



# Placenta

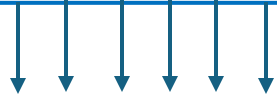
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*Prepared and adapted for teaching by Prof. Dr. Heba Kalbouneh.  
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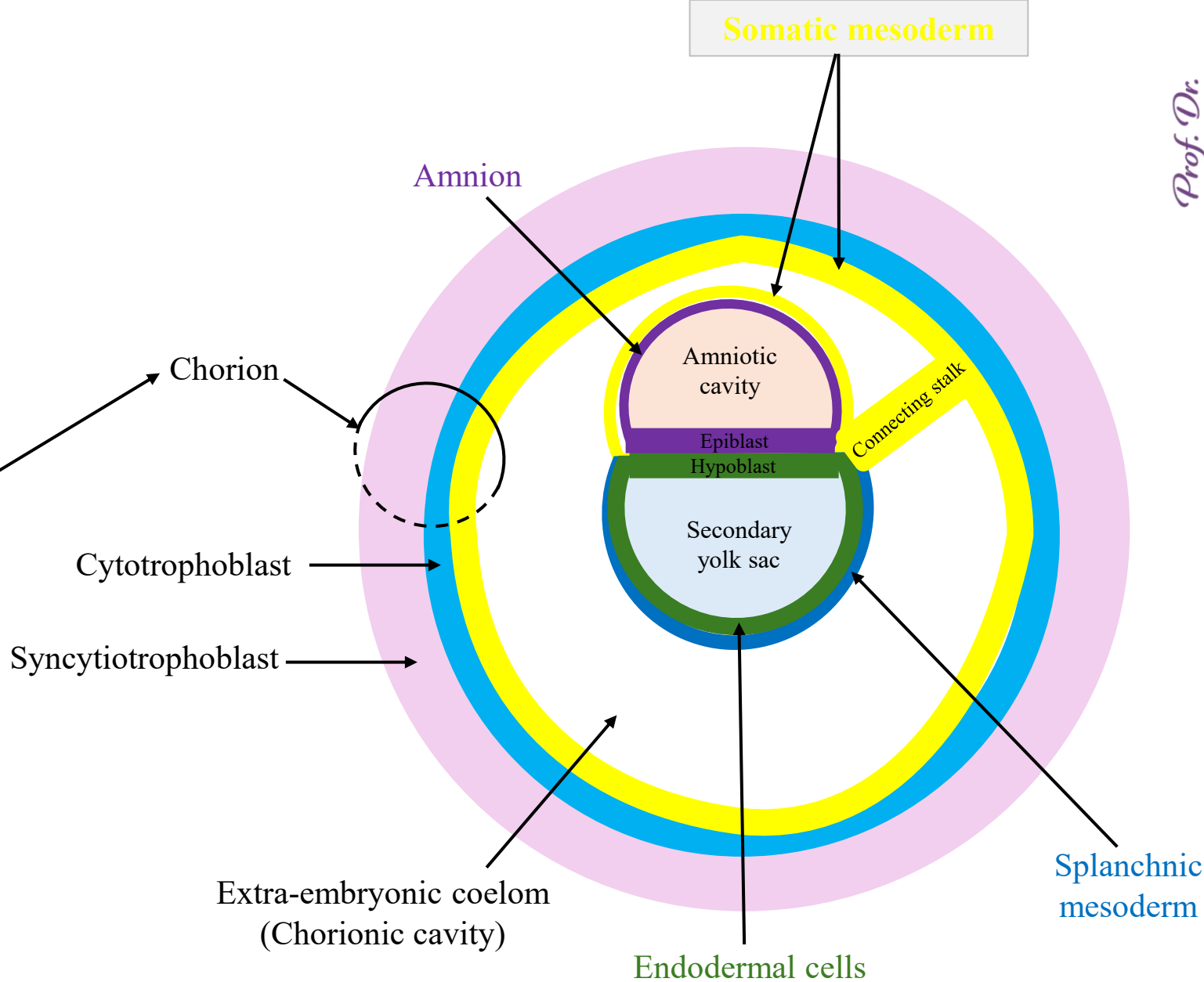
# A Quick Reminder: Conceptus Structure in Week 2

During the second week of development, the conceptus consists of a bilaminar embryonic disc (epiblast and hypoblast) suspended between two cavities: the amniotic cavity above and the secondary yolk sac below. Surrounding the embryo, the extra-embryonic mesoderm splits to form the extra-embryonic coelom (chorionic cavity), dividing into somatic and splanchnic layers. The trophoblast differentiates into cytotrophoblast and syncytiotrophoblast.

The **chorion** is the outermost fetal membrane. It consists of syncytiotrophoblast + cytotrophoblast + extraembryonic somatic mesoderm.



*This structural organization establishes the basic framework from which the placenta will later develop.*

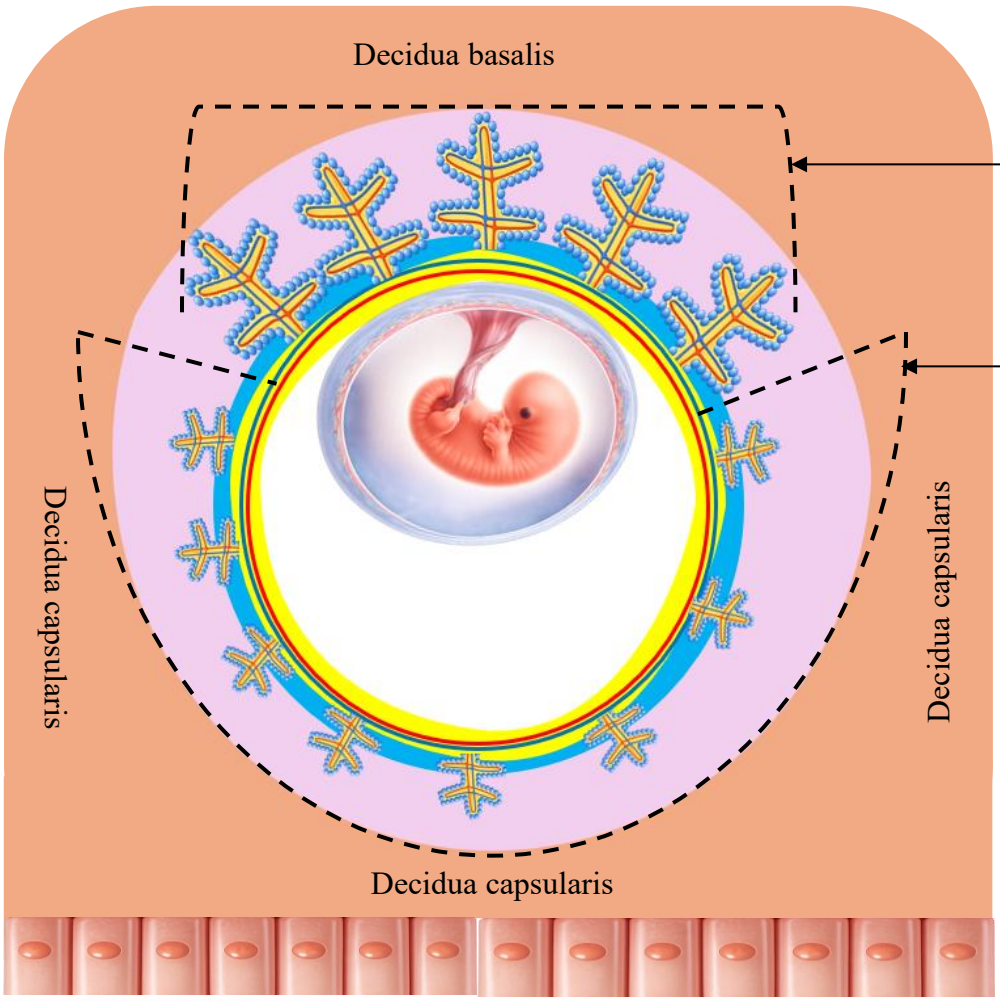


# Changes of the chorion

Formation of chorionic villi:

- 1- Primary villi
- 2- Secondary villi
- 3- Tertiary villi
  - A-Chorion frondosum
  - B-Chorion laeve

Note: Tertiary villi opposite the decidua basalis proliferate and form numerous branching villi, constituting the **chorion frondosum**. In contrast, villi beneath the decidua capsularis degenerate, forming the **chorion laeve**.



Chorion frondosum

Chorion laeve

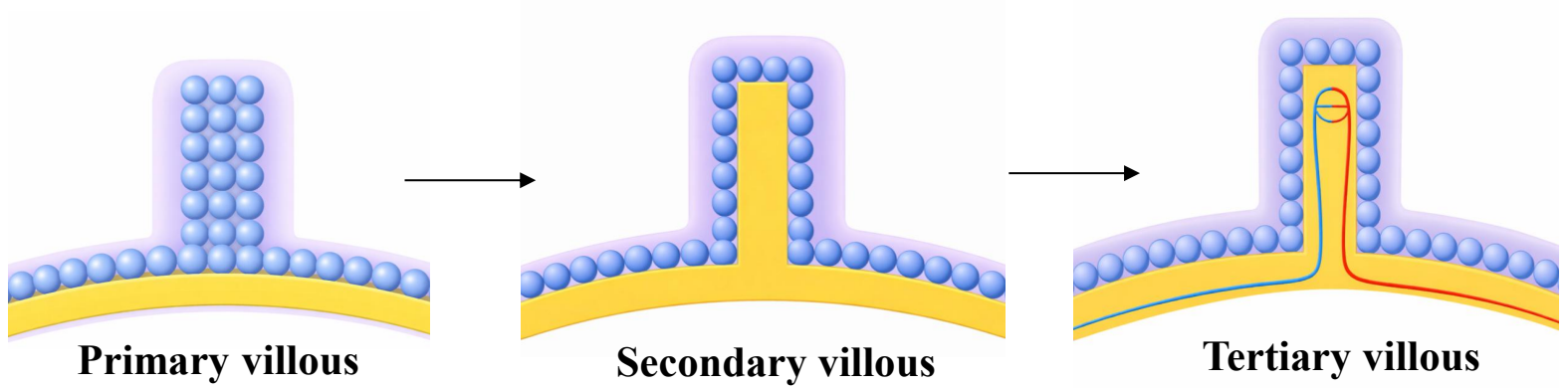
Decidua capsularis

Decidua capsularis

Decidua basalis

Decidua capsularis

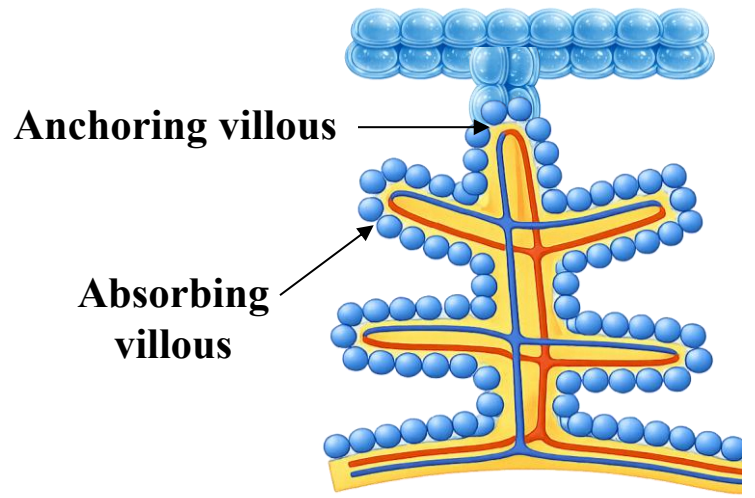
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Primary villous

Secondary villous

Tertiary villous



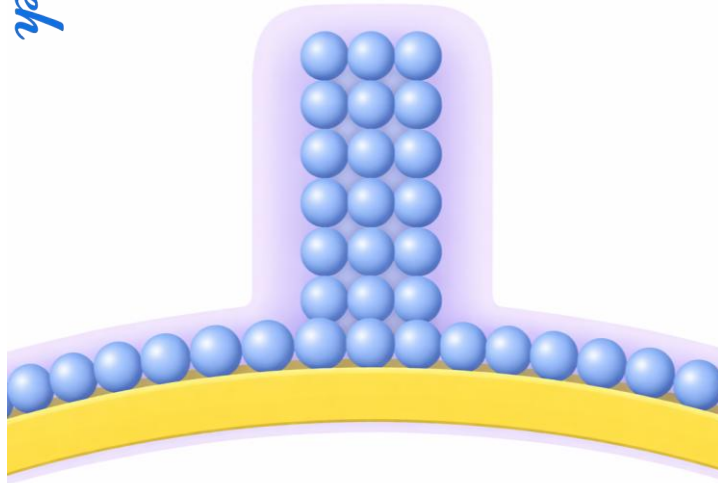
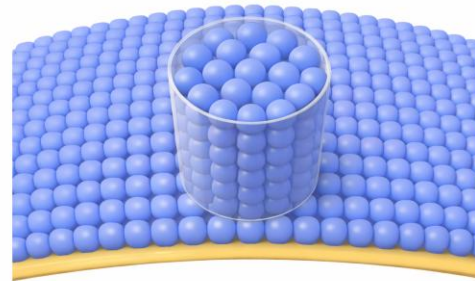
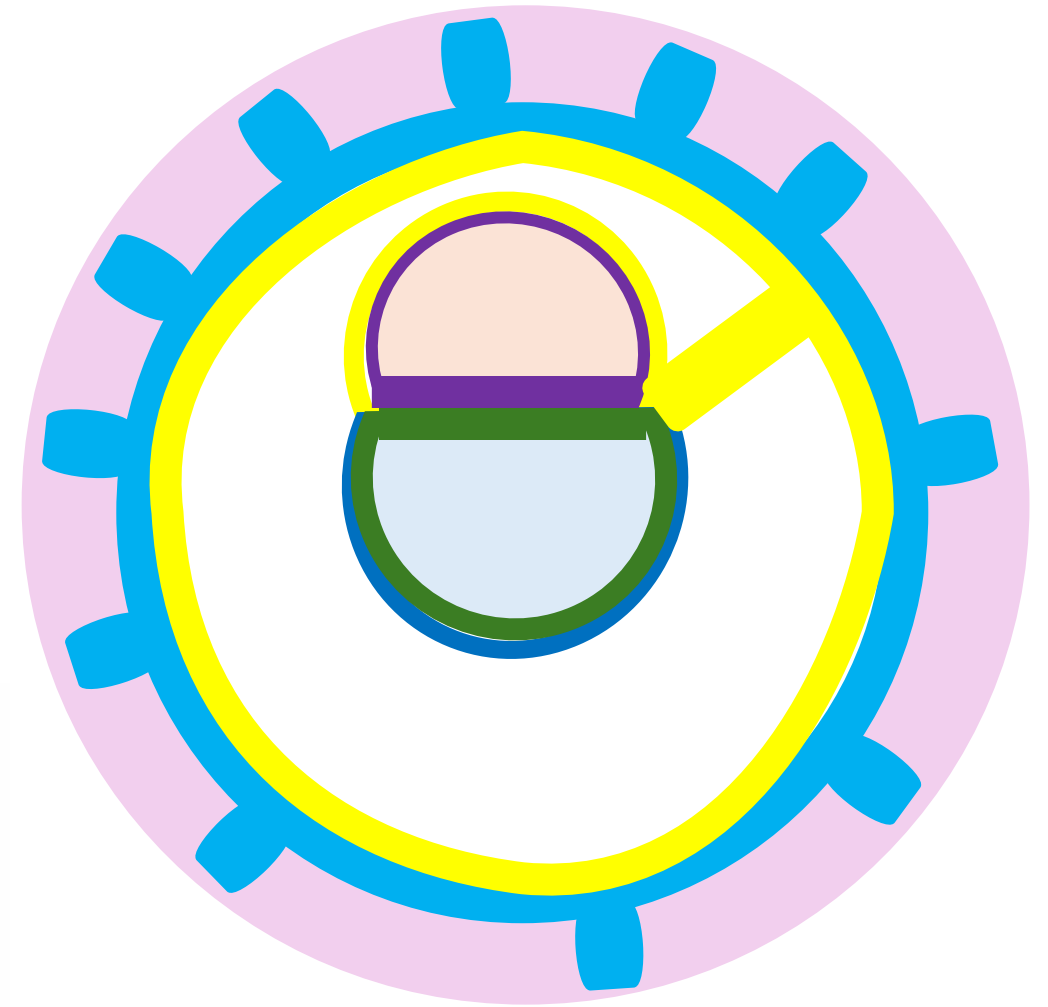
Anchoring villous

Absorbing villous

Syncytiotrophoblast  
Cytotrophoblast  
Extraembryonic mesoderm

## Primary chorionic villi

- ✓ **Definition:** Finger-like projections composed of cytotrophoblast cells covered externally by syncytiotrophoblast.
- ✓ No mesoderm, no blood vessels.

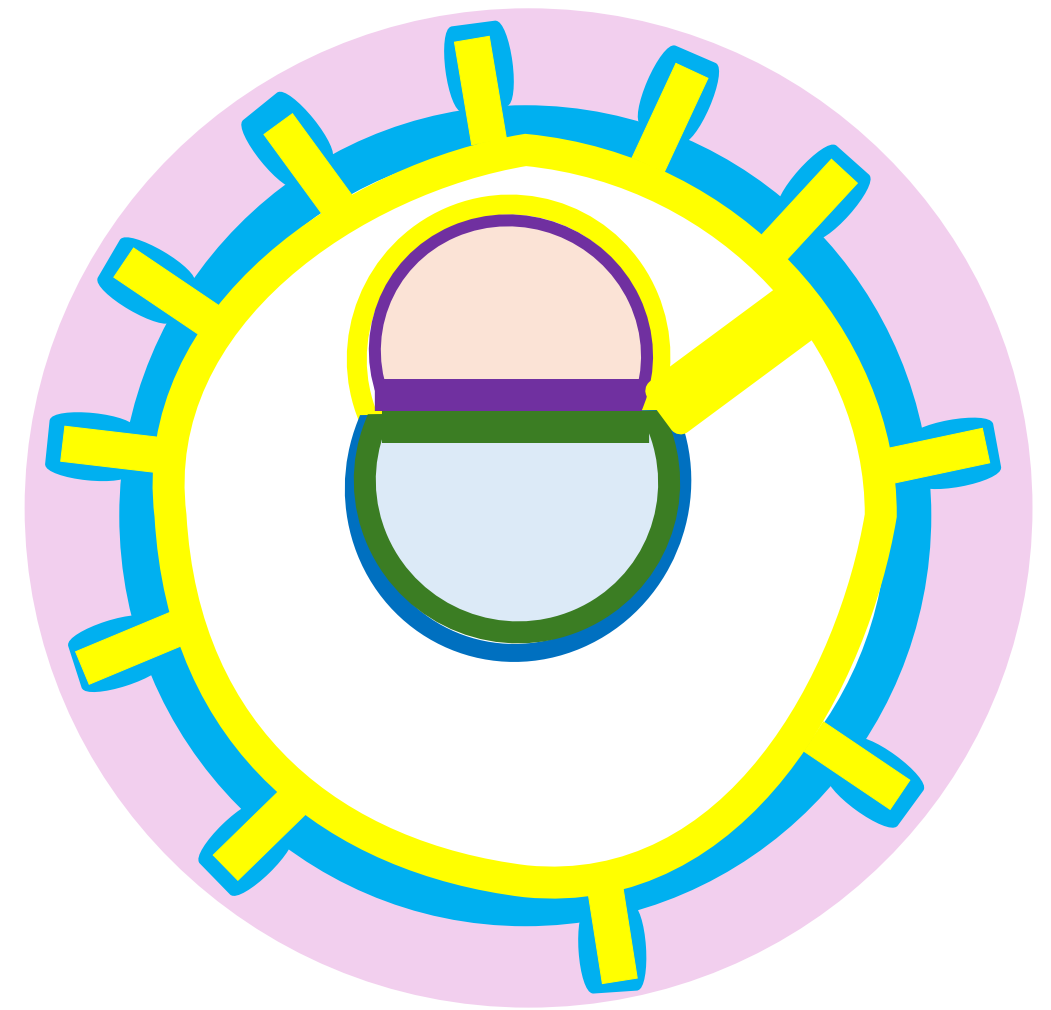
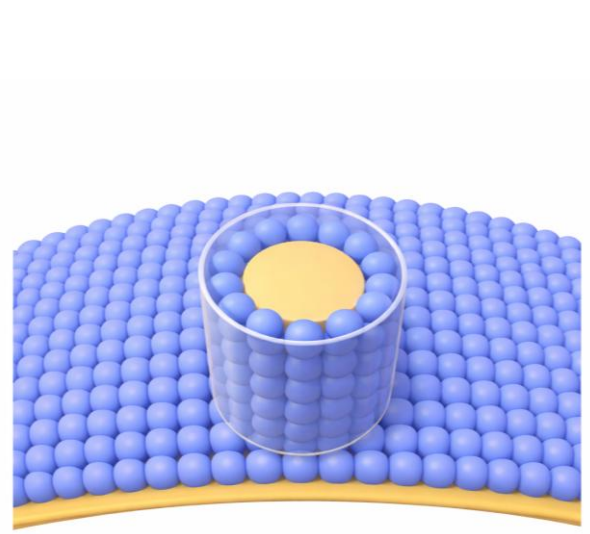
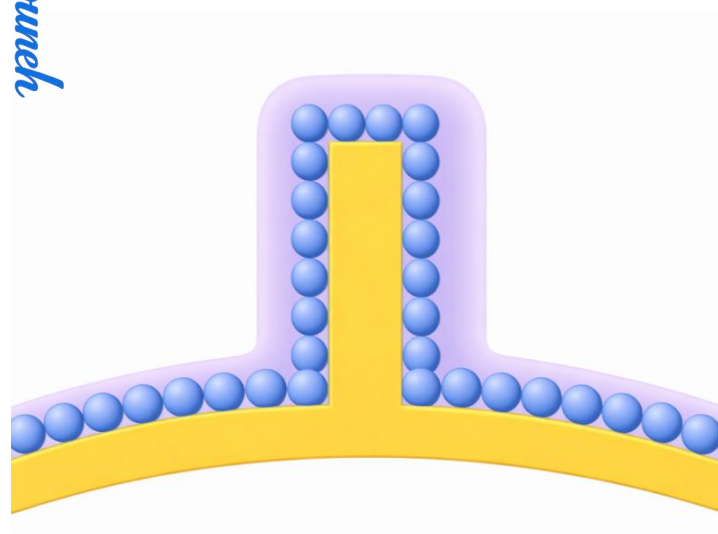


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## Secondary chorionic villi

- ✓ **Definition:** Primary villi into which extraembryonic mesoderm has grown into the core.
- ✓ Have a mesodermal core, but still no blood vessels.

