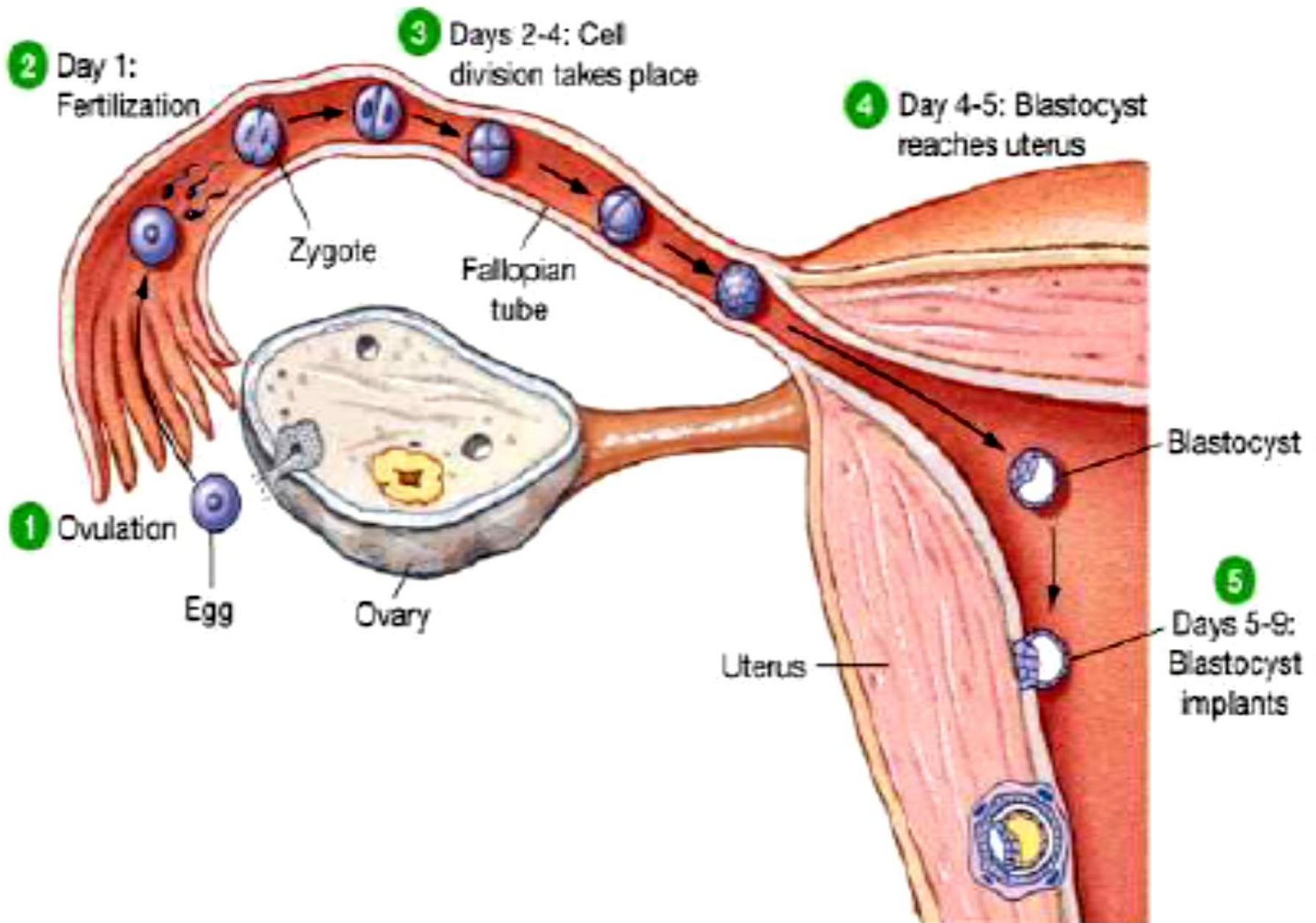
