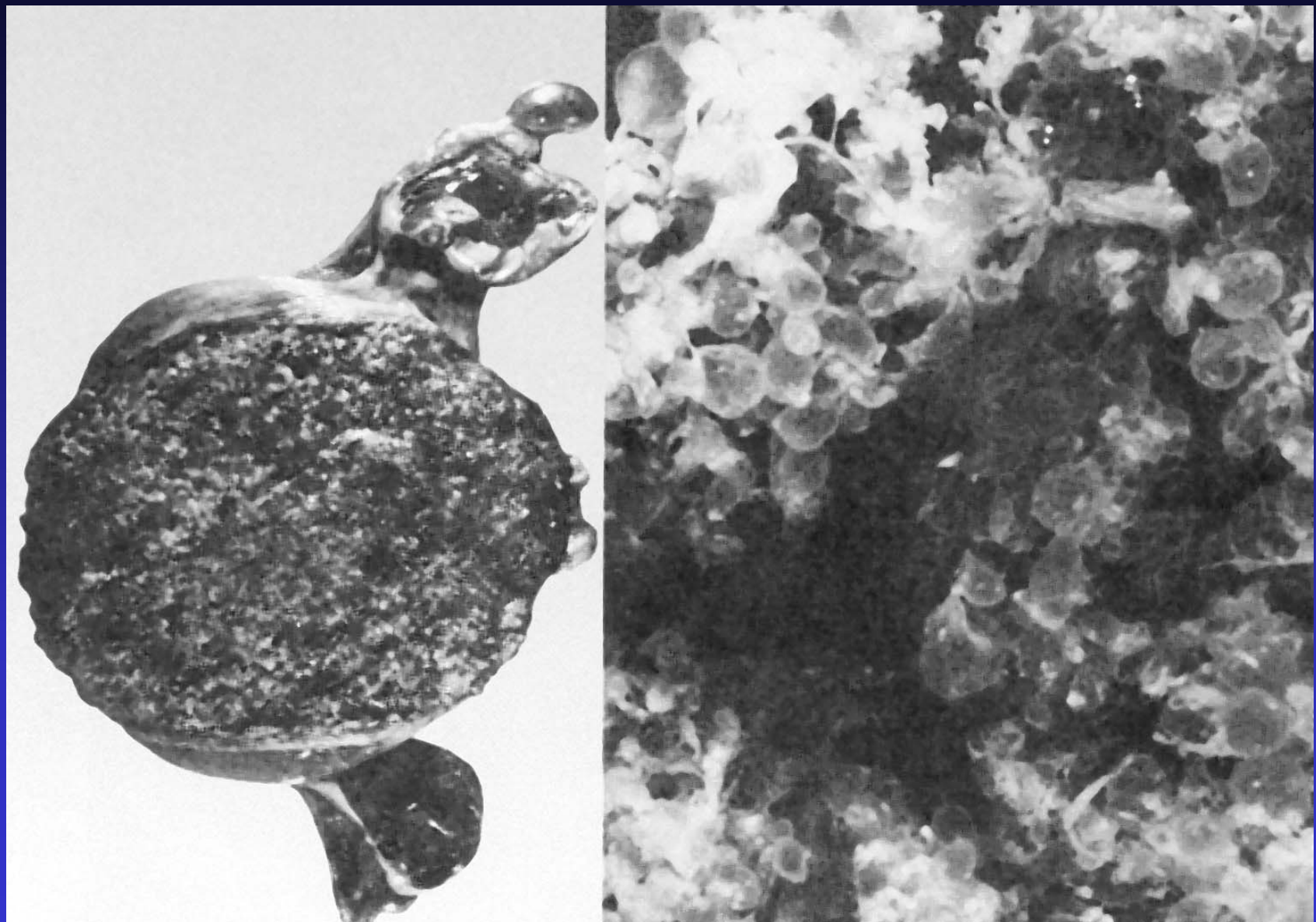
Monochorionic/Dichorionic

Monoamnionic/Diamnionic


b
5
5
5
3


5
1
2
1
5
3
1
1
5
5

Hydatiform Mole



Erythroblastosis fetalis

Fetus / newborn - hemolytic disease (anemia)

Rh factor is a RBC surface antigen

Rh- mother with Rh+ 1st baby – Maternal antibodies are induced after birth

At risk is second Rh+ baby

Maternal Rh antibodies cross placenta

Hemolysis of fetal Rh+ RBC