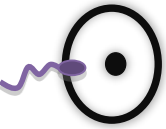
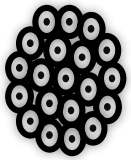
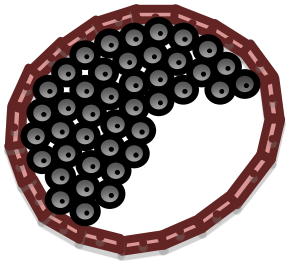
THE STORY OF LIFE…

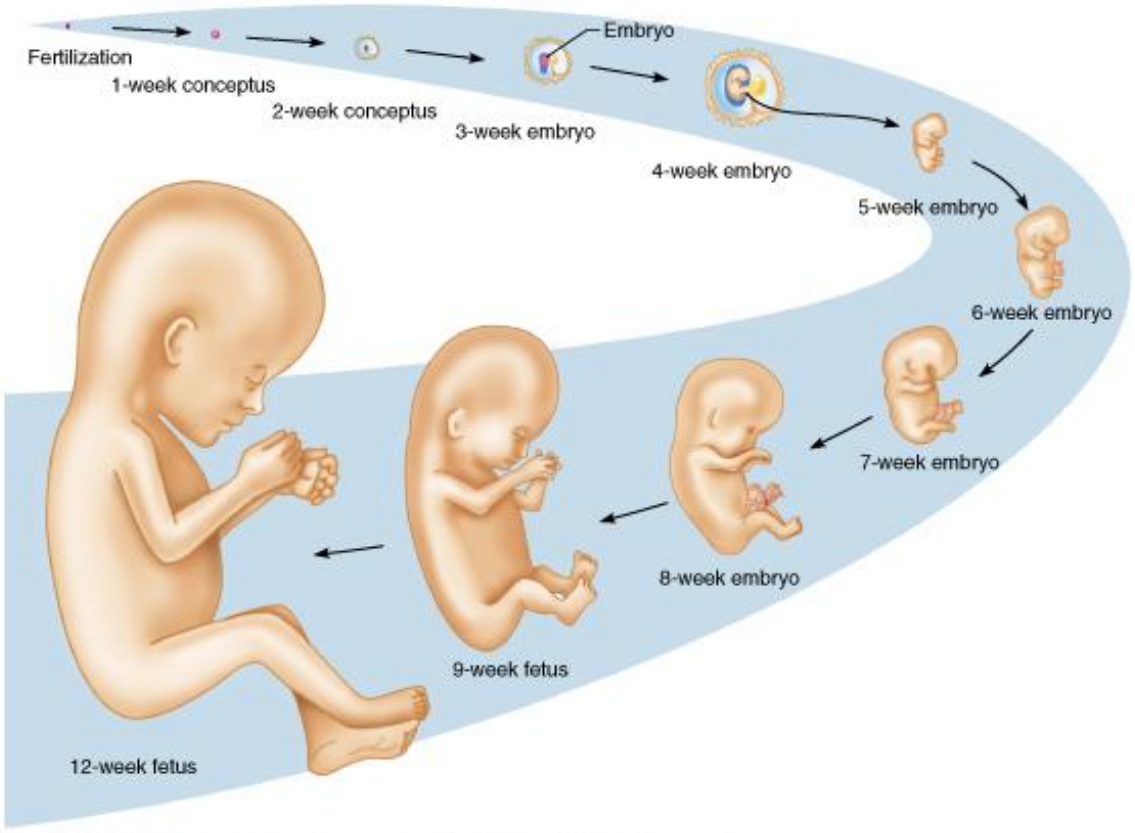




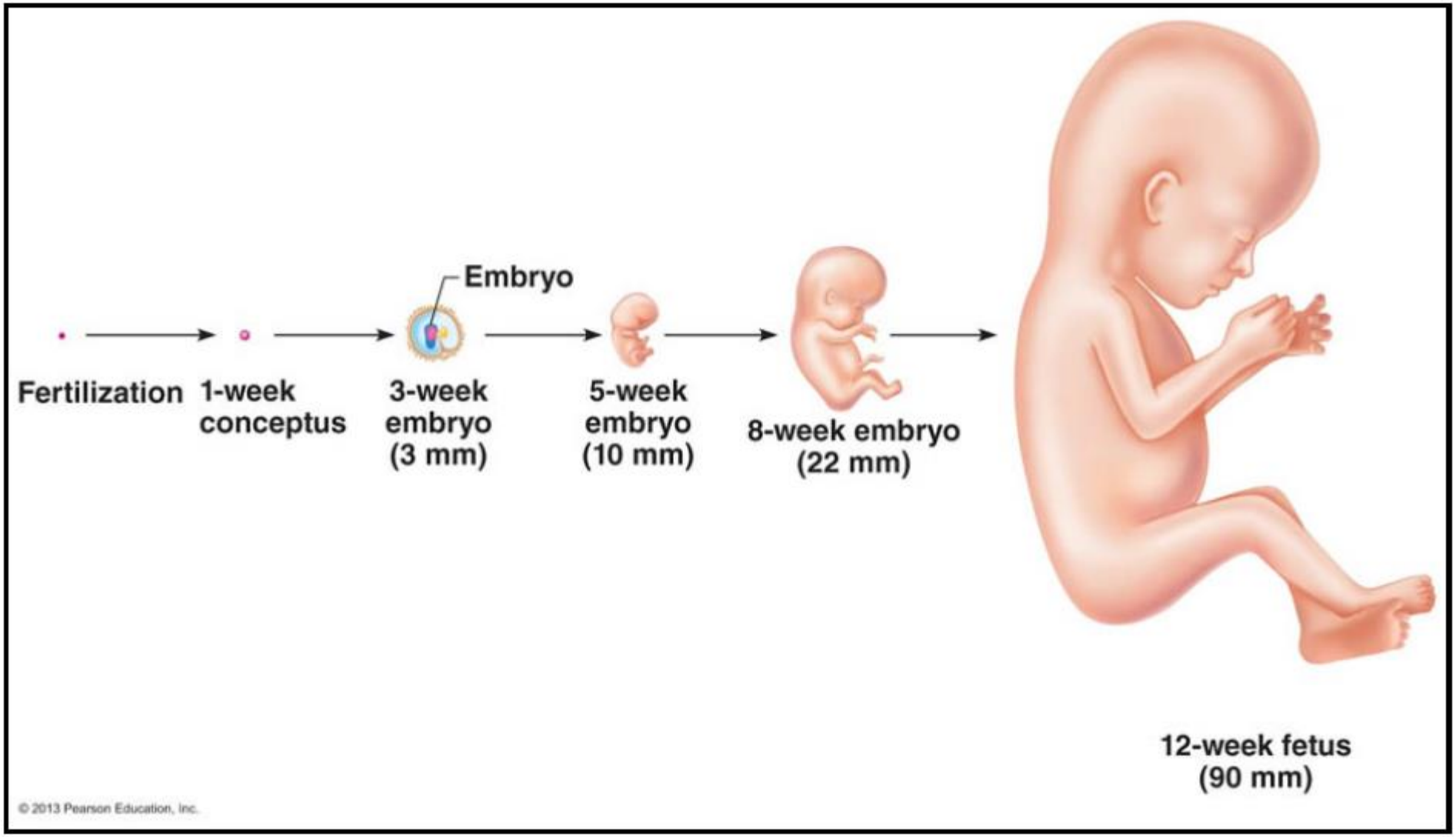


Pregnancy

- Events from fertilization to birth
- Conceptus → Embryo → Fetus : the developing offspring
- Gestation period: the time during which development occurs



Pregnancy


Embryo
Fertilization
1-week conceptus
3-week embryo (3 mm)
5-week embryo (10 mm)
8-week embryo (22 mm)
12-week fetus (90 mm)
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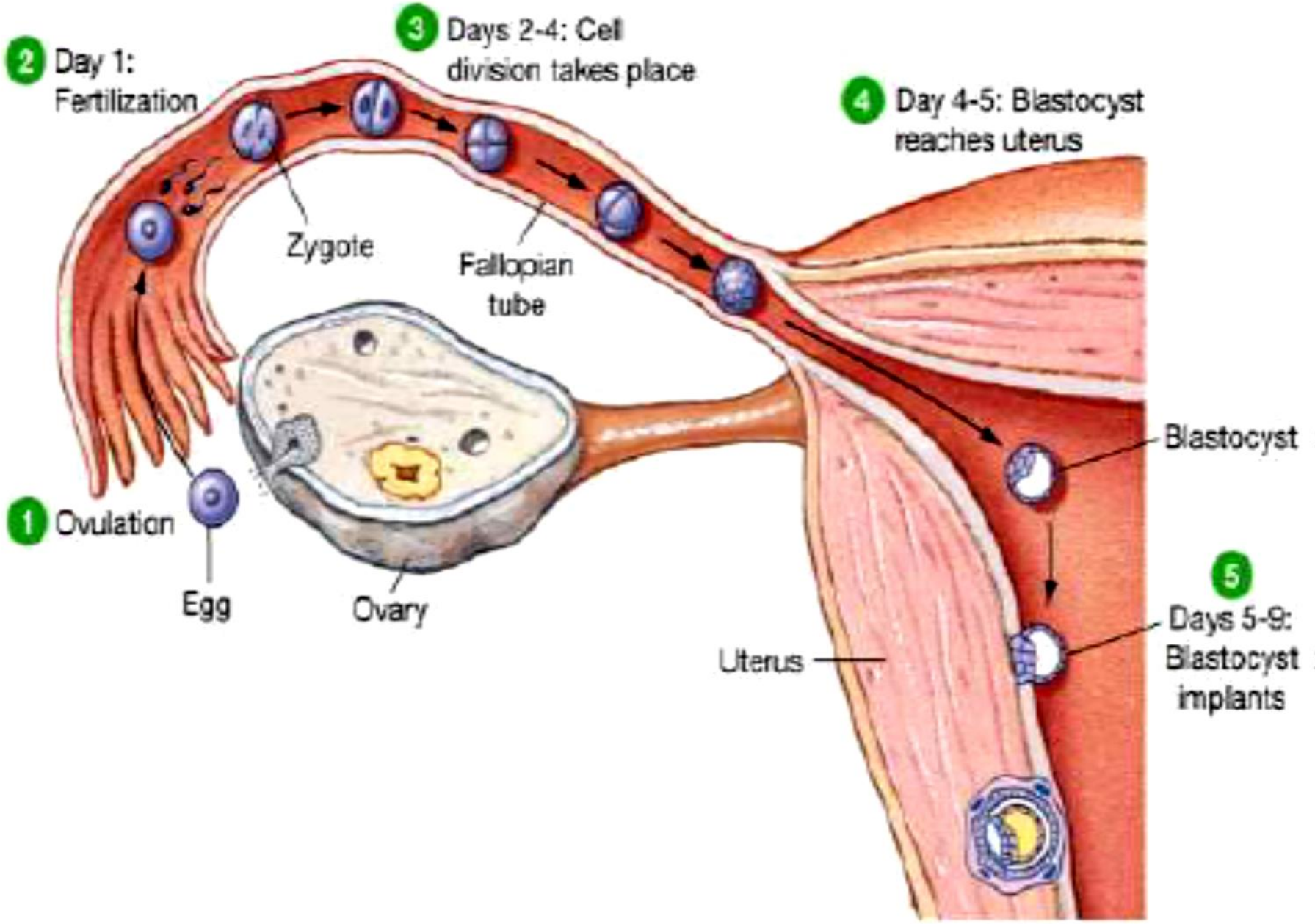
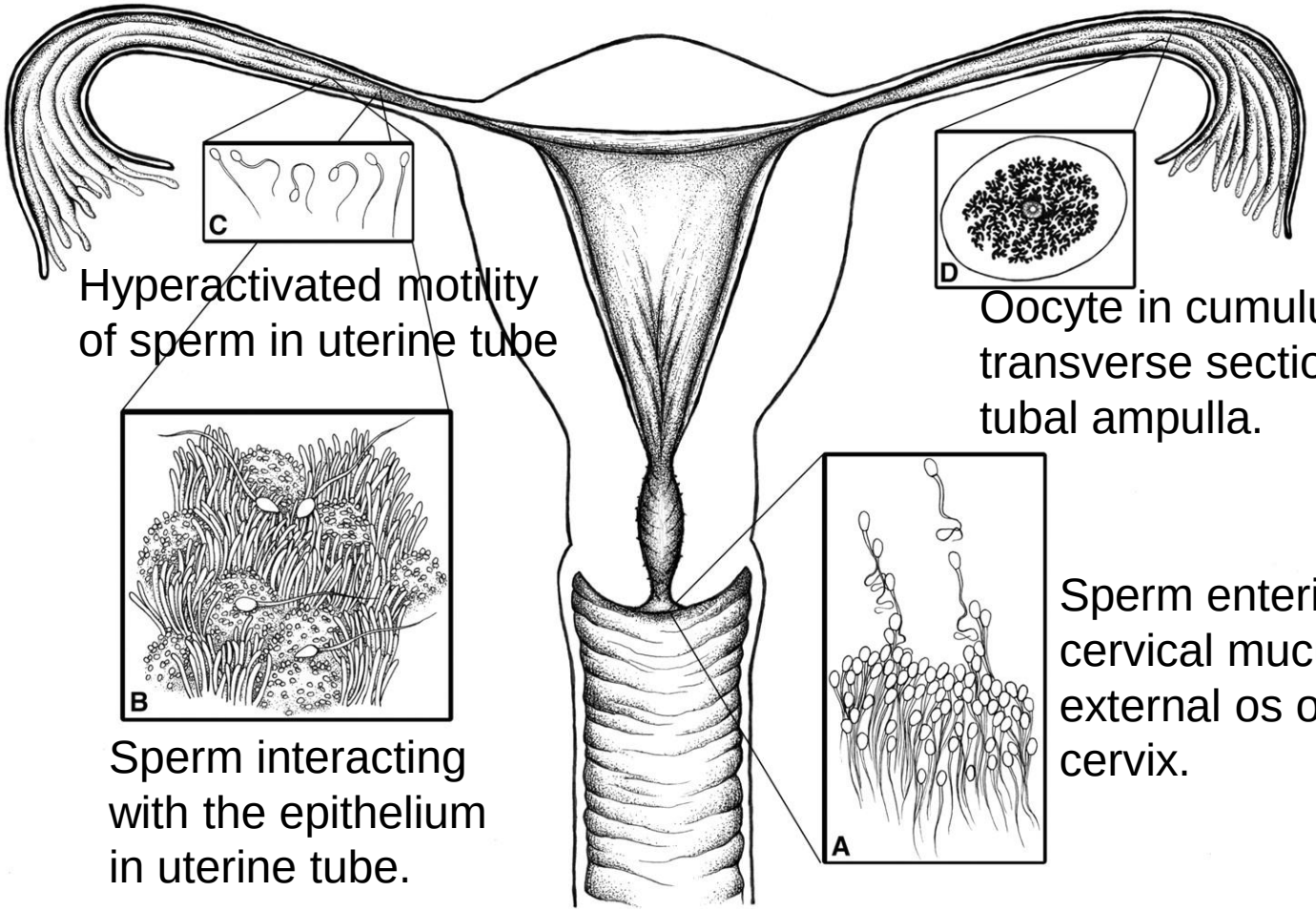
Accomplishing Fertilization