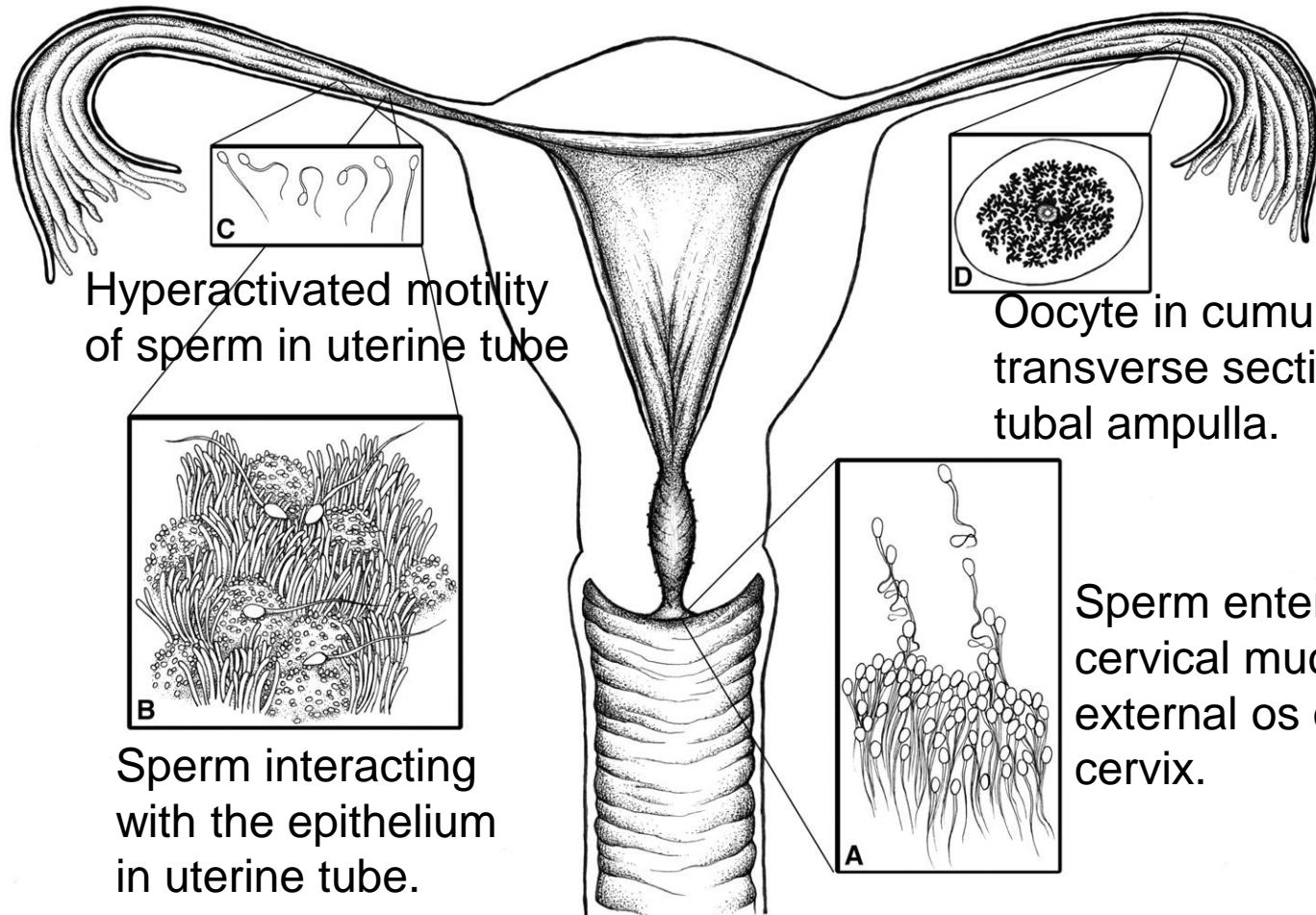