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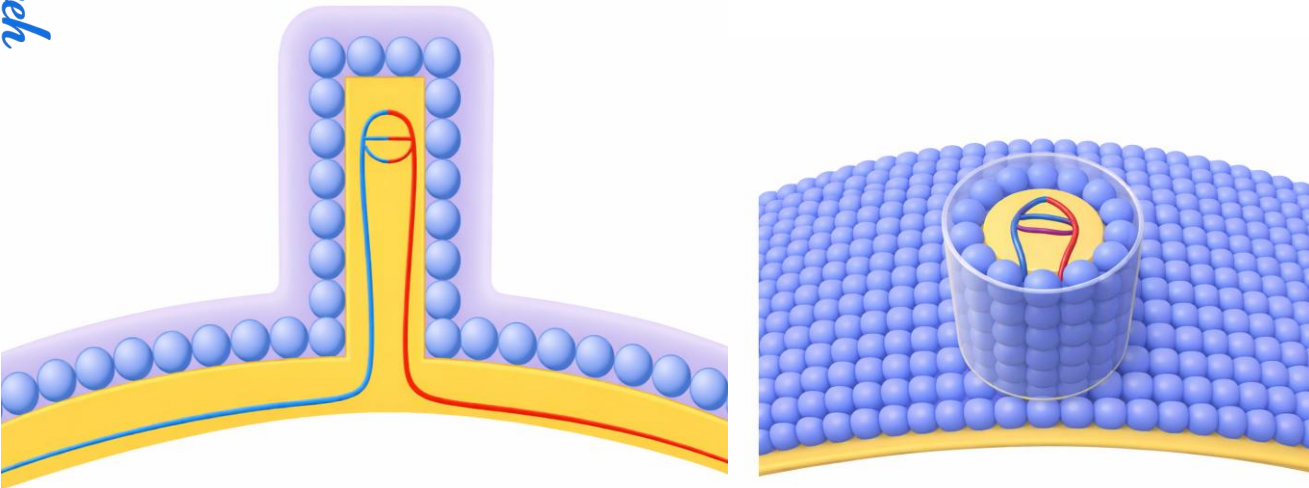
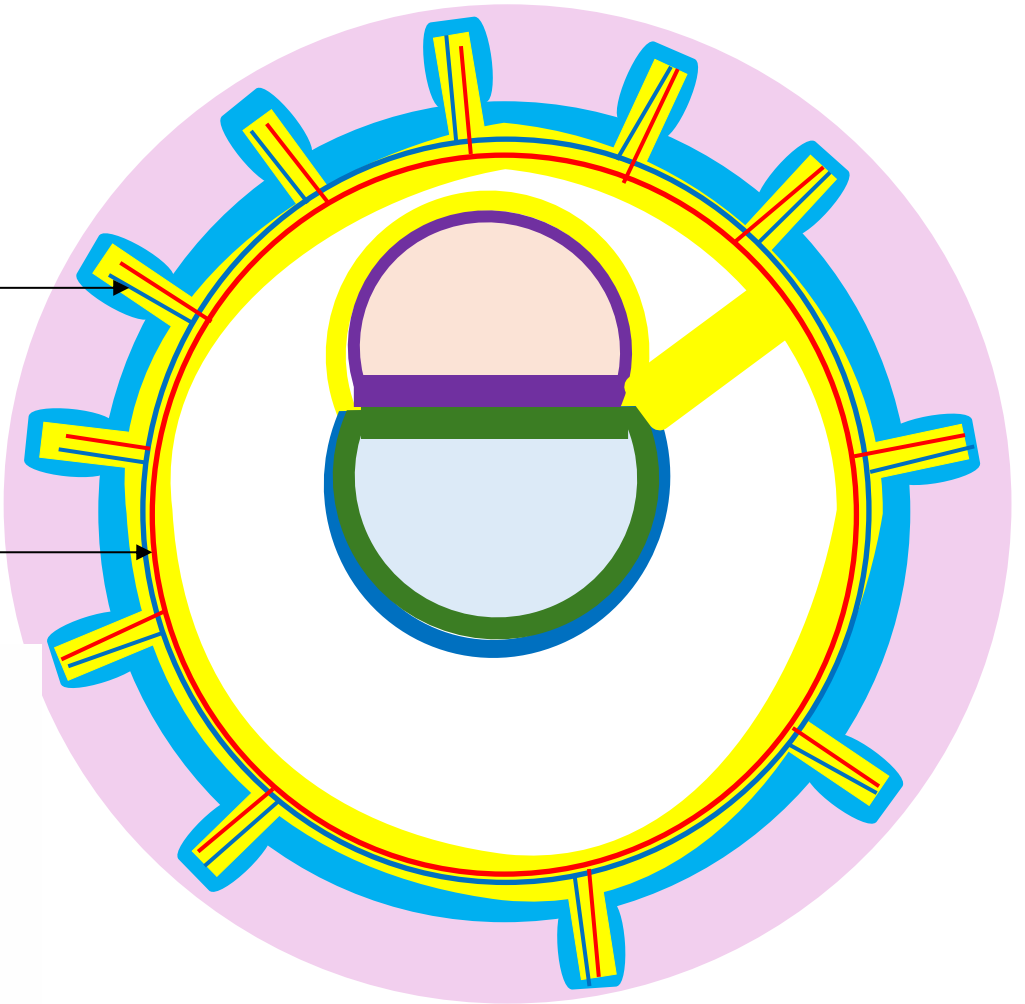
Syncytiotrophoblast  
Cytotrophoblast  
Extraembryonic mesoderm

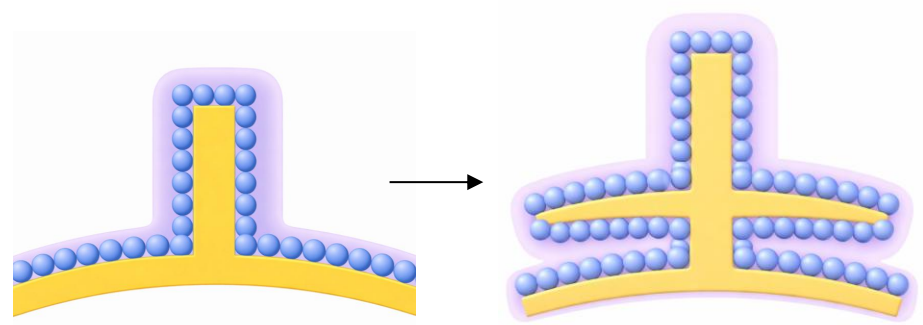
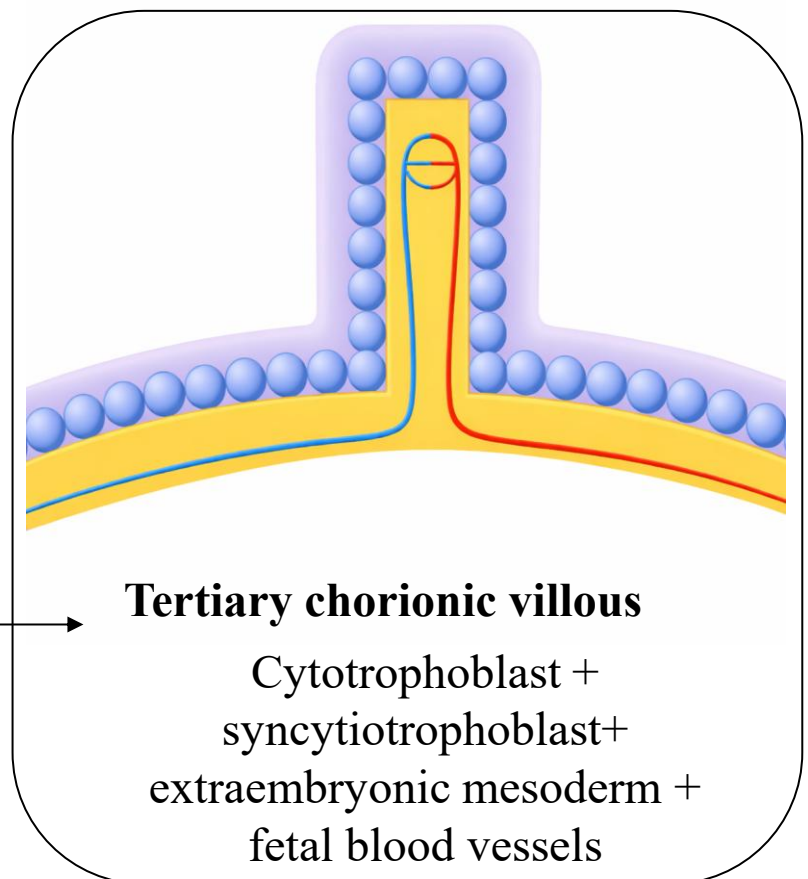
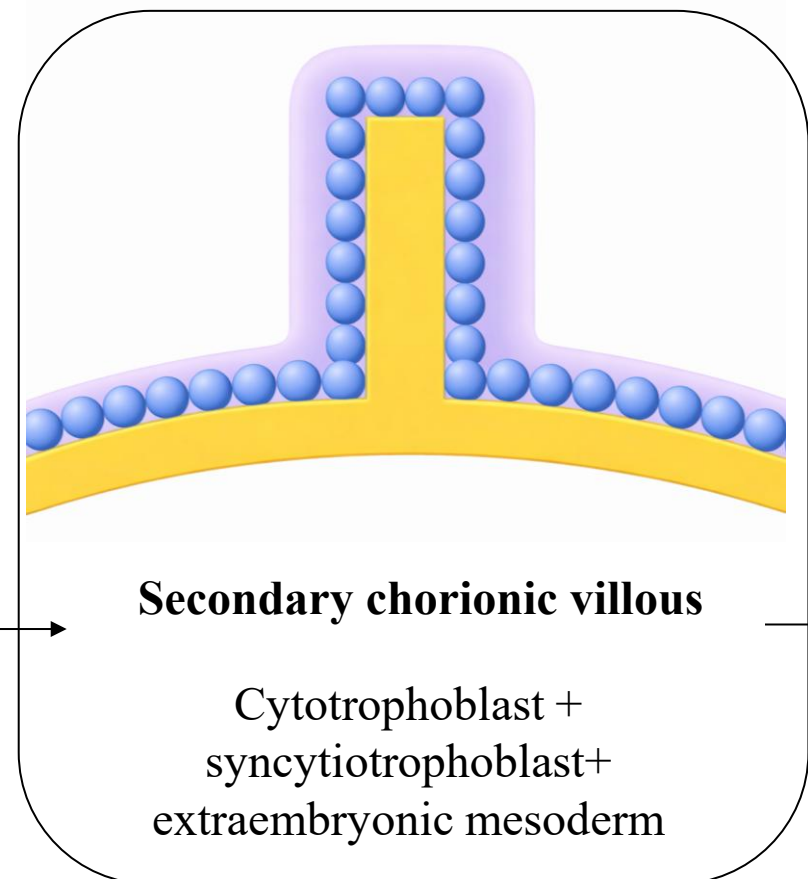
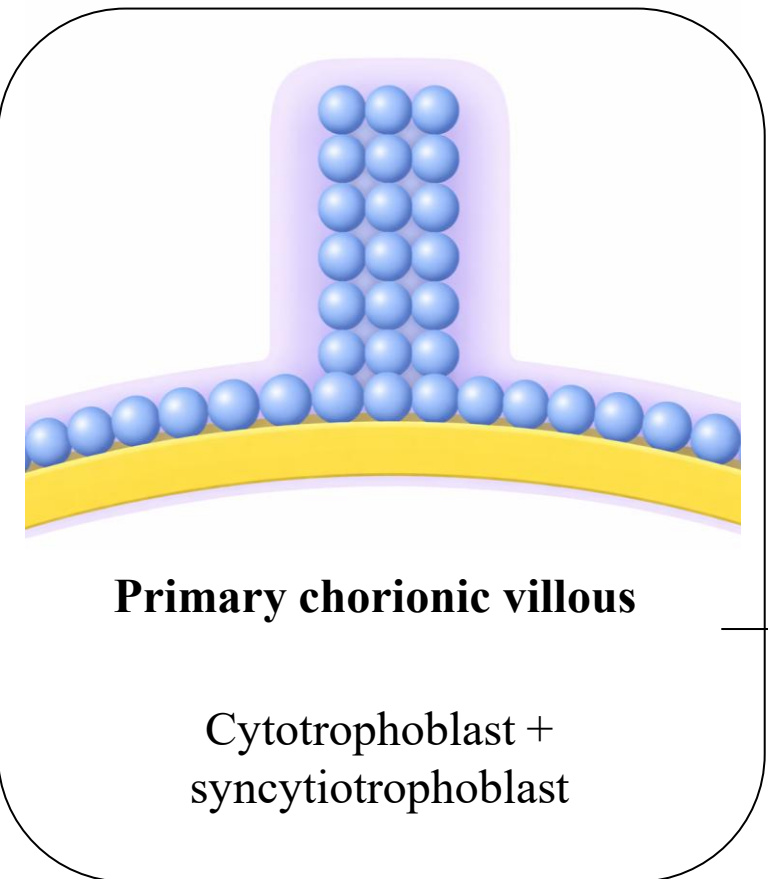
## Tertiary chorionic villi

- ✓ **Definition:** Secondary villi in which the mesodermal core differentiates into blood vessels that connect with the embryonic circulation.
- ✓ Functional villi involved in maternal–fetal exchange.

Villous capillaries

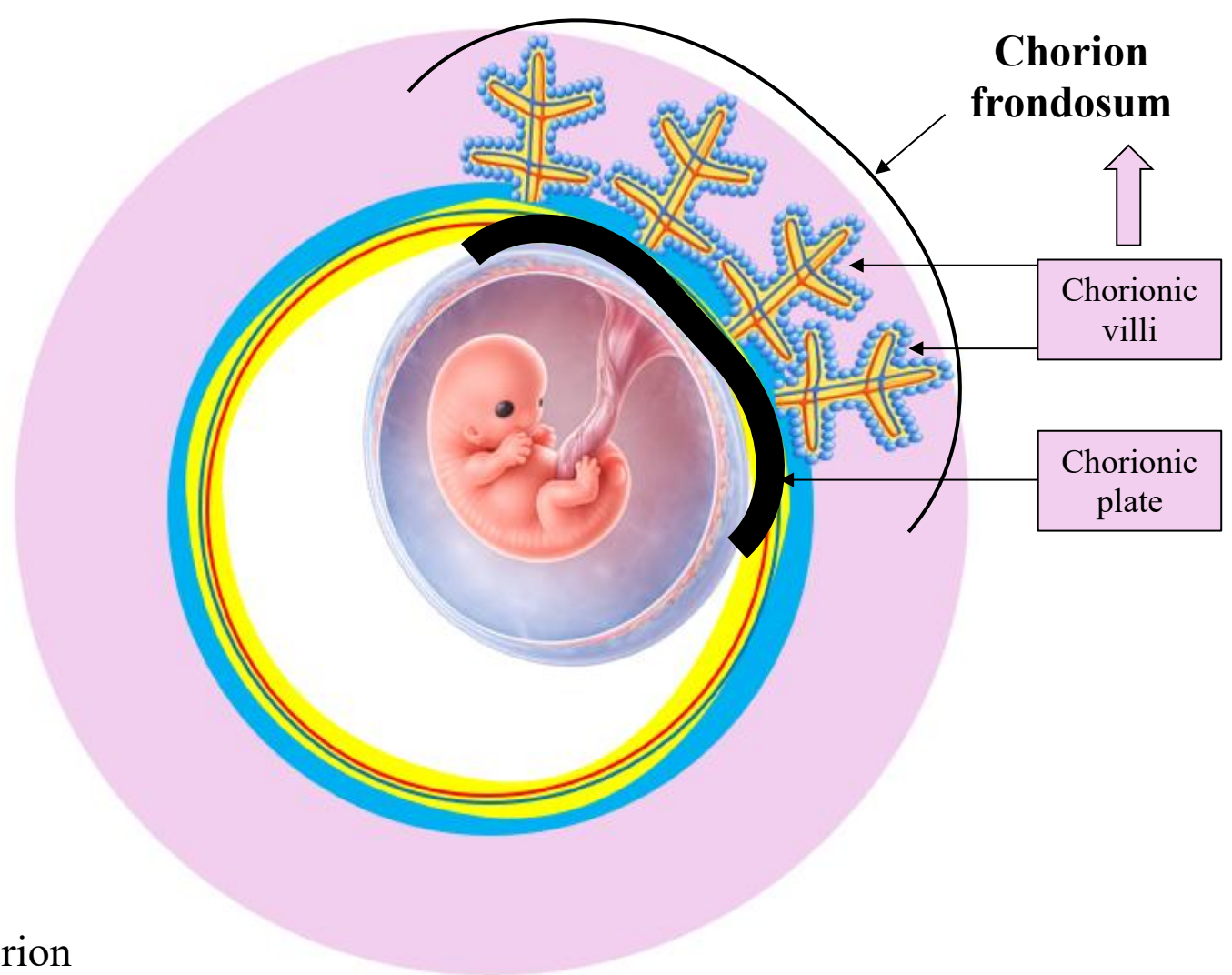
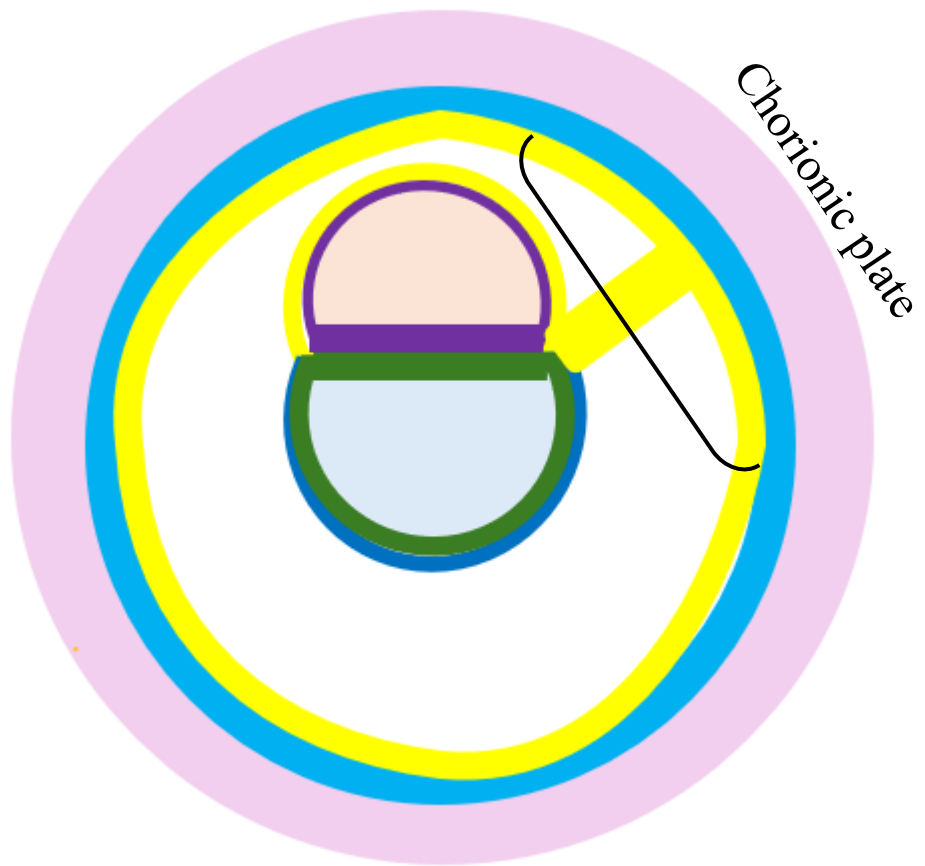
Chorionic vessels





The branching of chorionic villi serves to markedly increase the surface area of contact between fetal and maternal tissues, ensuring efficient exchange of gases, nutrients, and waste products as the placenta grows and matures.

