

EMBRYOLOGY

CHAPTER 4

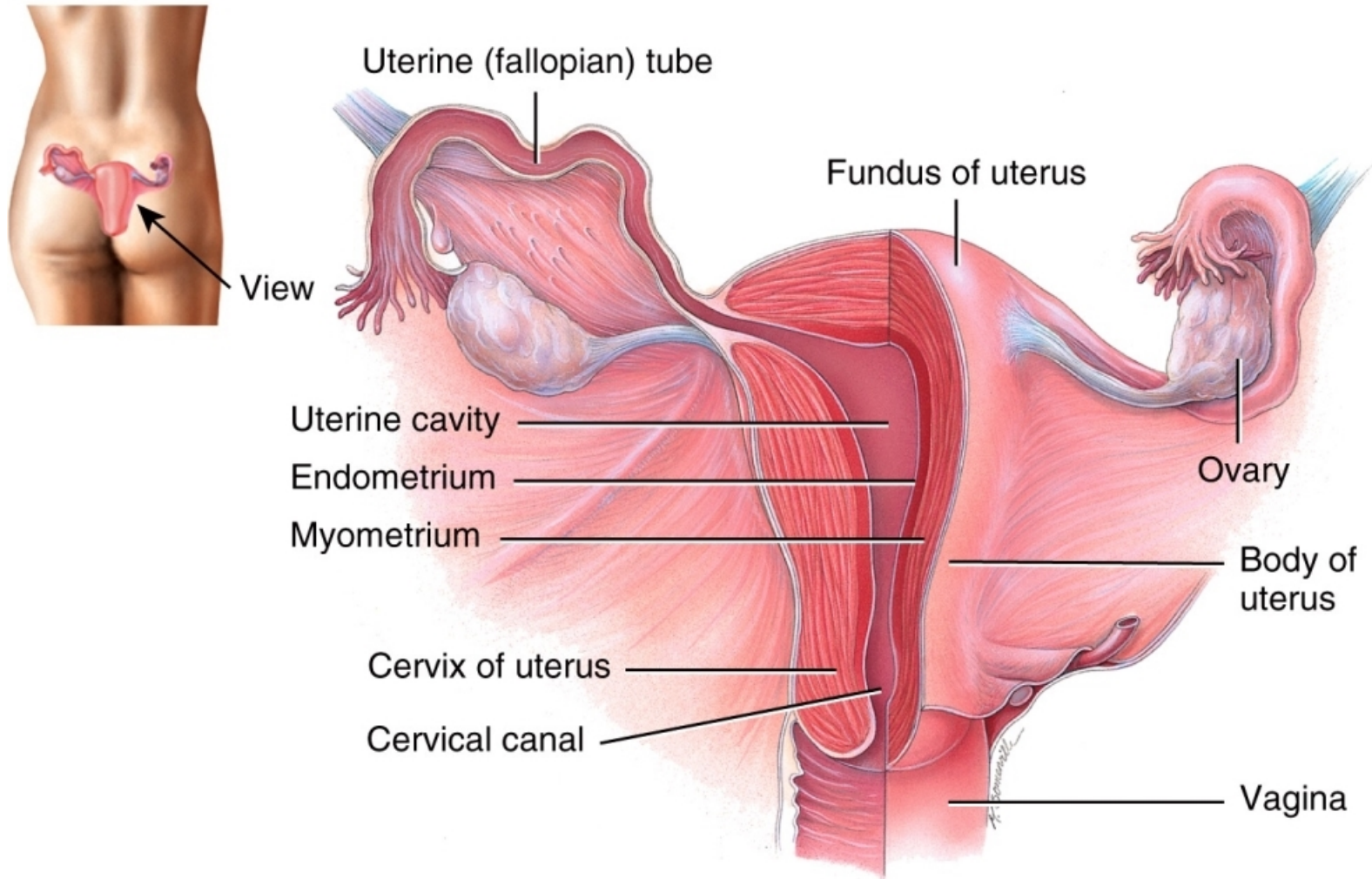
Development



Introduction

- Sexual Reproduction
- Male and Female Gametes
- Pregnancy
- Developmental Biology
- Embryology

Uterus and Associated Structures



Posterior view

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Embryology

- Embryo
- Fetal Period
- Fetus
- Prenatal Development

Trimesters

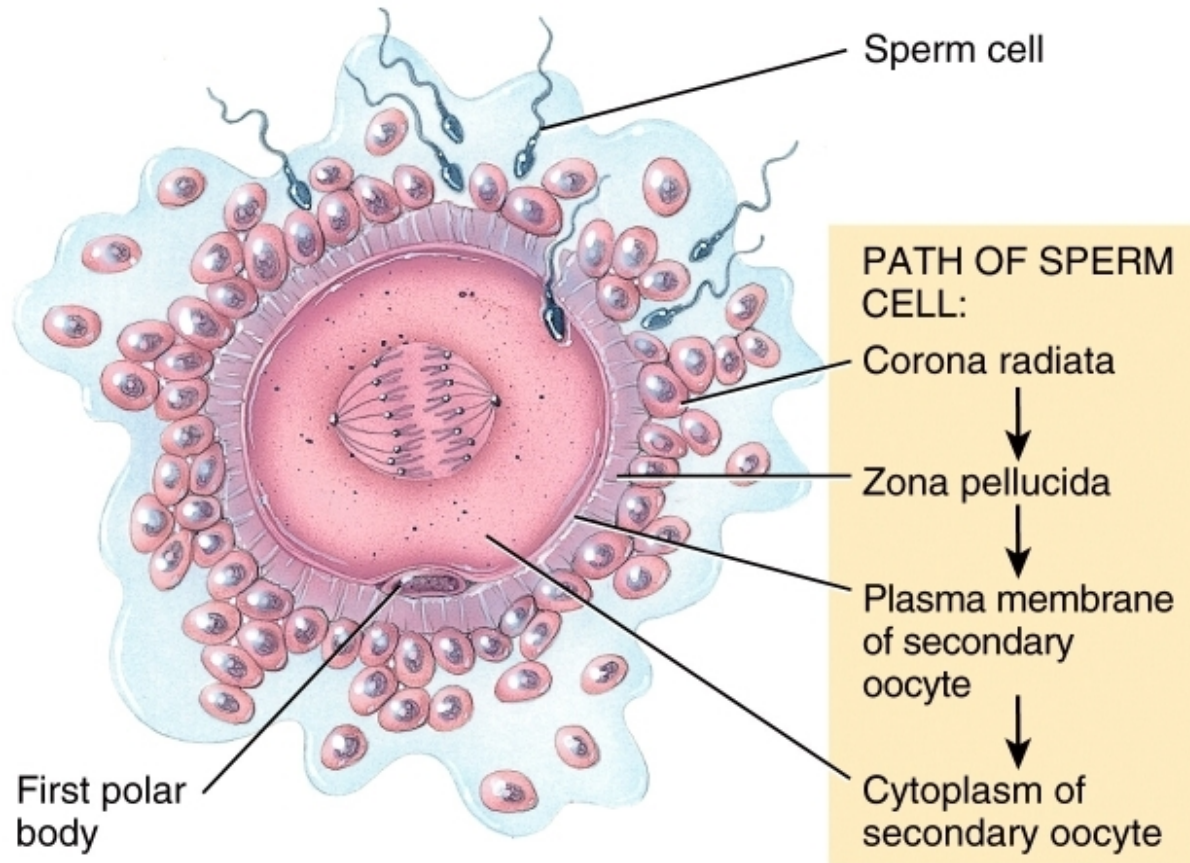
- First trimester
- Second trimester
- Third trimester

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Embryonic Period

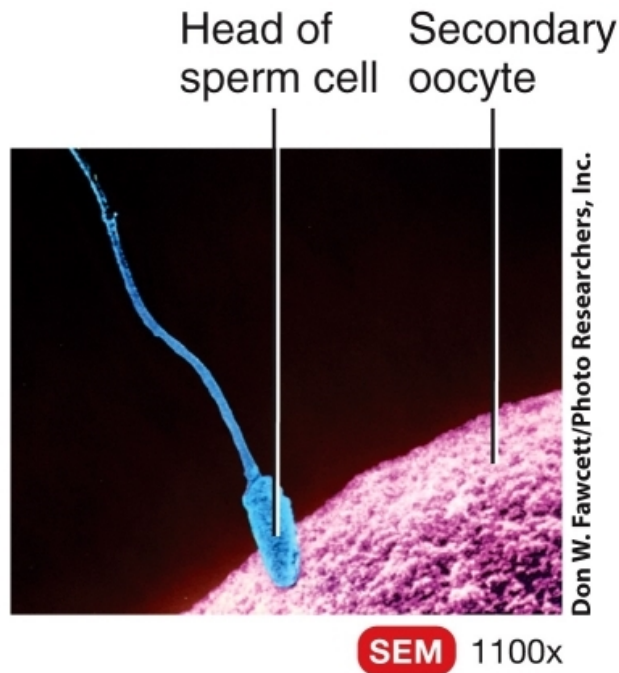
- Fertilization
- Normally occurs in the uterine (fallopian) tube about 12 to 24 hours after ovulation
- Sperm swim (due to the actions of their tails) from the vagina into the cervical canal
- Capacitation

Selected Structures and Events in Fertilization

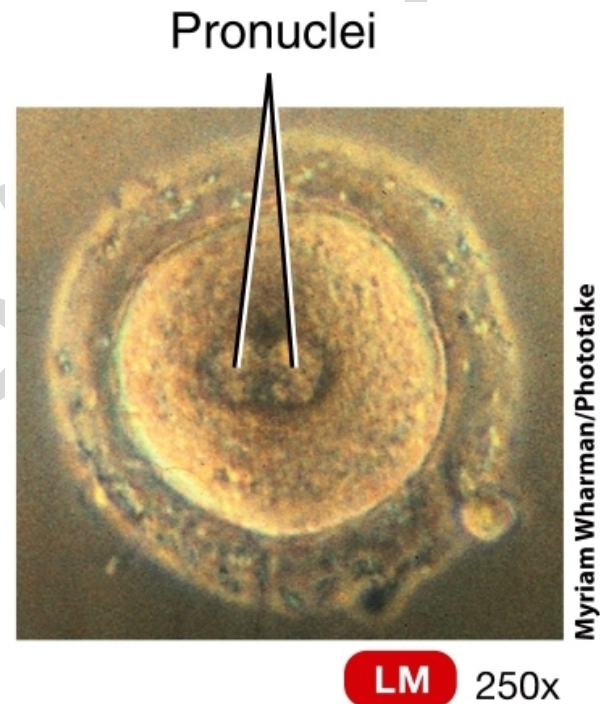


(a) Sperm cell penetrating a secondary oocyte

Selected Structures and Events in Fertilization



(b) Sperm cell in contact with a secondary oocyte



(c) Male and female pronuclei

Fertilization

- Zona pellucida receptor molecules trigger the acrosomal reaction
- Corona radiata and the zona pellucida
- Syngamy
- Polyspermy