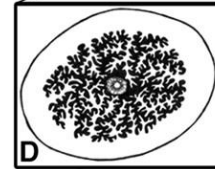
Accomplishing Fertilization



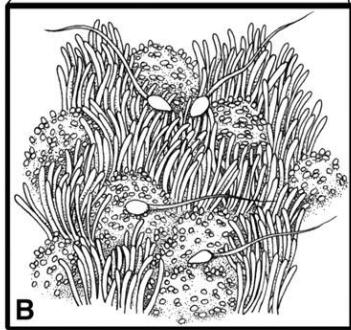
Sperm Transport



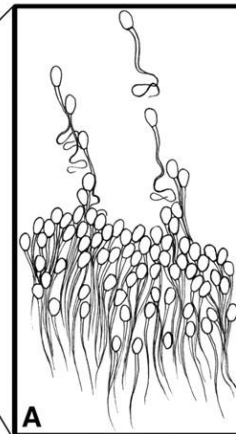
C
Hyperactivated motility
of sperm in uterine tube



D
Oocyte in cumulus within a
transverse section of the
tubal ampulla.



B
Sperm interacting
with the epithelium
in uterine tube.



A
Sperm entering
cervical mucus at
external os of
cervix.

Human female reproductive tract illustrating stages of gamete transport

- **Capacitation:** the process in the female 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

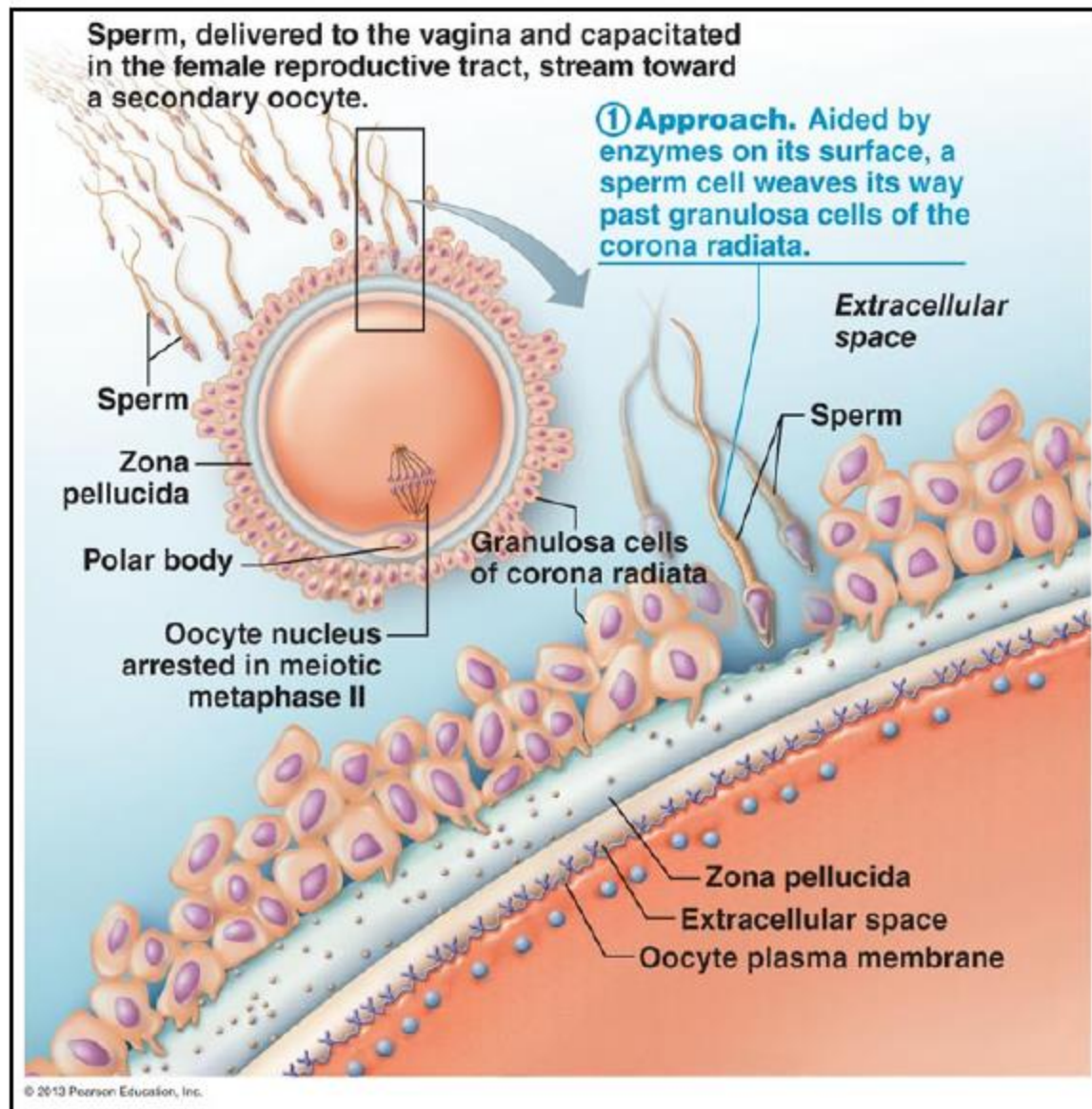
Characteristics	Before	After
Vitamin E (ng/108 sperm) ² ±184.3 6 18.7a	210.9 6 25.0 (148.1±394.8)	26.5 6 19.2 (0±199.0)
Cholesterol (nmol/108 sperm) ±41.9 6 5.5a	93.0 6 4.5 (68.8±114.6)	51.1 6 3.3 (32.7±70.5)
D*22:6/16:0 (nmol/108 sperm) 6 3.2a	33.6 6 1.5 (38.8±27.2)	22.9 6 2.3 (34.7±13.4) ±10.7
D22:4/16:0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