Syncytiotrophoblast  
Cytotrophoblast  
Extraembryonic mesoderm



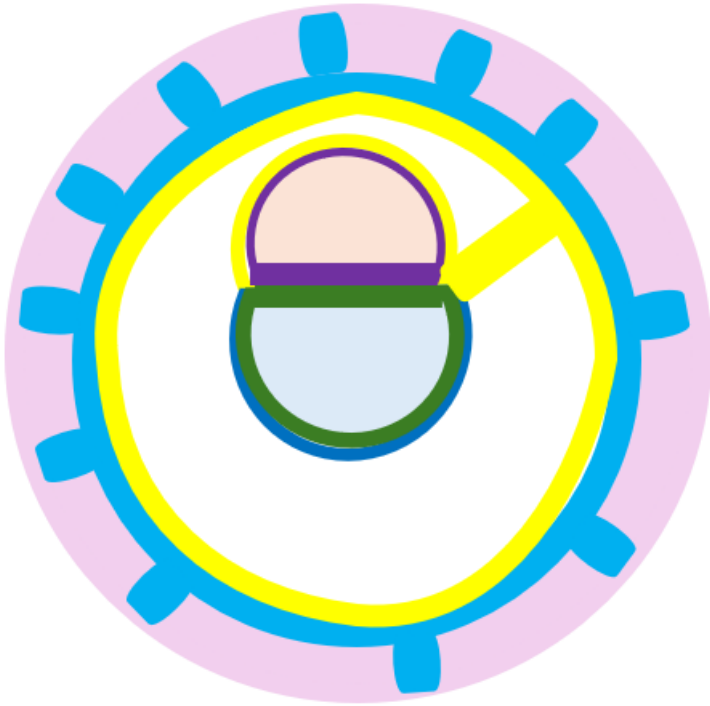
**Chorion frondosum** refers to the villous part of the chorion

- ✓ It is the region where chorionic villi proliferate, branch, and persist
- ✓ It forms the entire fetal component of the placenta
- ✓ Includes: Chorionic plate and Chorionic villi

**Chorionic plate** is the fetal surface of the placenta

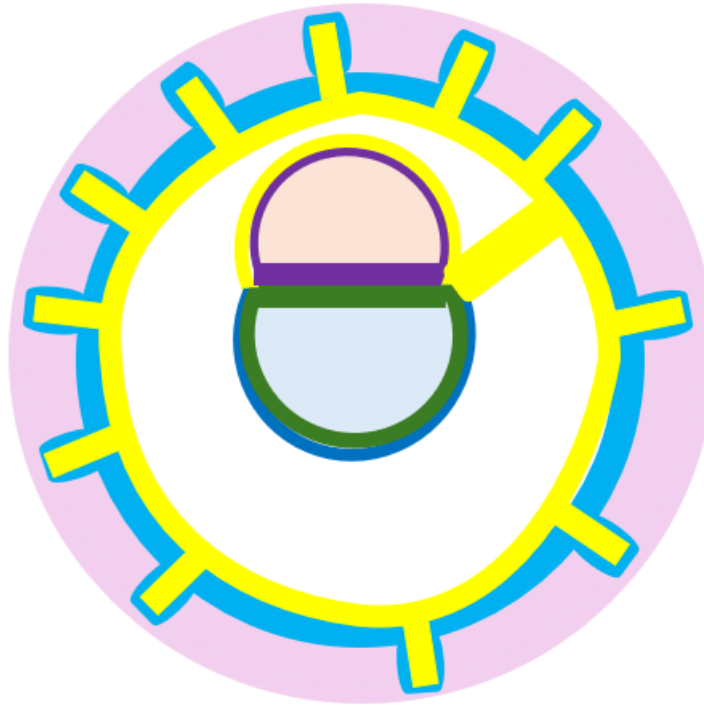
- ✓ It is a part of the chorion frondosum
- ✓ From it, chorionic villi arise
- ✓ Contains the chorionic (fetal) vessels beneath the amnion

## Primary chorionic villi



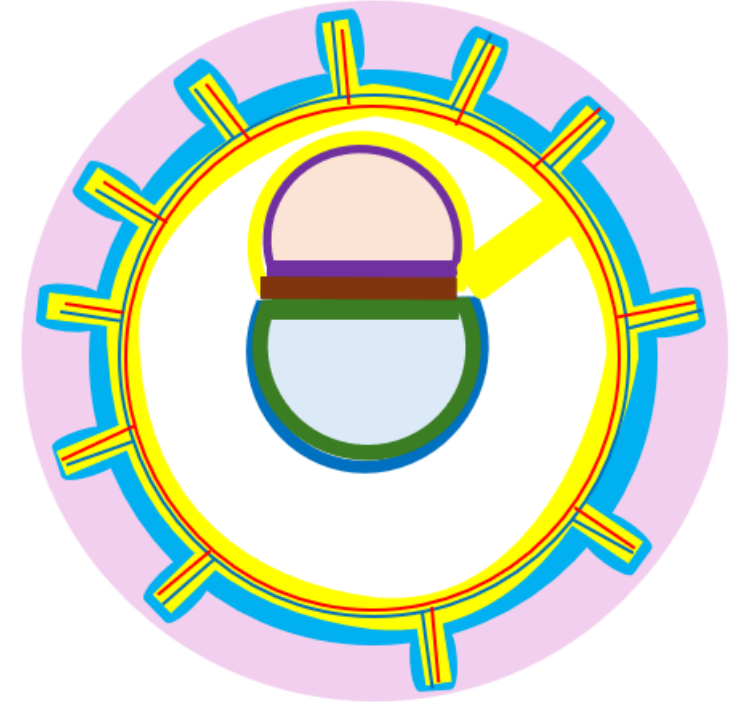
End of week 2

## Secondary chorionic villi



Week 3 (early)

## Tertiary chorionic villi



Week 3 (late)

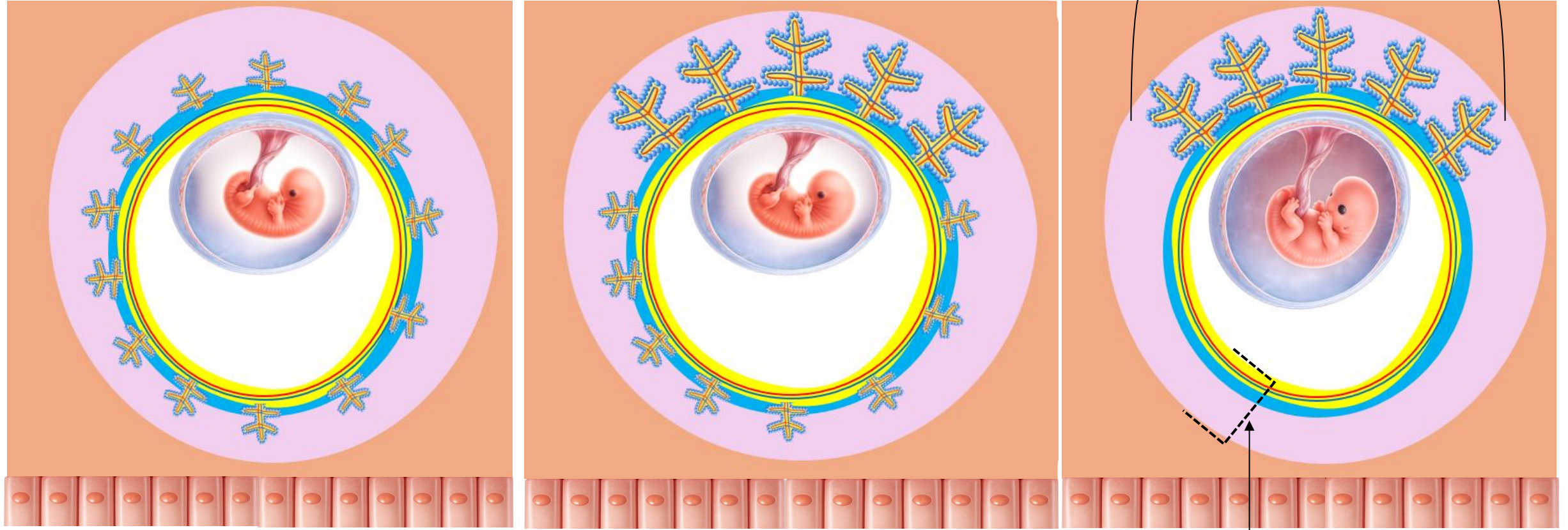
Primary → secondary → tertiary chorionic villi initially develop over the entire surface of the chorionic sac.

Week 2 → primary

Week 3 → secondary → tertiary

Weeks 4 onward → branching, functional placenta

Syncytiotrophoblast  
Cytotrophoblast  
Extraembryonic mesoderm



**Chorion frondosum**

**Chorion laeve**

Note: Tertiary chorionic villi initially develop over the entire chorion, but later regress in the chorion laeve and persist only in the chorion frondosum, where the placenta forms.

## Chorion frondosum (rough chorion)

The chorion frondosum is the part of the chorion in which chorionic villi are numerous, well developed, and highly branched.

→ It lies at the implantation site (embryonic pole), remains in contact with the decidua basalis, and forms the fetal part of the placenta, permitting efficient maternal–fetal exchange.

Remember:

The chorion is the outermost fetal membrane.

It consists of syncytiotrophoblast + cytotrophoblast + extraembryonic somatic mesoderm. It contributes to placenta formation

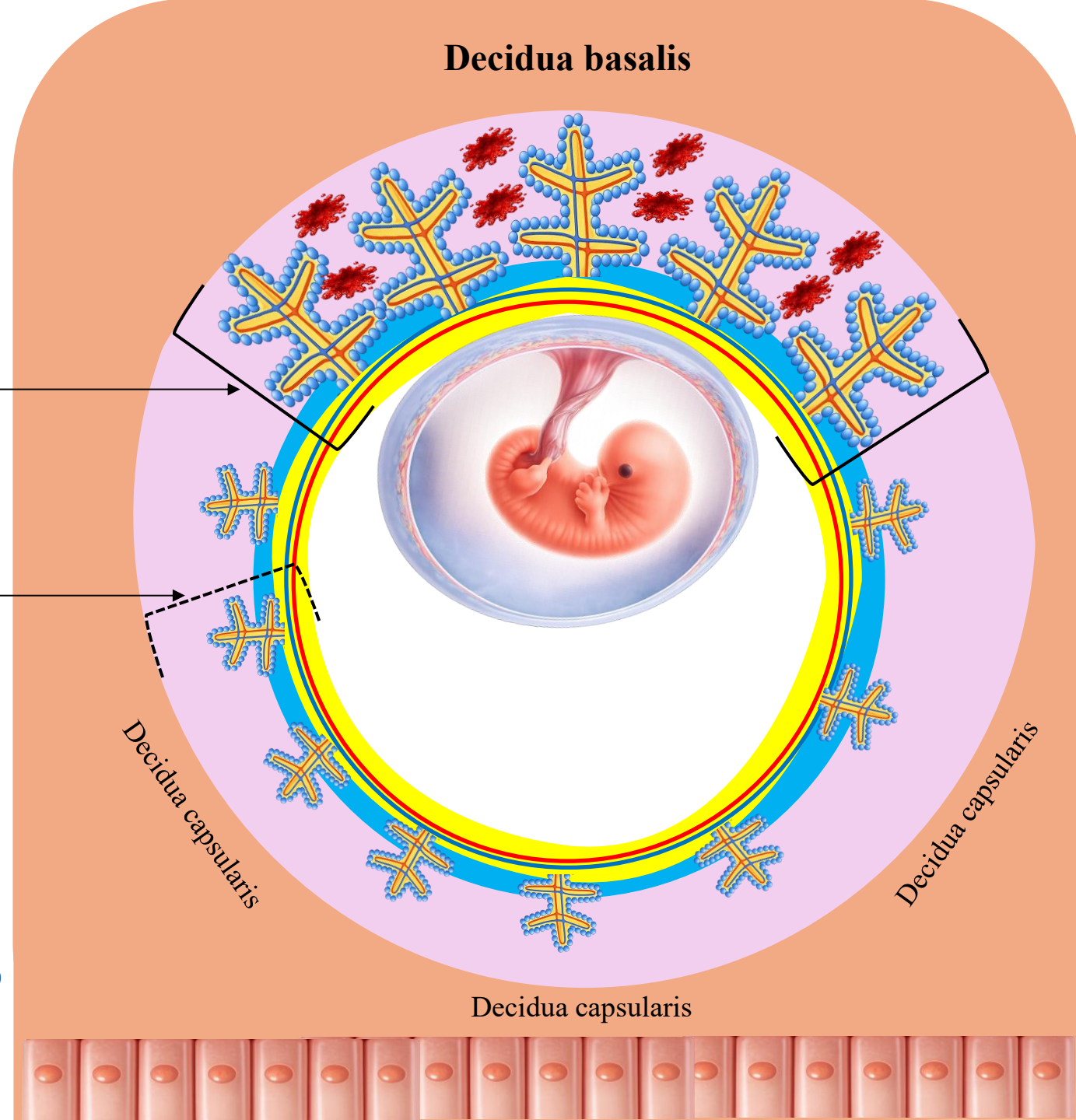
## Chorion laeve (smooth chorion)

The chorion laeve is the part of the chorion where chorionic villi regress and disappear as pregnancy progresses.

→ It is smooth, lies away from the implantation site, and does not participate in placental formation.

**Chorion frondosum**

**Chorion laeve**



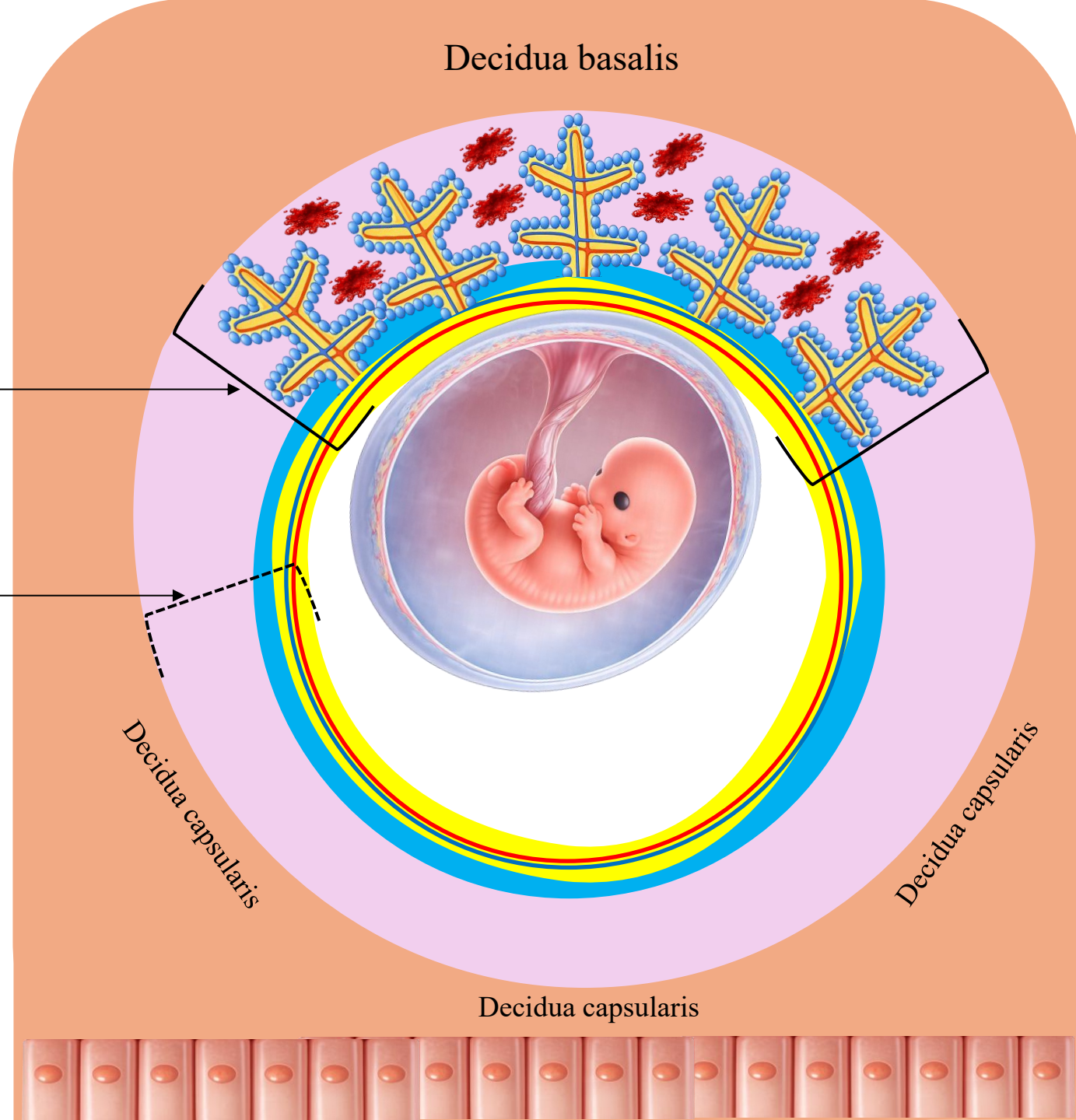
Villi facing the decidua basalis → proliferate, branch, and mature  
👉 form the chorion frondosum (fetal part of the placenta)

**Chorion frondosum**

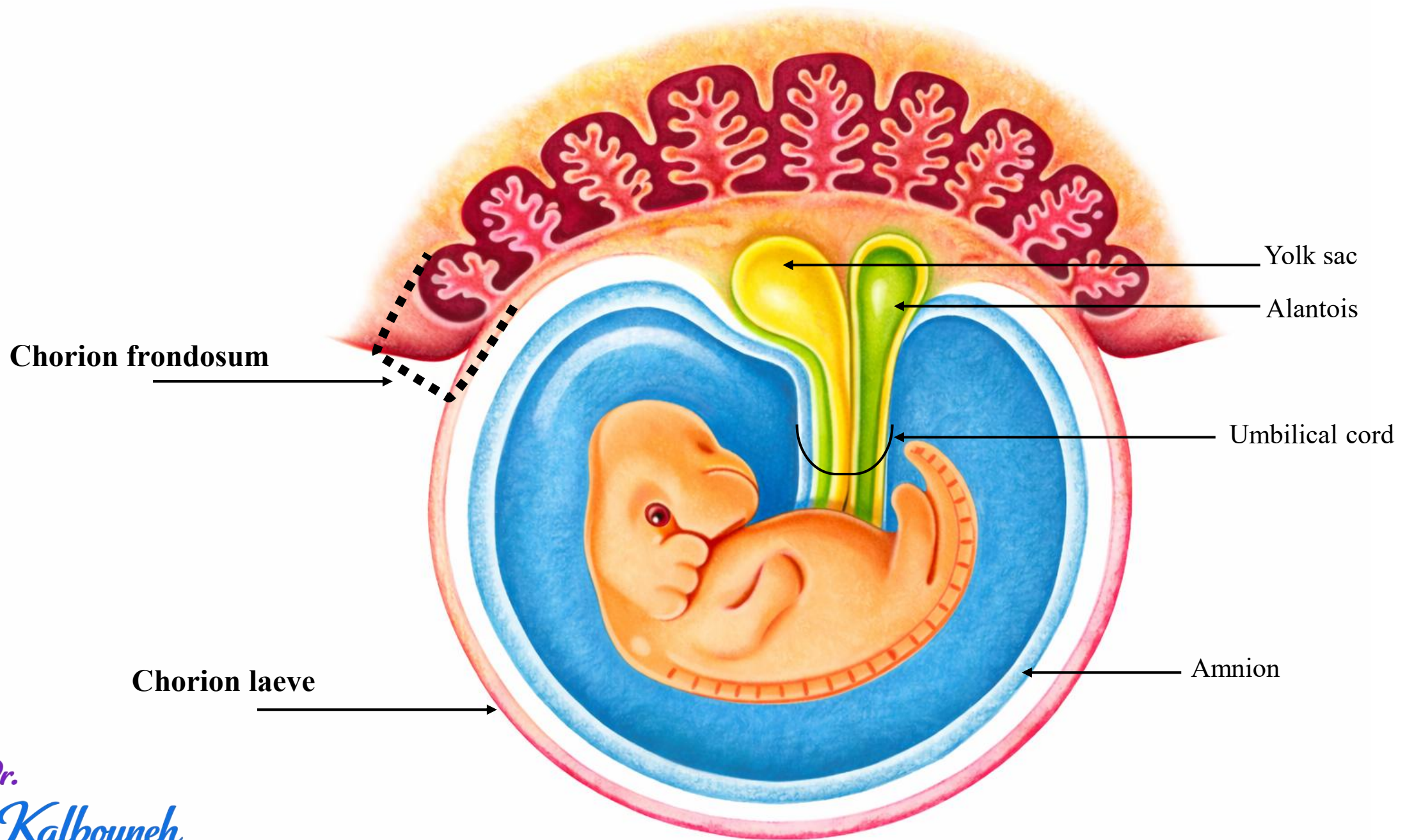
By the end of the 2<sup>nd</sup> month, a regional difference appears:

**Chorion laeve**

Villi facing the decidua capsularis → gradually regress and disappear  
👉 leaving a smooth surface = chorion laeve



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**Chorion frondosum**

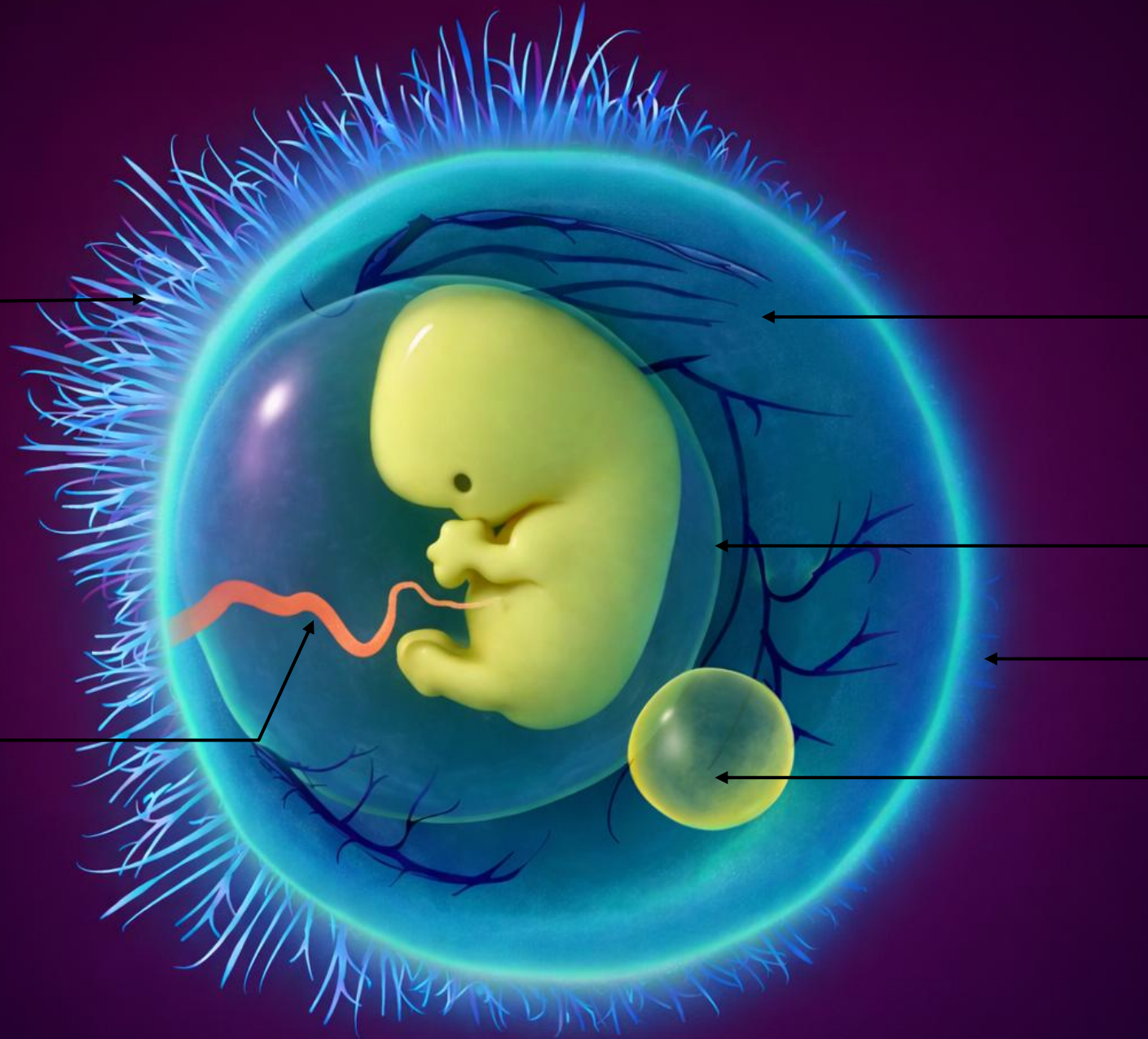
**Extraembryonic coelom (chorionic cavity)**