Fertilization

- Meiosis II
- Male pronucleus
- Female pronucleus
- Zygote

Fertilization

- Dizygotic (fraternal) twins
- Monozygotic (identical) twins
- Conjoined twins

Clinical Connection

- Ectopic pregnancy

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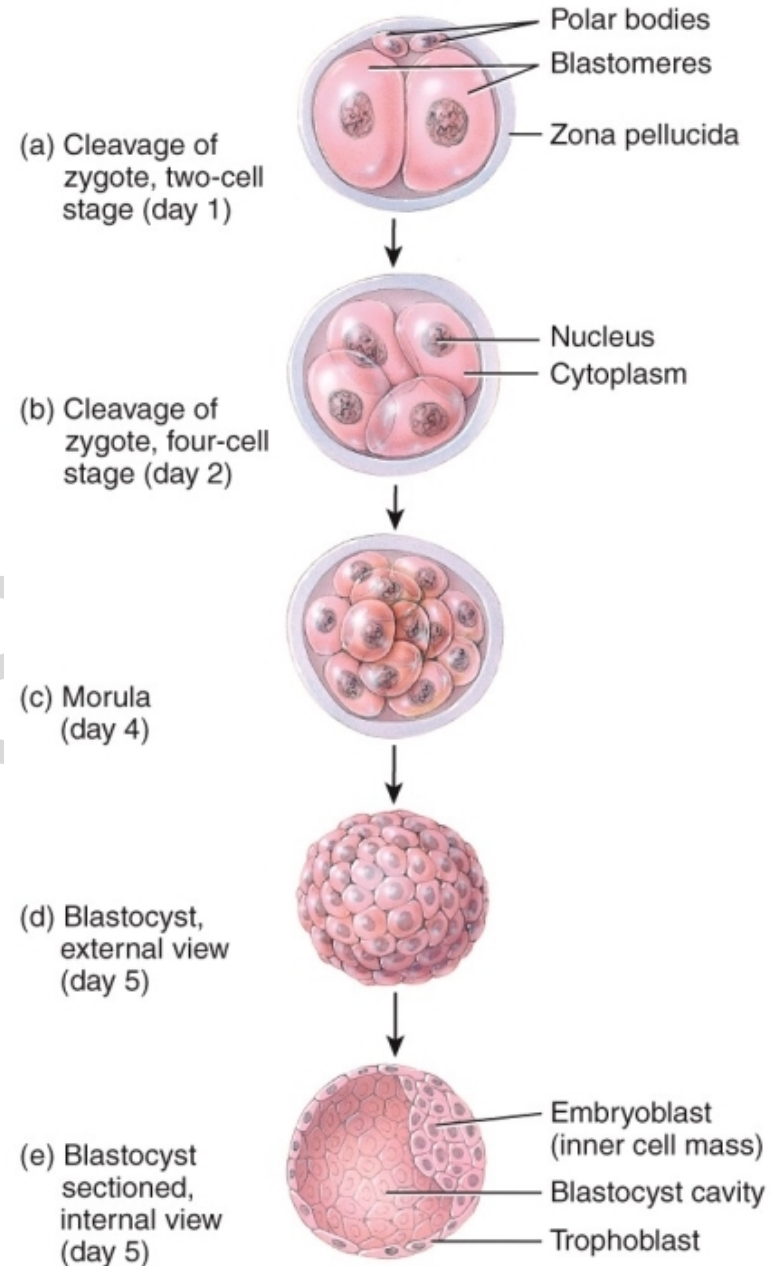
Cleavage of the zygote

- Cleavage
- Blastocyst formation
- Uterine milk
- Morula

Fertilization

- Blastocyst, which has the following components:
 - 1. embryoblast or inner cell mass
 - 2. outer covering of cells called the trophoblast

Cleavage and Formation of Morula and Blastocyst



Clinical Connection

- Stem cells
- Early pregnancy tests

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Implantation

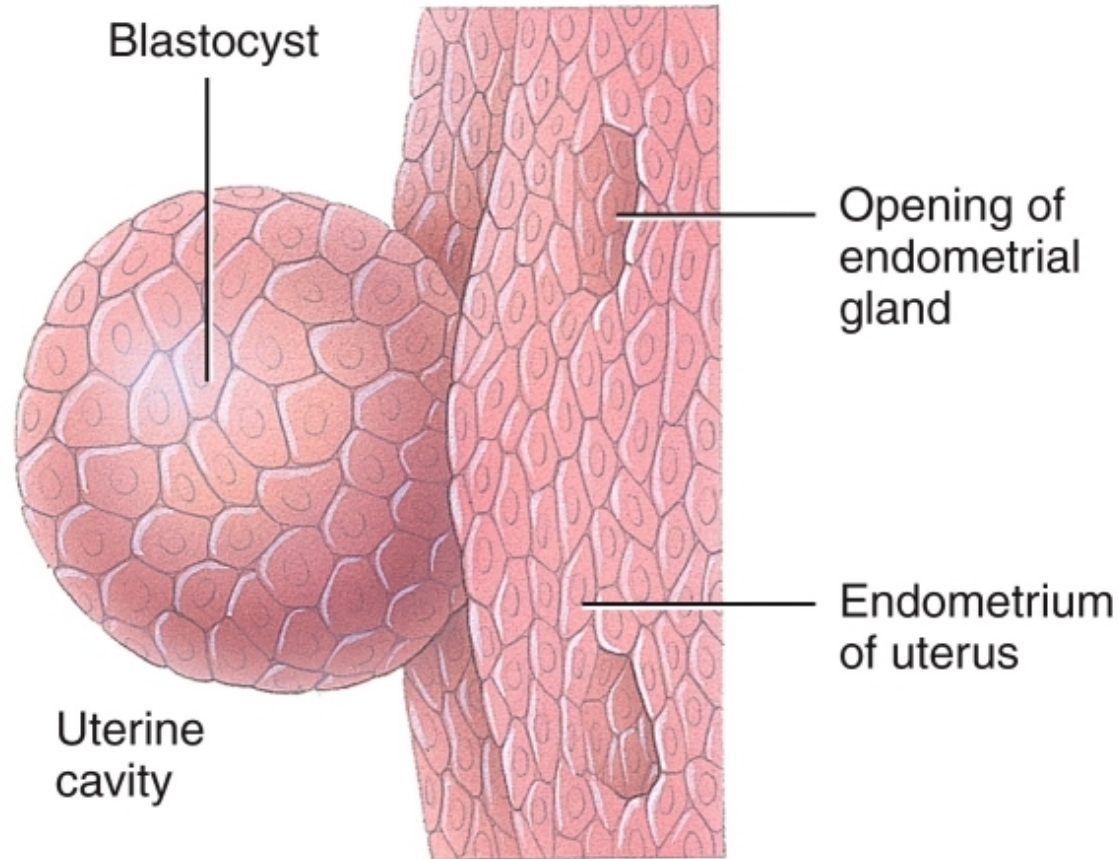
- Implantation
- Decidua
- As the blastocyst implants, usually on the posterior wall of the fundus or body of the uterus, it is oriented so that the inner cell mass faces the endometrium
- Different regions of the decidua are named based on their positions relative to the site of the implanted blastocyst

Implantation

- 1. Decidua basalis
- 2. Decidua capsularis
- 3. Decidua parietalis

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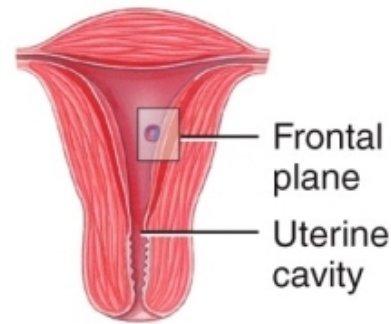
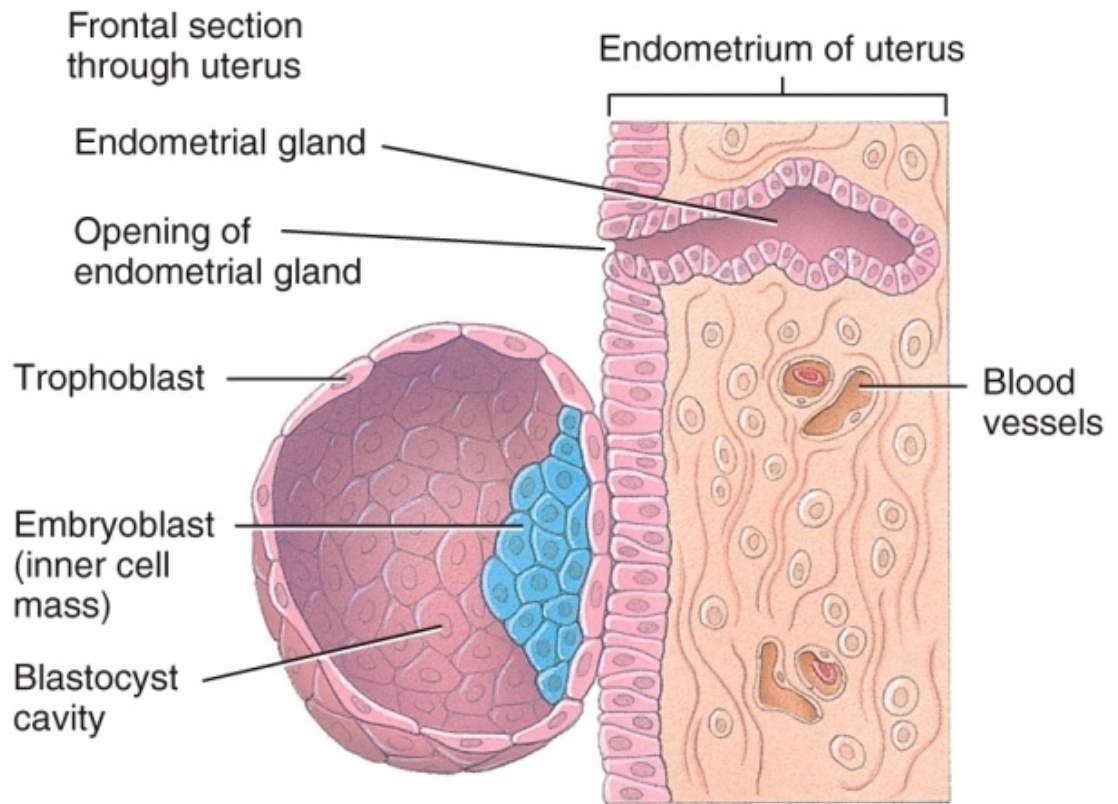
Relation of Blastocyst to Endometrium – Time of Implantation