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

Acrosomal Reaction and Sperm Penetration

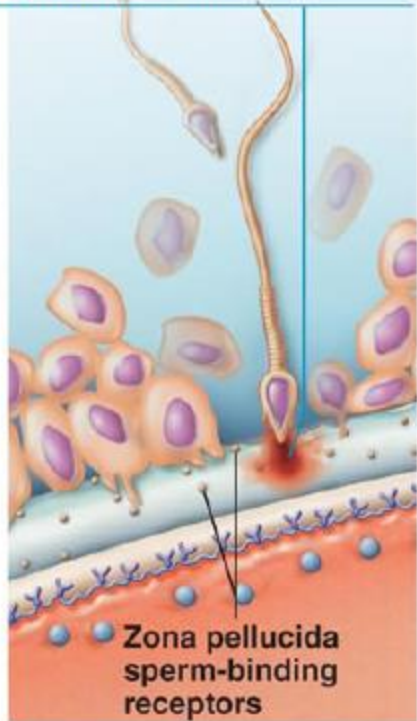
- Acrosomal reaction: release of the digestive enzymes (acrosin, other proteases) from the sperms' acrosome
 - Hundreds of sperm must participate

Acrosomal Reaction and Sperm Penetration

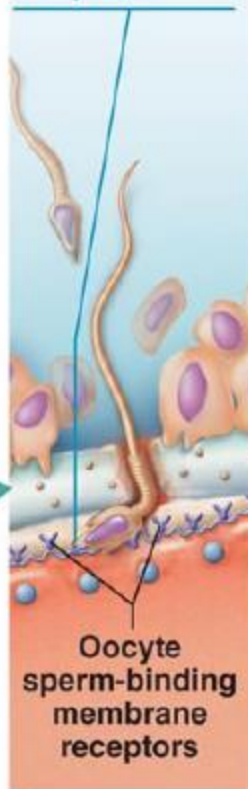


Acrosomal Reaction and Sperm Penetration

② Acrosomal reaction. Binding of the sperm to sperm-binding receptors in the zona pellucida causes the Ca^{2+} levels within the sperm to rise, triggering the acrosomal reaction. Acrosomal enzymes from many sperm digest holes through the zona pellucida, clearing a path to the oocyte membrane.