**Amnion**

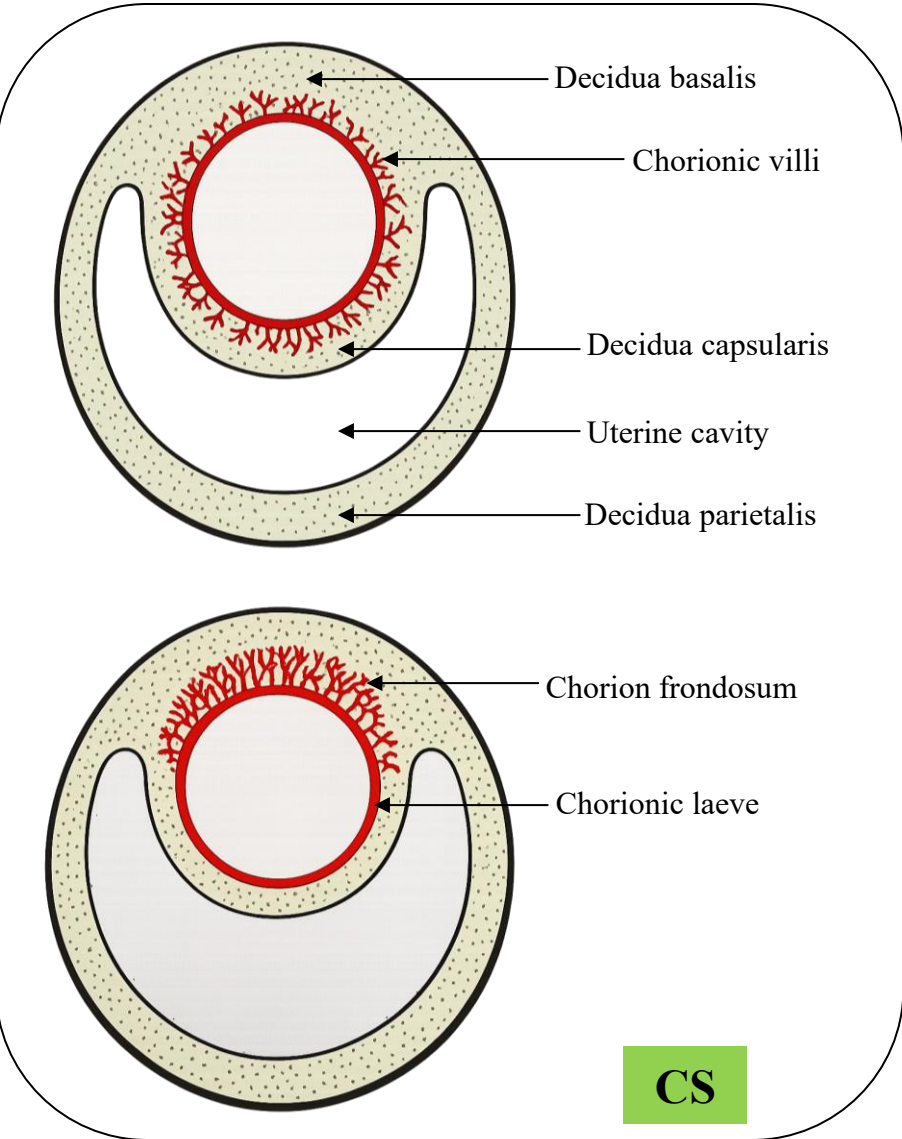
**Chorion laeve**

**Umbilical cord**

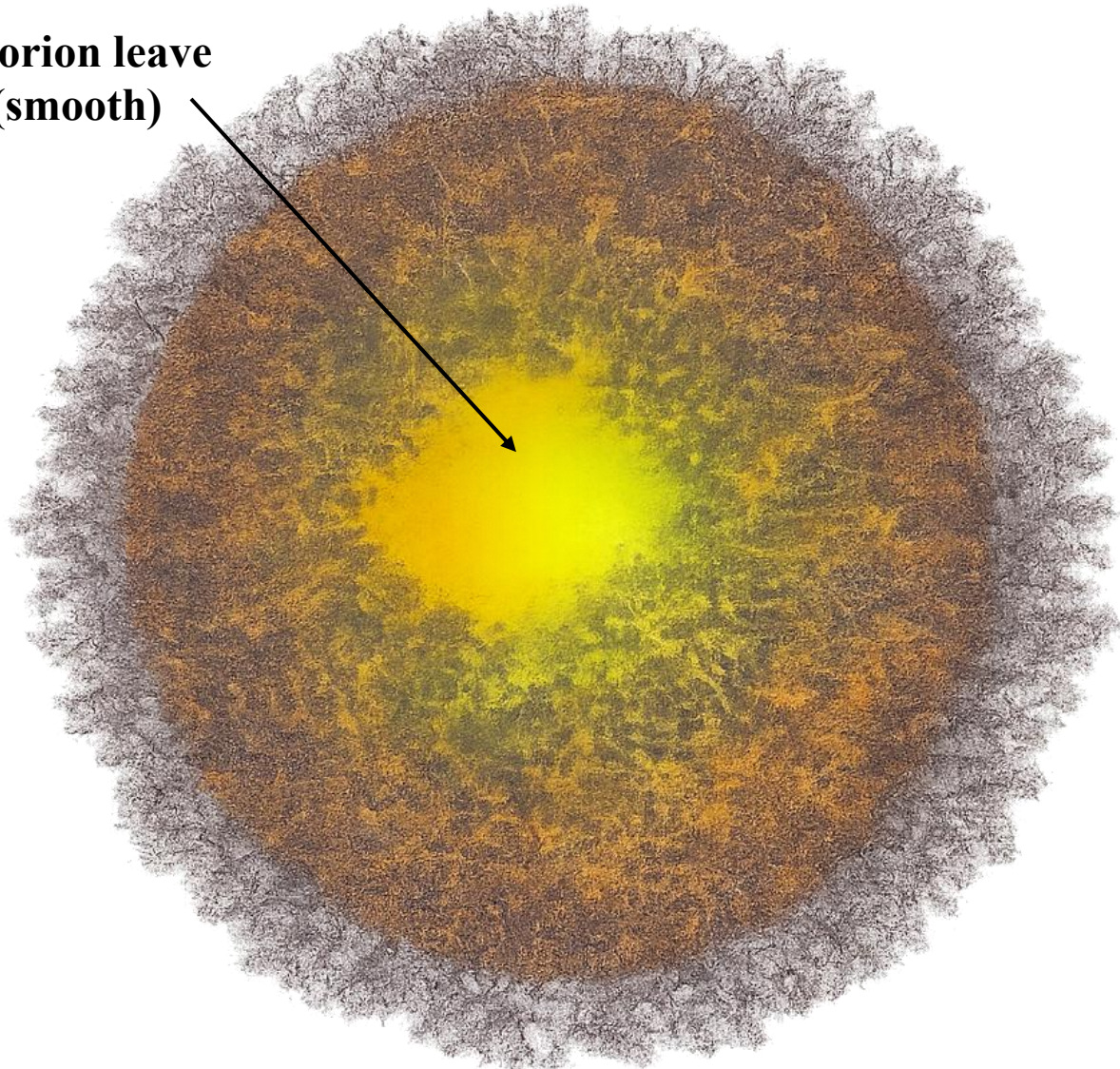
**Yolk sac**



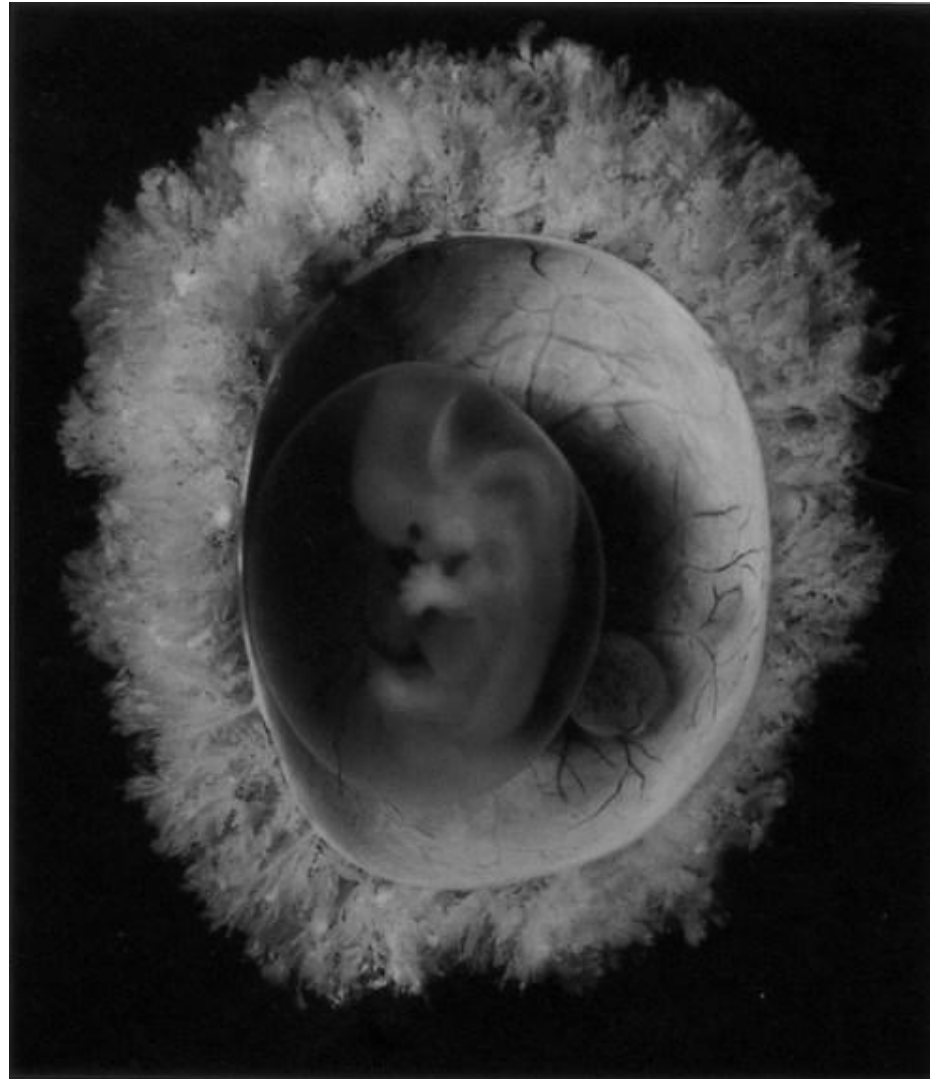
# Chorion leave vs Chorion frondosum



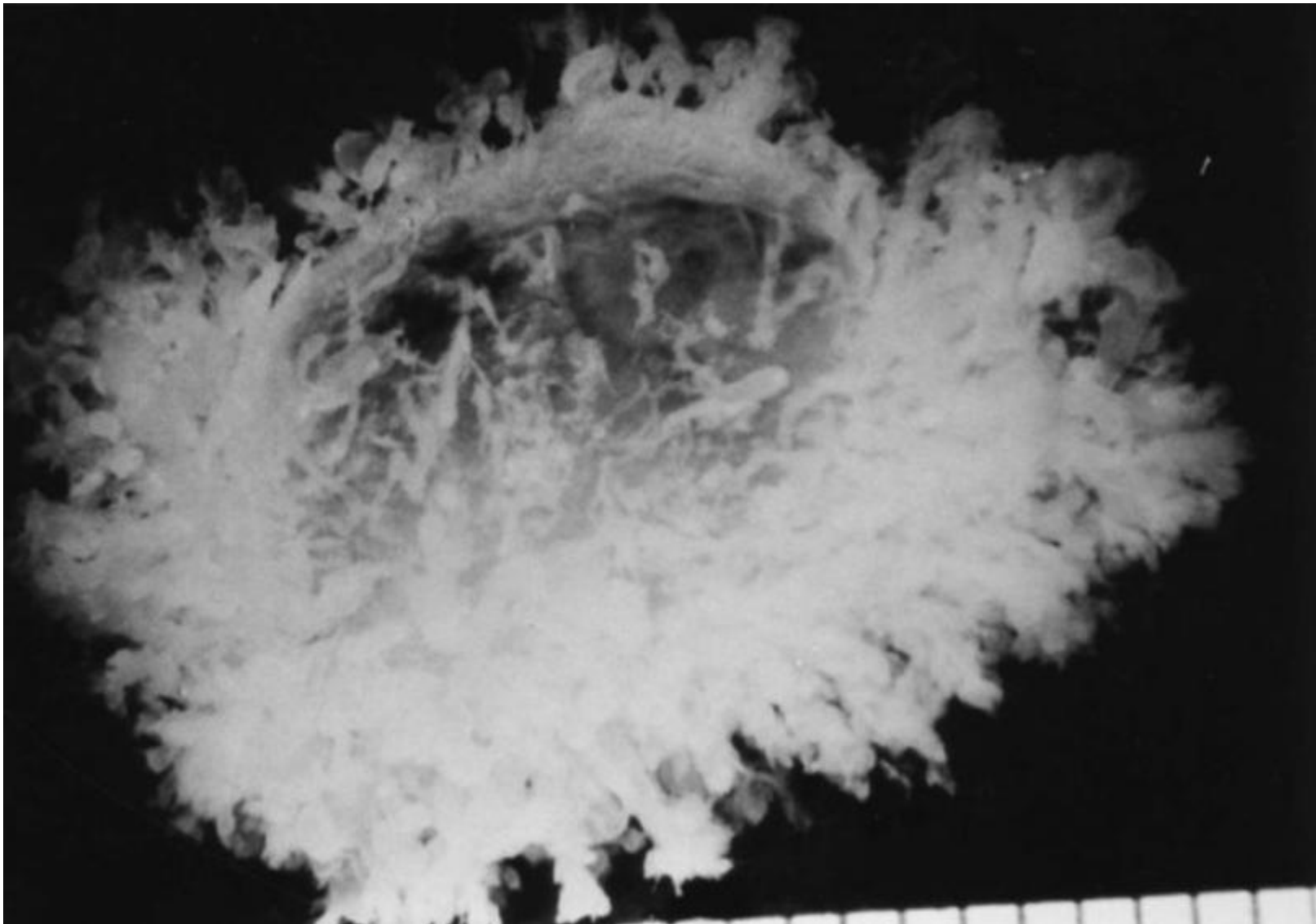
Chorion leave  
(smooth)



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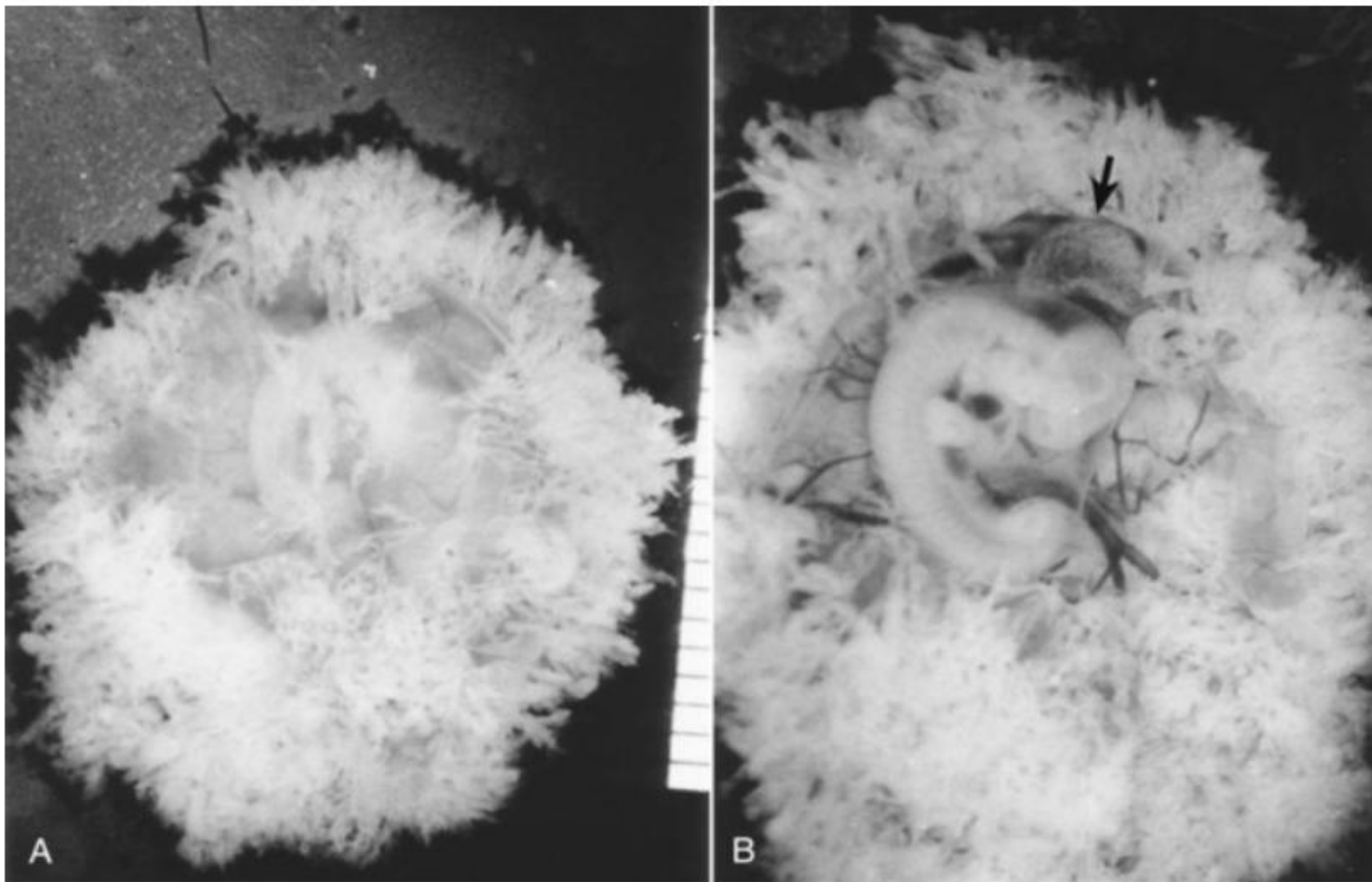


A 7-week-old human embryo surrounded by its amnion. The embryo was exposed by cutting open the chorion. The small sphere to the right of the embryo is the yolk sac.  
(Carnegie embryo No. 8537A, Courtesy of Chester Reather, Baltimore)



Early formation of the chorion laeve. The small, bare area in this photograph of a human chorionic vesicle is a region where the chorionic villi have atrophied. This area will enlarge in succeeding weeks.

(From Gilbert-Barness E, ed: *Potter's pathology of the fetus and infant*, St Louis, 1997, Mosby)



**A:** Intact chorionic vesicle containing an embryo in the fourth week of development. The outline of the embryo can be seen through the thinned chorion laeve region. **B:** Opened chorionic vesicle, showing the disposition of the embryo inside. The yolk sac is indicated by the *arrow*.

(From Gilbert-Barness E, ed: *Potter's pathology of the fetus and infant*, St Louis, 1997, Mosby)

# The placenta

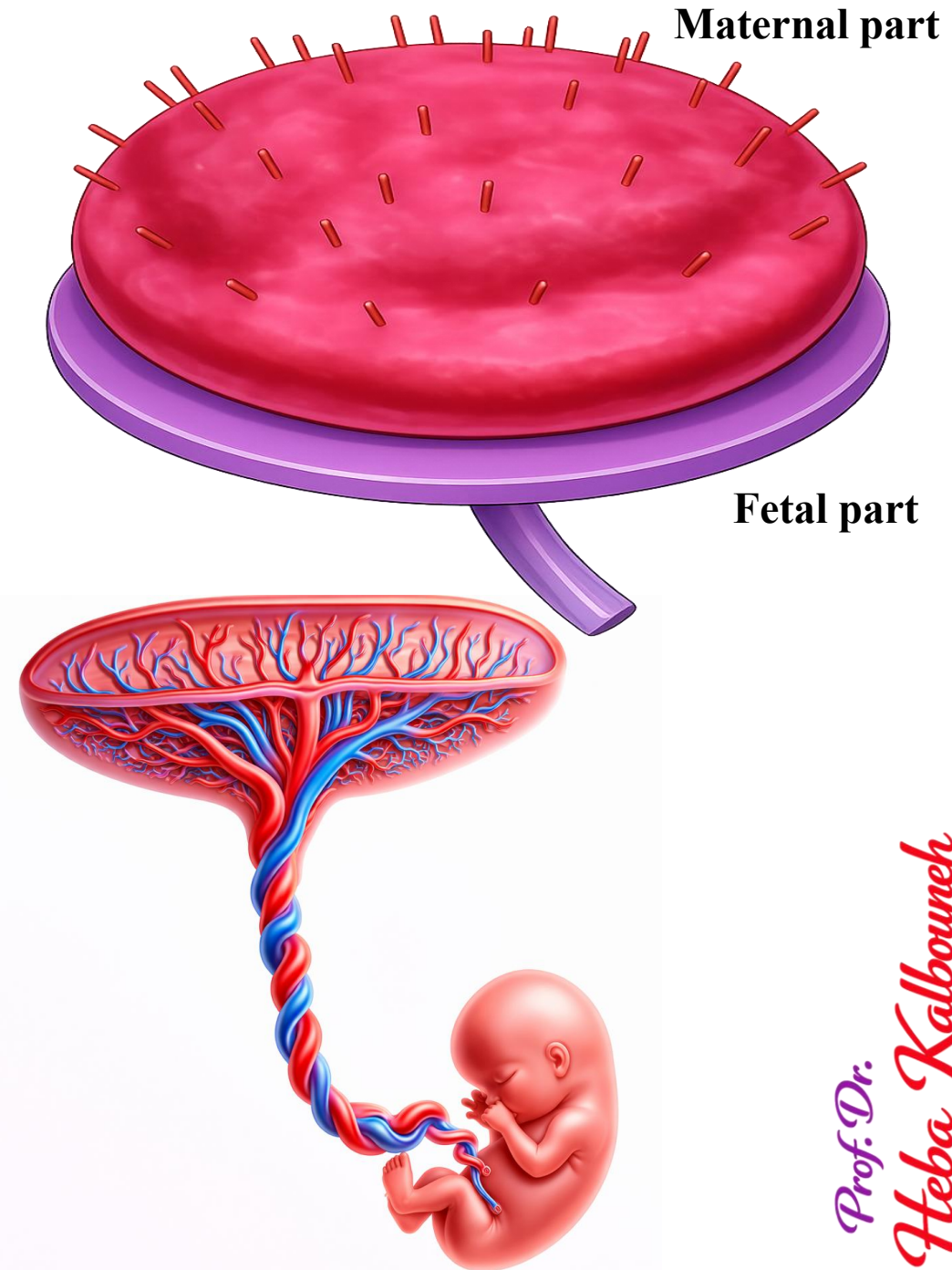
- ✓ Is a temporary organ that develops during pregnancy and connects the mother and the fetus. It allows the fetus to grow and survive inside the uterus.
- ✓ Inside the placenta are many chorionic villi that project into spaces filled with maternal blood (intervillous spaces).

## Functions

- ✓ **Exchange:** oxygen, nutrients, and water pass from mother to fetus; carbon dioxide and wastes pass from fetus to mother.
- ✓ **Endocrine:** produces hormones such as hCG, progesterone, estrogens, and human placental lactogen (hPL), which help maintain pregnancy, support fetal growth, and prepare the mother for lactation.
- ✓ **Protection:** acts as a selective barrier (placental membrane), limiting the passage of many bacteria and harmful agents.

**Attachment:** anchors the fetus to the uterine wall via the umbilical cord and anchoring villi.

- ✓ **Diameter:** 15 -25 cm.
- ✓ **Thickness:** About 3 cm.
- ✓ **Weight:** About 500 – 600 gm
- ✓ **Site:** At original implantation site which is upper part of uterus.