(a) External view of blastocyst, about 6 days after fertilization

Blastocyst to Endometrium

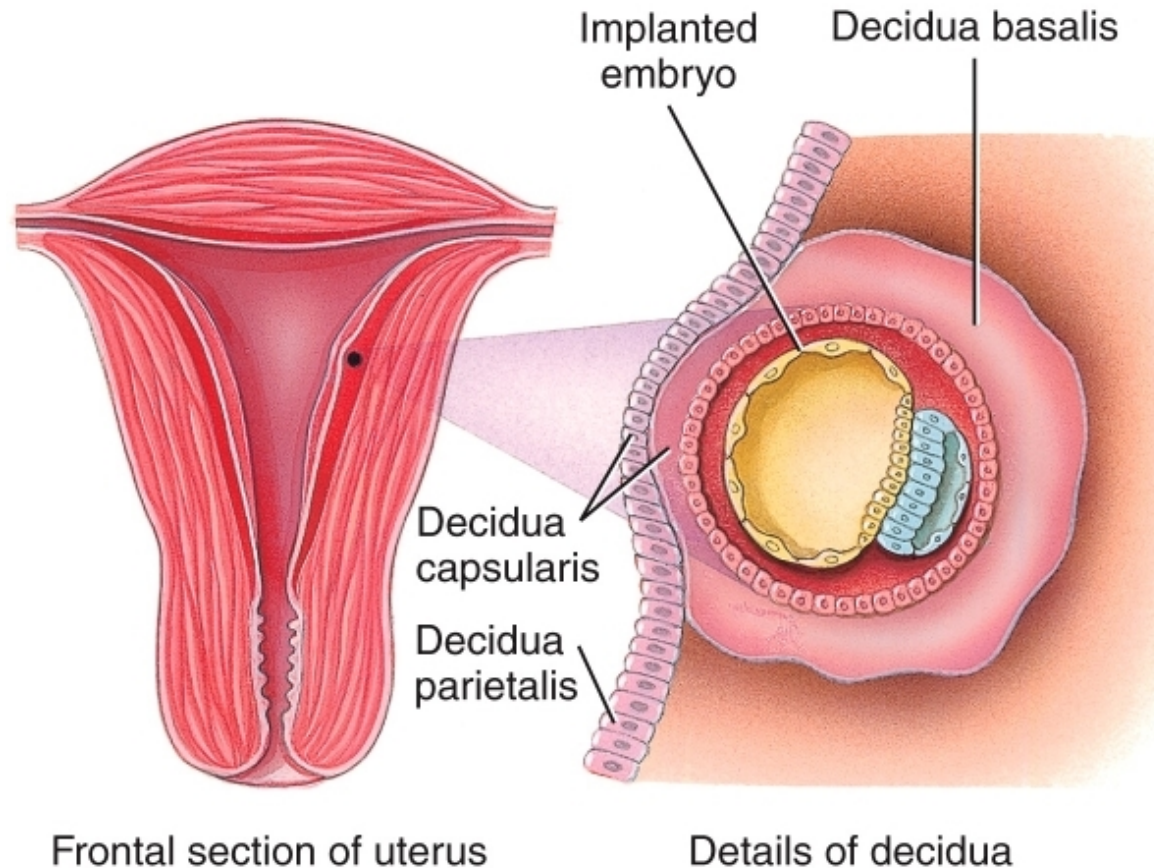
– Time of Implantation



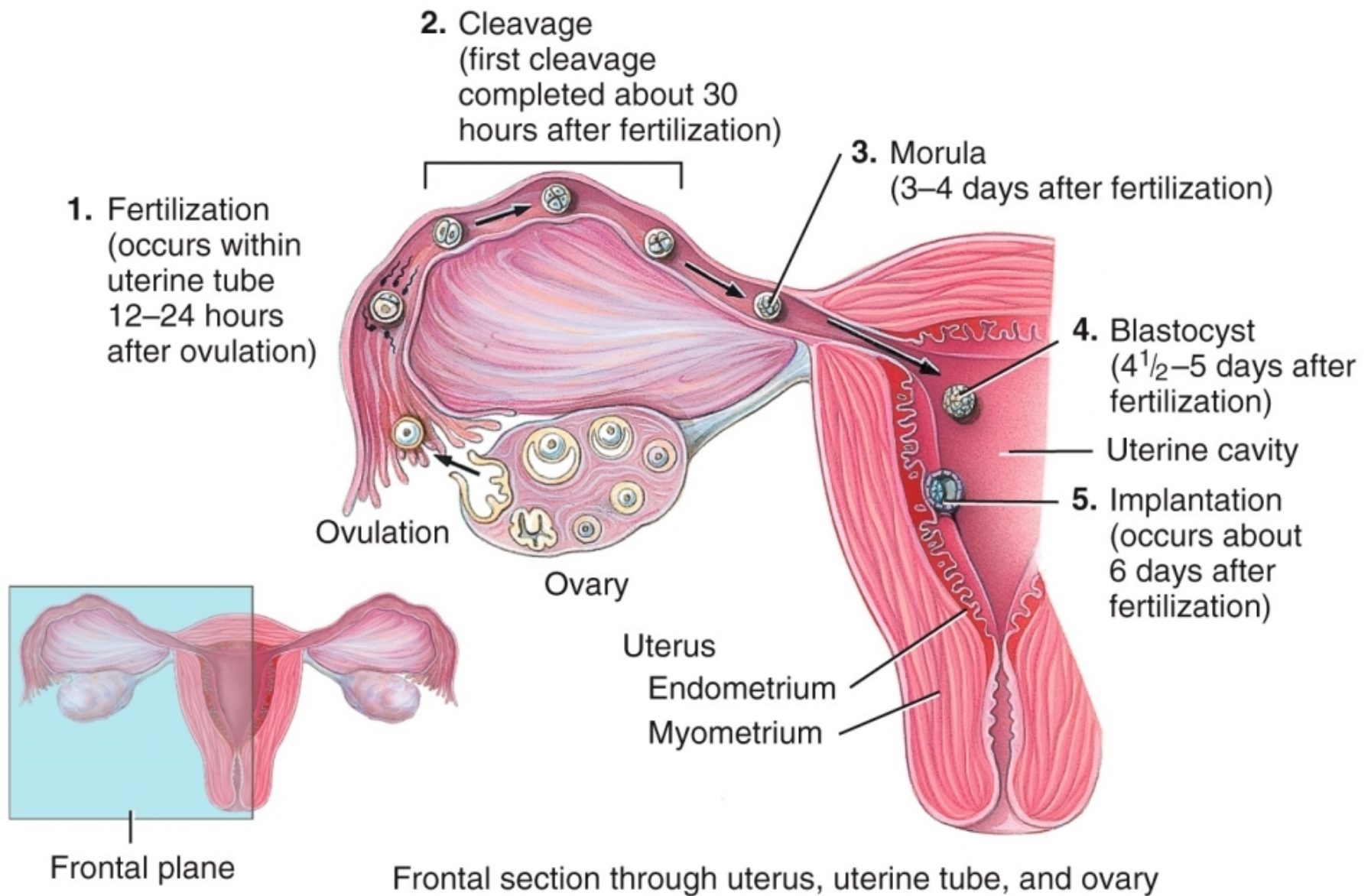
(b) Frontal section through endometrium of uterus and blastocyst, about 6 days after fertilization