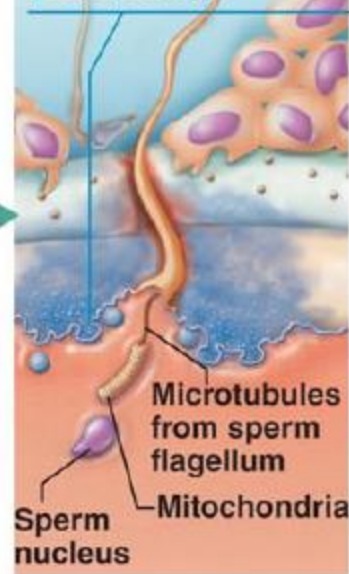
③ Binding. The sperm's membrane binds to the oocyte's sperm-binding receptors.



④ Fusion. The sperm and oocyte plasma membranes fuse, allowing sperm contents to enter the oocyte.

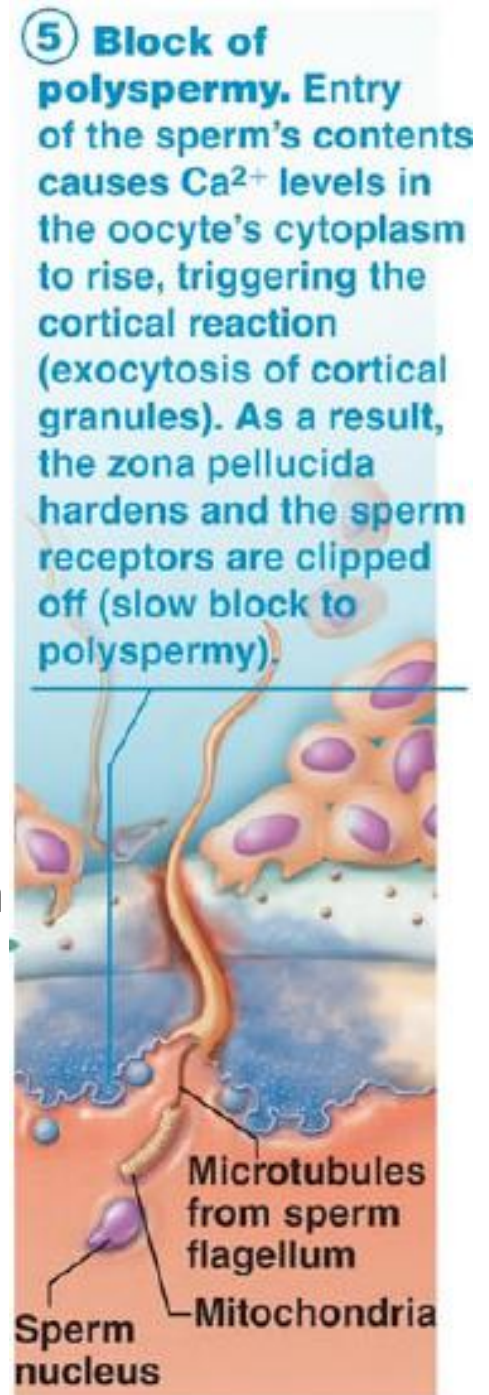


⑤ Block of polyspermy. Entry of the sperm's contents causes Ca^{2+} levels in the oocyte's cytoplasm to rise, triggering the cortical reaction (exocytosis of cortical granules). As a result, the zona pellucida hardens and the sperm receptors are clipped off (slow block to polyspermy).