**Appearance:**

✓ Disc-shaped organ

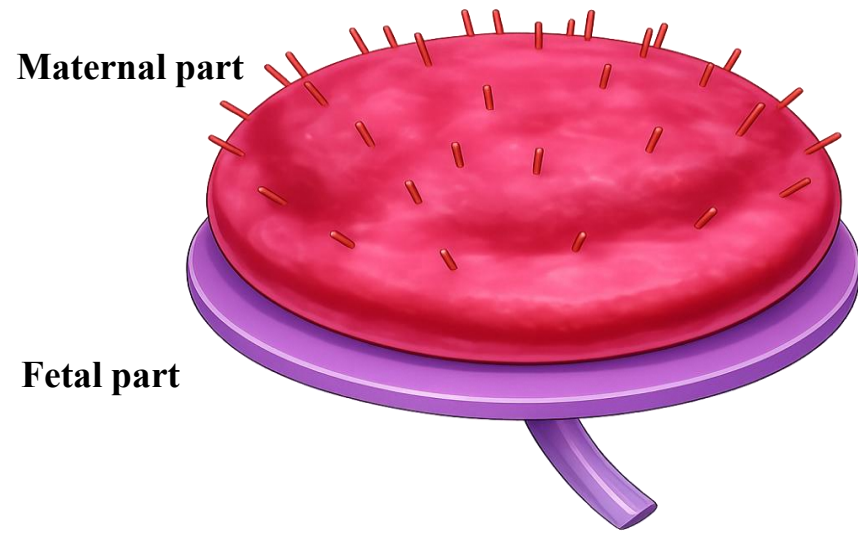
✓ It has two parts:

**Fetal part:** formed by the **chorion frondosum** (chorionic plate and villi)

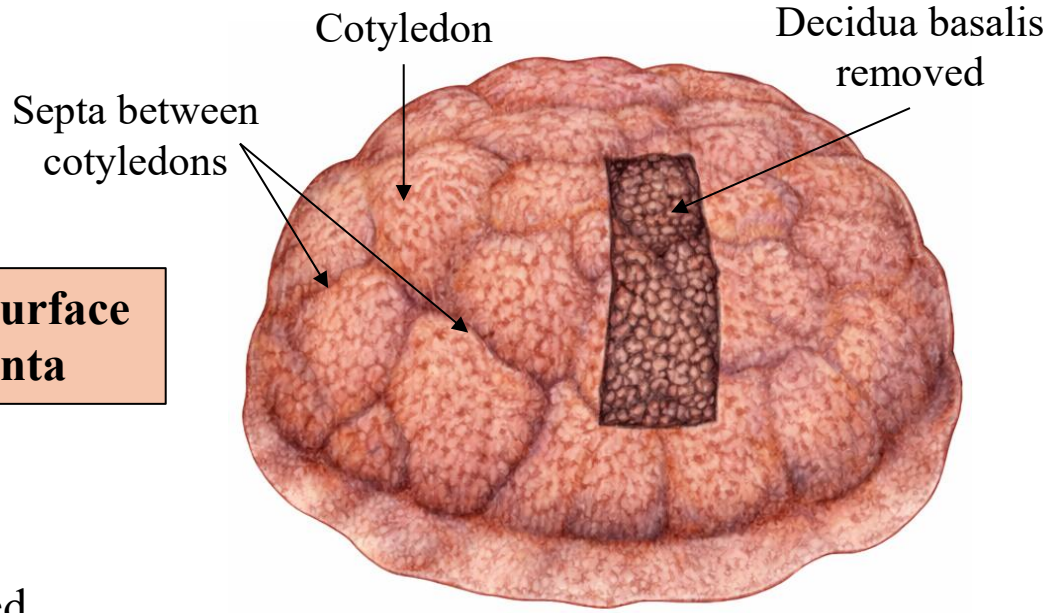
**Maternal part:** formed by the **decidua basalis**

✓ **Maternal surface:** rough and divided into lobules (cotyledons)

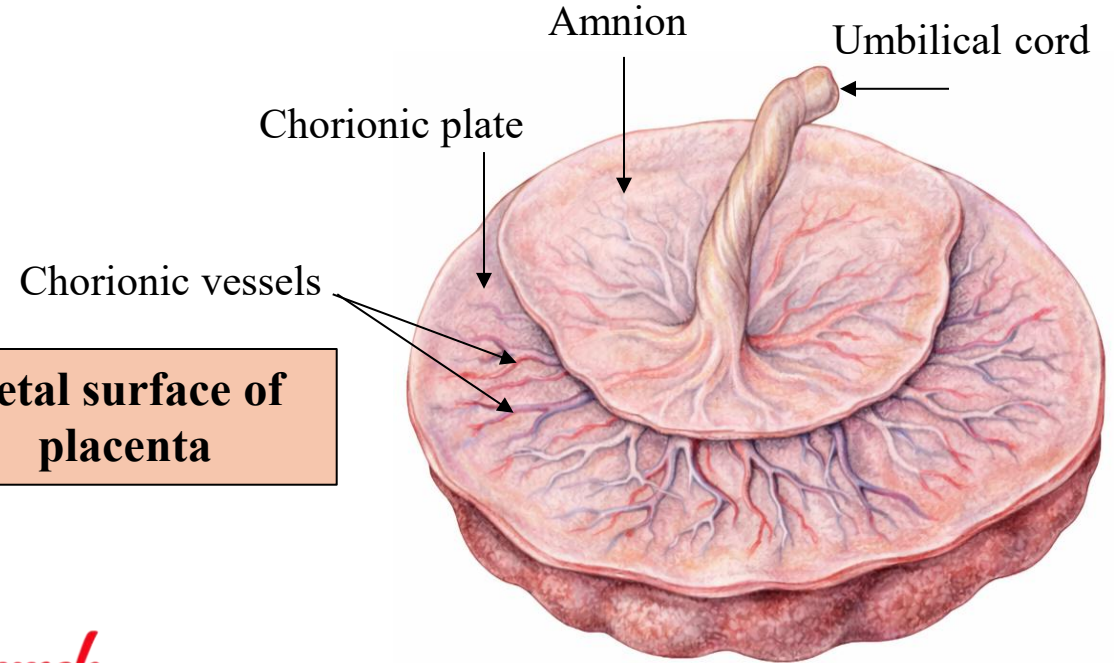
✓ **Fetal surface:** smooth, covered by amnion, with umbilical cord attached

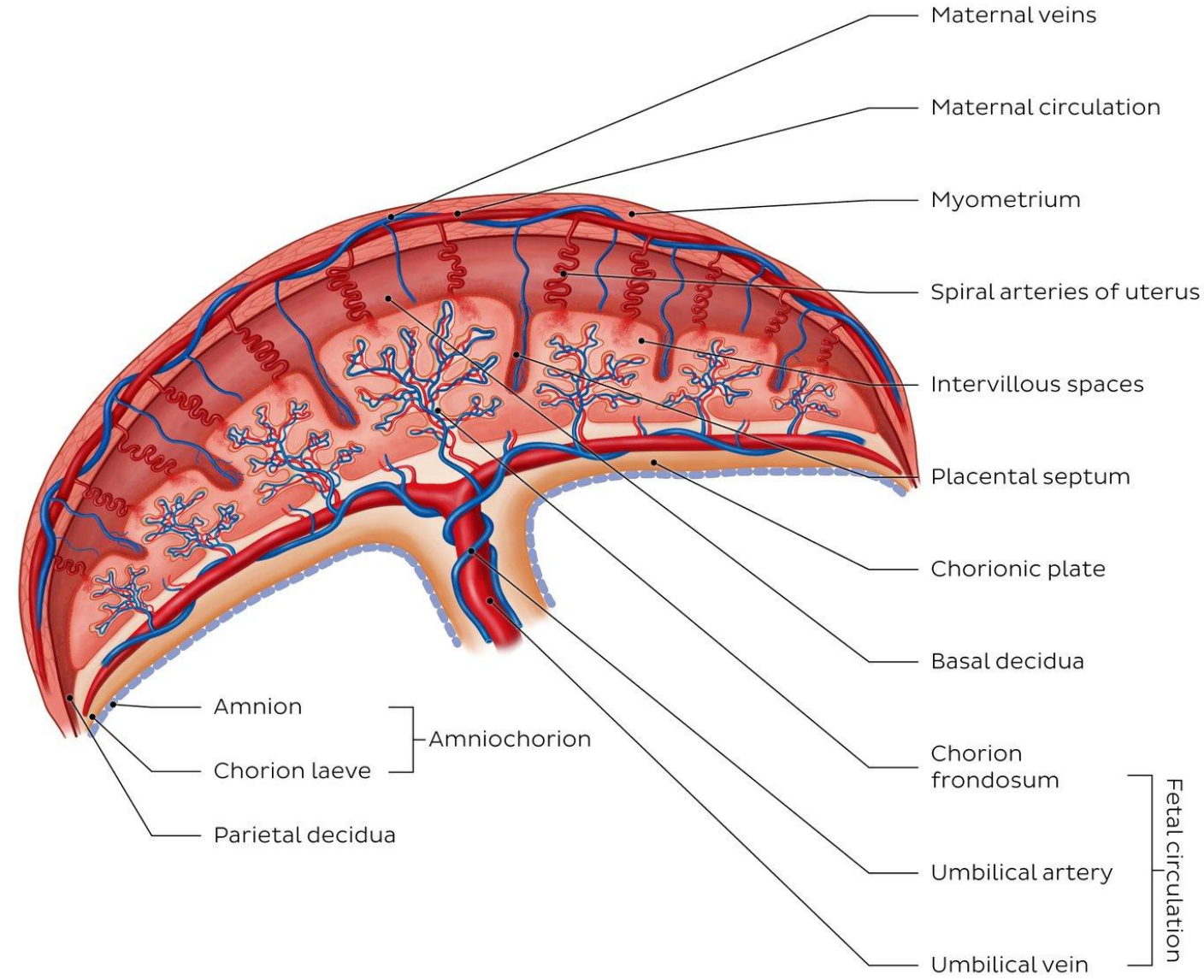
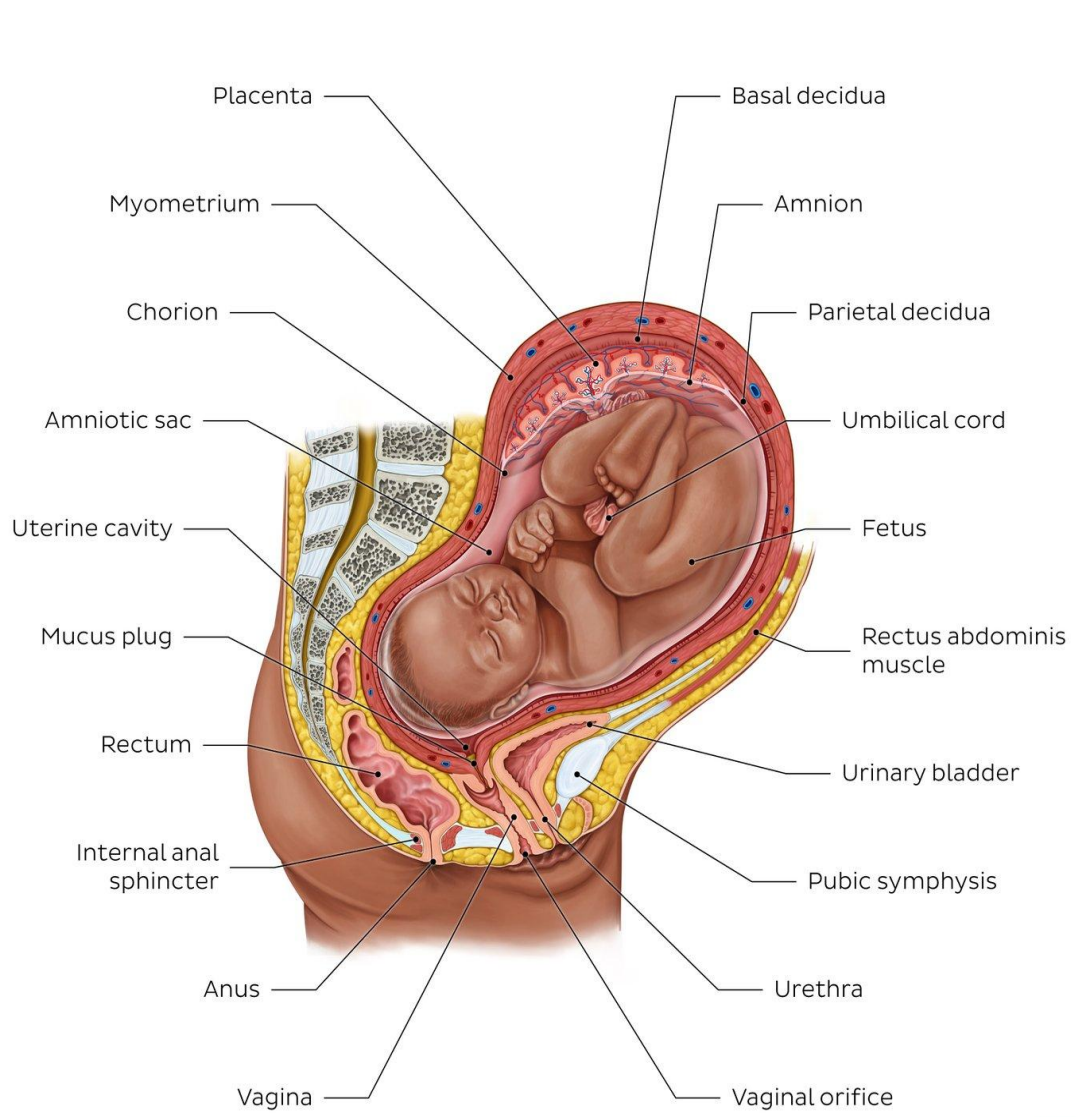


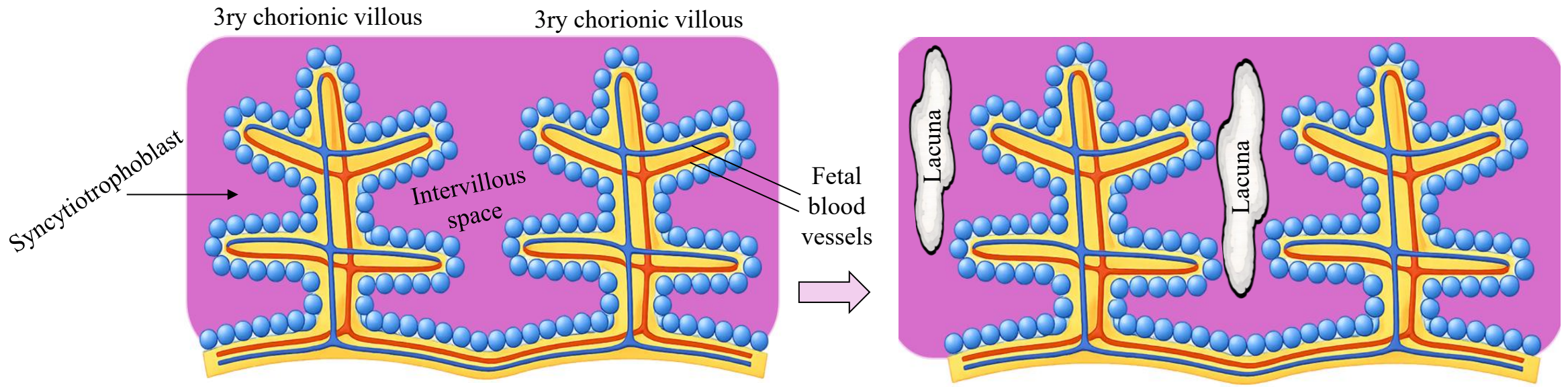
**Maternal surface of placenta**



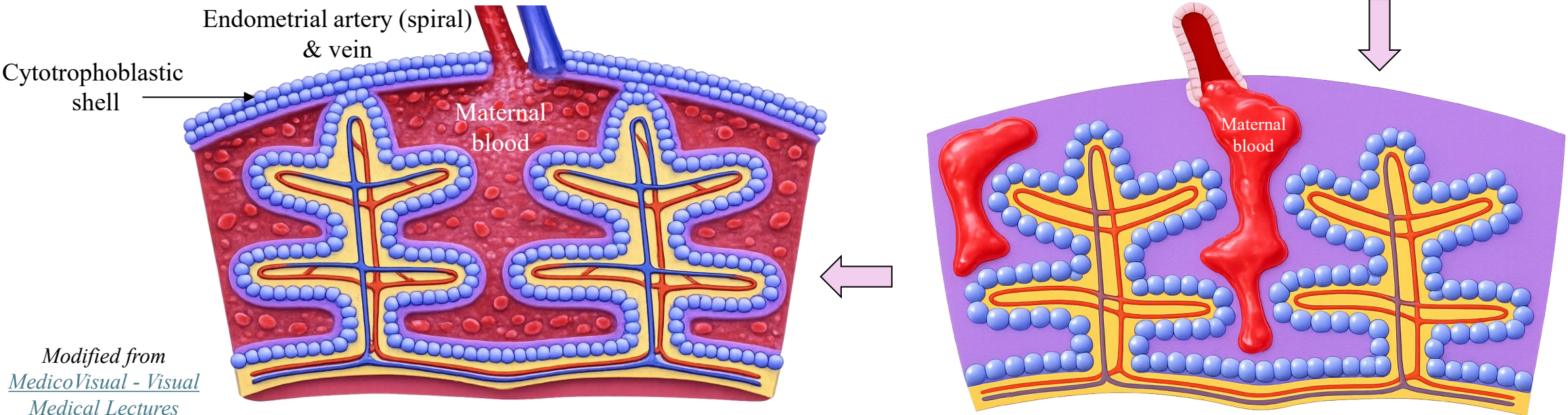
**Fetal surface of placenta**







Lacunae form within the syncytiotrophoblast, fill with maternal blood, and later coalesce to form the intervillous spaces that surround chorionic villi and establish uteroplacental circulation.



Modified from  
 MedicoVisual - Visual  
 Medical Lectures

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## Fetal part of the placenta

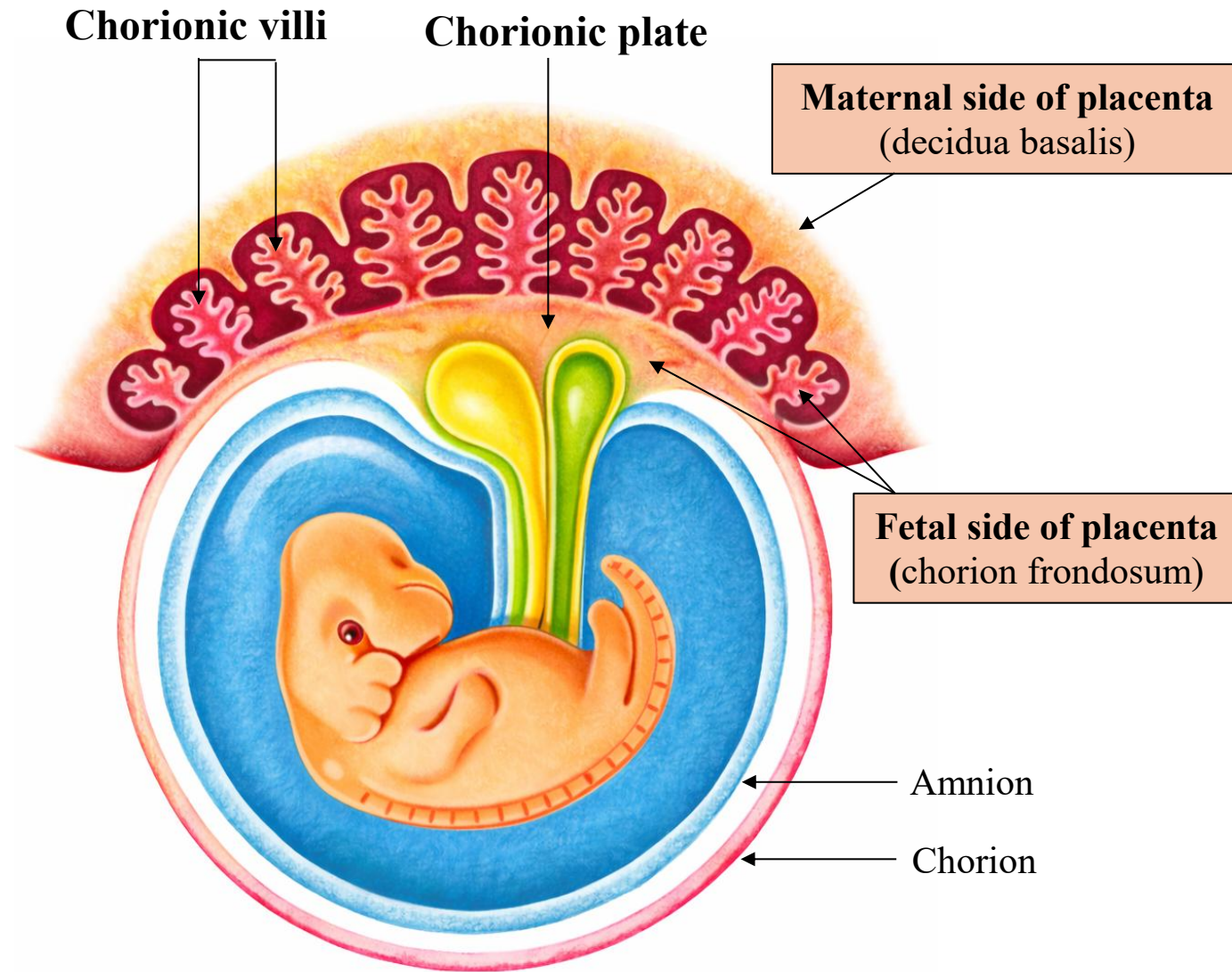
Formed by the chorion frondosum

## Chorionic plate

- ✓ Forms the fetal surface of the placenta
- ✓ Covered by the amnion
- ✓ Contains chorionic (fetal) vessels branching from the umbilical vessels
- ✓ These vessels spread over the plate and enter the villi

## Chorionic villi

- ✓ Finger-like projections extending from the chorionic plate into the intervillous space
- ✓ Types:
  - Anchoring (stem) villi: attach the chorionic plate to the decidua basalis
  - Free (floating) villi: specialized for exchange



### Anchoring villi (stem villi)

Are chorionic villi that extend from the chorionic plate to the decidua basalis. They form cytotrophoblastic columns that penetrate and attach firmly to the maternal decidua, forming the trophoblastic shell.