Relation of Blastocyst to Endometrium

– Time of Implantation



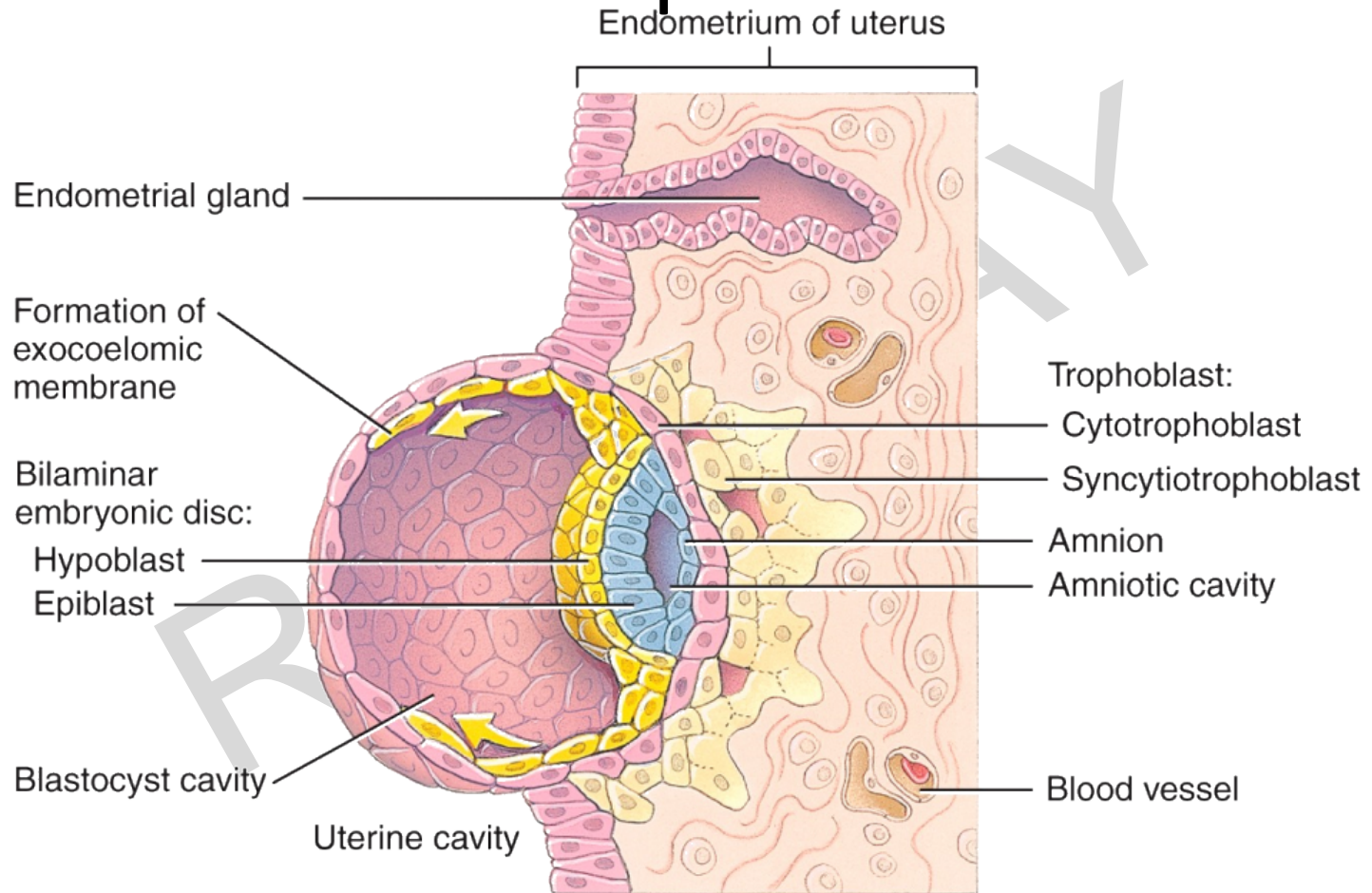
(c) Regions of the decidua



Second Week of Development

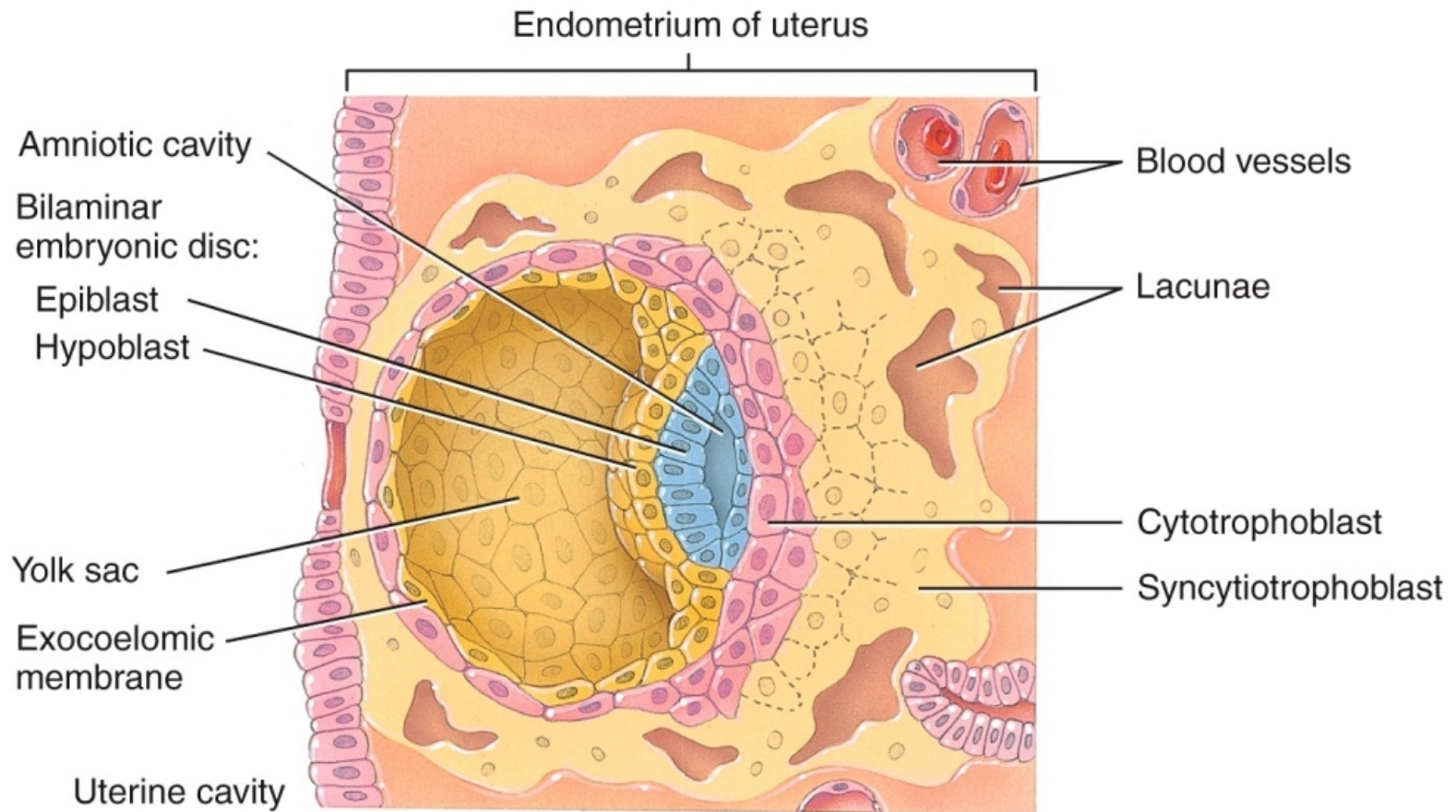
- Development of the trophoblast: the trophoblast develops two layers:
 1. outer syncytiotrophoblast
 2. inner cytotrophoblast
- Trophoblast produces human chorionic gonadotropin (hCG)

Events of Second Week of Development



(a) Frontal section through endometrium of uterus showing blastocyst, about 8 days after fertilization

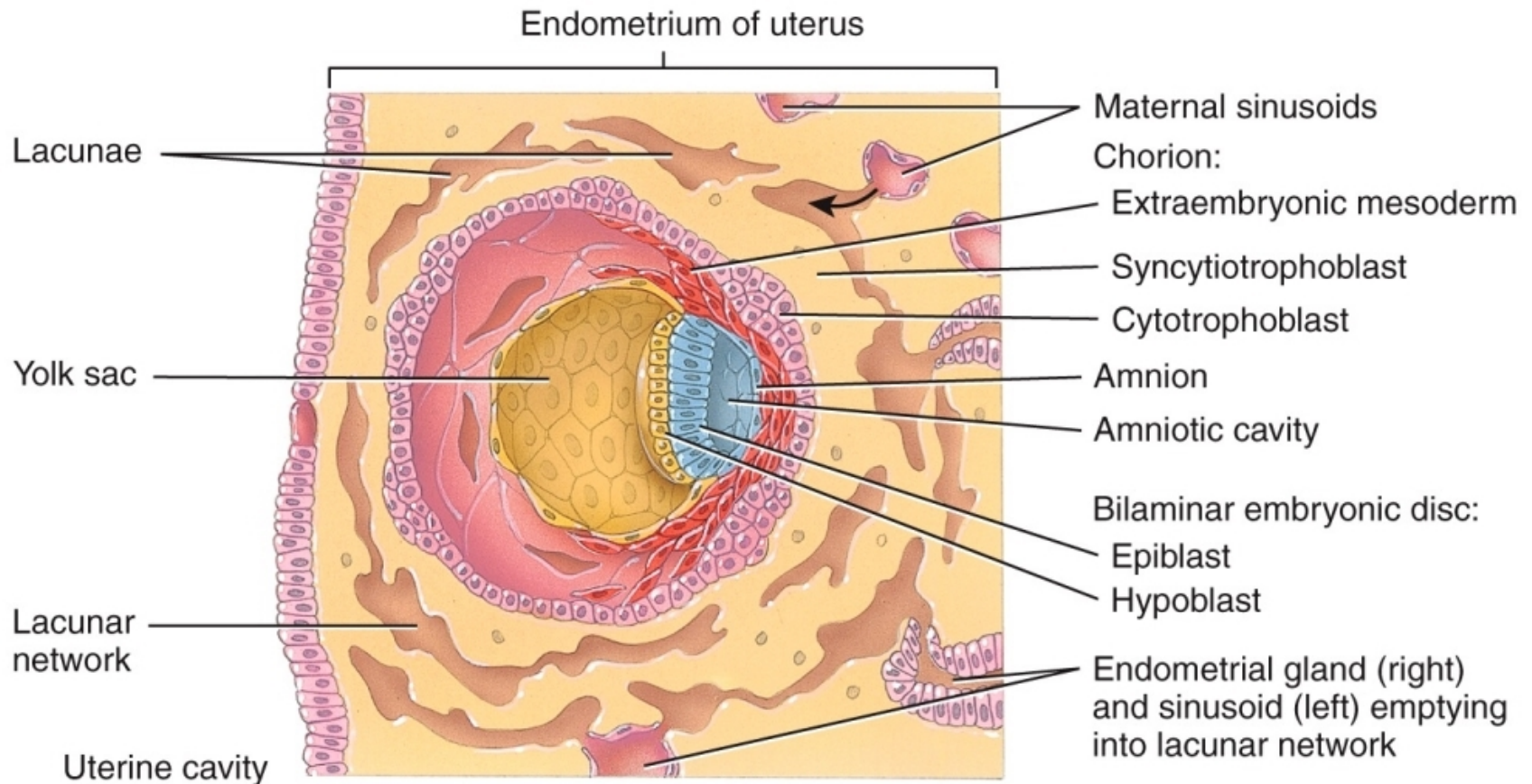
Events of Second Week of Development



(b) Frontal section through endometrium of uterus showing blastocyst, about 9 days after fertilization

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Events of Second Week of Development



(c) Frontal section through endometrium of uterus showing blastocyst, about 12 days after fertilization

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Second Week of Development

- Development of the bilaminar embryonic disc
 - hypoblast (primitive endoderm)
 - epiblast (primitive ectoderm)
 - bilaminar embryonic disc
- Amniotic cavity
- Amniotic fluid

Second Week of Development

- Development of the yolk sac
- Exocoelomic membrane
 - in humans, the yolk sac is relatively empty, small, and progressively decreases in size
 - it has several important functions

Second Week of Development

- Development of sinusoids: small spaces called lacunae
- Lacunar networks
- Sinusoids
 - maternal blood and endometrial secretions enter the lacunar networks to provide embryonic nutrition and to serve as a disposal site for embryonic wastes

Second Week of Development

- Development of the extraembryonic coelom
- Extraembryonic mesoderm
- Extraembryonic coelom

Second Week of Development

- Development of the chorion
 - it surrounds the embryo and, later, the fetus
 - it eventually becomes the major embryonic component of the placenta
- Gonadotropin (hCG)

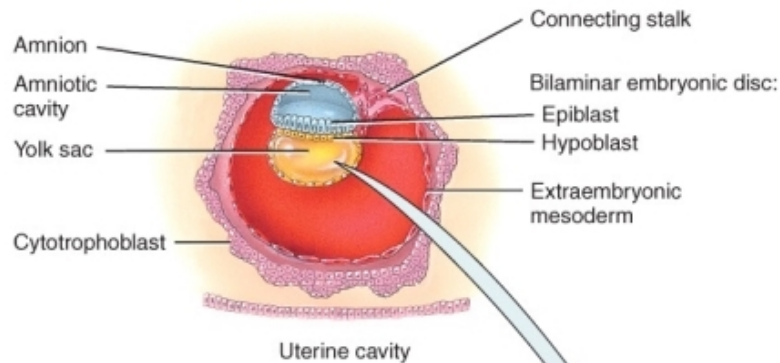
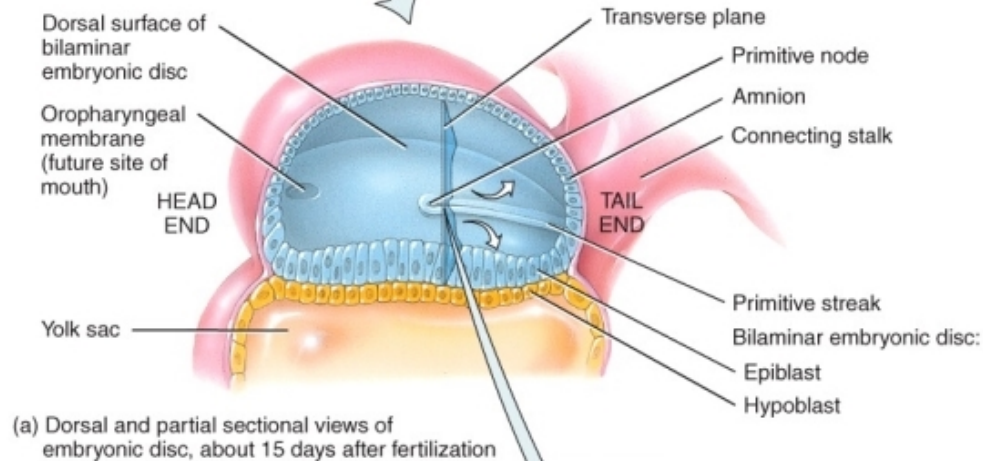
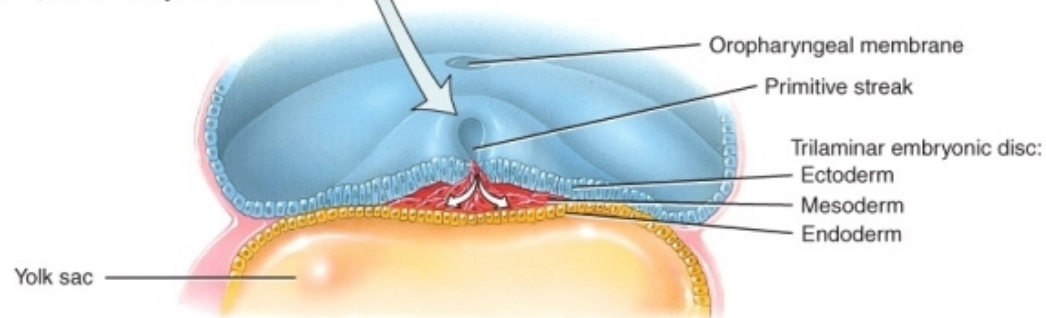
Second Week of Development