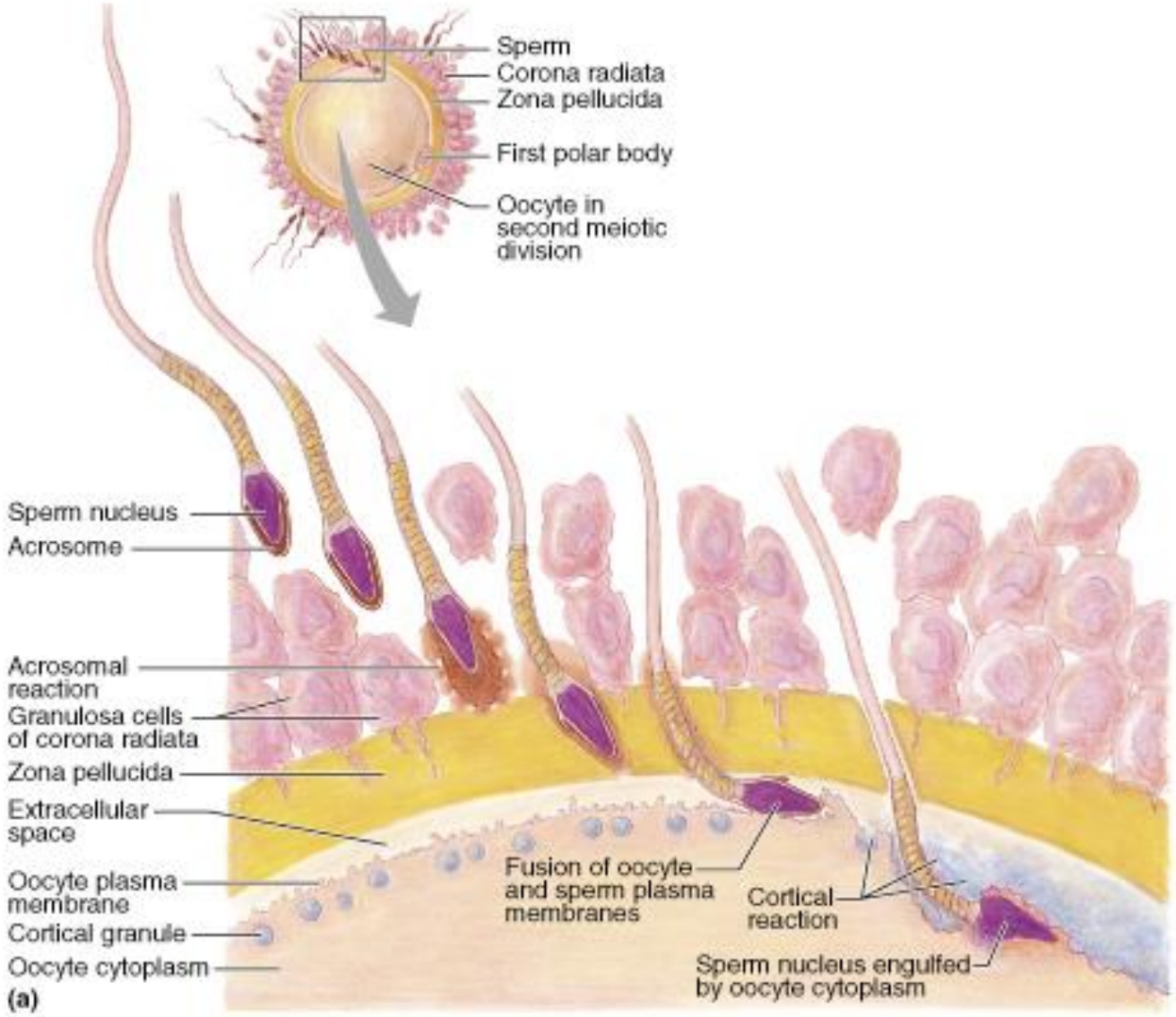
Sperm Transport



Human female reproductive tract illustrating stages of gamete transport

Fertilization

- If timing is ideal, sperm reach the oocyte in the ampulla of the uterine tube
- Sperm move by flagellar action but also receive an assist from uterine tube peristalsis



- **Capacitation**: the process in the femal reproductive tract whereby the ejaculated sperm become capable of fertilizing the egg
  - –Acrosomal membrane must become fragile

Sperm lipid concentrations before and after migration through cervical mucus

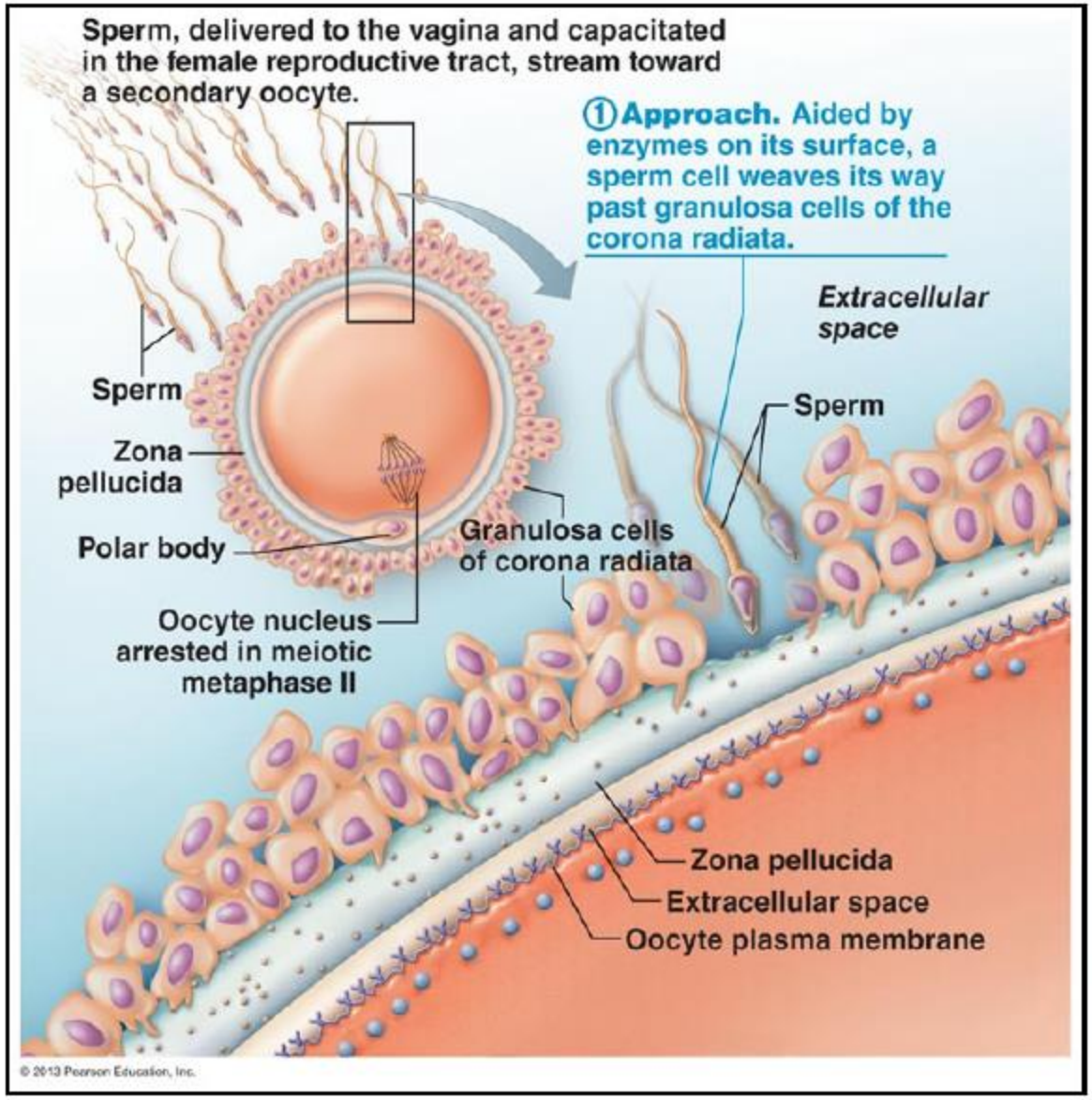
Characteristics	Before	After
Vitamin E (ng/108 sperm)[2]	210.9 6 25.0 (148.1±394.8) ±184.3 6 18.7a	26.5 6 19.2 (0±199.0)
Cholesterol (nmol/108 sperm)	93.0 6 4.5 (68.8±114.6) ±41.9 6 5.5a	51.1 6 3.3 (32.7±70.5)
D*22:6/16:0 (nmol/108 sperm)	33.6 6 1.5 (38.8±27.2) 6 3.2a	22.9 6 2.3 (34.7±13.4) ±10.7
D22:4/16:0 (nmol/108 sperm)[2]	5.5 6 0.1 (5.8±4.9)	2.9 6 0.5 (4.9±1.7) ±2.6 6 0.5a
D18:2/16:0 (nmol/108 sperm)[2]	11.3 6 0.7 (8.8±15.7)	4.0 6 0.8 (9.5±2.0) ±7.3 6 0.8a
D22:6/18:0 (nmol/108 sperm)[2]	9.1 6 0.6 (8.5±12.8)	4.5 6 0.8 (2.7±9.1) ±4.7 6 0.7a
D20:4/18:0 (nmol/108 sperm)[2]	4.8 6 0.3 (4.2±5.7)	2.1 6 0.5 (1.4±4.3) ±2.7 6 0.5a
Total diacyls (nmol/108 sperm)	67.1 6 3.4 (54±80)	37.2 6 4.5 (22.5±62.5) ±30.0 6 5.7a
Plasmalogen (nmol/108 sperm)	19.3 6 2.7 (11.6±35.8)	9.2 6 1.1 (5.0±14.9) ±10.1 6 3.3a
Sphingomyelin (nmol/108 sperm)	39.0 6 10.9 (28.9±65.1)	18.9 6 7.1 (8.0±27.2) ±20.1 6 3.8a

Values are mean 6 SEM (range in parentheses); n = 11. *D = Diacyl. [2]Concentrations under the detection limit were considered to be 0 for statistical purposes; aP < 0.001 with the Wilcoxon test.