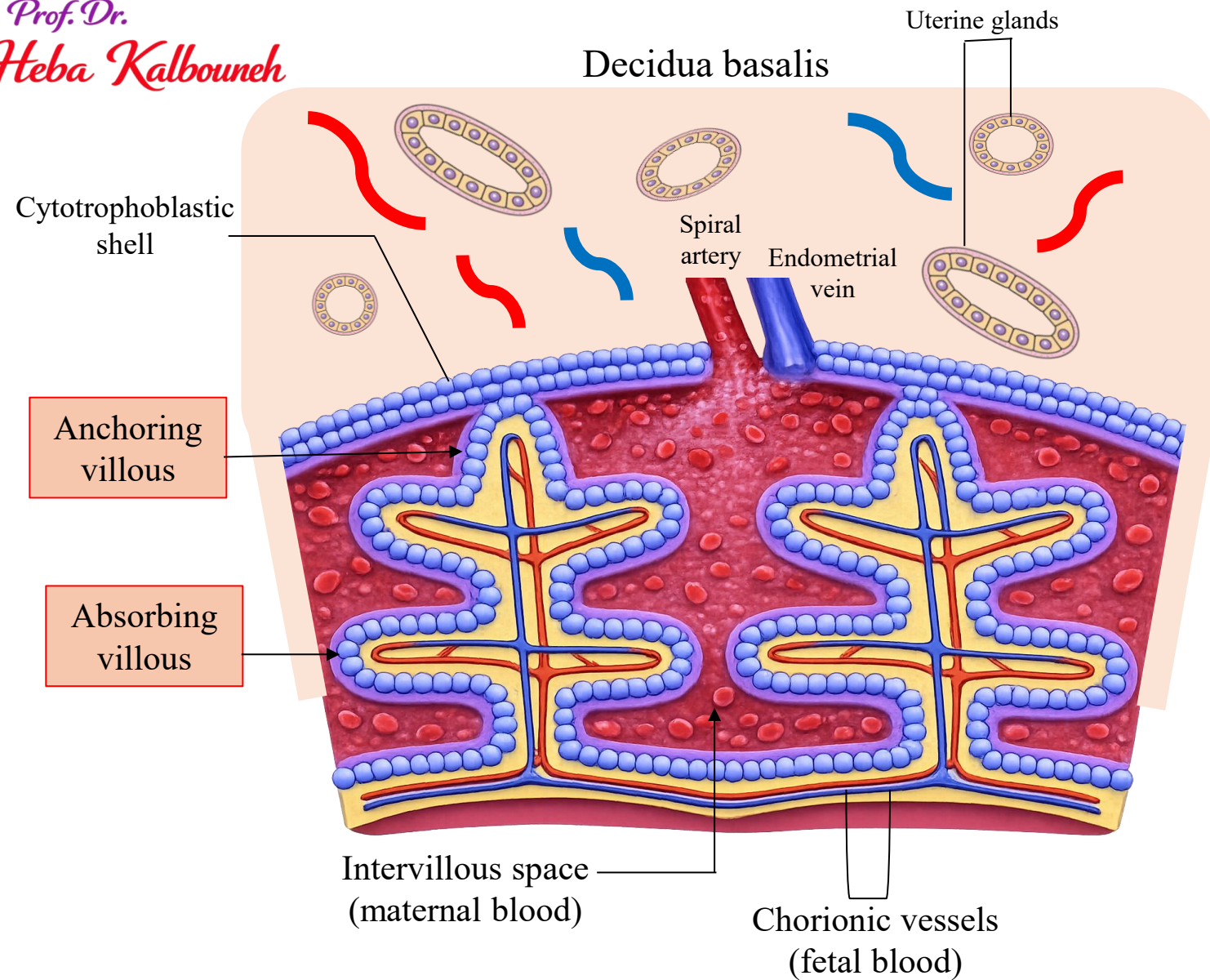
Function: mechanical attachment and stabilization of the placenta to the uterine wall and support for the villous tree.

### Absorbing villi (floating villi)

Are chorionic villi that do not reach the decidua and instead project freely into the intervillous space, bathed in maternal blood. They contain fetal capillaries and form the major component of the placental membrane.

Function: exchange of gases, nutrients, and waste products between maternal and fetal blood.

Cytotrophoblastic shell: A continuous layer of cytotrophoblast cells derived from anchoring chorionic villi that spreads over the surface of the chorion frondosum and anchors the fetal placenta to the decidua basalis.

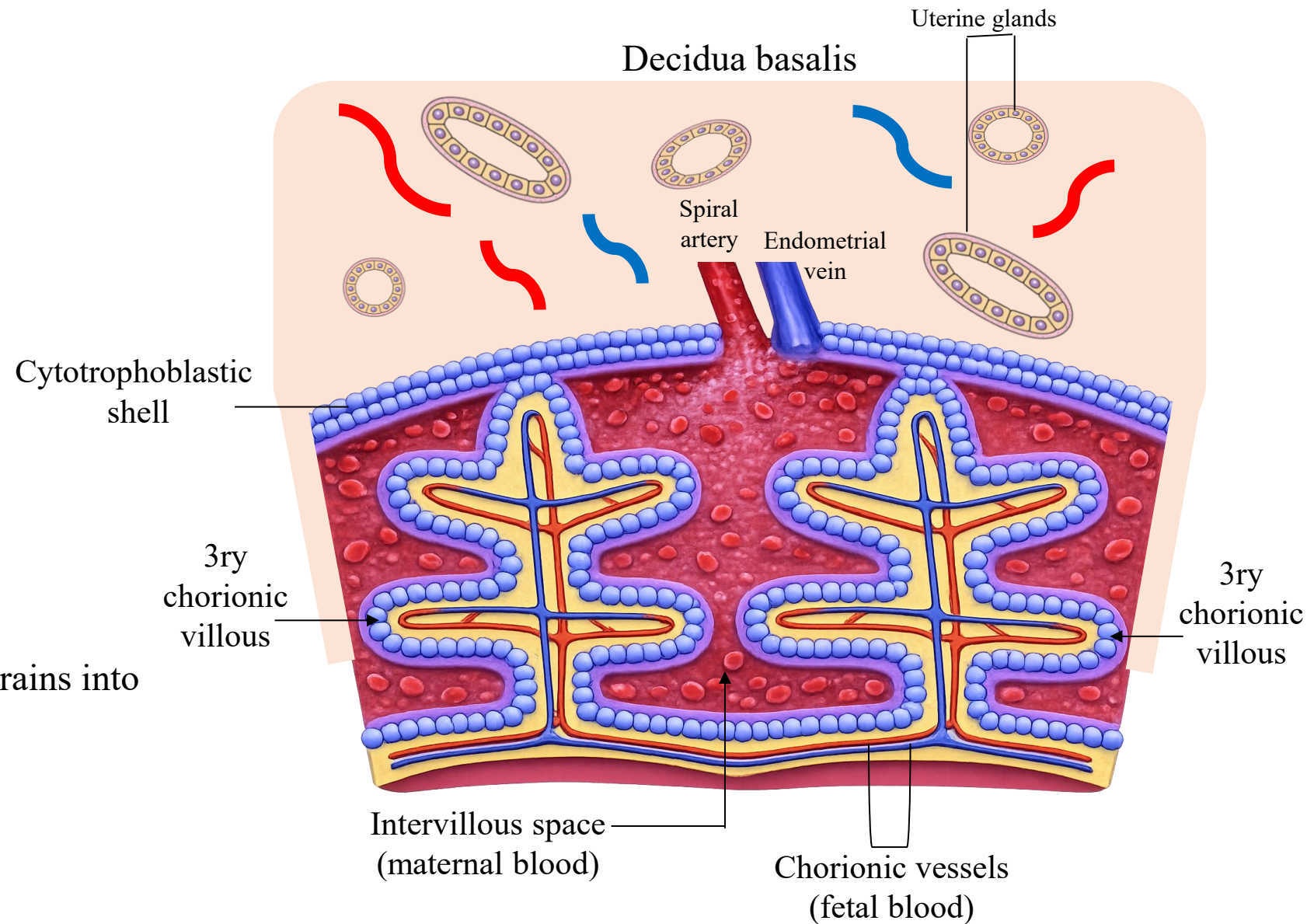


Anchoring villi = attachment and support  
Floating villi = exchange and absorption



## Intervillous space

- ✓ Space between chorionic villi
  - ✓ Filled with maternal blood
  - ✓ Blood enters from spiral arteries and drains into endometrial veins
  - ✓ Site of:
    - Gas exchange
    - Nutrient transfer
    - Waste removal
- ⚠ Maternal and fetal blood do not mix directly.



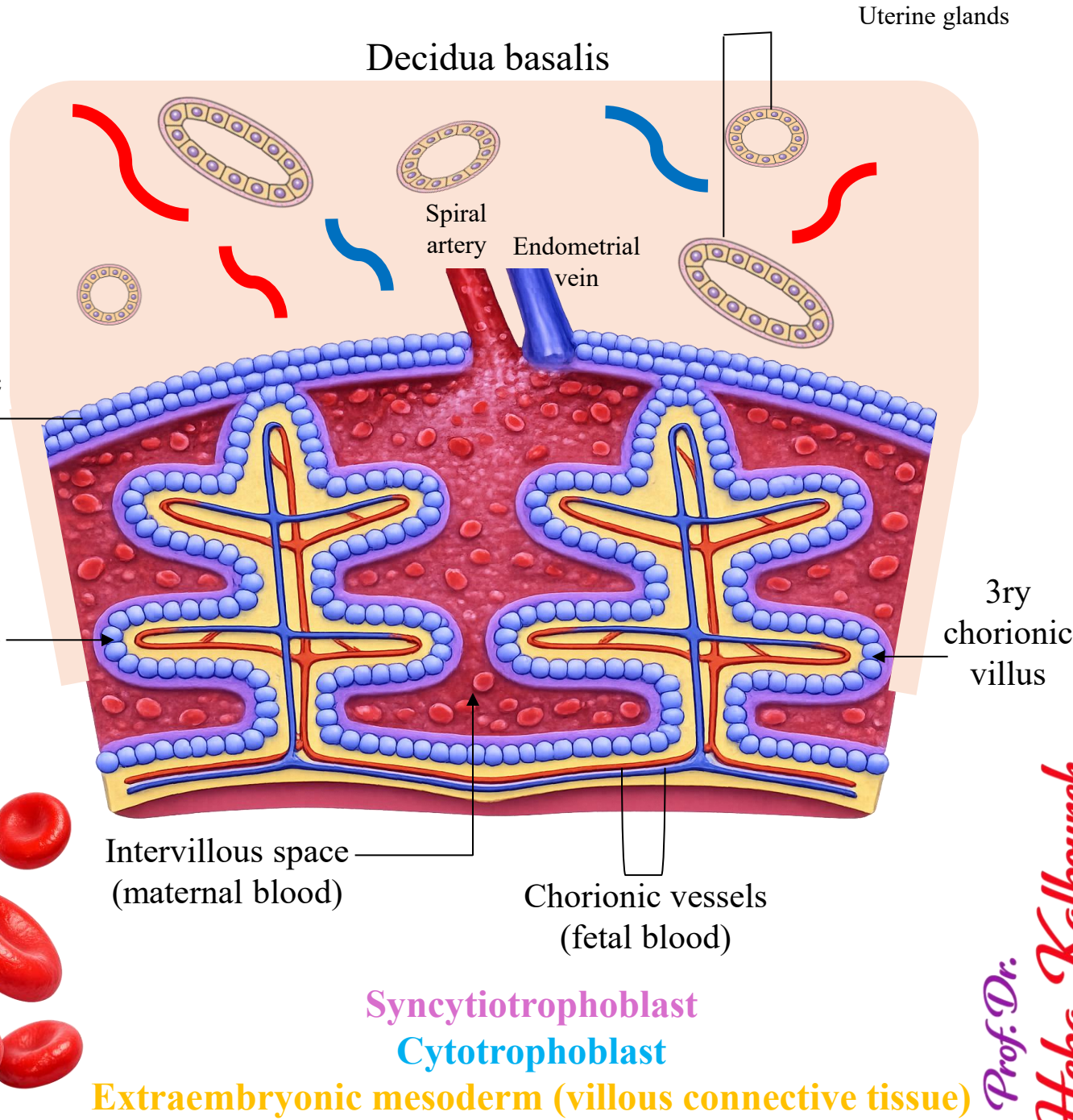
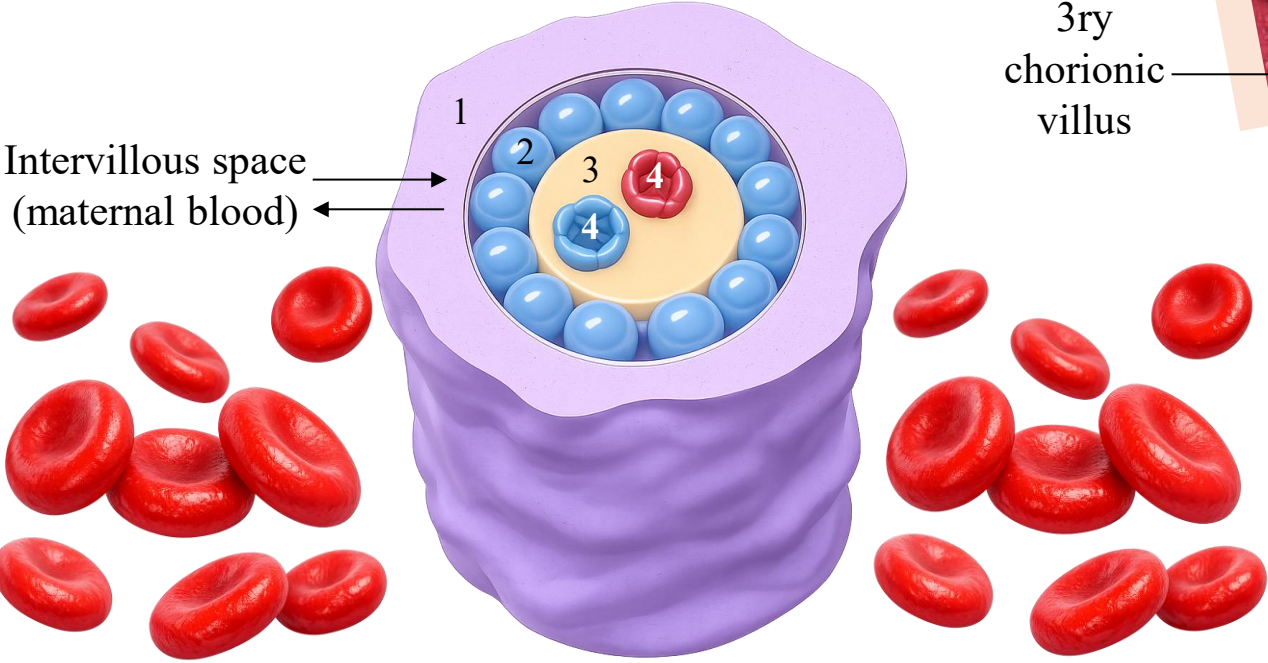
**The placental barrier (placental membrane):**

is the thin cellular layer that separates maternal blood in the intervillous space from fetal blood in the chorionic villi, allowing selective exchange of gases, nutrients, and wastes while preventing direct mixing of the two bloods.

**Early pregnancy**

From maternal → fetal side:

- 1. Syncytiotrophoblast
- 2. Cytotrophoblast
- 3. Villous connective tissue (extraembryonic mesoderm)
- 4. Endothelium of villous capillary (fetal)



Syncytiotrophoblast  
 Cytotrophoblast  
 Extraembryonic mesoderm (villous connective tissue)

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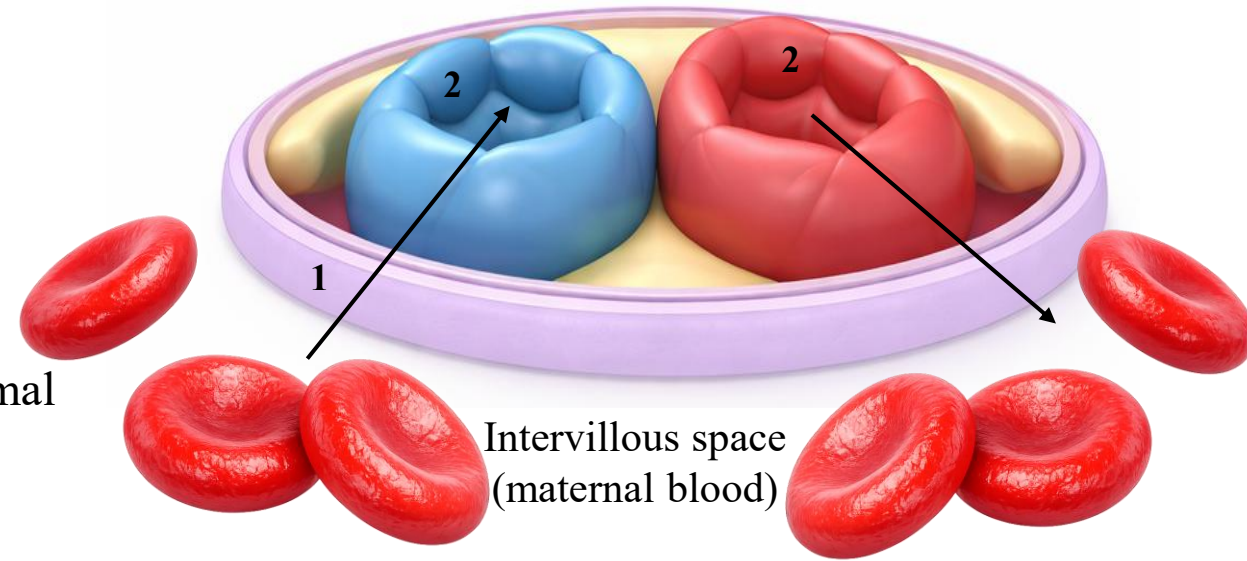
## Late pregnancy

From maternal → fetal side:

1. Syncytiotrophoblast (very thin)
2. Endothelium of villous capillary (fetal)

### Notes:

- ✓ Cytotrophoblast is absent or very sparse
- ✓ Villous connective tissue (extraembryonic mesoderm) is minimal
- ✓ Fetal capillaries lie close to the syncytiotrophoblast
- ✓ Barrier thickness is greatly reduced



✓ Most bacteria are prevented from crossing the placental barrier

⚠ Some viruses can cross the placenta

✗ Not all damaging factors are blocked — some drugs, toxins, alcohol, nicotine, and radiation can cross

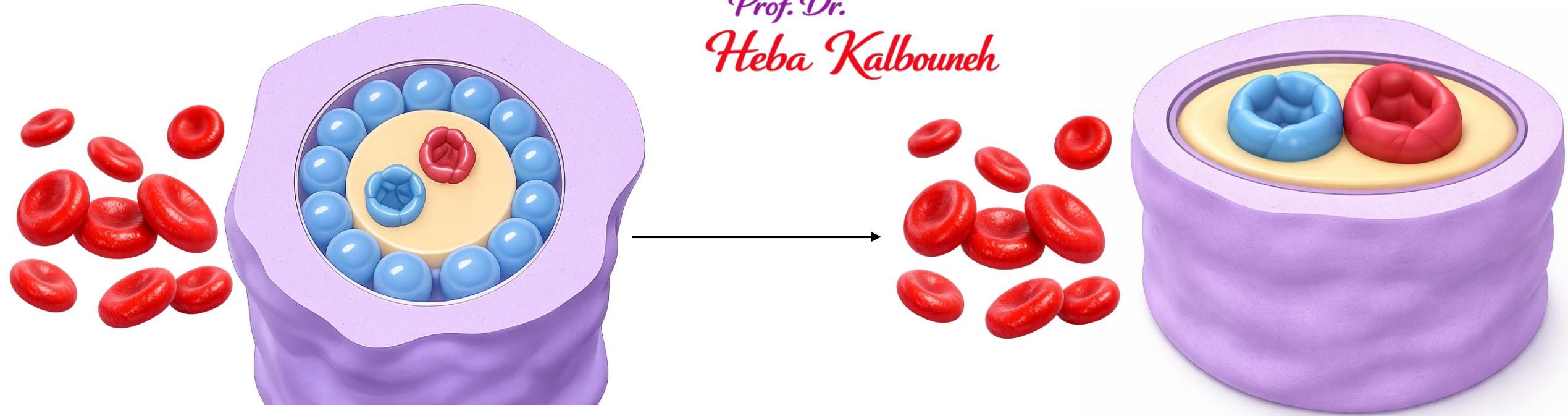
### Examples of things that can cross the placenta:

- ✓ Certain viruses (e.g., rubella virus, cytomegalovirus)
- ✓ Alcohol, nicotine, many drugs
- ✓ Some toxins
- ✓ IgG antibodies (physiological and important)

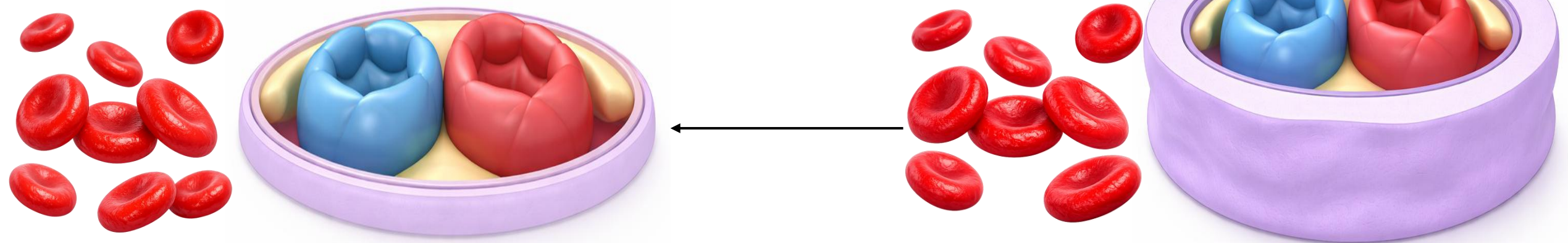
Syncytiotrophoblast  
Cytotrophoblast

Extraembryonic mesoderm (villous connective tissue)