- Chorionic cavity
- Connecting (body) stalk, the future umbilical cord

Third Week of Development

- Gastrulation
 - the bilaminar embryonic disc is transformed into a trilaminar embryonic disc consisting of three primary germ layers:
 - ectoderm, mesoderm, and endoderm
- Gastrulation
 - primitive streak
 - primitive node
- Invagination results in formation of the three primary germ layers

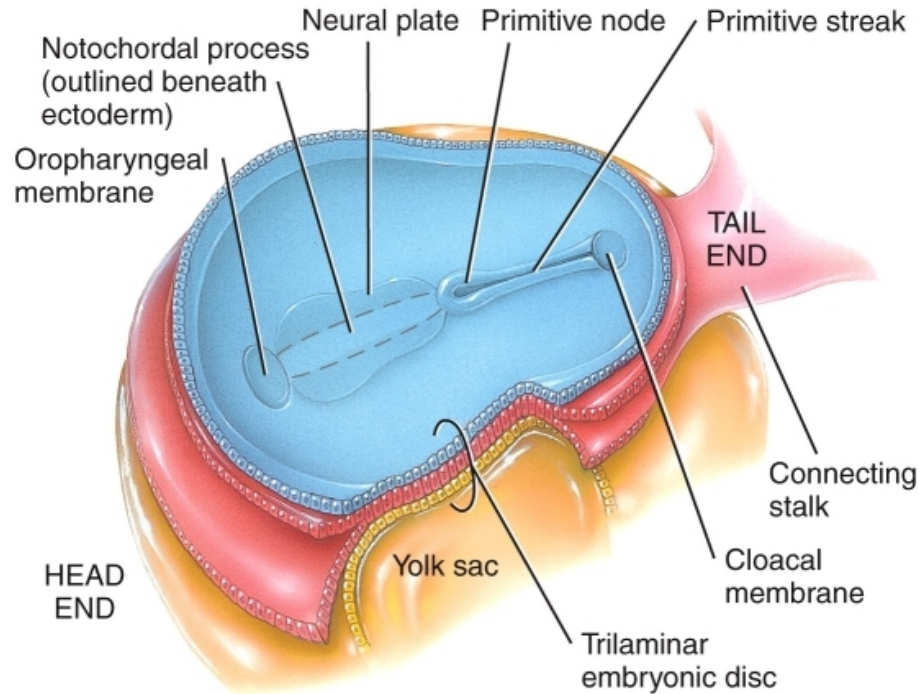
Gastrulation



Third Week of Development

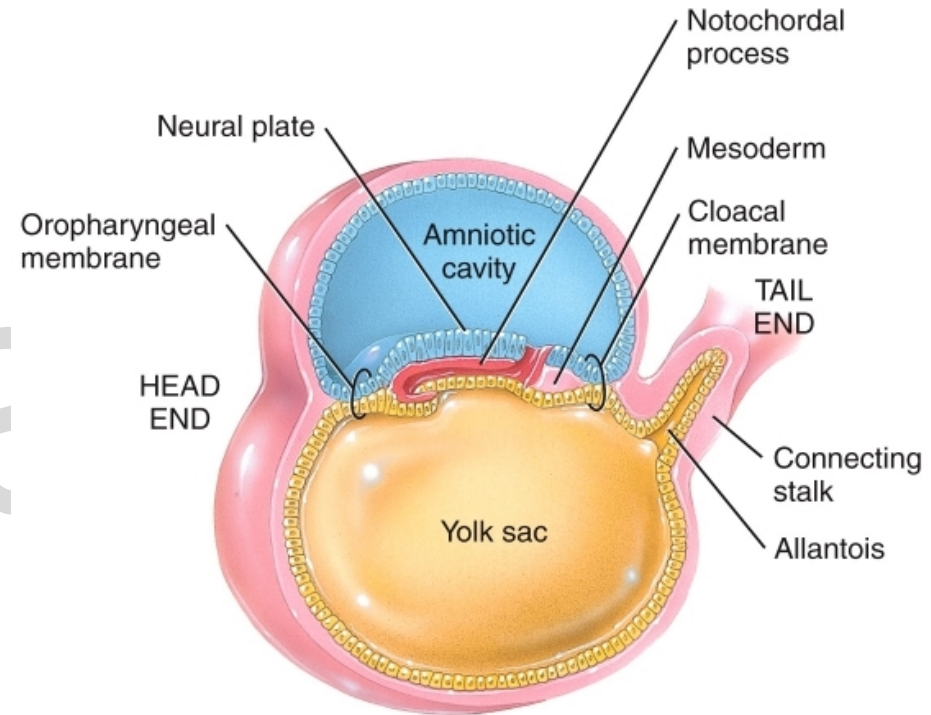
- Notochordal process develops
 - notochord
- The (1) oropharyngeal membrane and the (2) cloacal membranes develop

Development of Notochordal Process



(a) Dorsal and partial sectional views of trilaminar embryonic disc, about 16 days after fertilization

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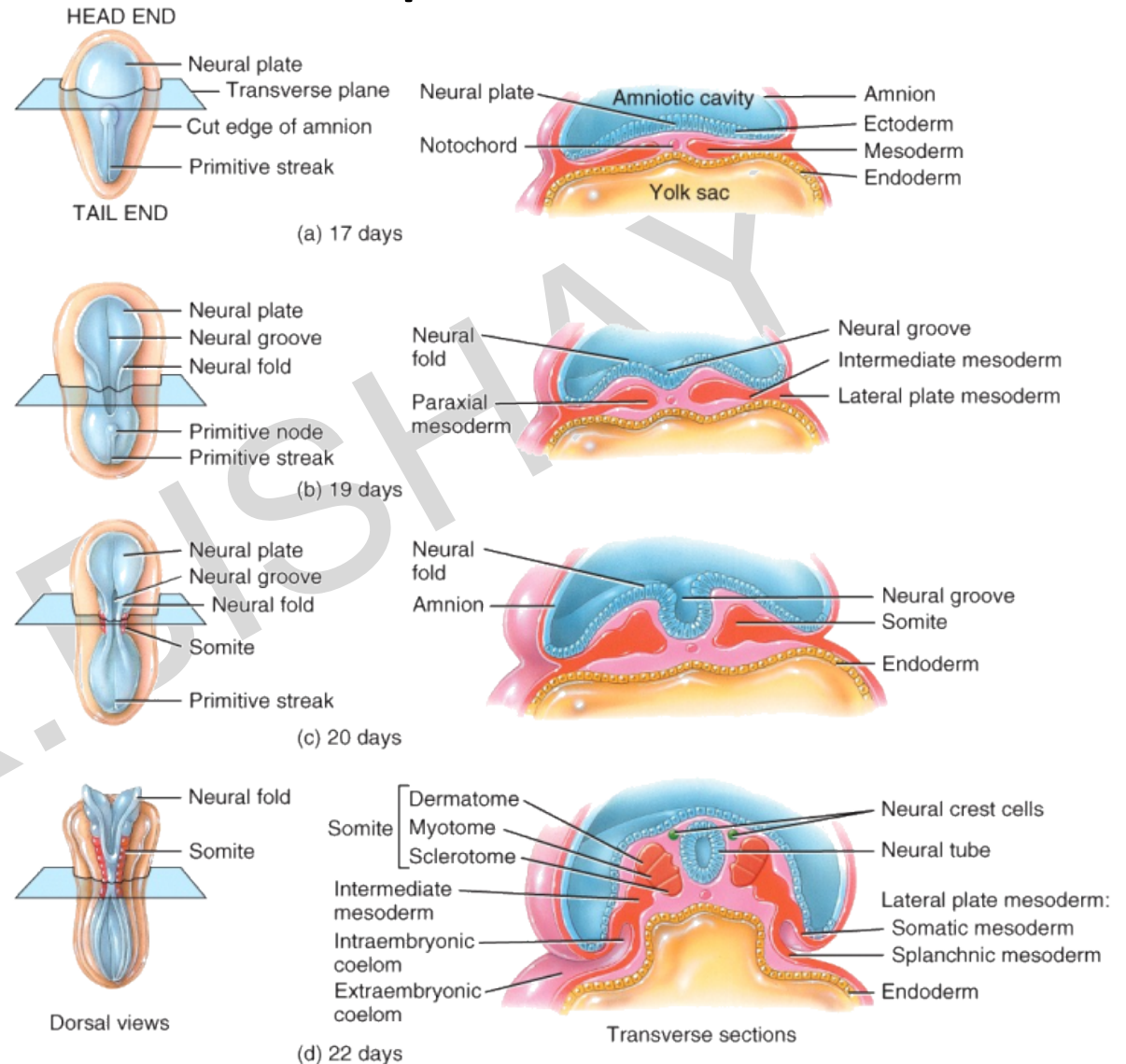
(b) Sagittal section of trilaminar embryonic disc, about 16 days after fertilization

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Third Week of Development

- Allantois develops
- Neurulation
- The head end of the neural tube develops into the brain

Neurulation and Development of Somites



Clinical Connection

- Neural tube defects

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Development of Somites

- The mesoderm segments into cube-shaped structures called somites
- Each somite differentiates into a myotome, dermatome, and sclerotome

Development of the Intraembryonic Coelom

- Small spaces appear in the lateral plate mesoderm and merge into a larger cavity called the intraembryonic coelom
- Consequently, the lateral plate mesoderm is split
 - splanchnic mesoderm
 - somatic mesoderm