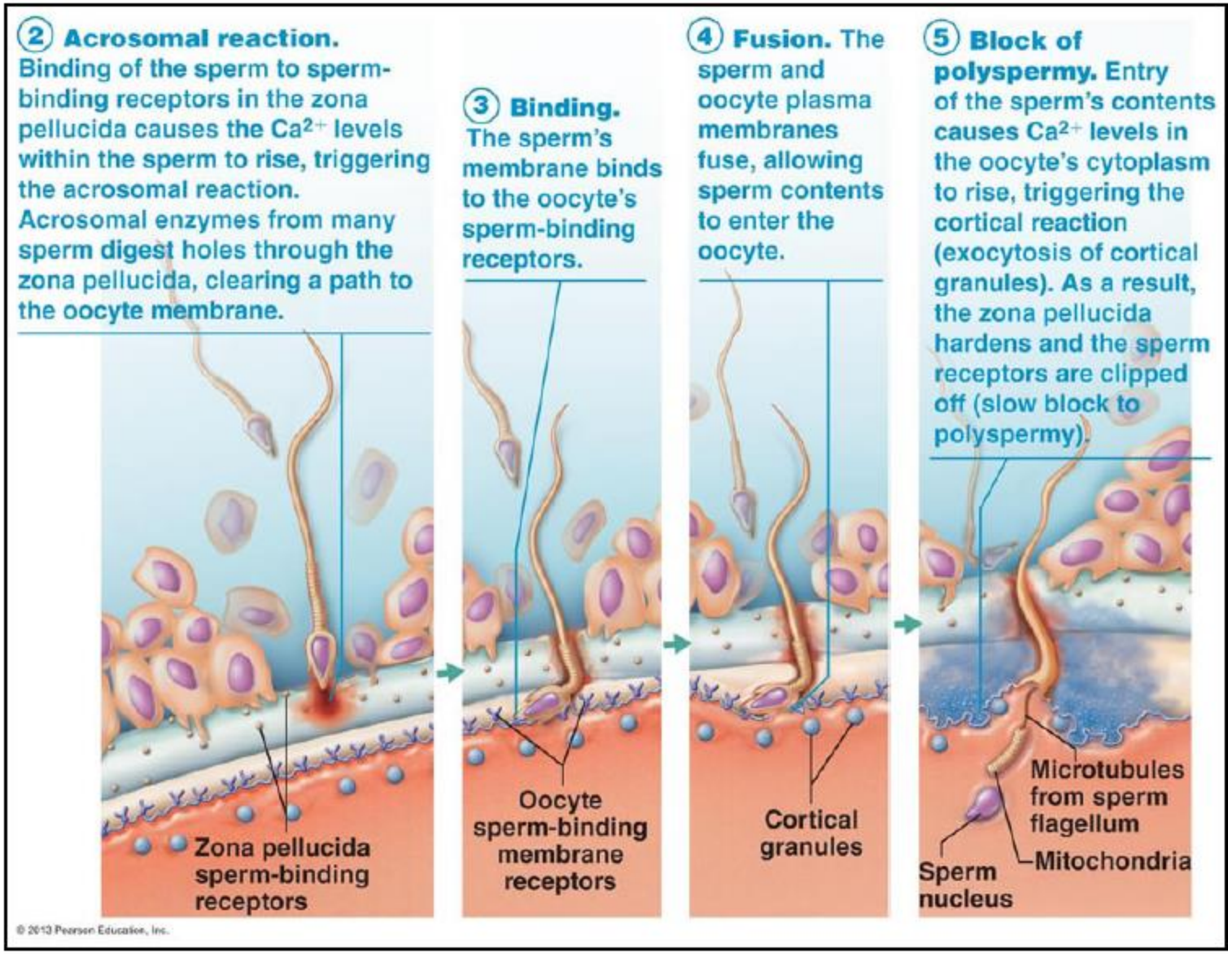
Acrosomal Reaction and Sperm Penetration

- Acrosomal reaction: release of the digestive enzymes (acrosin, other proteases) from the sperms' acrosome
  - Hundreds of sperm must participate

Acrosomal Reaction and Sperm Penetration

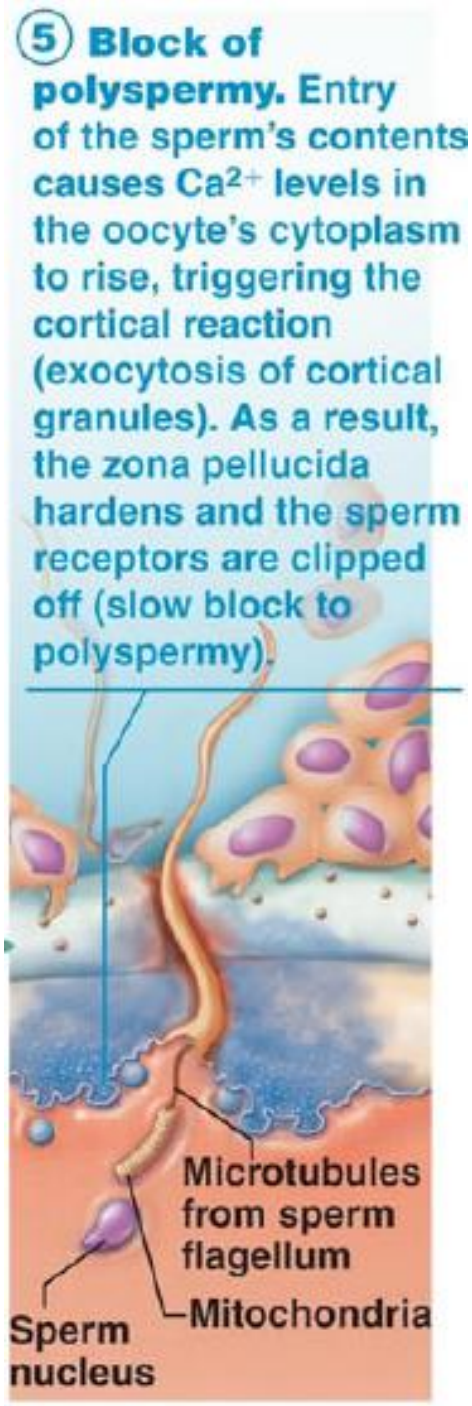


Acrosomal Reaction and Sperm Penetration



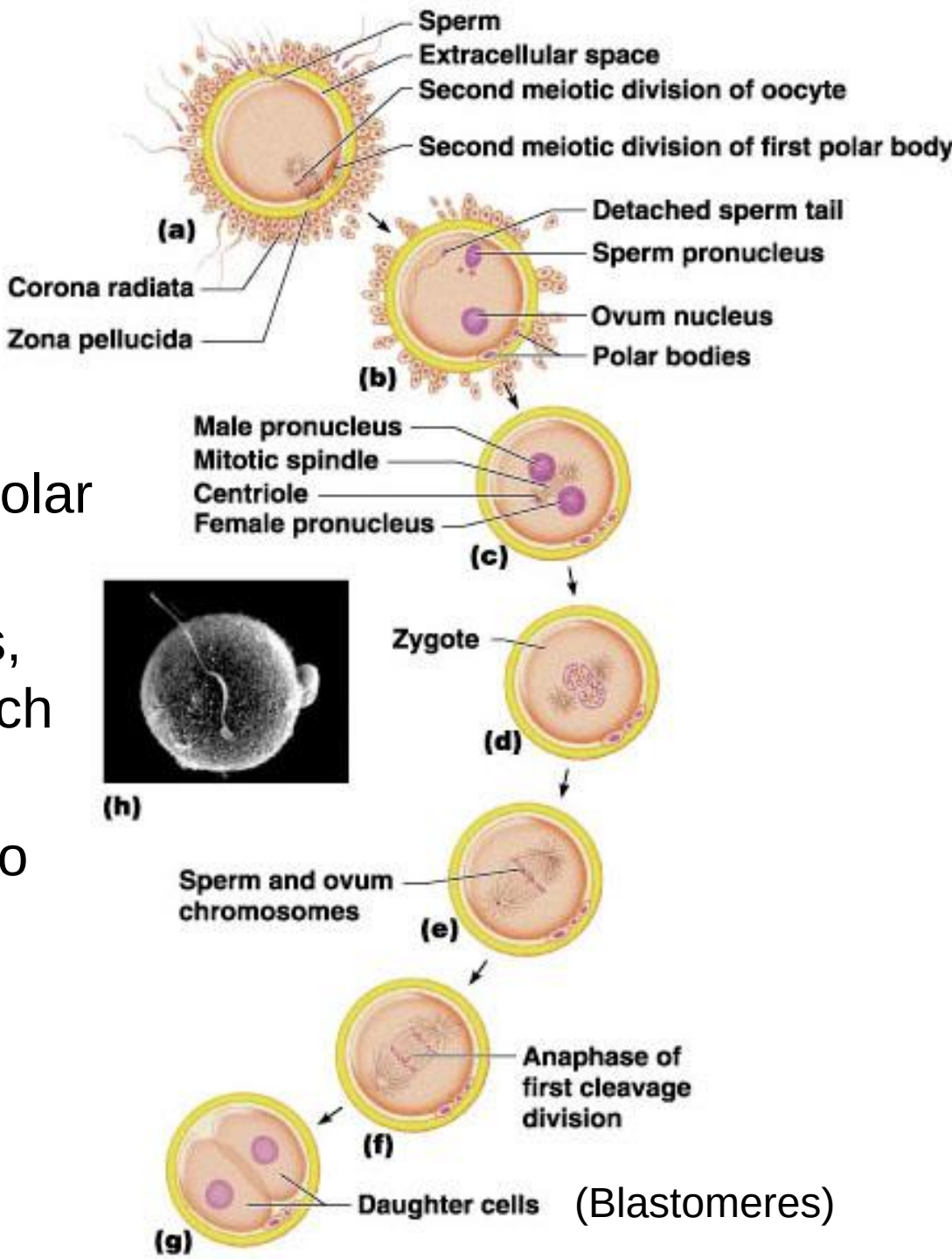
Prevention of Polyspermy

- Penetration of the oocyte membrane by the first sperm causes the membrane to depolarize (Ca^{2+} release) (*fast block*)
- Cell membrane depolarization triggers release of stored Ca^{++} from the endoplasmic reticulum
- Ca^{++} causes **cortical reaction** resulting in formation of fertilization membrane from cortical vesicles (*slow block*)
- Polyploid zygotes cannot survive