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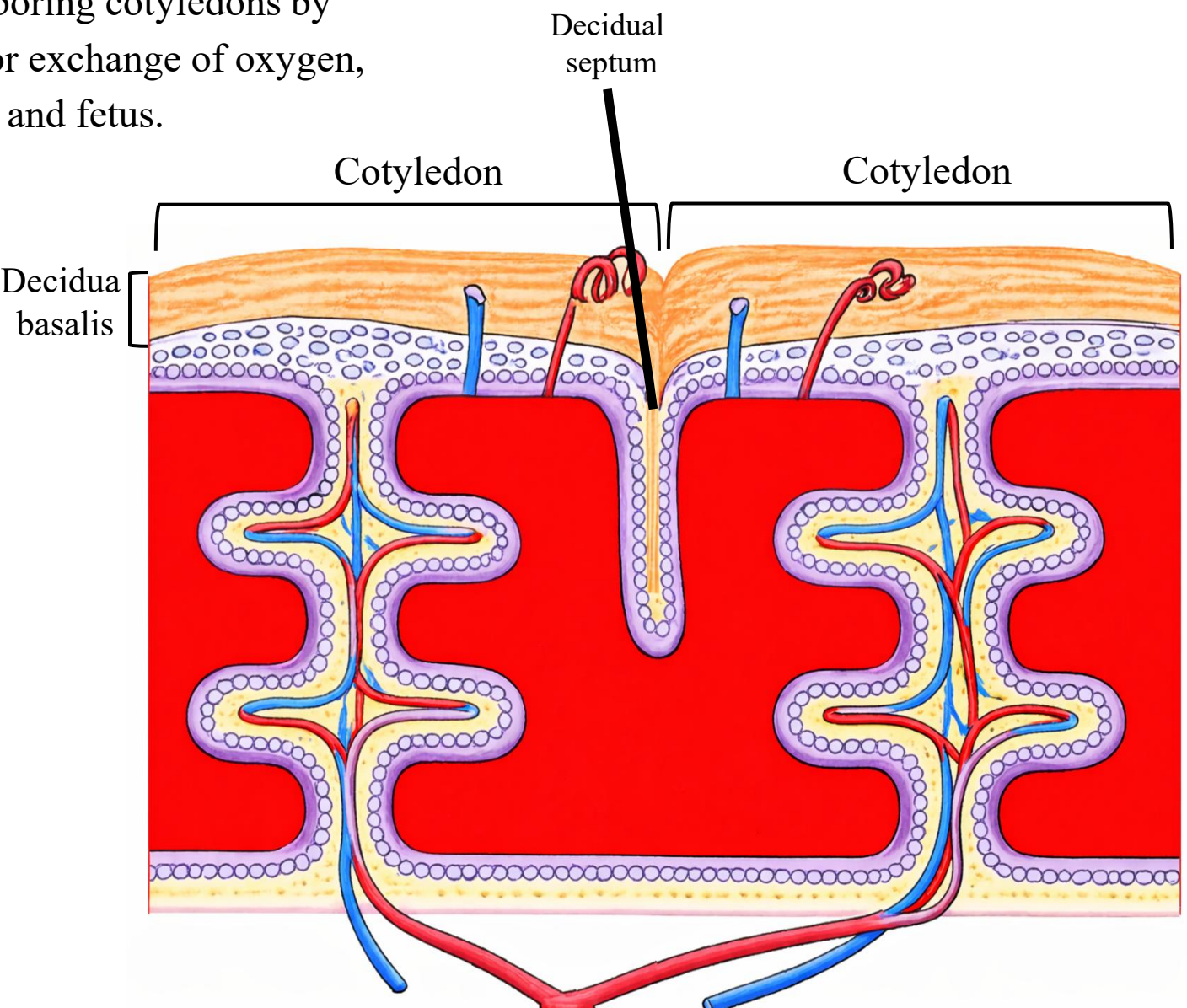
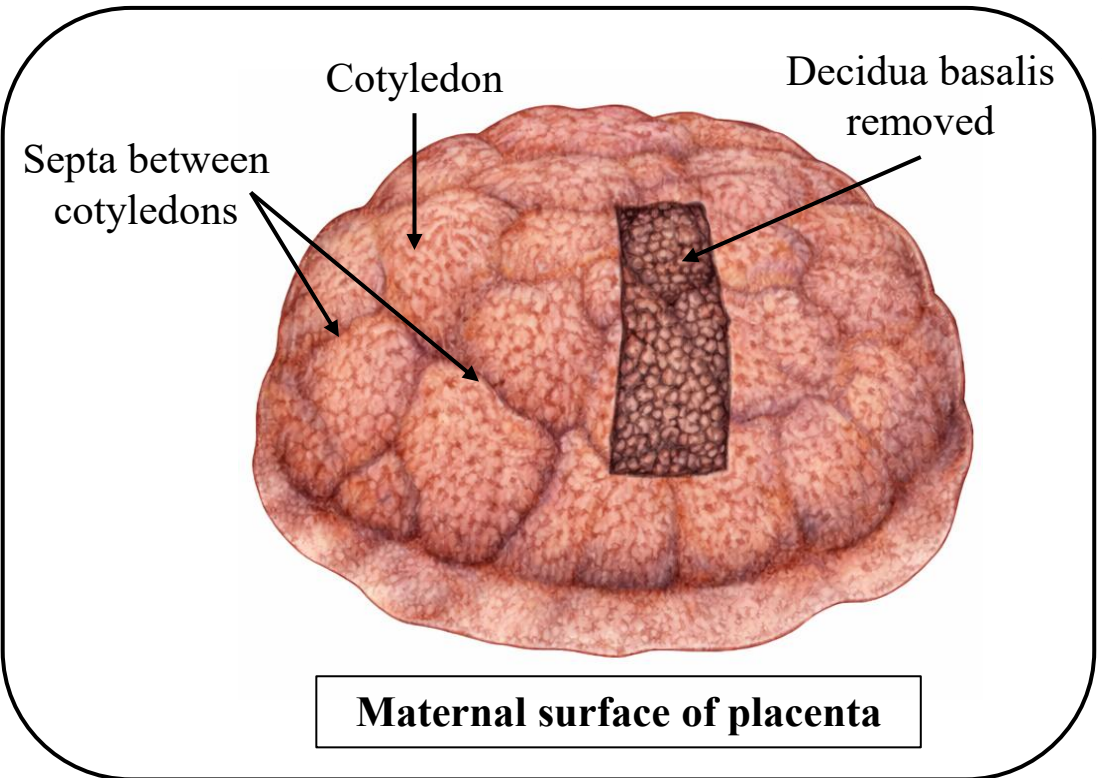


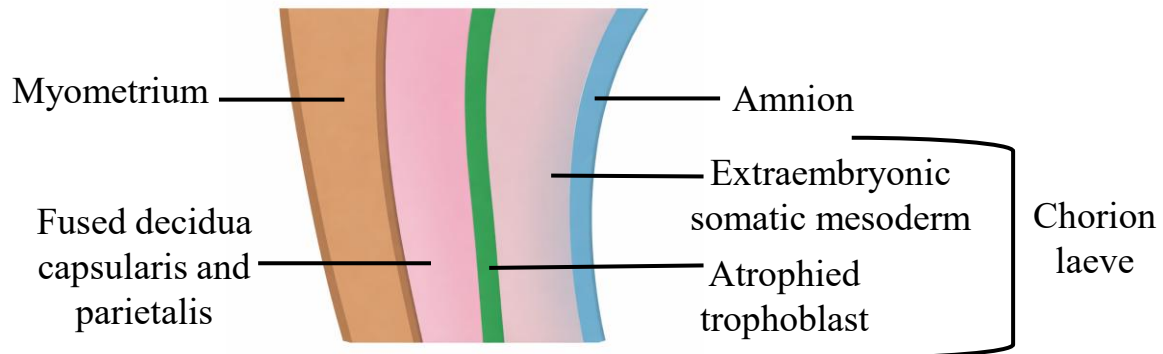
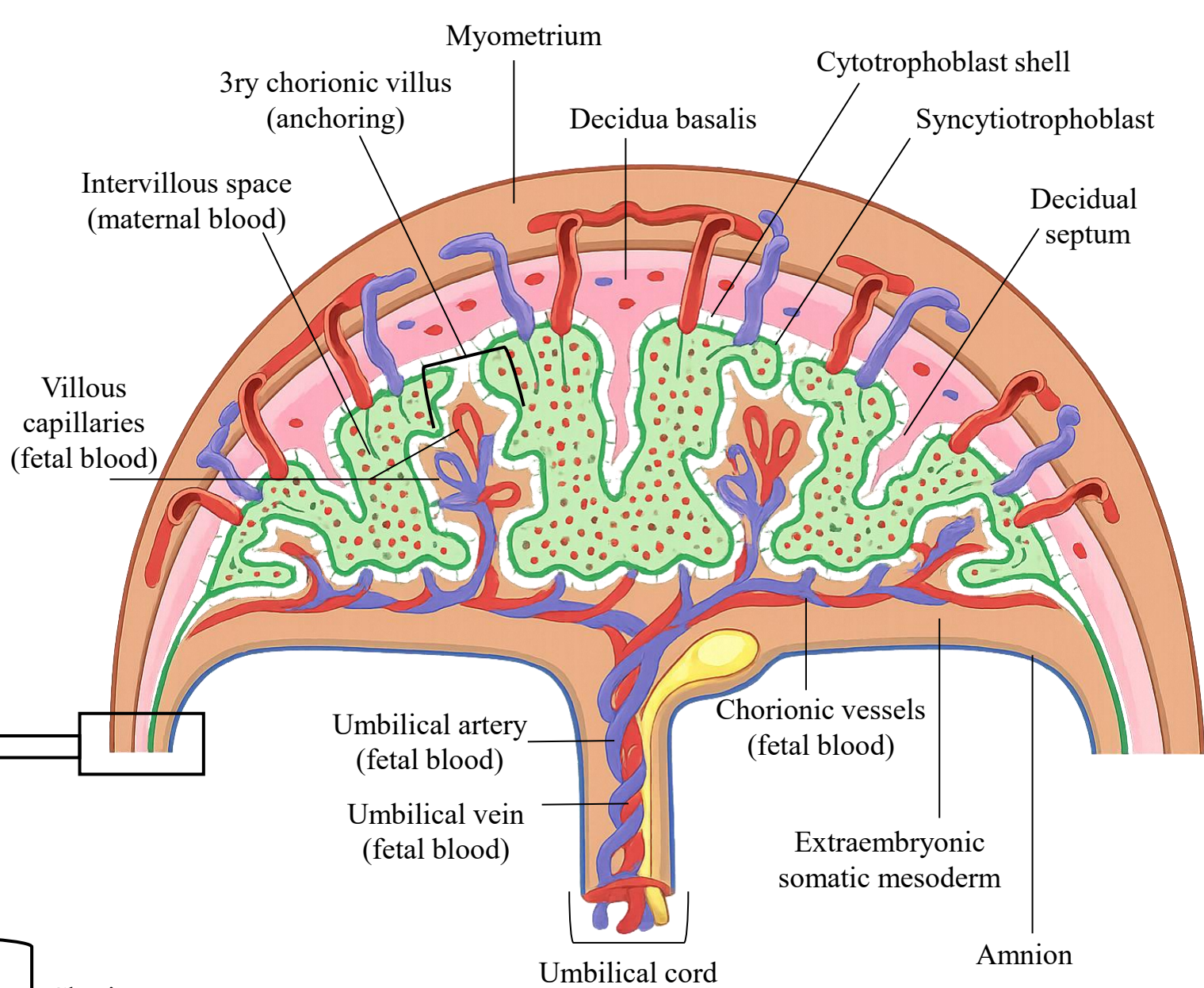
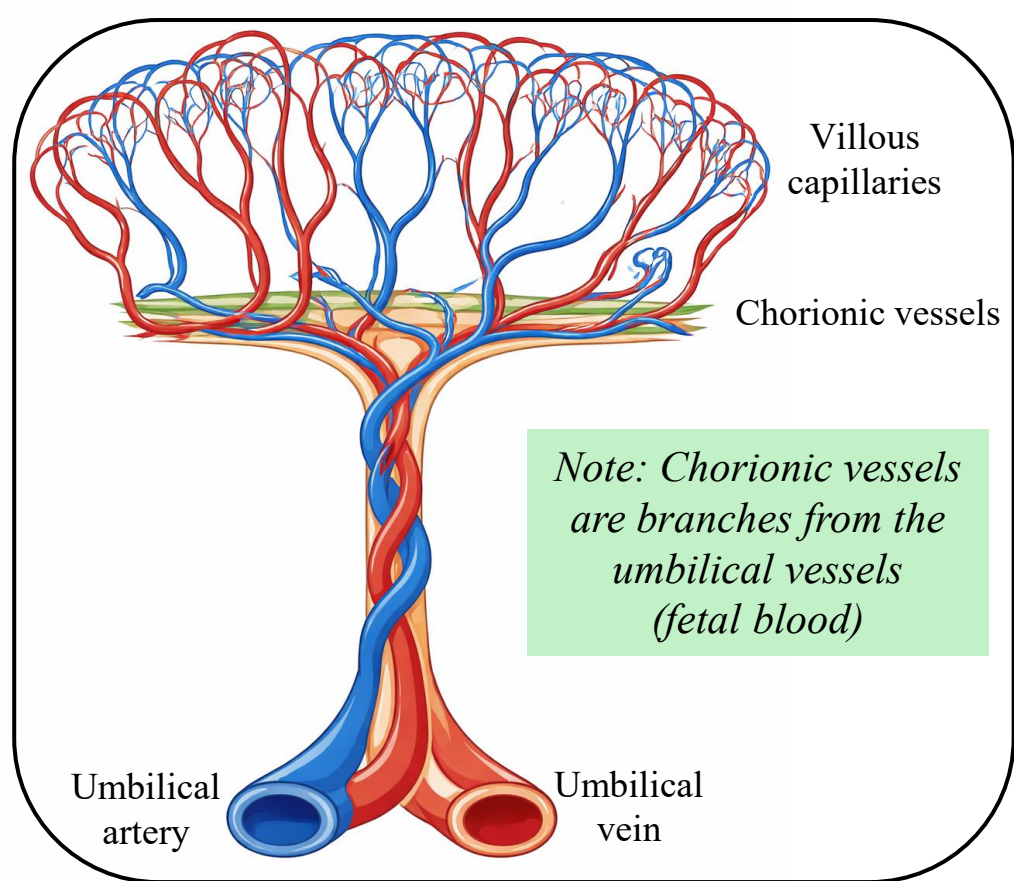
*In late pregnancy, the placental barrier becomes thinner to allow more efficient exchange between maternal and fetal blood. This occurs because the cytotrophoblast largely disappears, the villous connective tissue is reduced, and the syncytiotrophoblast becomes thinner. As a result, fetal capillaries lie very close to the maternal blood in the intervillous space.*



**Placental cotyledons** are small functional units of the placenta seen on its maternal surface.

Each cotyledon consists of one main anchoring villus and its many branching villi, which are separated from neighboring cotyledons by decidual septa and are bathed in maternal blood for exchange of oxygen, nutrients, and wastes between mother and fetus.





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## Placental circulation:

### 1. Maternal part:

Maternal blood flows from the uterine spiral arteries into the intervillous spaces, where the floating chorionic villi are bathed in maternal blood. Exchange of gases, nutrients, and waste products occurs across the placental membrane. Maternal blood then drains from the intervillous space into endometrial veins.

### 2. Fetal part:

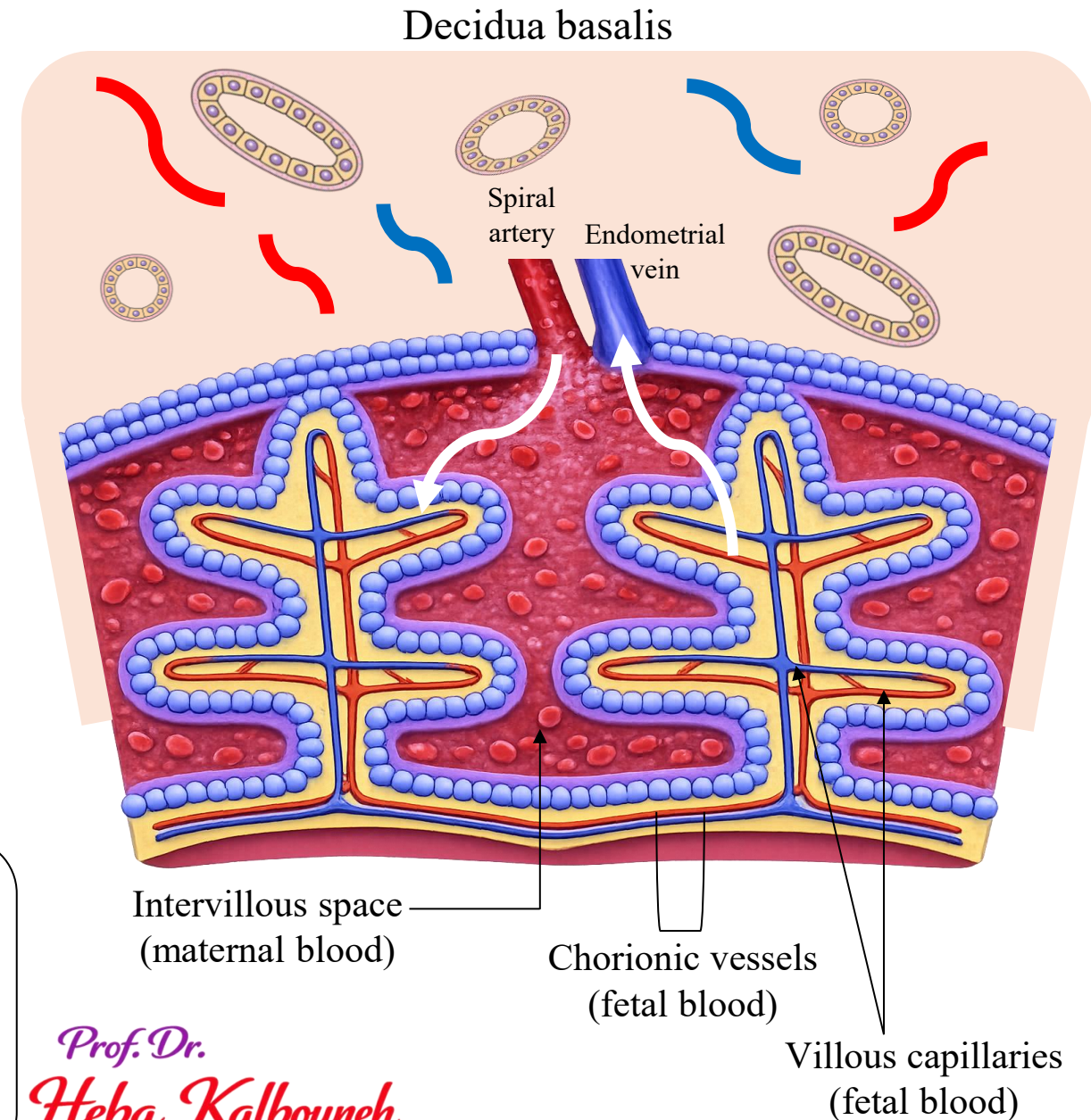
The two umbilical arteries carry deoxygenated blood from the fetus to the placenta, while the umbilical vein carries oxygenated blood and nutrients from the placenta back to the fetus.

*Note: Chorionic vessels are branches from the umbilical vessels (fetal blood)*

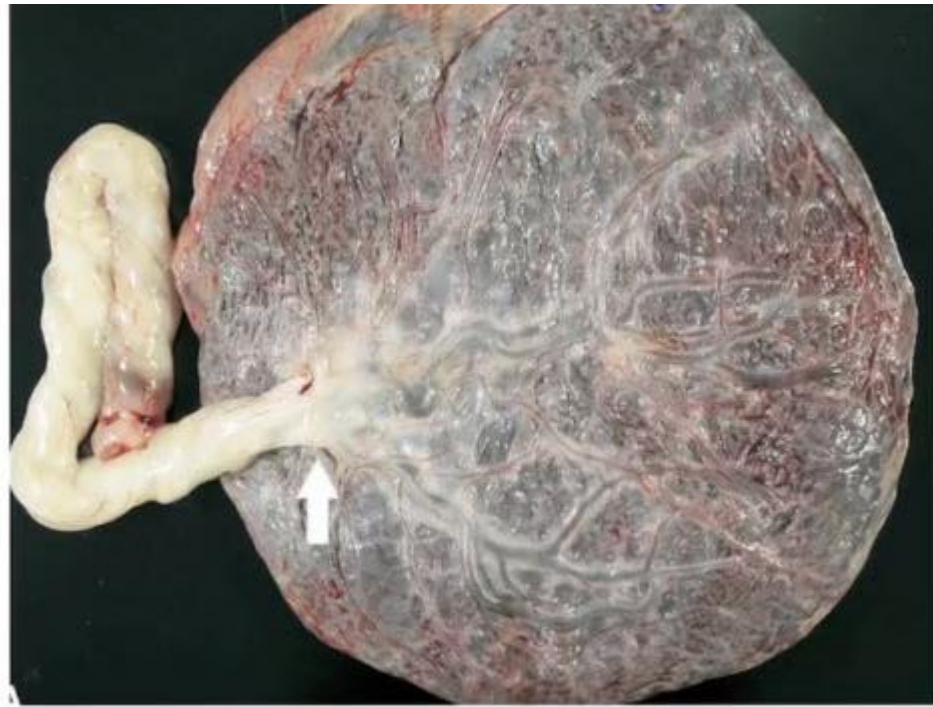
**2 Umbilical arteries** → **chorionic arteries** → **villous capillary network** → **chorionic veins** → **1 umbilical vein**



This accurately represents fetal placental circulation from the fetus to the placenta and back.



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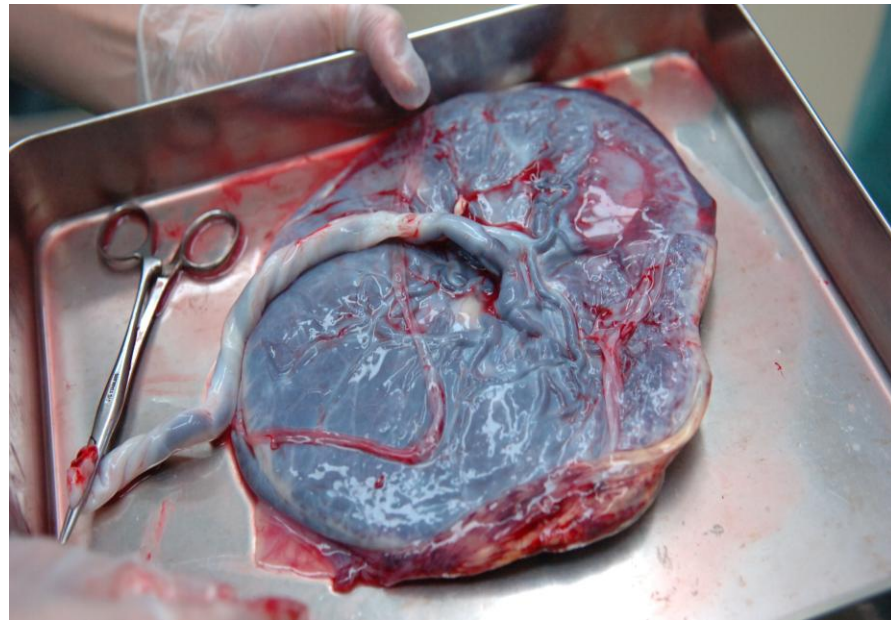
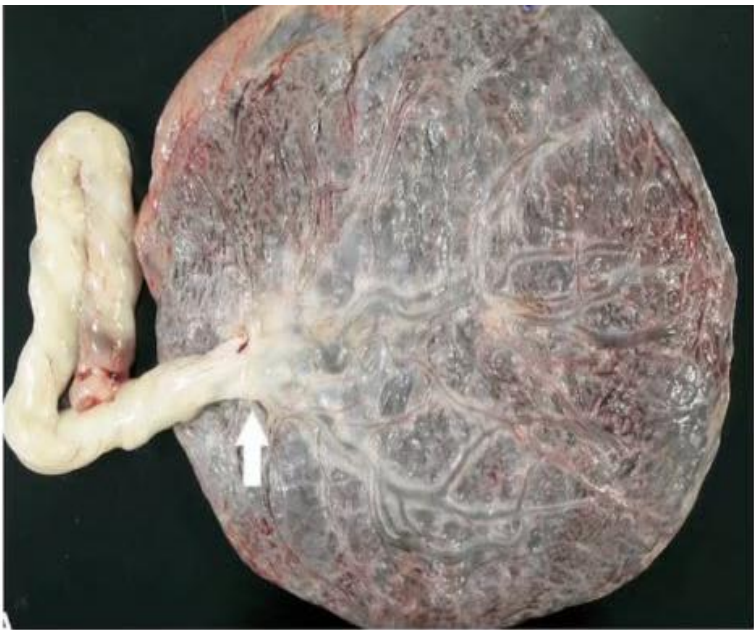
**Fetal surface of placenta**

Fetal surface is covered with amnion and fetal blood vessels (chorionic vessels). Umbilical cord is attached near the center of this surface.