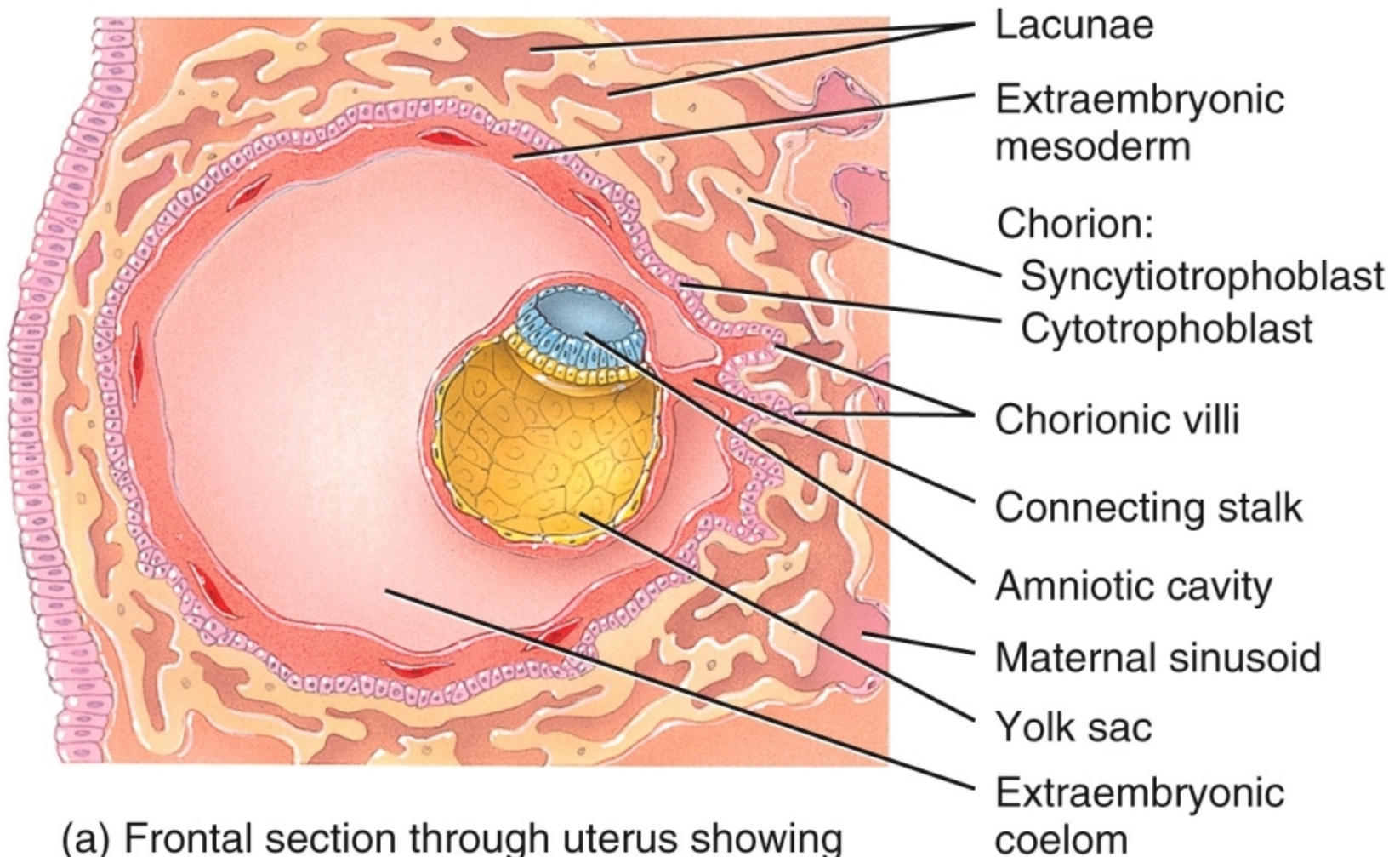
Development of the Cardiovascular System

- Angiogenesis
 - hemangioblasts
 - angioblasts
 - blood islands
- Blood cells arise from pluripotent stem cells
- Cardiogenic area
 - endocardial tubes which form a single primitive heart tube

Development of the Chorionic Villi and Placenta

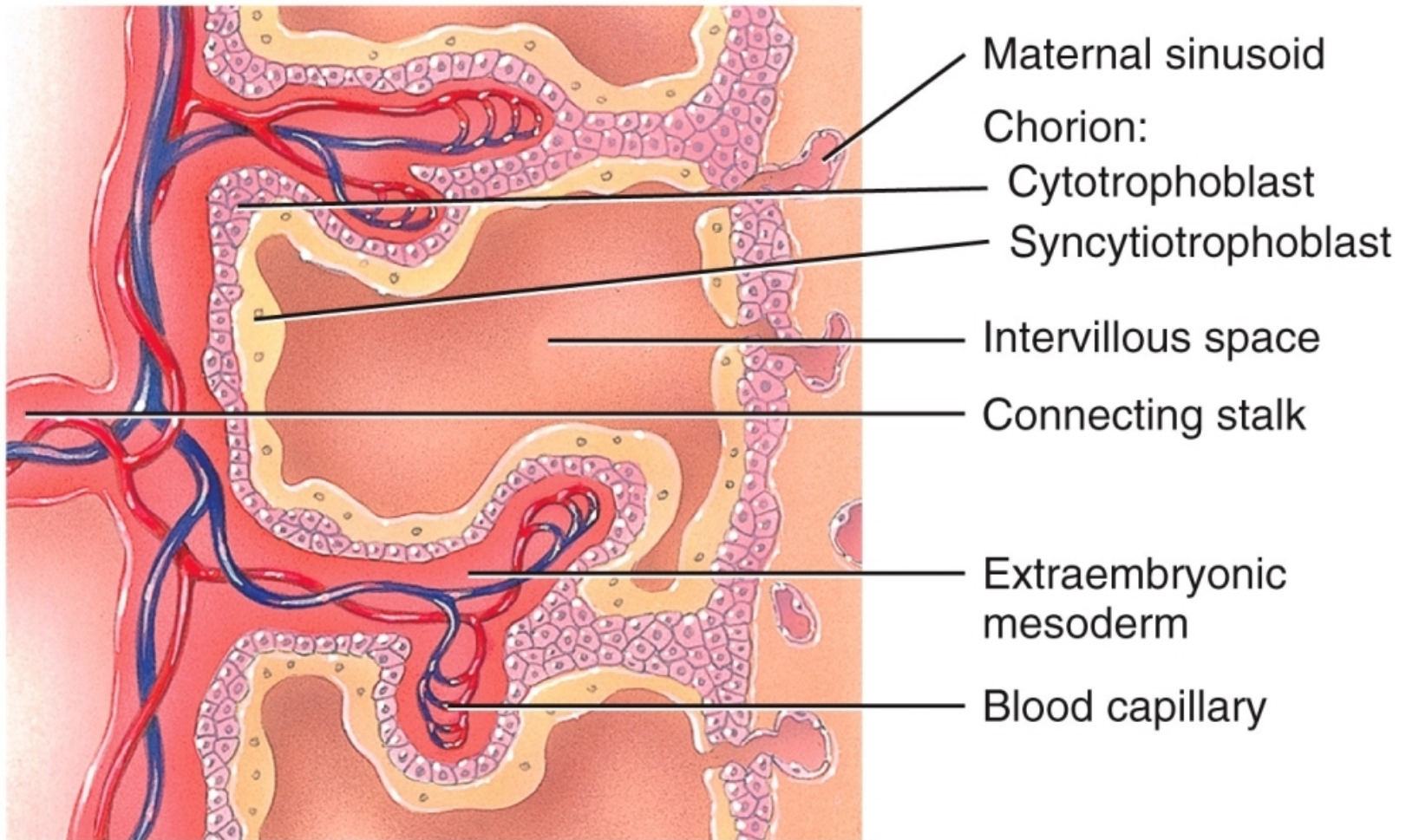
- Development of lacunae
- Chorionic villi grow and blood capillaries develop within them
- Maternal and fetal blood do not normally mix

Development of Chorionic Villi



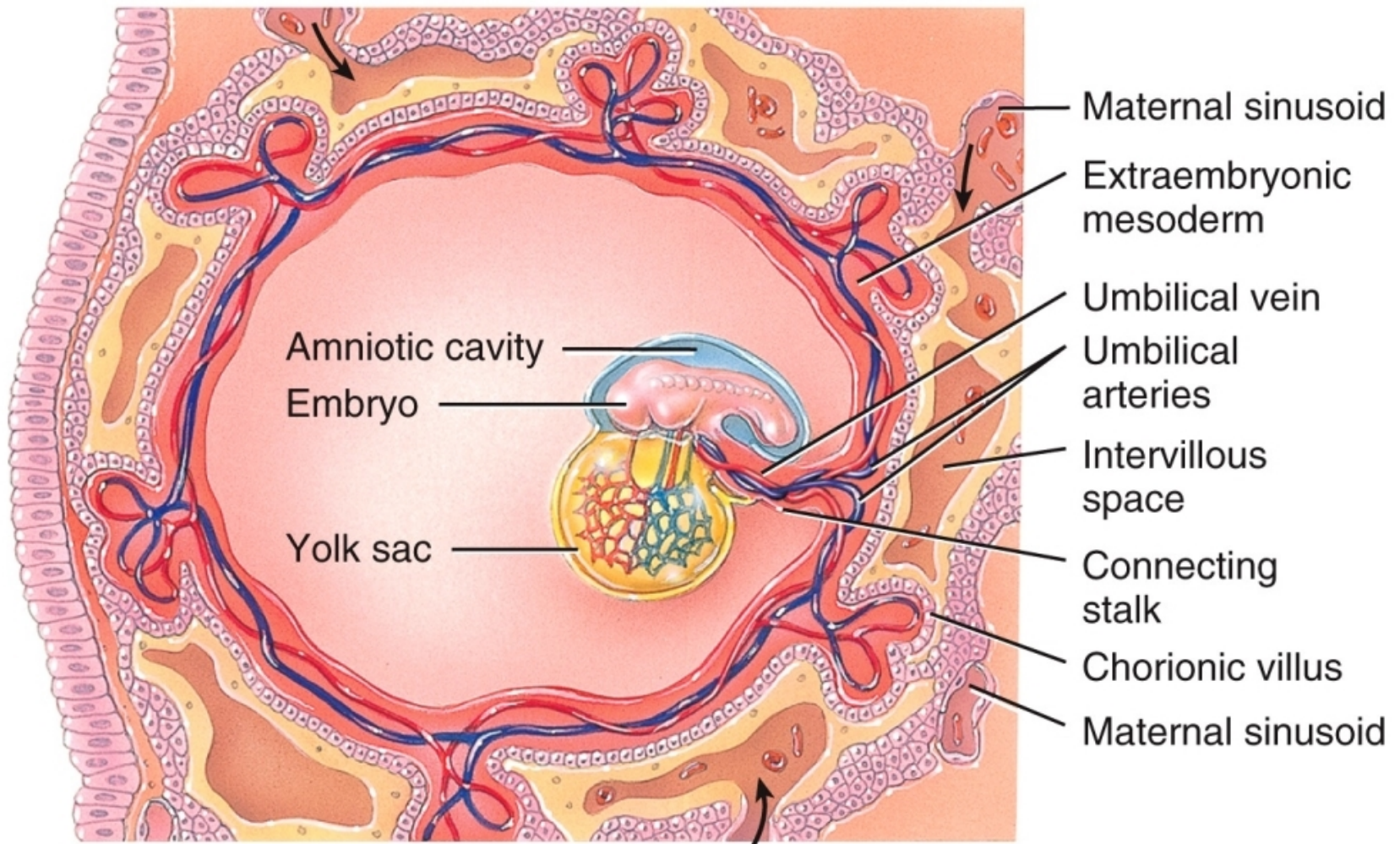
(a) Frontal section through uterus showing blastocyst, about 13 days after fertilization