Early Events of Fertilization

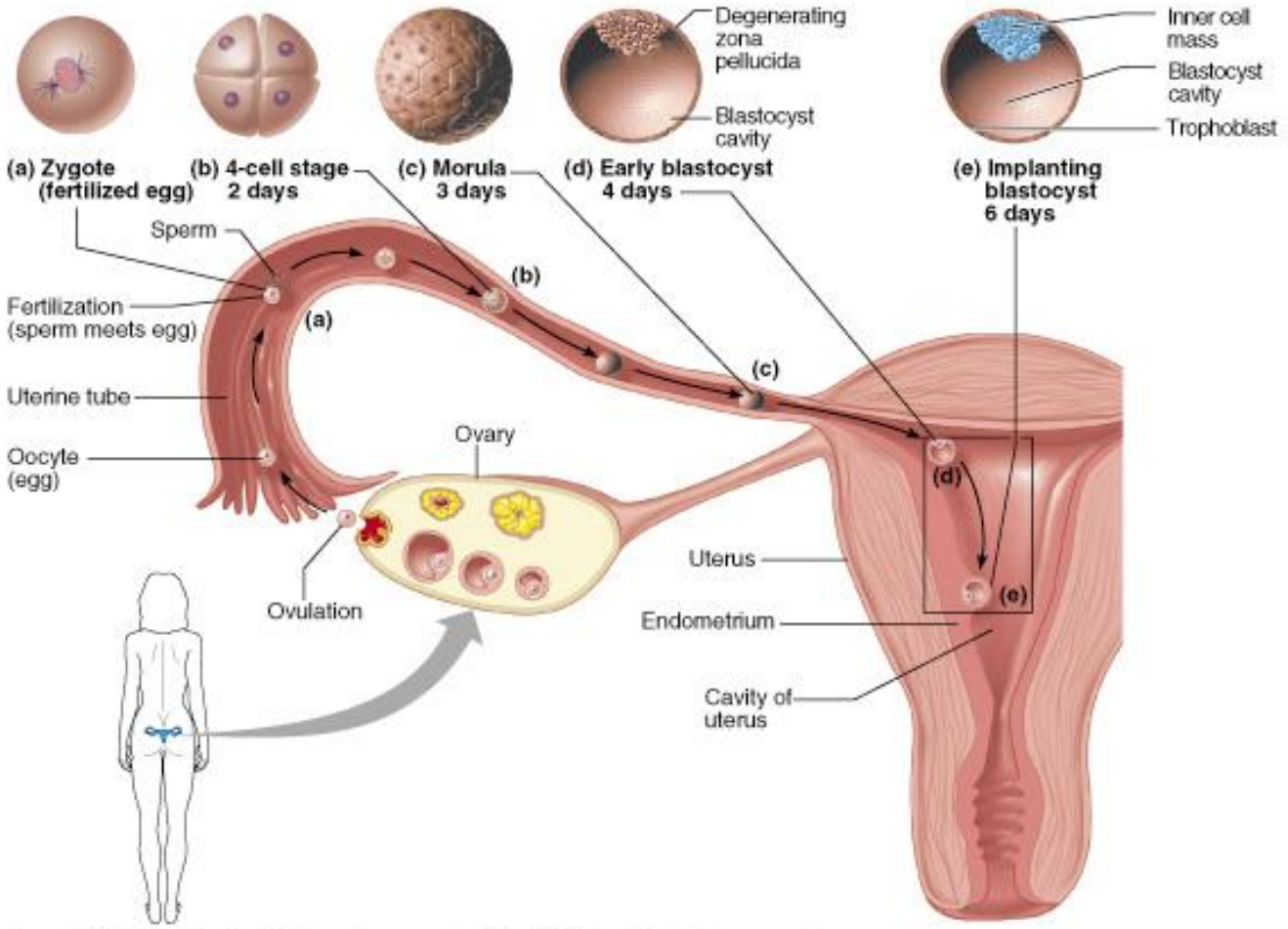
- Upon entry of sperm, the secondary oocyte:
  - Completes meiosis II
  - Casts out the second polar body
- The oocyte nucleus swells, and the two nuclei approach each other
- When fully swollen, the two nuclei are called pronuclei
- Pronuclei burst
- Fertilization – when the pronuclei come together



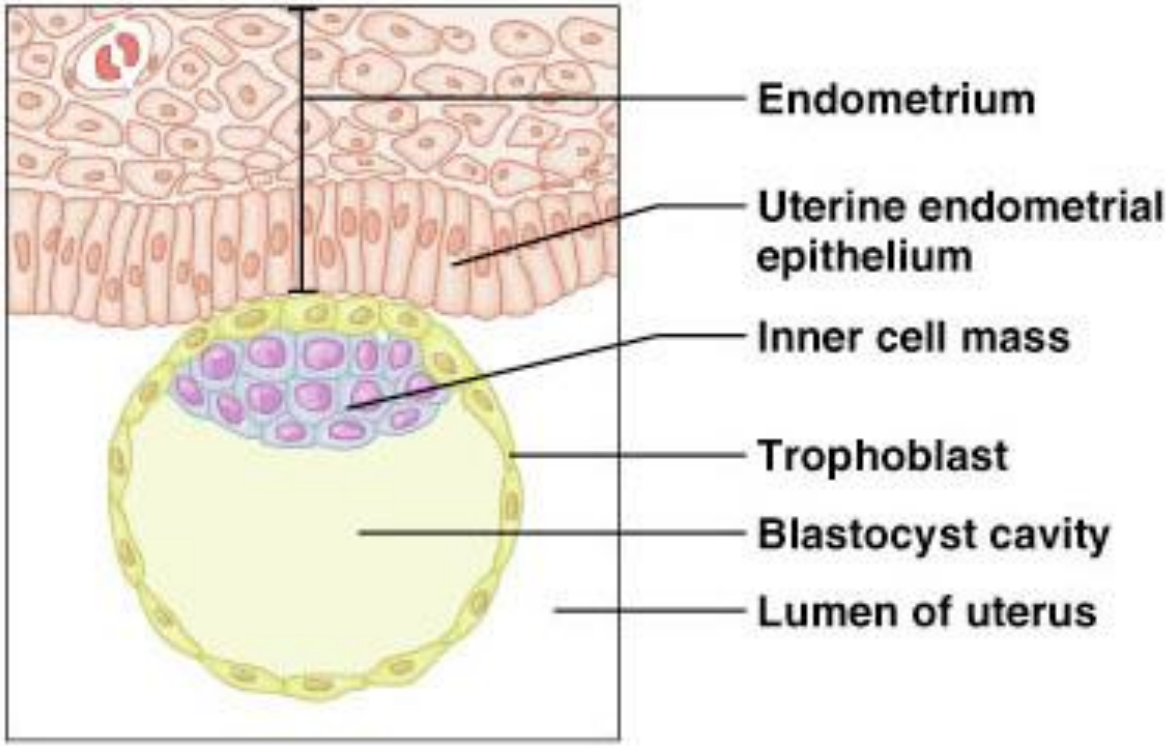
(Blastomeres)

Embryonic Development:
from Zygote To Blastocyst Implantation

- Zygote undergoes cleavage to morula and on to blastocyst; should be completed in the uterine tube



Implantation

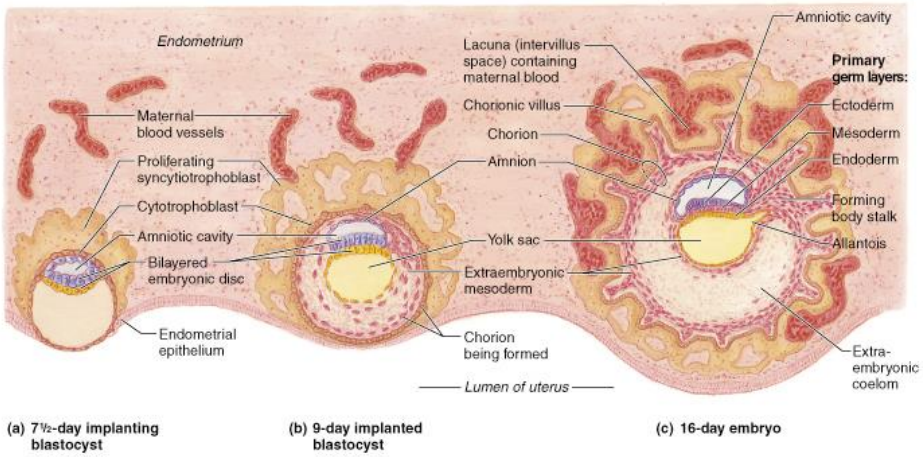


- Blastocyst “floats” in the uterus for 2-3 days

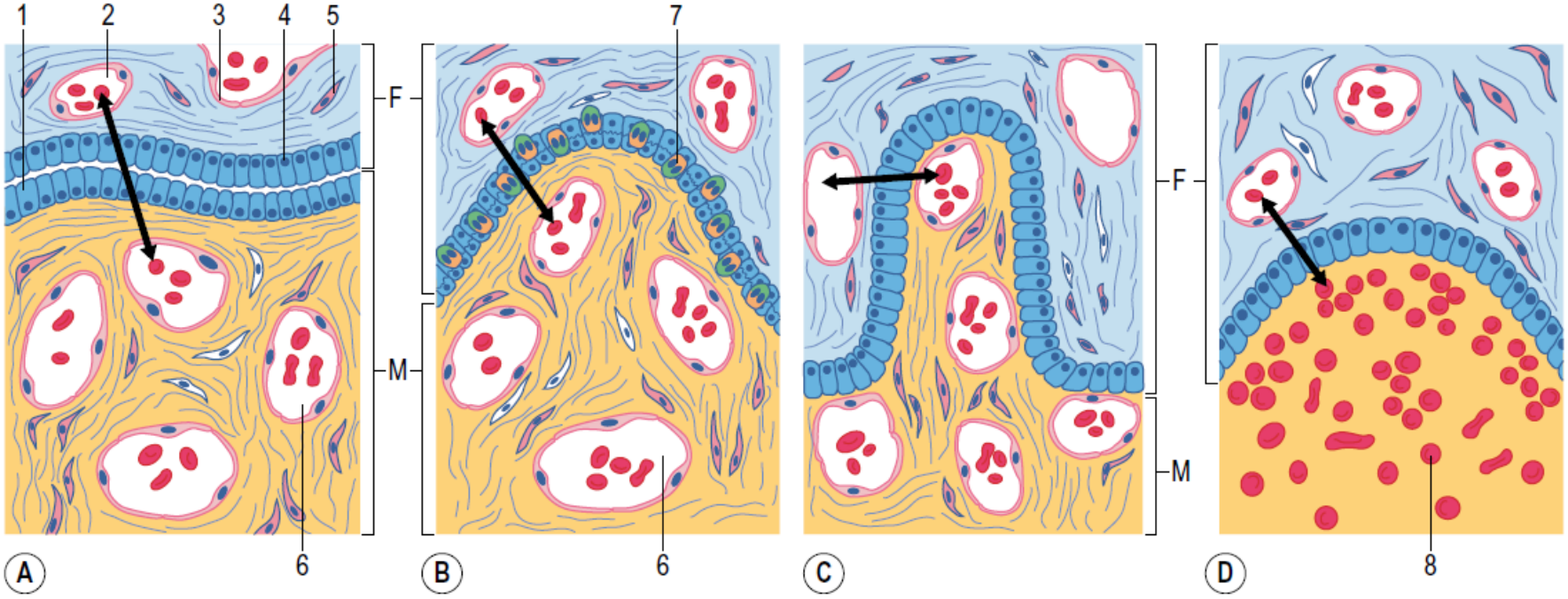
- Blastocyst implants 6-7 days after fertilization

Placentation

- The trophoblast develops fingerlike chorionic villi, which:
  - become vascularized
  - extend to the embryo as umbilical arteries and veins
  - lie immersed in maternal blood



Placentation: domestic animals



The placenta can be classified according to its gross anatomical appearance in:

- **Diffuse,**
- **Cotyledonary,**
- **Zonary,**
- **Discoid**.