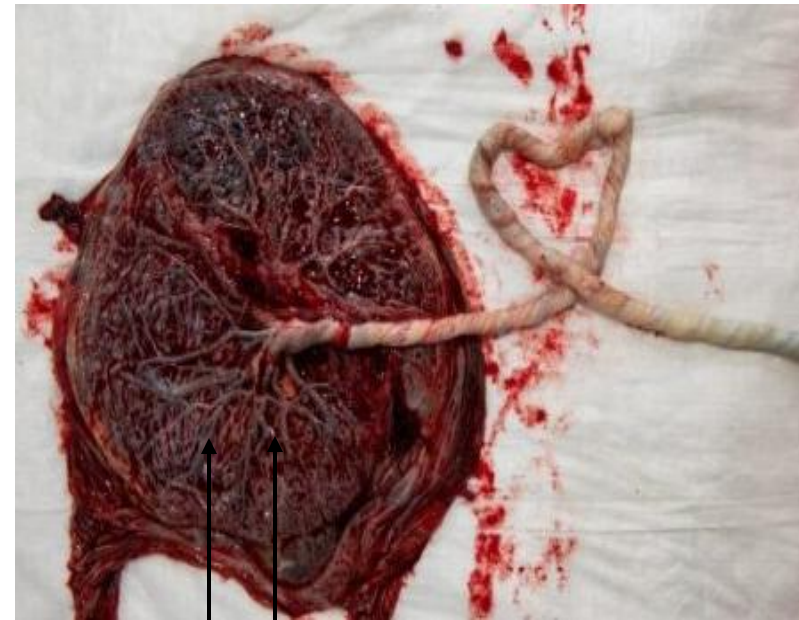


**Maternal surface of placenta**

Maternal surface shows 15 – 20 rounded elevations (cotyledons) with septa in between.



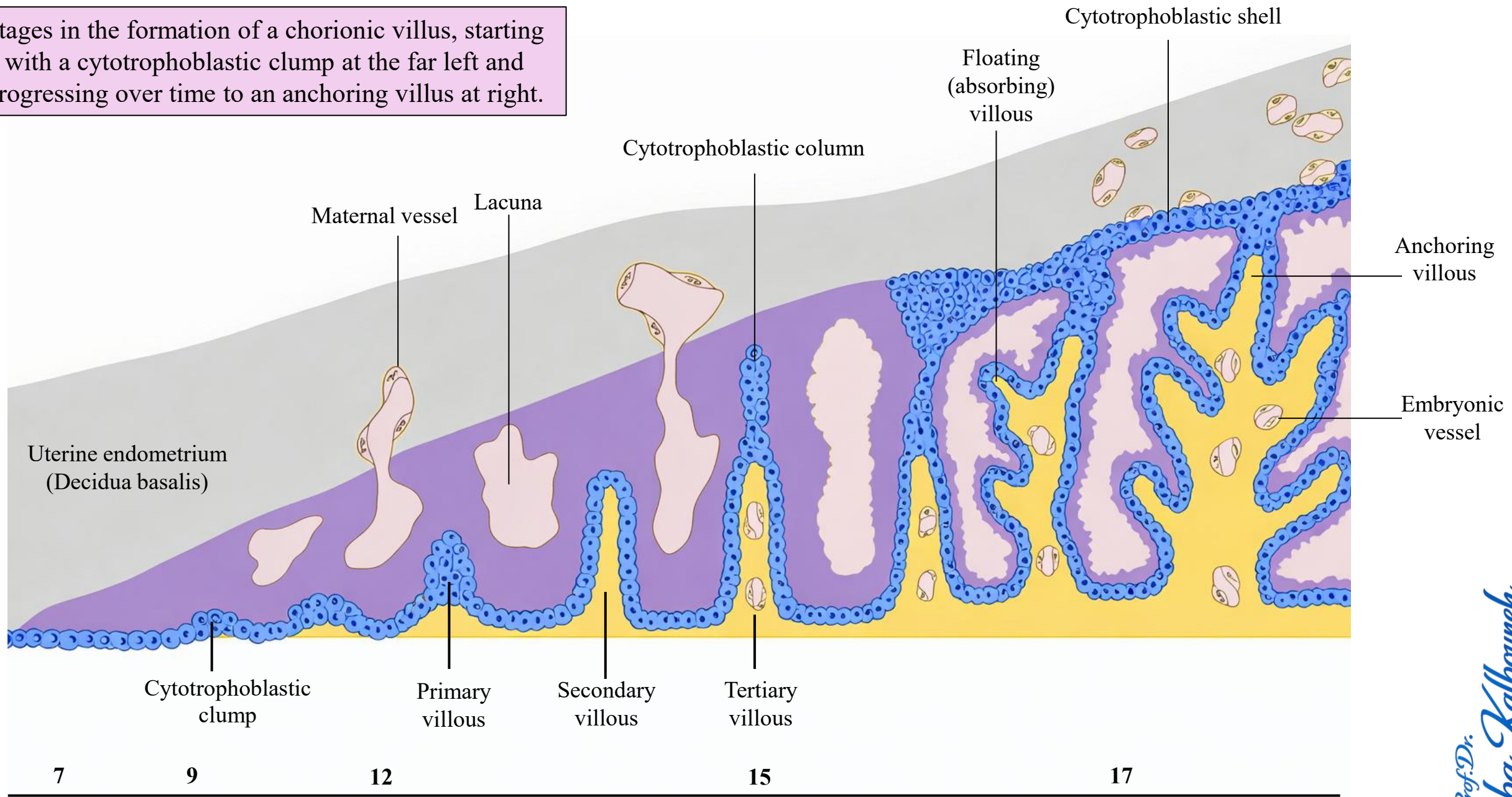
**Fetal surface of placenta**



Chorionic vessels

Fetal surface is covered with amnion and fetal blood vessels (chorionic vessels).  
Umbilical cord is attached near the center of this surface.

Stages in the formation of a chorionic villus, starting with a cytotrophoblastic clump at the far left and progressing over time to an anchoring villus at right.



Days

7

9

12

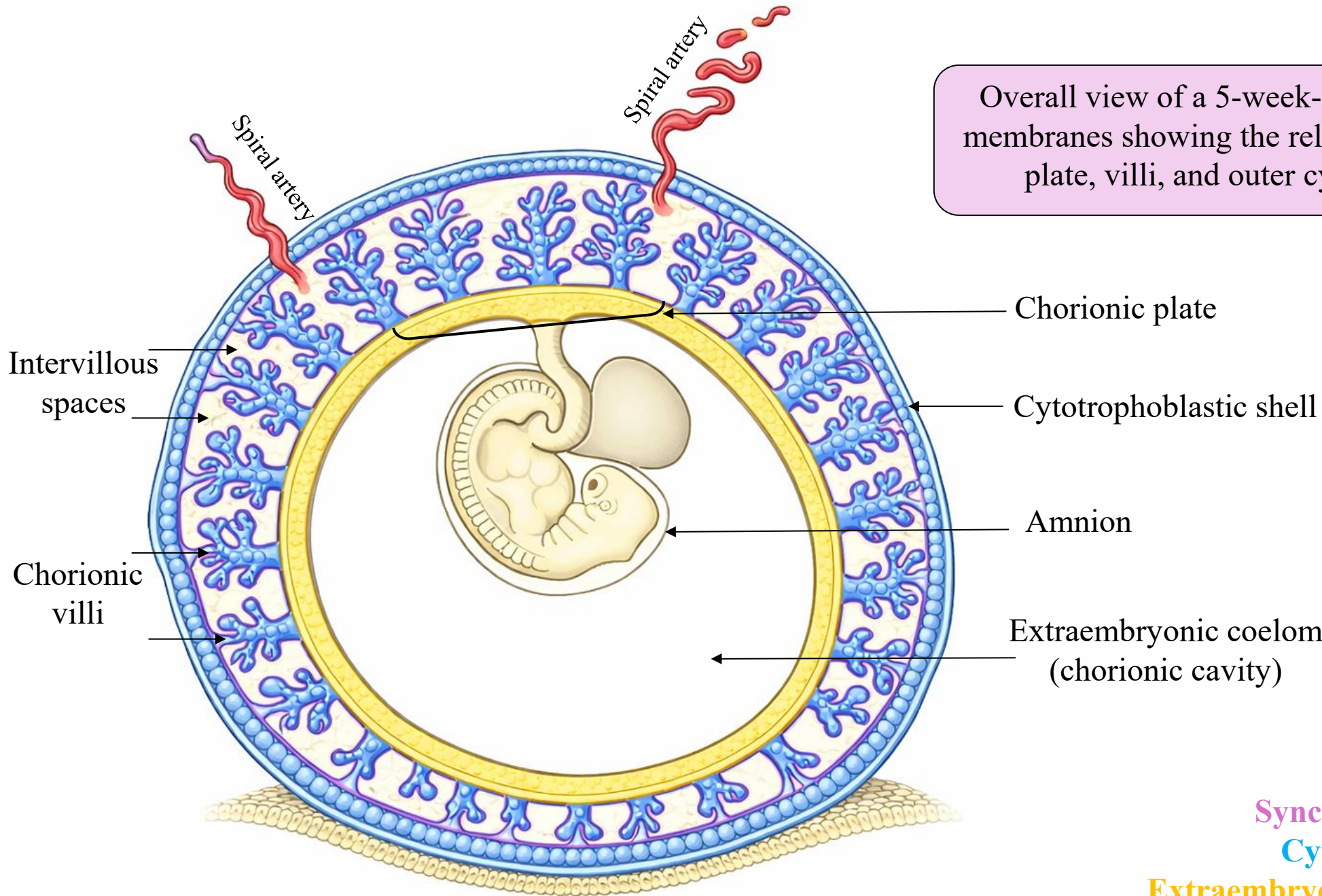
15

17

Implantation begins

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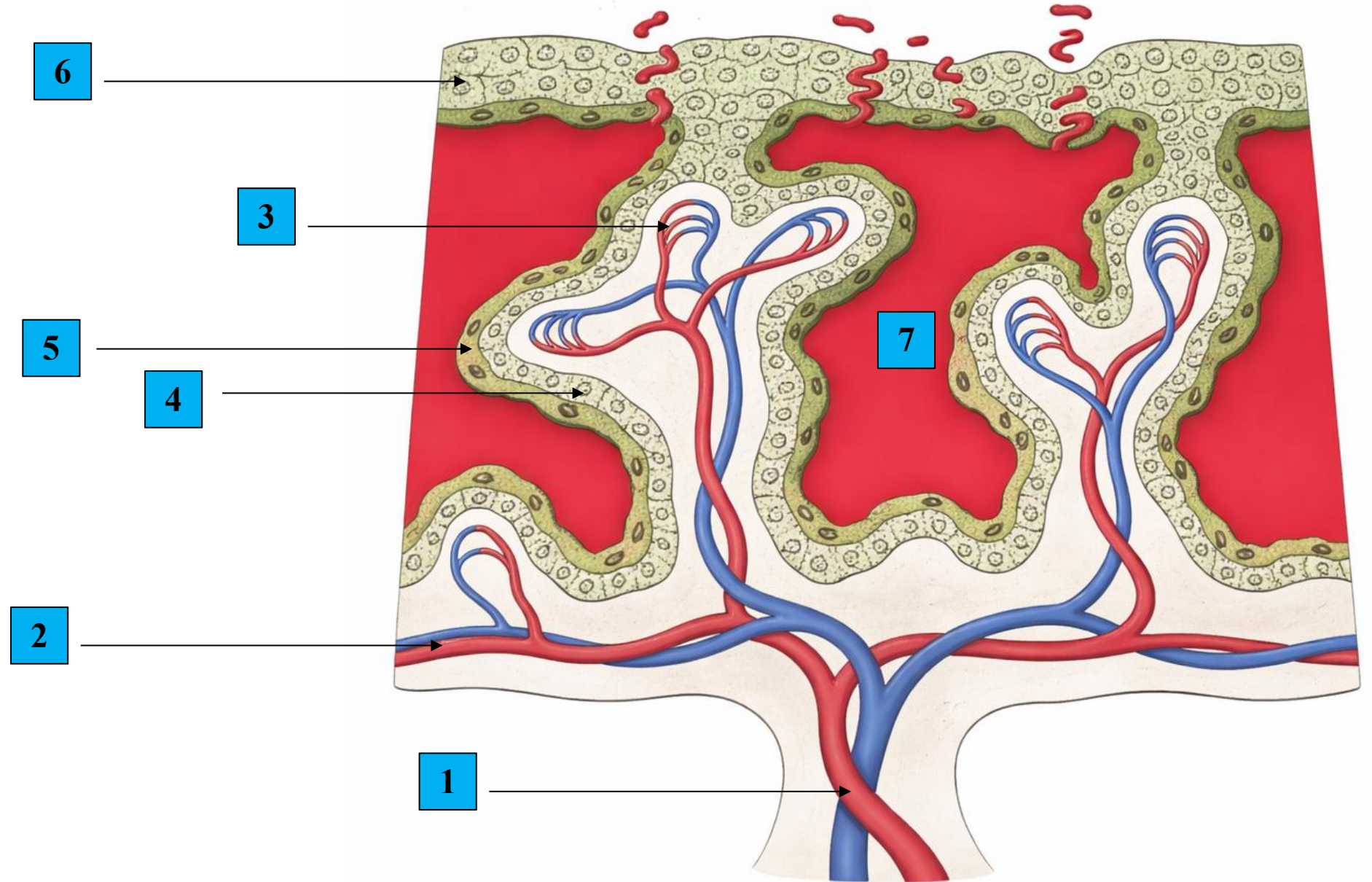
Overall view of a 5-week-old embryo in addition to membranes showing the relationships of the chorionic plate, villi, and outer cytotrophoblastic shell.

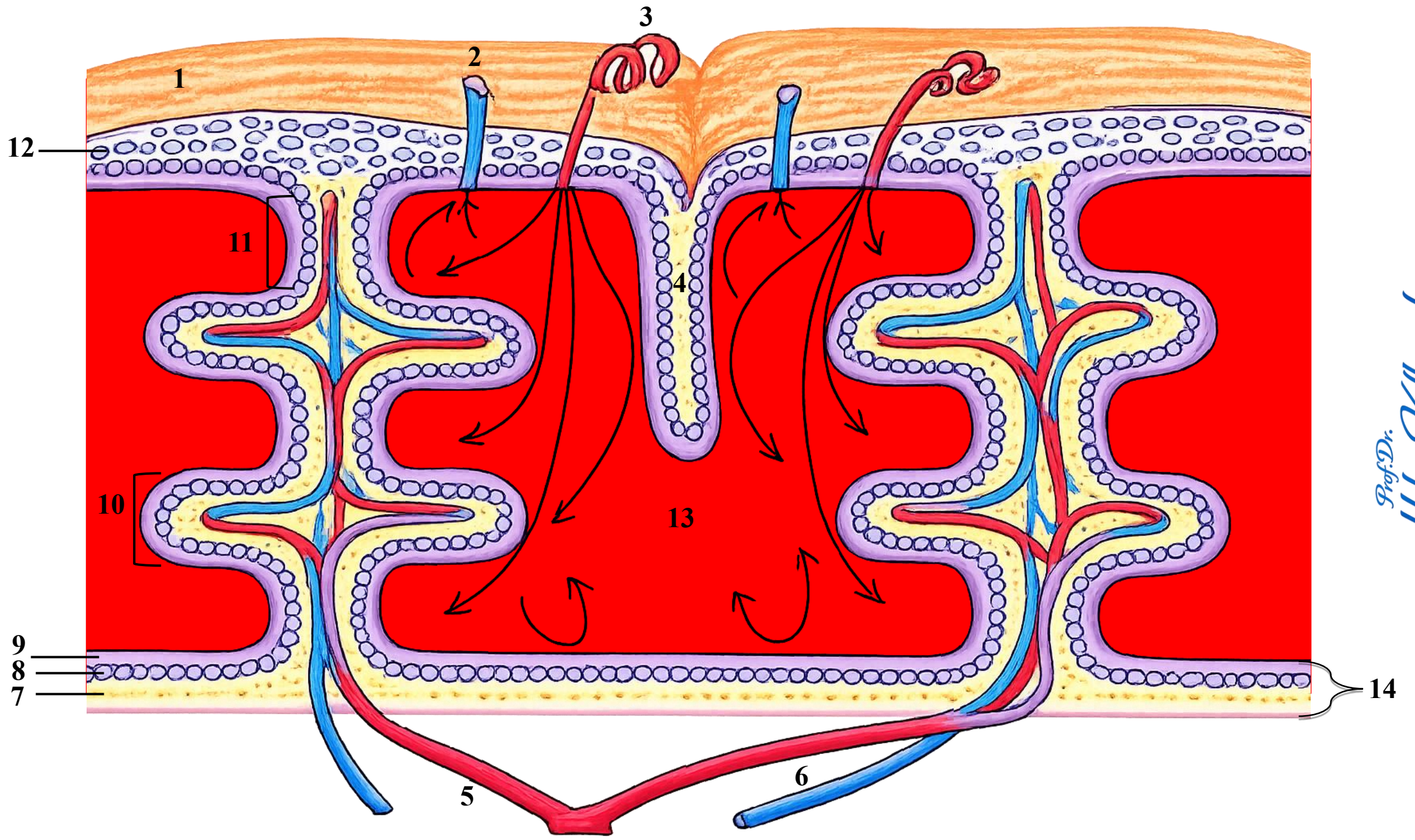


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Syncytiotrophoblast  
Cytotrophoblast  
Extraembryonic somatic mesoderm

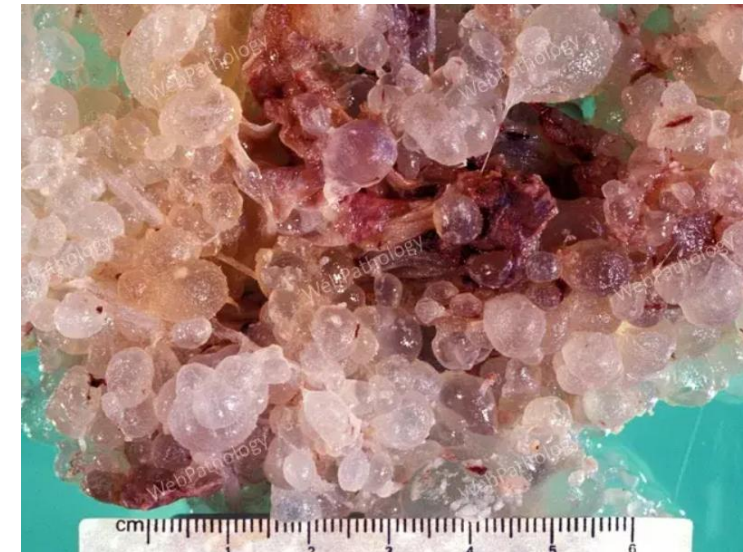
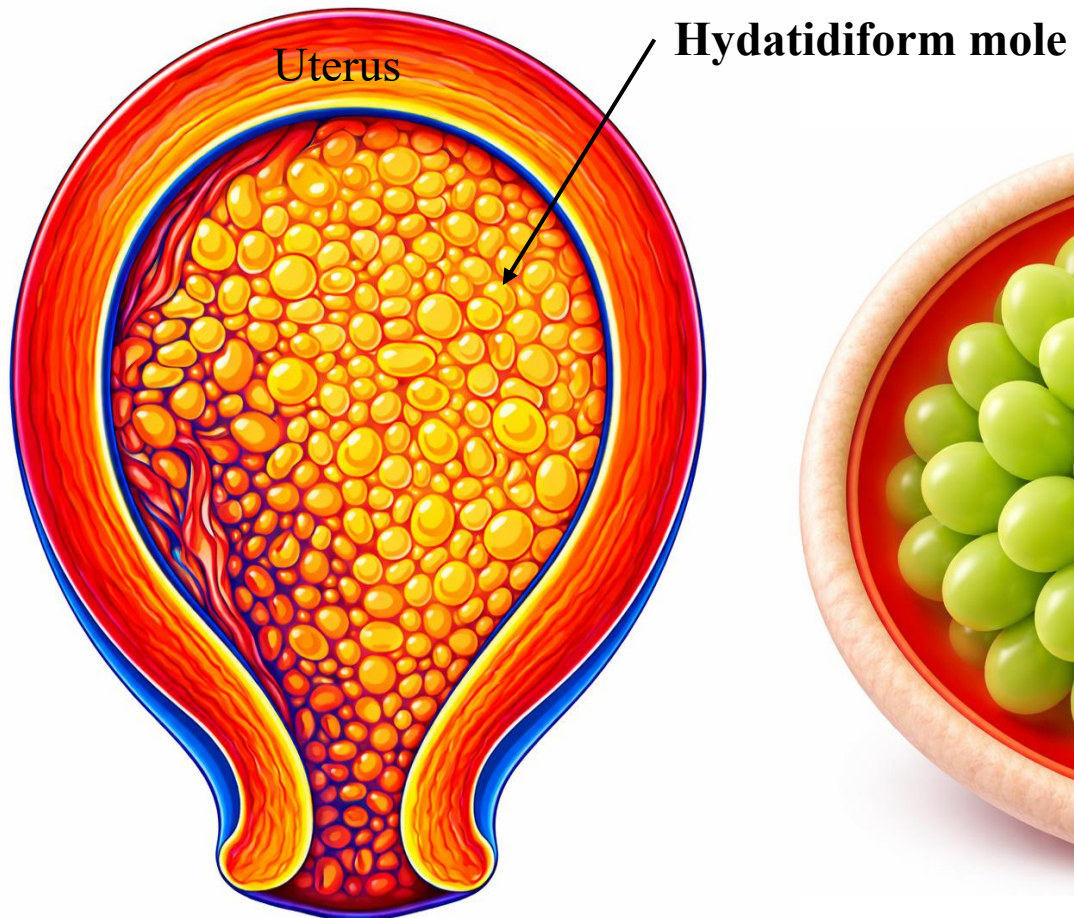
# Identify





# Abnormalities of Chorion

- 1- **Hydatidiform mole:** the trophoblasts develop and form placental membranes but little or no embryonic tissue is present (↑↑↑ hCG)
- 2- **Choriocarcinoma:** a highly malignant tumor develops on top of hydatidiform mole.



## Abnormalities of Chorion

### 3- Excessive trophoblastic invasion:

Excessive invasion of the uterine wall by trophoblasts may result in an abnormally adherent placenta, known as **placenta accreta spectrum**.

*In these abnormalities, the placenta fails to separate normally from the uterus after delivery of the fetus, which may lead to severe postpartum hemorrhage.*