Development of Chorionic Villi



(b) Details of two chorionic villi, about 21 days after fertilization

Development of Chorionic Villi



(c) Frontal section through uterus showing an embryo and its vascular supply, about 21 days after fertilization

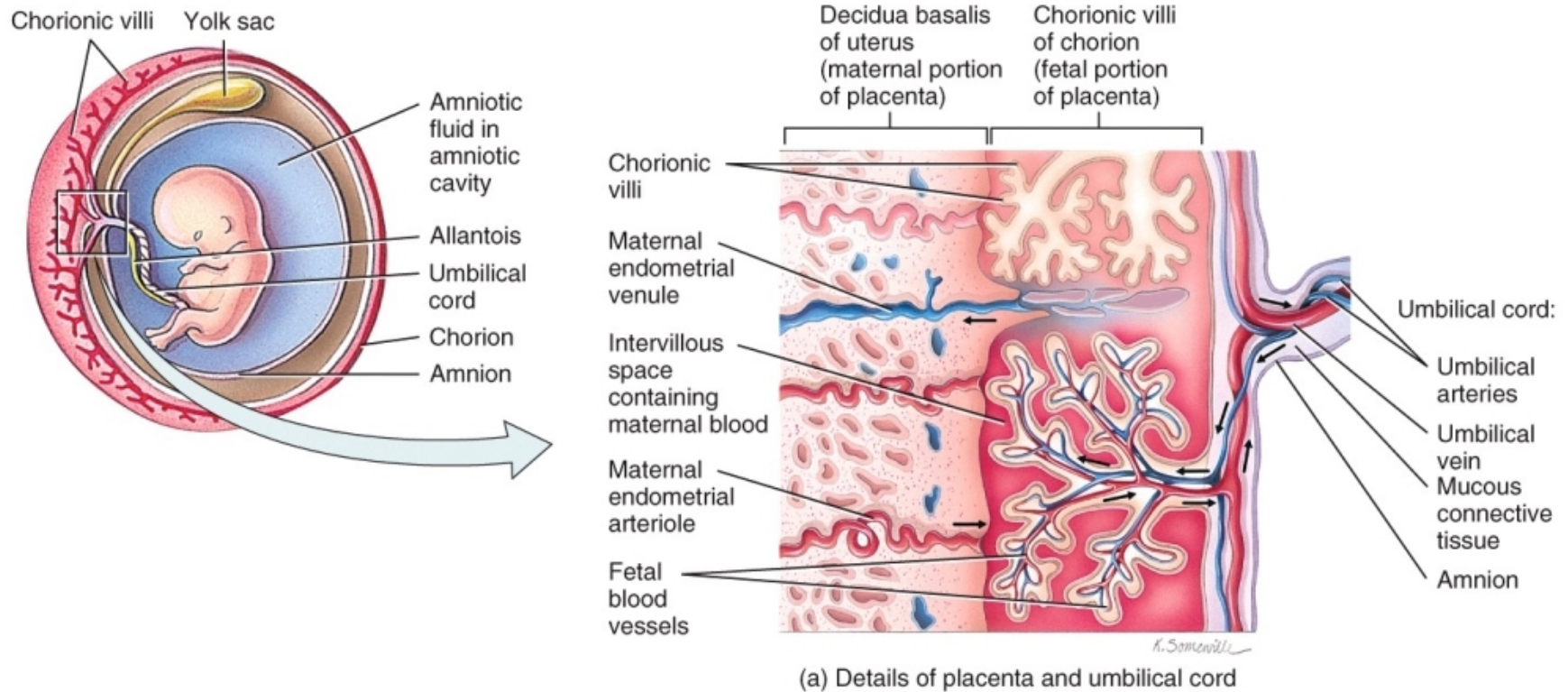
Placentation

- The process of forming the placenta
- Shaped like a pancake, it consists of a fetal portion formed by chorionic villi and a maternal portion formed by the decidua basalis

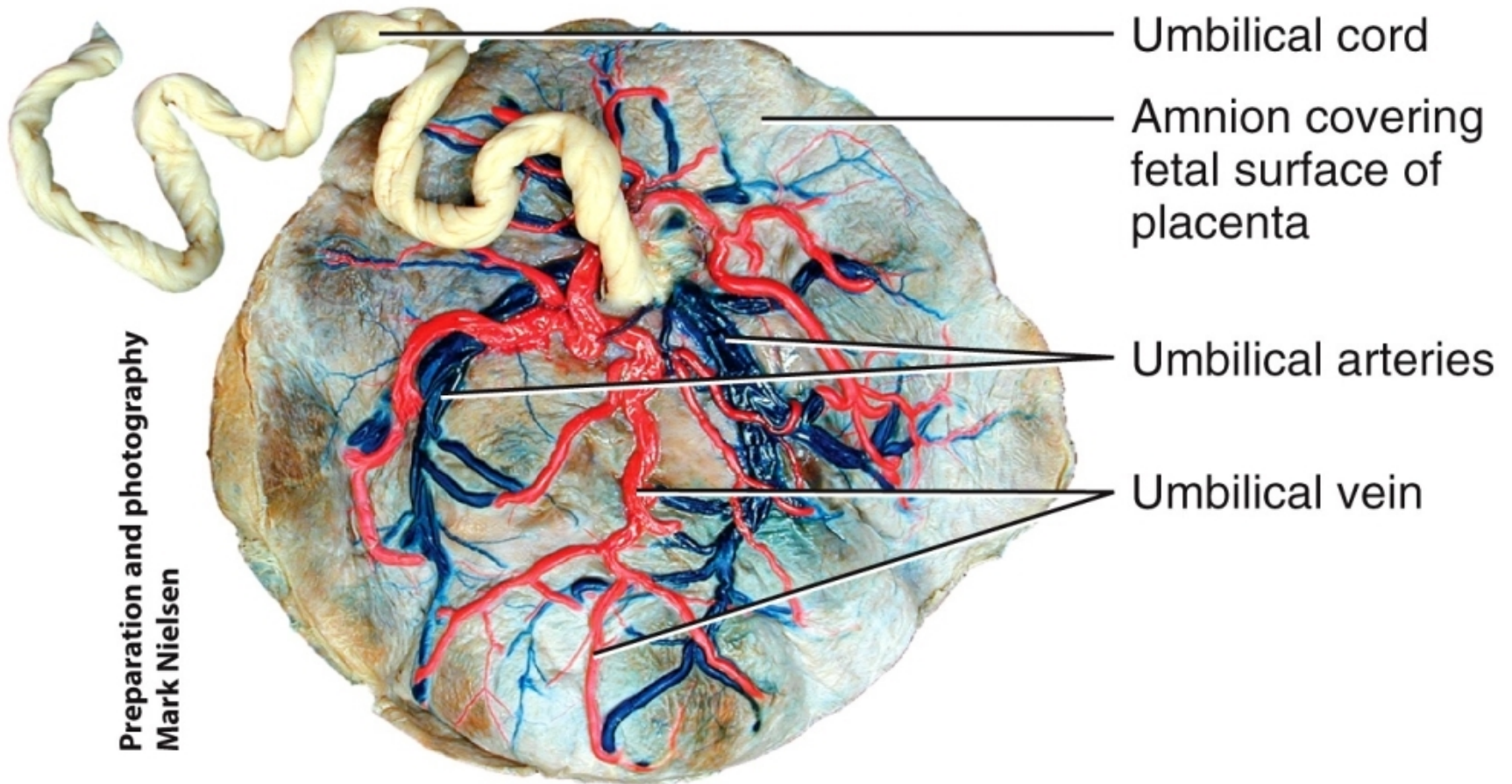
Placenta

- Umbilical cord consists of:
 - two umbilical arteries that carry deoxygenated fetal blood and wastes from the fetus to the placenta
 - one umbilical vein that carries oxygenated blood and nutrients from the placenta into the fetus
- Wharton's jelly

Placenta and Umbilical Cord



Placenta and Umbilical Cord



(b) Fetal surface of placenta

Placenta

- The placenta is a protective barrier
- Certain viruses such as those that cause AIDS, German measles, chickenpox, measles, encephalitis, and poliomyelitis can cross the placenta
- Certain drugs and alcohol can cause birth defects as they pass freely through the placenta