Placentation: Humans

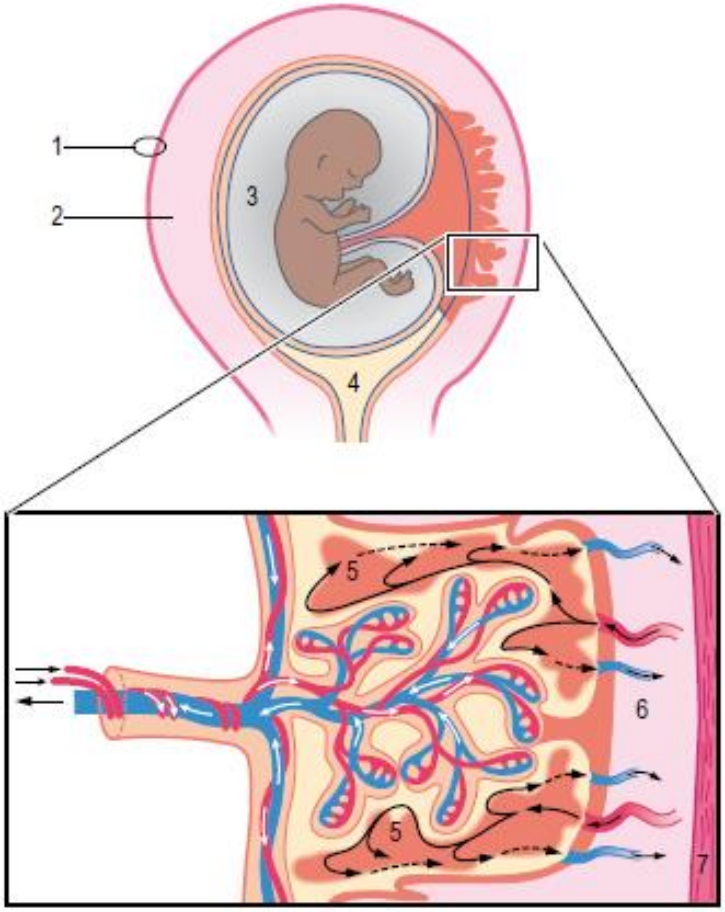
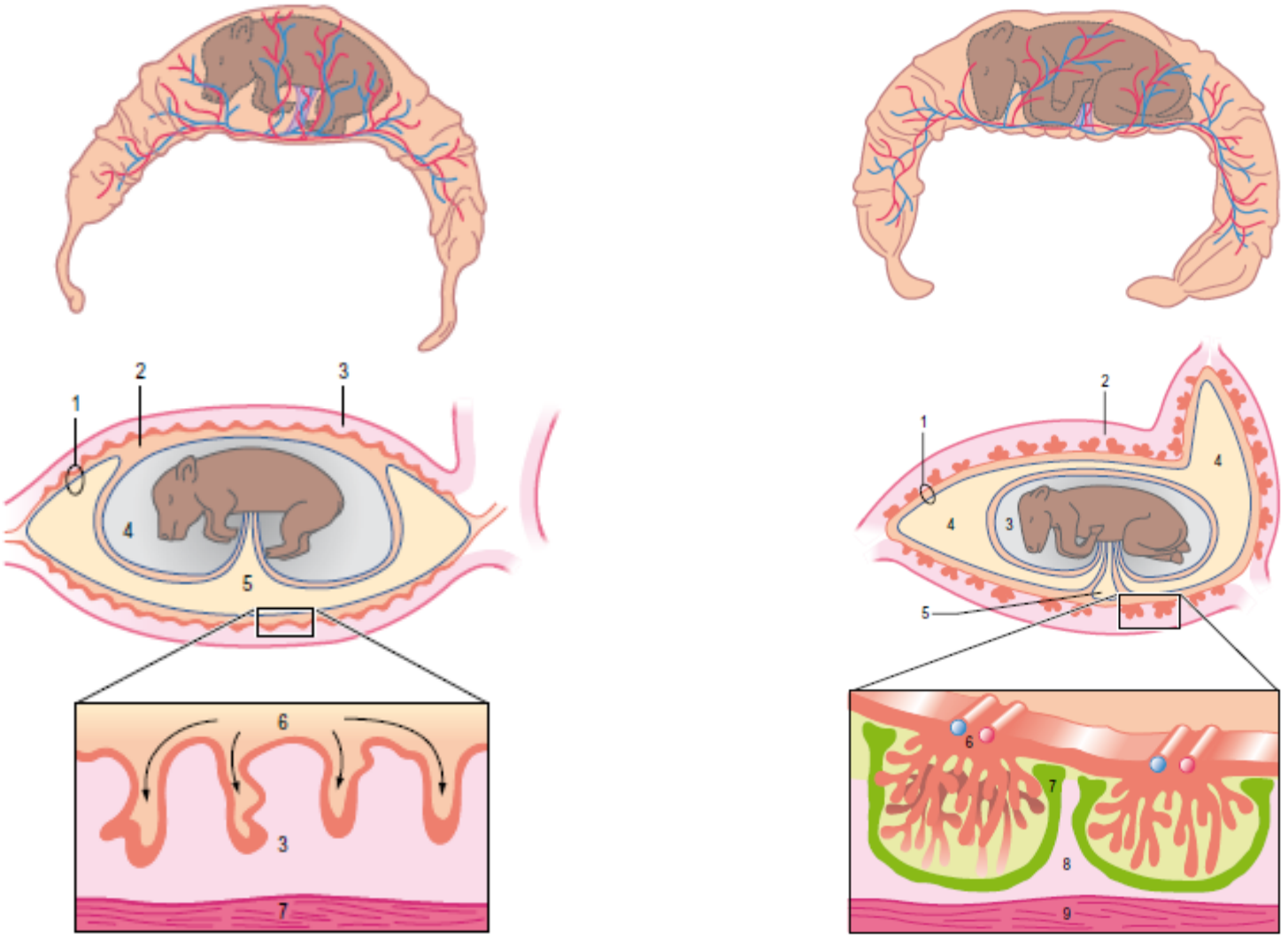


Fig. 9-14: The discoid primate placenta. 1: Perimetrium; 2: Endometrium and myometrium; 3: Amnion; 4: Uterine cavity; 5: Intervillous space with maternal blood; 6: Endometrium; 7: Myometrium.

Discoid Placenta

Placentation: Pigs and Horses



Diffuse Placenta

Placentation: Ruminants

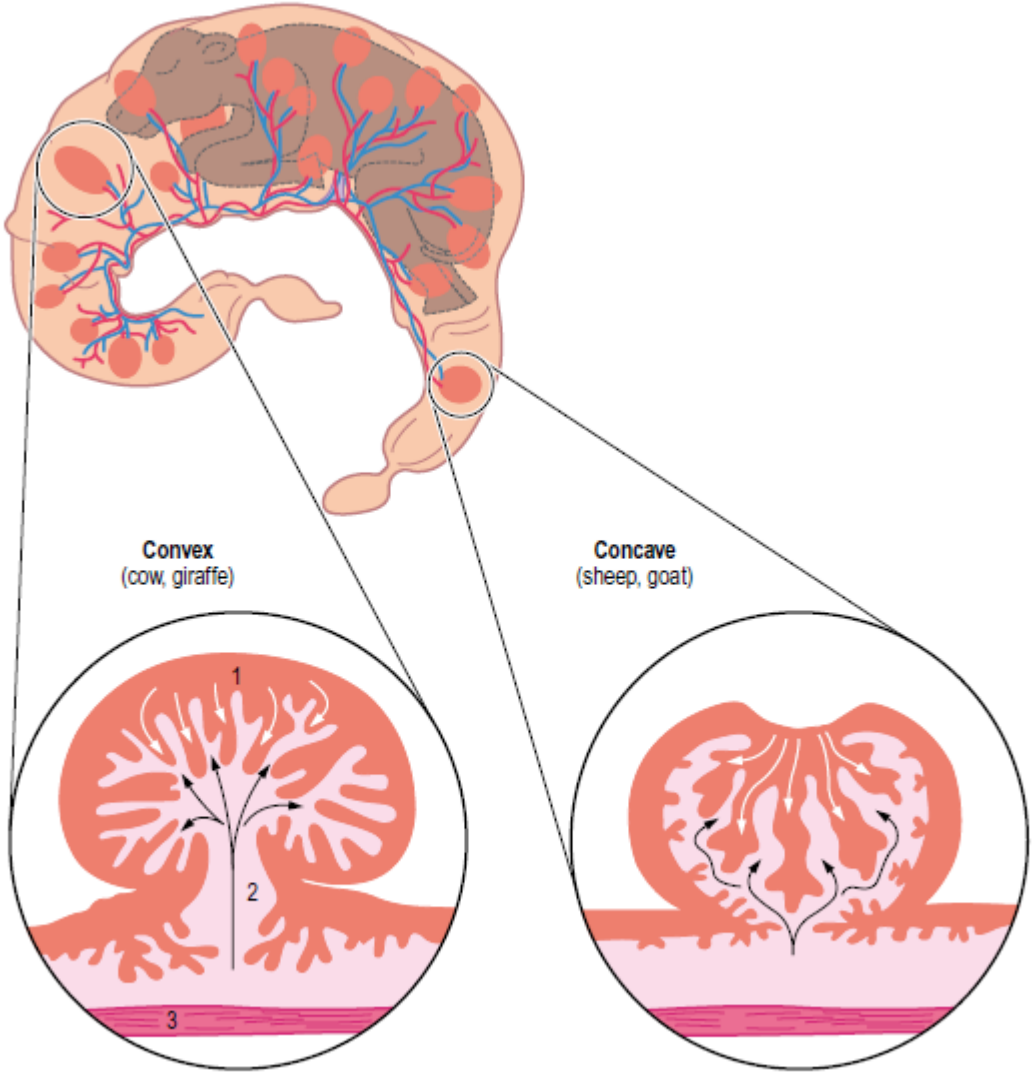


Fig. 9-6: The cotyledonary placenta of the ruminants. 1: Chorioallantois (cotyledon) forming villi; 2: Caruncle with crypts enclosing the villi; 3: Myometrium.

Cotiledonary Placenta

Placentation: Carnivores

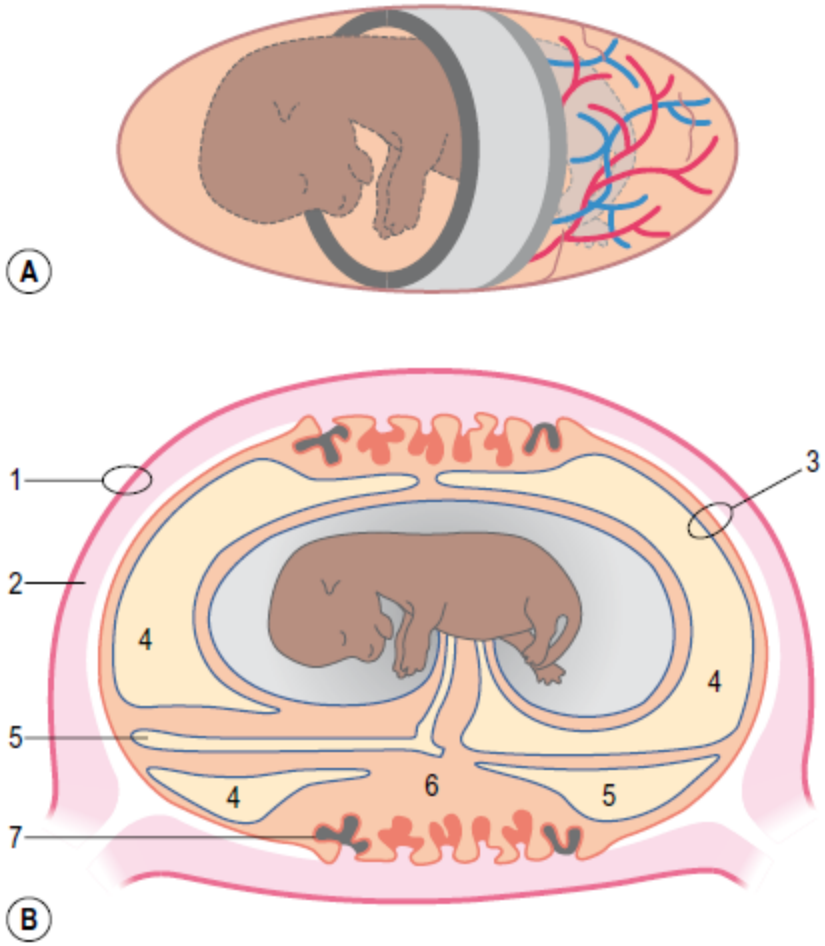
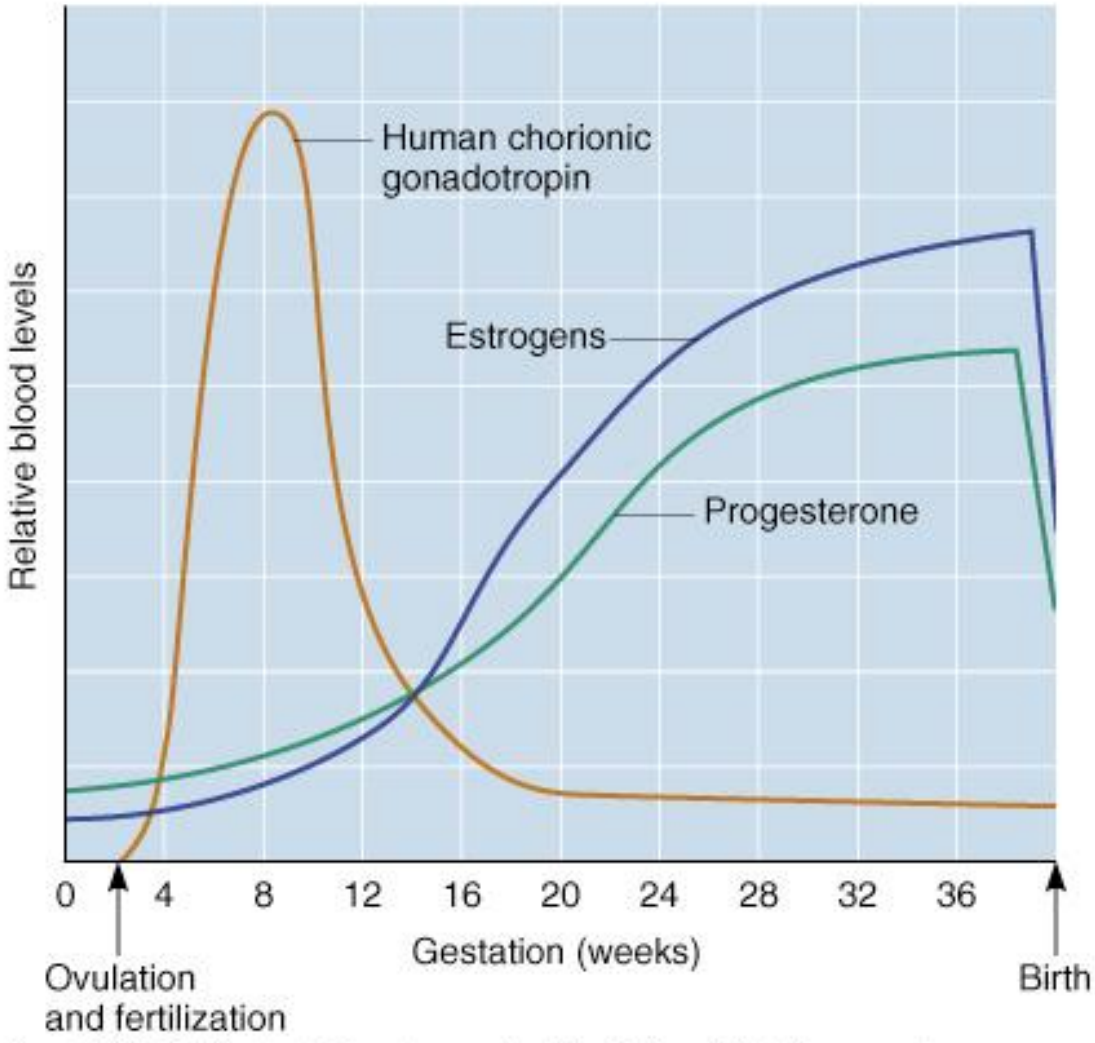


Fig. 9-12: The zonary placenta of the bitch. 1: Perimetrium; 2: Endometrium and myometrium; 3: Chorioallantois; 4: Allantois; 5: Yolk sac; 6: Chorioallantois forming lamellae in the placental zone; 7: Marginal haematoma.

Zonary Placenta

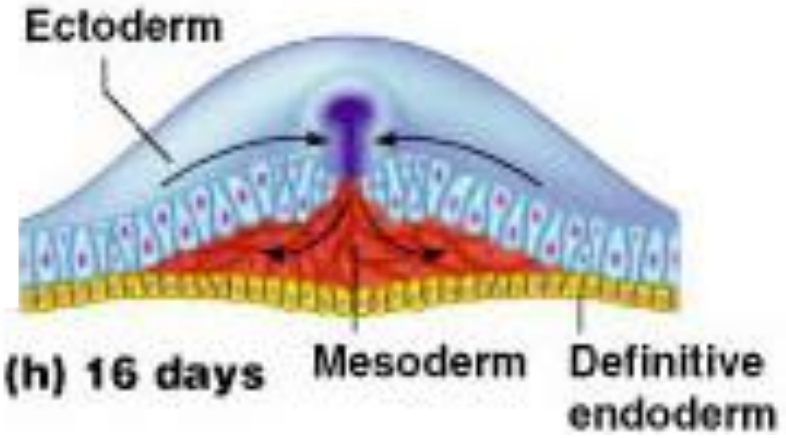
Placenta in humans produces hCG, estrogen, progesterone, etc.

- hCG maintains the corpus luteum which produces estrogen and progesterone (positive feedback)
- hCG informs the hypothalamus and pituitary that implantation has occurred
- eventually, the placenta produces its own estrogen & progesterone to support uterine proliferation



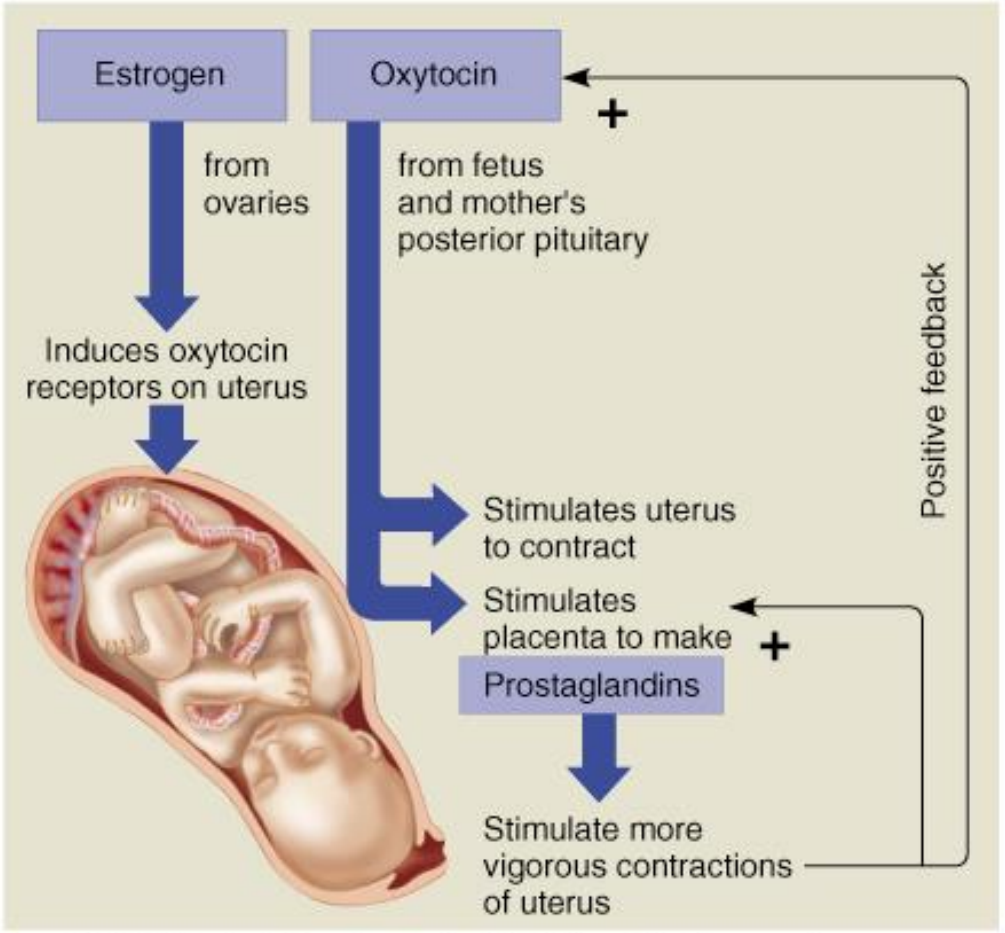
The Primary Germ Layers

- form populations of stem cells from which all body tissues and organs are derived
- **Ectoderm** – forms structures of the nervous system and skin epidermis
- **Endoderm** – forms epithelial linings of the digestive, respiratory, and urogenital systems
- Endoderm and ectoderm give rise to the epithelial tissues
- **Mesoderm** – forms all other tissues (all connective tissues, bone, all types of muscle, blood and blood vessels, the gonads and the adrenal cortex)



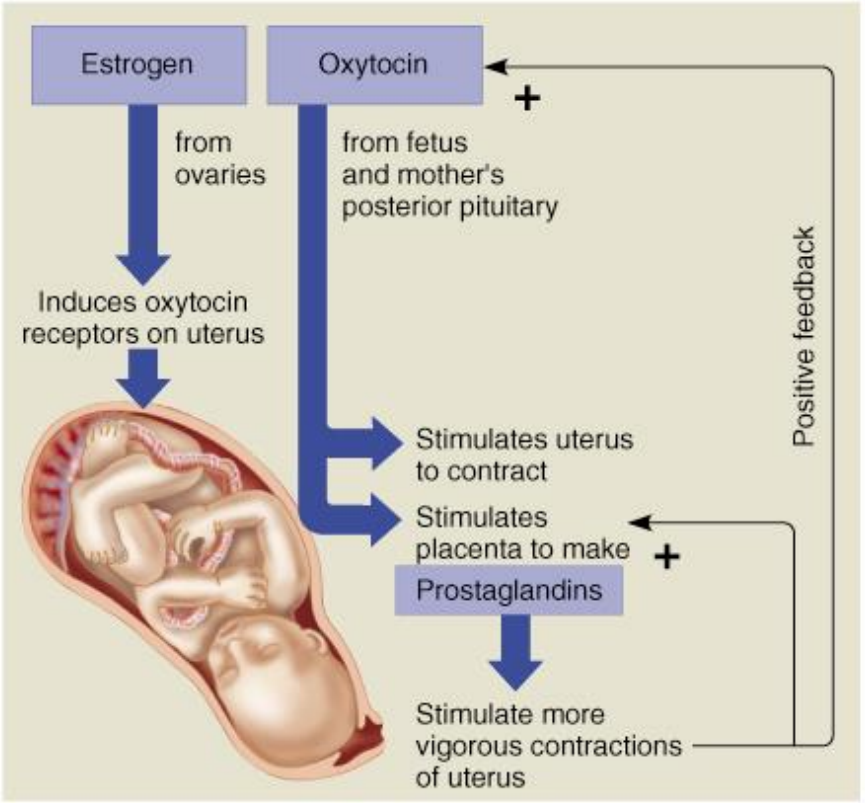
Regulation of Parturition (birth)

- Labor and Delivery are regulated cooperatively by hormones and the NS



Regulation of Parturition

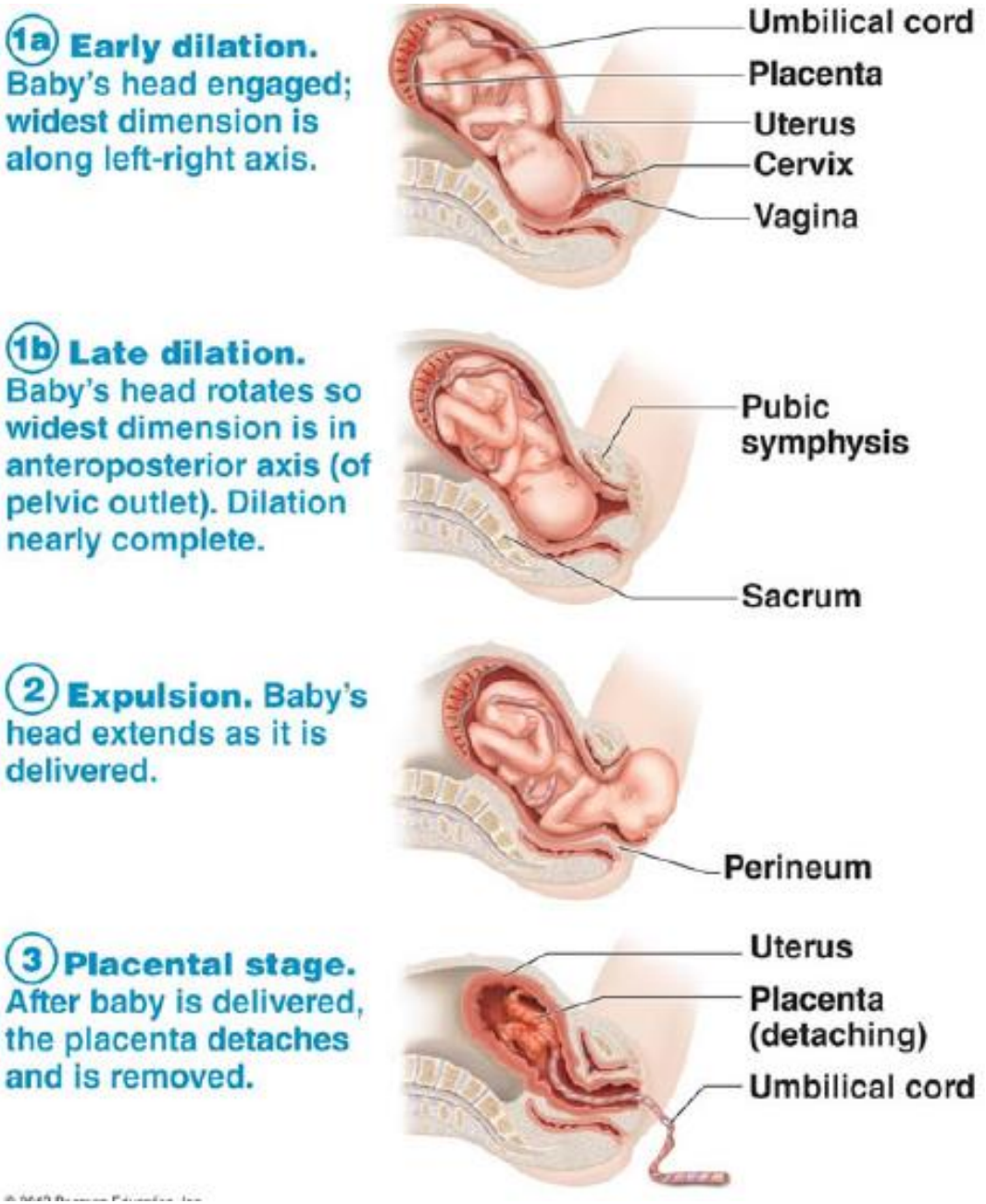
- **Cortisol** from fetus increases estrogen
- **Estrogen** peaks during the last weeks of pregnancy increasing **oxytocin** receptors and antagonzing P_4 causing myometrial weakness and irritability
- As birth nears, the fetus produces oxytocin and the placenta produces **prostaglandins** causing uterine contractions
- Emotional and physical stress:
  - activates the hypothalamus
  - sets up a positive feedback mechanism, releasing more oxytocin
- **Relaxin** is secreted by the corpus luteum; it helps to soften the cervix and relax the pelvic ligaments in preparation for childbirth