Clinical Connection

- Placenta previa

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Placenta

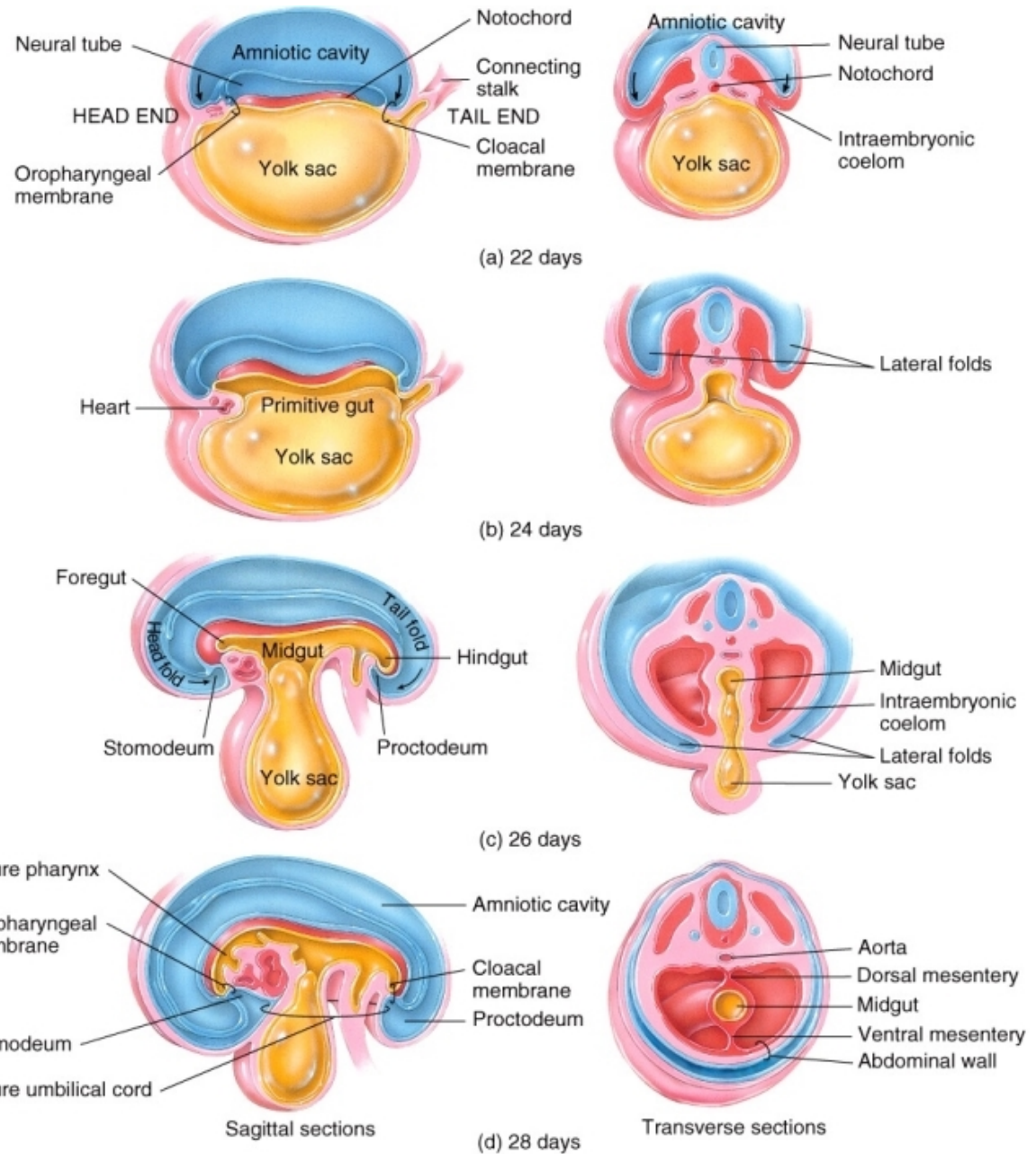
- Afterbirth
- Umbilicus

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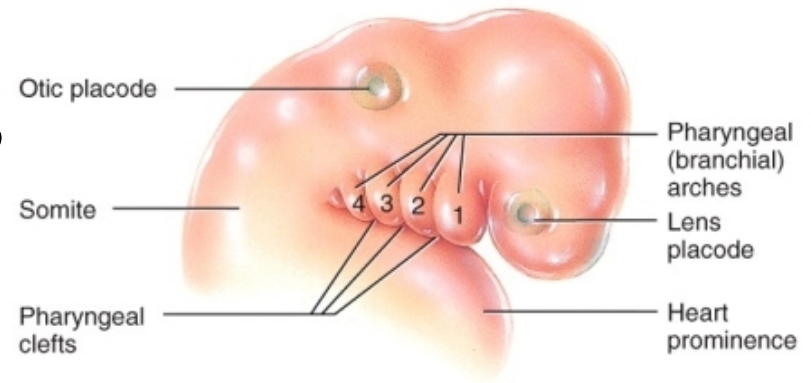
Fourth Week of Development

- Organogenesis
- Embryonic folding
 - head fold, tail fold, and two lateral folds
- Formation of the primitive gut
- Pharyngeal (throat)
- Future ears and eyes occurs
- Upper limb buds, lower limb buds, and a heart prominence

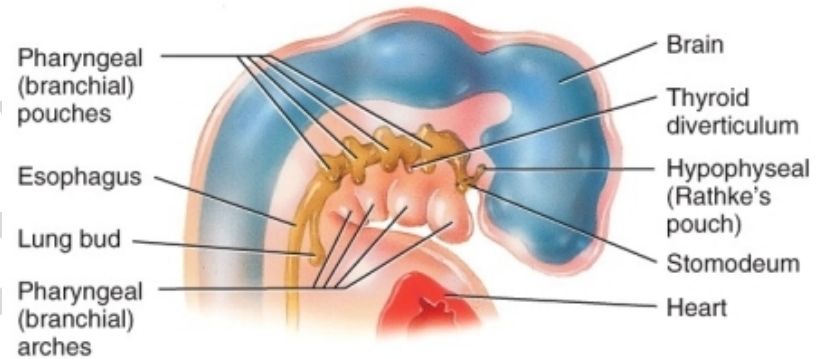
Embryon Folding



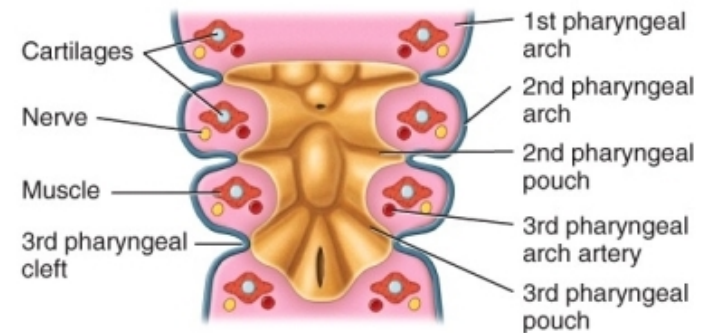
Development of Pharyngeal Arches, Clefts, and Pouches



(a) External view, about 28-day embryo



(b) Sagittal section, about 28-day embryo



(c) Transverse section of the pharynx, about 28-day embryo

Fifth Through Eighth Weeks of Development

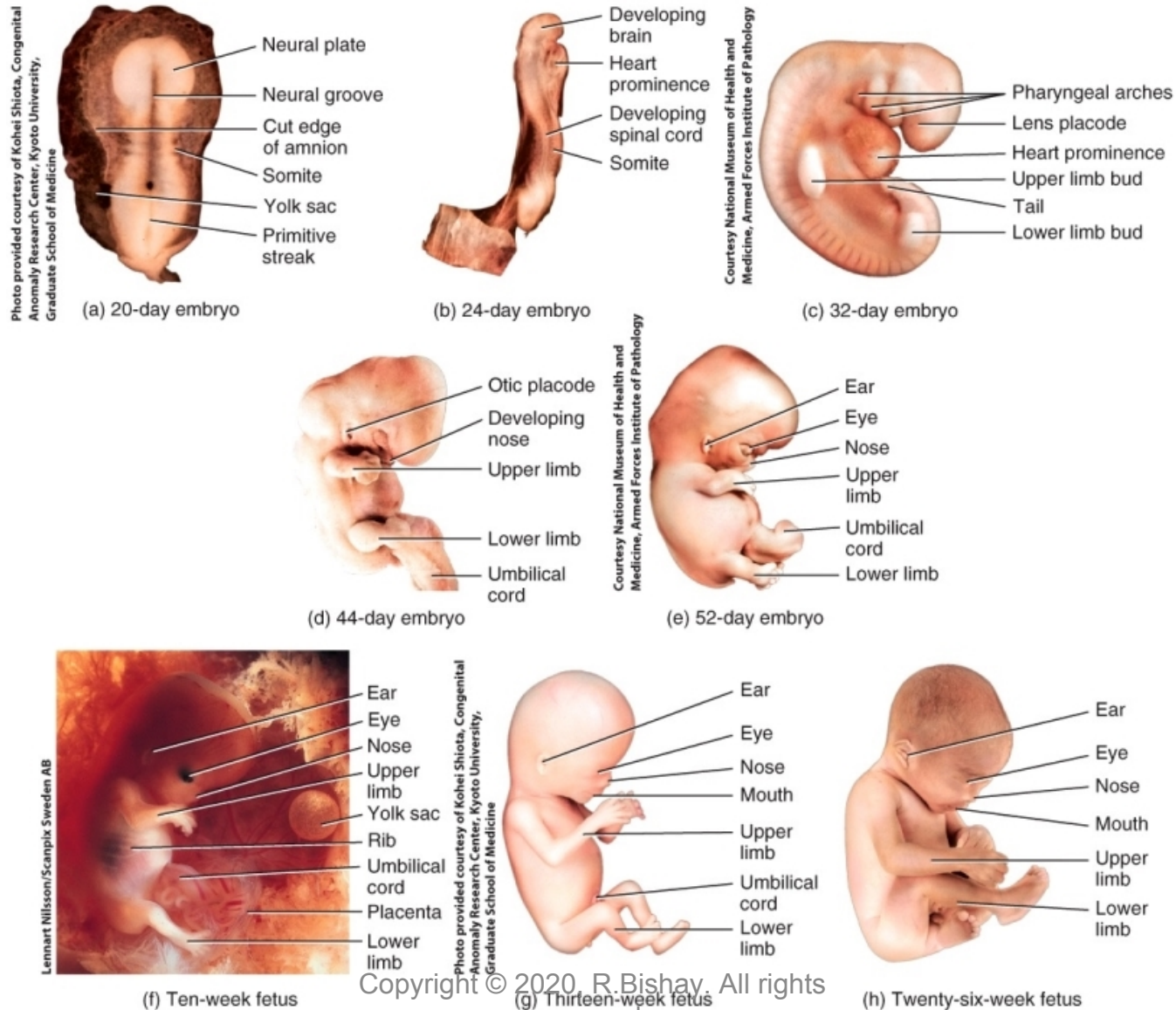
- Rapid development of the brain and head
- Development of distinct limb regions
- Further development of the eyes and ears
- Tail disappears
- External genitals begin to differentiate
- End of the eighth week, the embryo has clearly human characteristics

Fetal Period

- Fetal period

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Summary of Developmental Events



Clinical Connection

- Premature infant

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Maternal Changes During Pregnancy

- Progressive growth of the uterus
- Weight gain
- Increased storage of nutrients
- Breast enlargement
- Lower back pain
- Specific changes in cardiovascular, respiratory, digestive, urinary, integumentary, and reproductive systems

Clinical Connection

- Pregnancy-induced hypertension
- Preeclampsia
- Eclampsia

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Labor

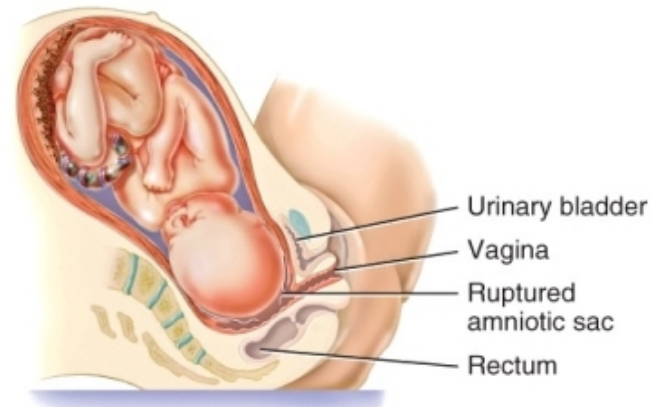
- Obstetrics
- Neonatal period
- Labor
- Parturition

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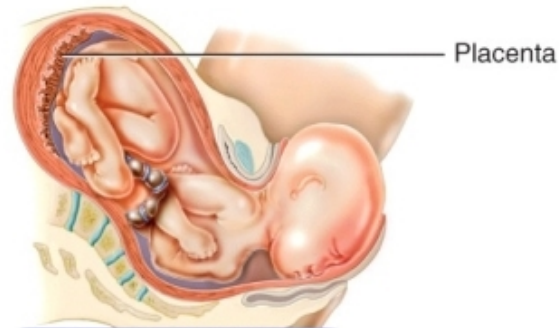
True Labor - Three Stages

- Stage of dilation
- Stage of expulsion
- Placental stage

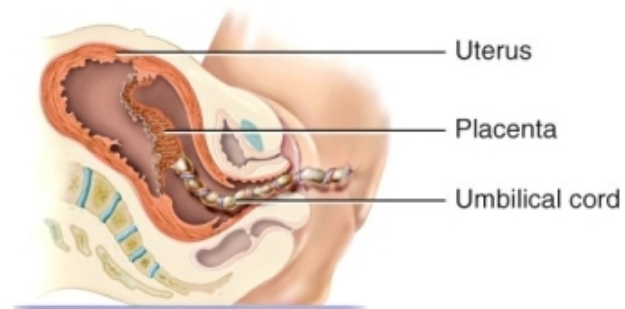
Stages of True Labor



1 Stage of dilation



2 Stage of expulsion



3 Placental stage