Parturition

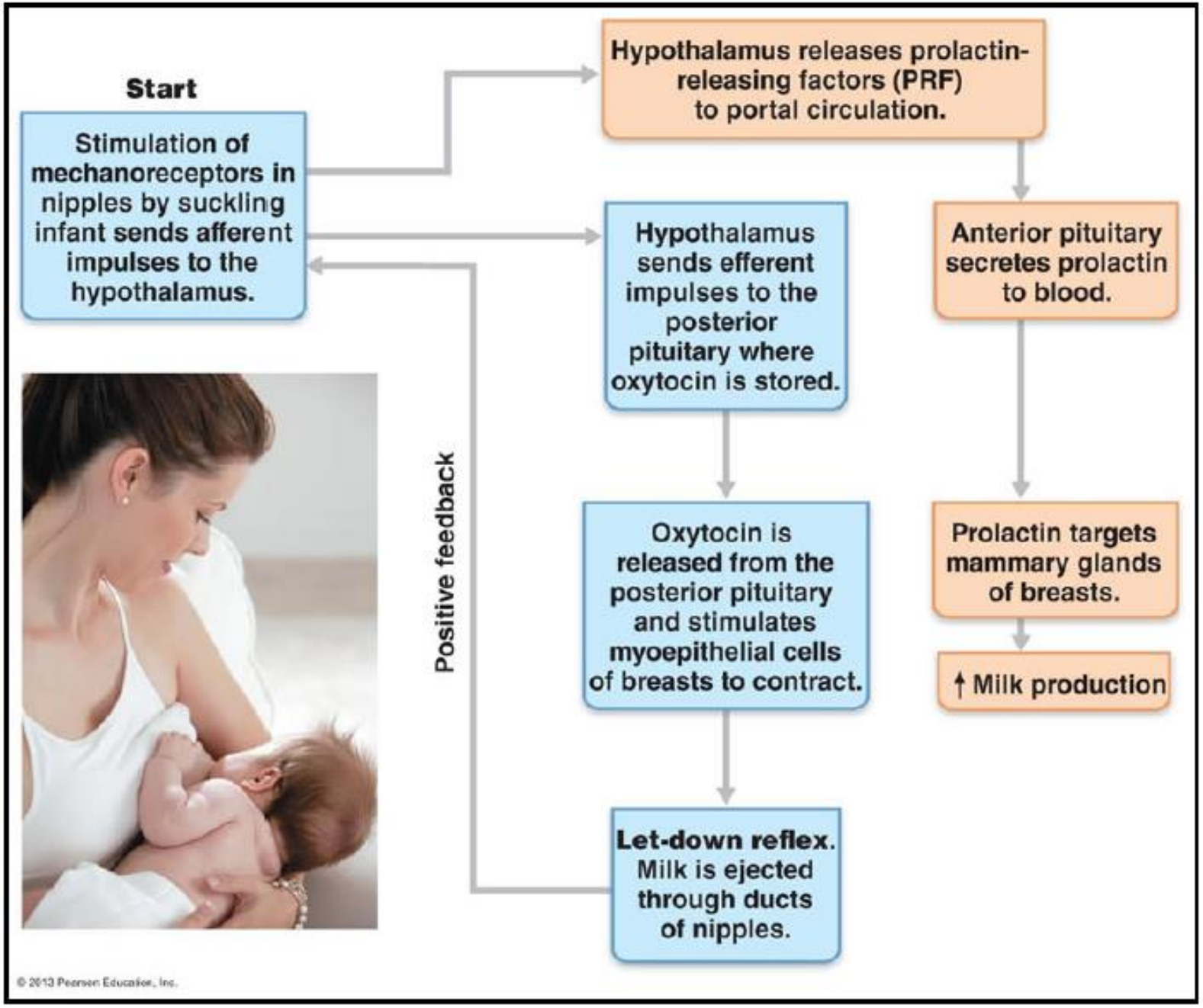
- Dilation → Expulsion of Neonate → Expulsion of Placenta

- Eventually conscious motor commands add the “push” for delivery



Lactation

- the production of milk by the mammary glands
- **estrogens**, **progesterone**, and **lactogen** stimulate the hypothalamus to release a prolactin-releasing hormone (PRH)
- the anterior pituitary responds by releasing **prolactin**
- **Colostrum**
  - a yellowish solution rich in vitamin A, protein, minerals, and IgA antibodies
  - is released the first 2–3 days
  - is followed by true milk production


Start
Stimulation of mechanoreceptors in nipples by suckling infant sends afferent impulses to the hypothalamus.
Hypothalamus releases prolactin-releasing factors (PRF) to portal circulation.
Anterior pituitary secretes prolactin to blood.
Prolactin targets mammary glands of breasts.
↑ Milk production
Hypothalamus sends efferent impulses to the posterior pituitary where oxytocin is stored.
Oxytocin is released from the posterior pituitary and stimulates myoepithelial cells of breasts to contract.
Let-down reflex. Milk is ejected through ducts of nipples.
Positive feedback
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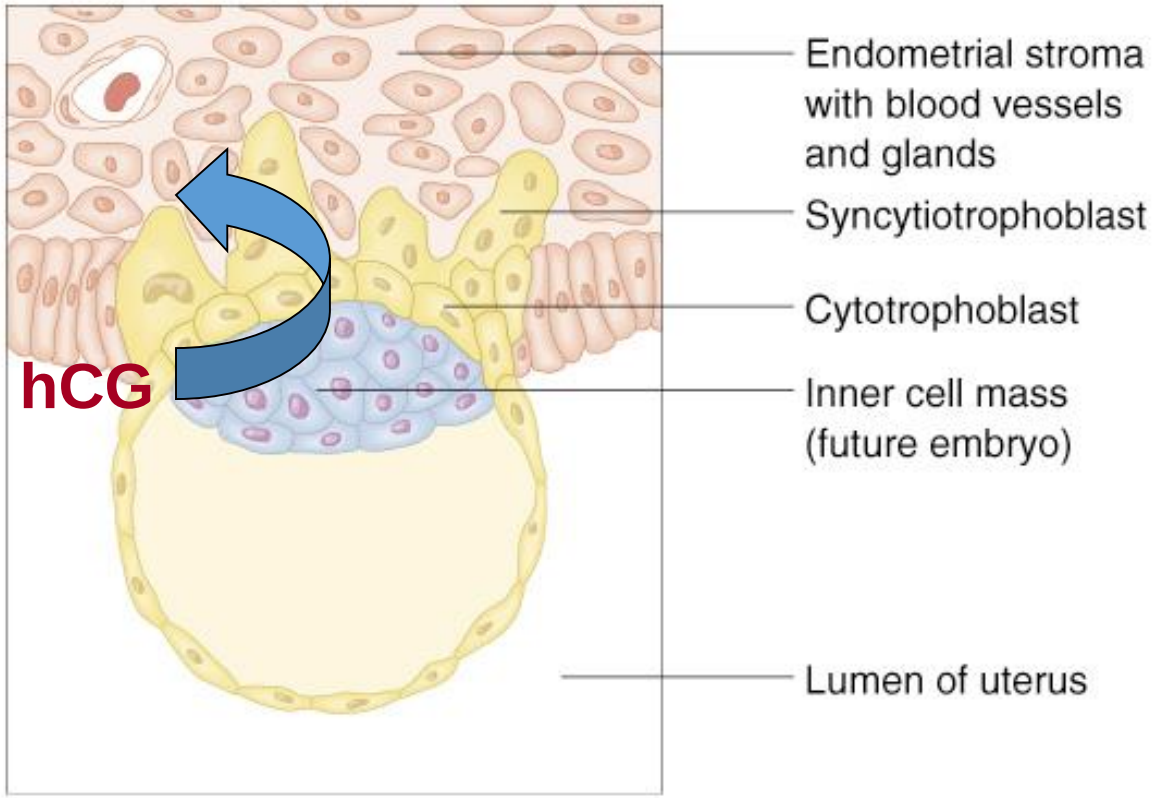
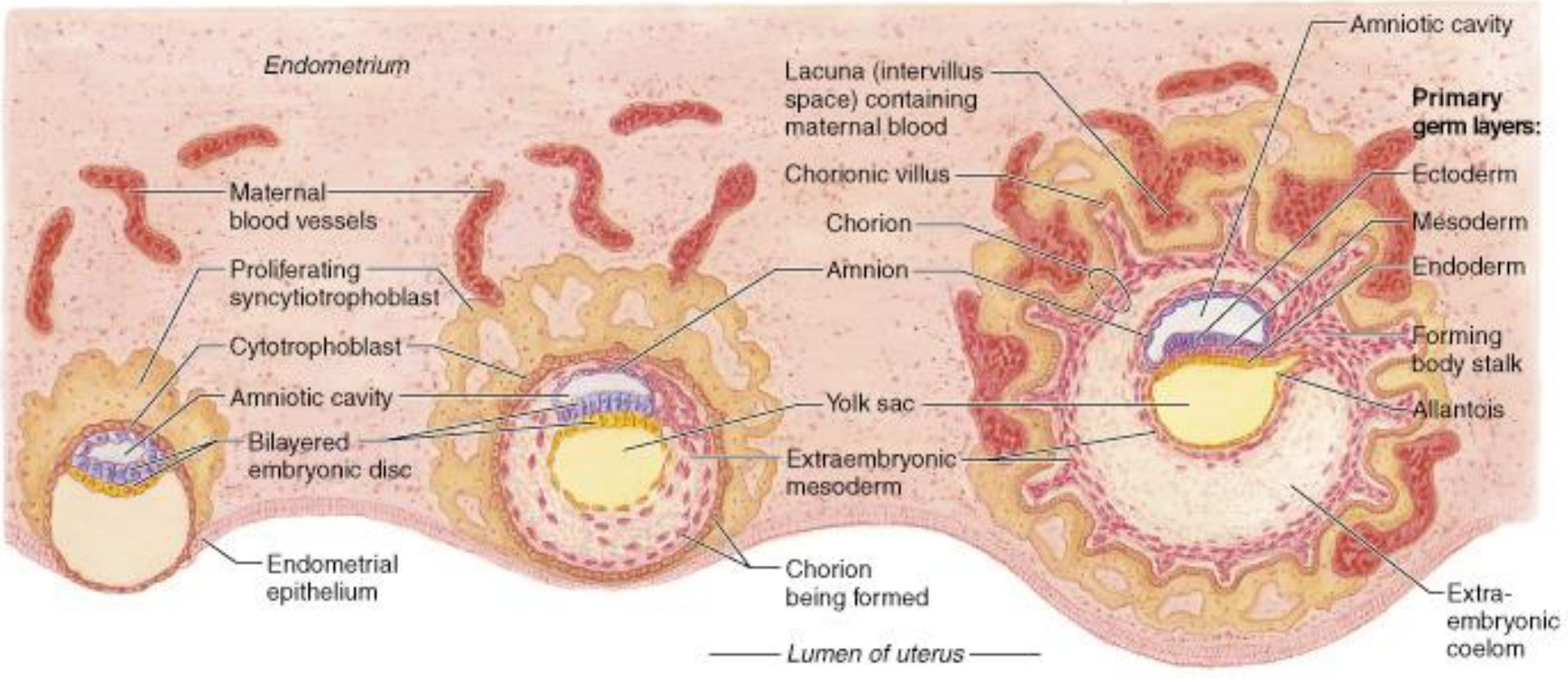
Implantation

- implantation completed by 14 days after ovulation
- hCG from the placenta signals the hypothalamus, pituitary, and corpus luteum that implantation has occurred
- steroid hormone levels are maintained which prevents uterine sloughing (menses)



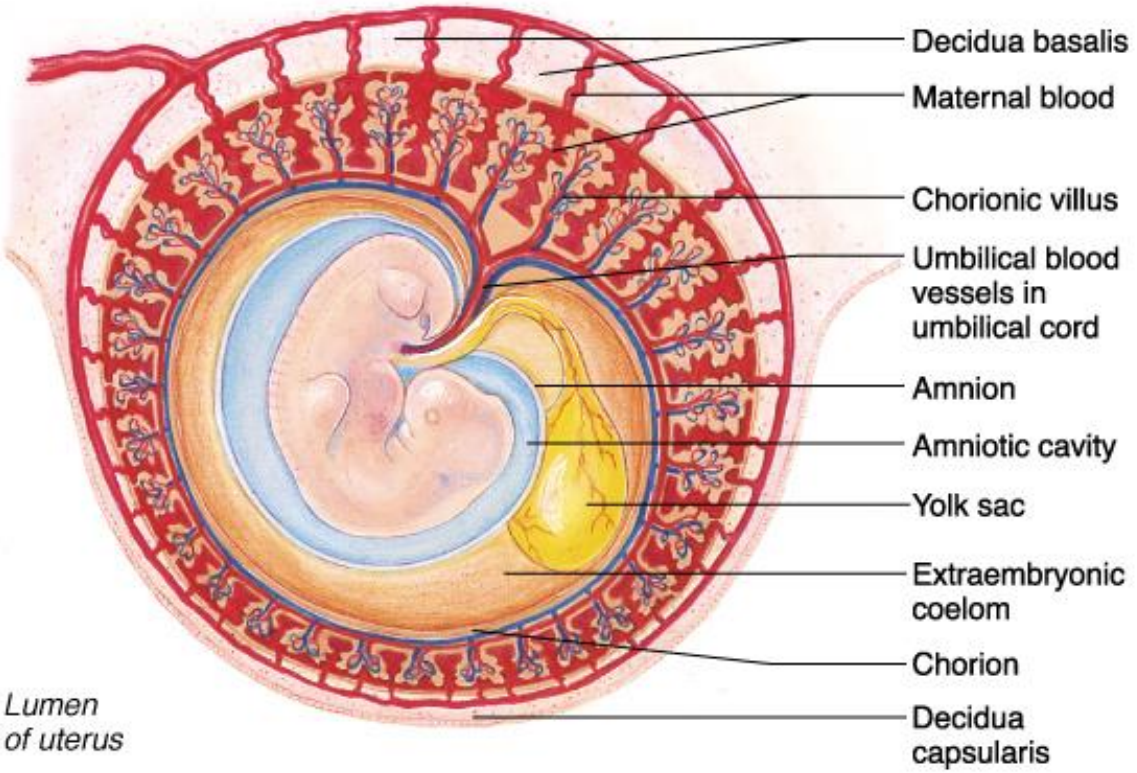
Placentation

- The embryo is supported by three external embryonic membranes: **chorion**, **allantois**, and **amnion**.



Chorion (outer membrane) forms from the embryonic trophoblast

- chorion forms the bulk of the placenta
- chorionic villi develop and become vascularized
- villi are surrounded by maternal blood vessels in the uterine lacunae
- nutrients, gases, and wastes are exchanged by diffusion between the maternal and fetal circulations

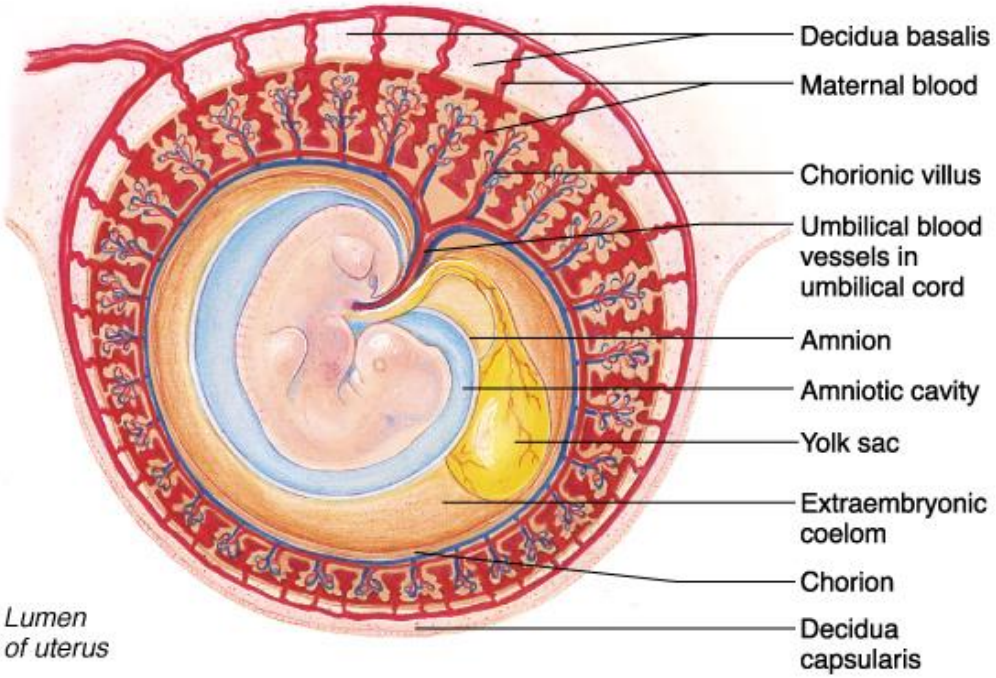


(d) 4½-week embryo

Allantois

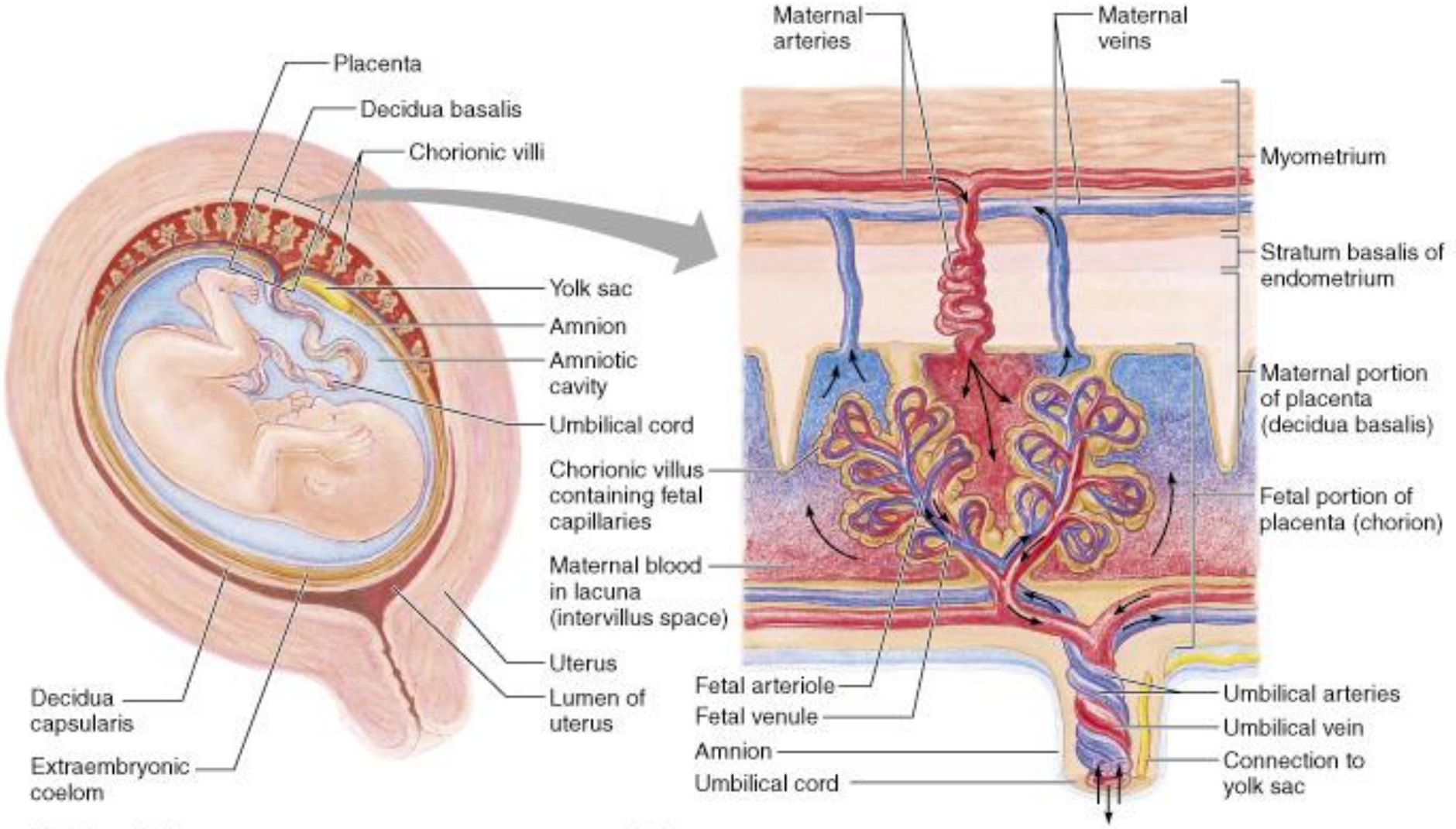
- Allantois – a small outpocketing at the caudal end of the yolk sac
  - structural base for the umbilical cord
  - becomes part of the urinary bladder

- Yolk sac – hypoblast cells that form a sac on the ventral surface of the embryo
  - forms part of the digestive tube
  - produces earliest blood cells and vessels
  - is the source of primordial germ cells



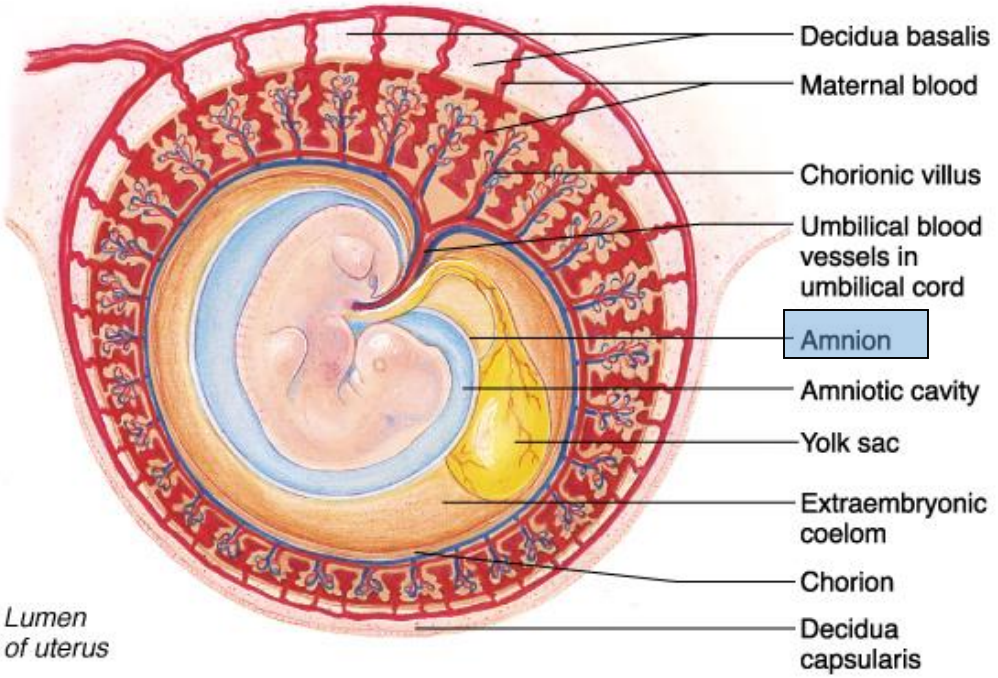
(d) 4½-week embryo

Umbilical cord with fetal blood vessels develops from allantois



Amnion (inner membrane) envelops and protects embryo

- amnion – epiblast cells form a transparent membrane filled with amniotic fluid – a maternal plasma filtrate
- amniotic fluid comes from maternal blood, and, later, fetal urine adds to it
- amniotic fluid acts as a liquid shock absorber to protect the fetus
- helps maintain uterine internal homeostatis
- amniotic fluid may be sampled to determine certain aspects of fetal health



(d) 4½-week embryo