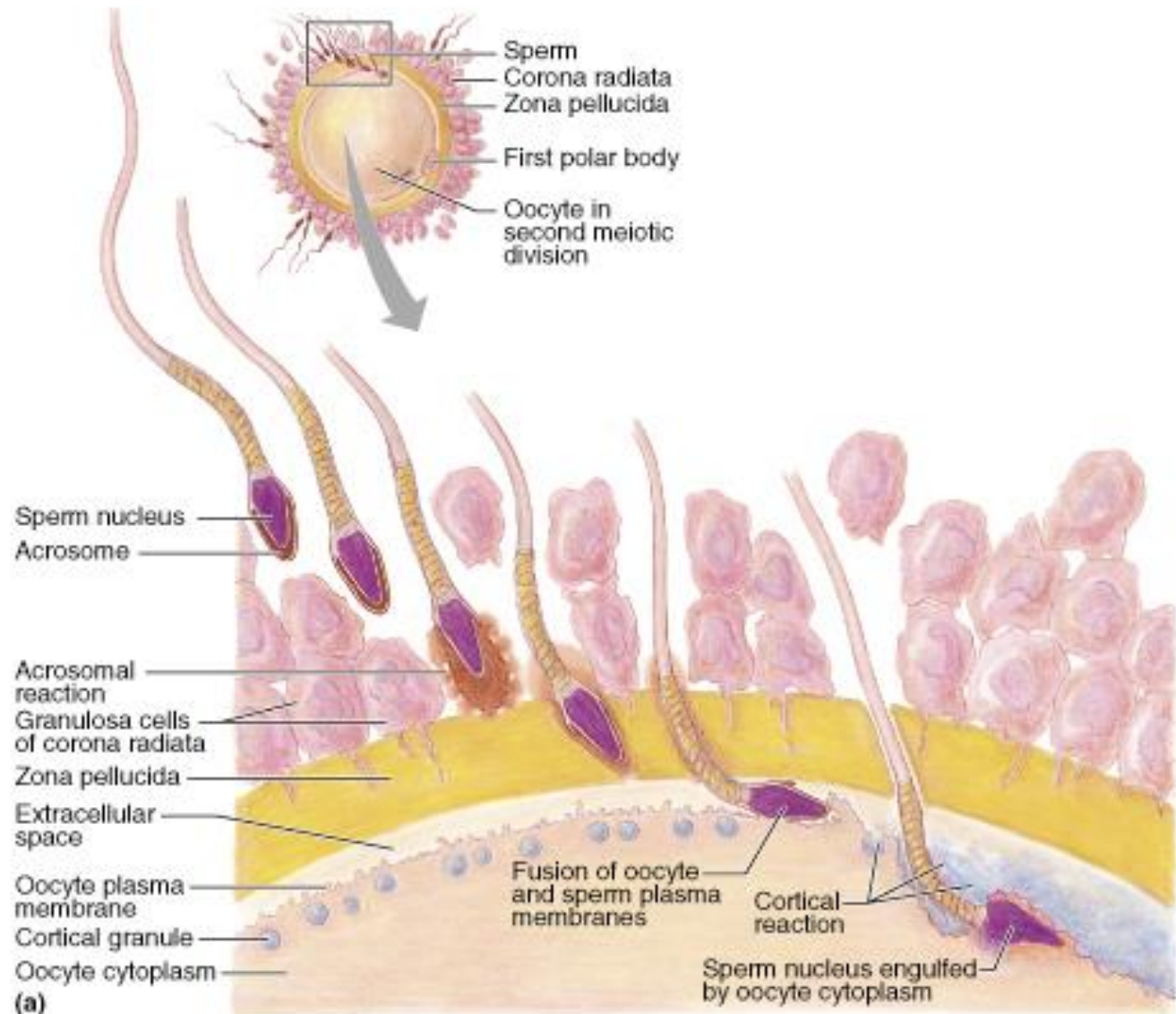
Prevention of Polyspermy

- 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



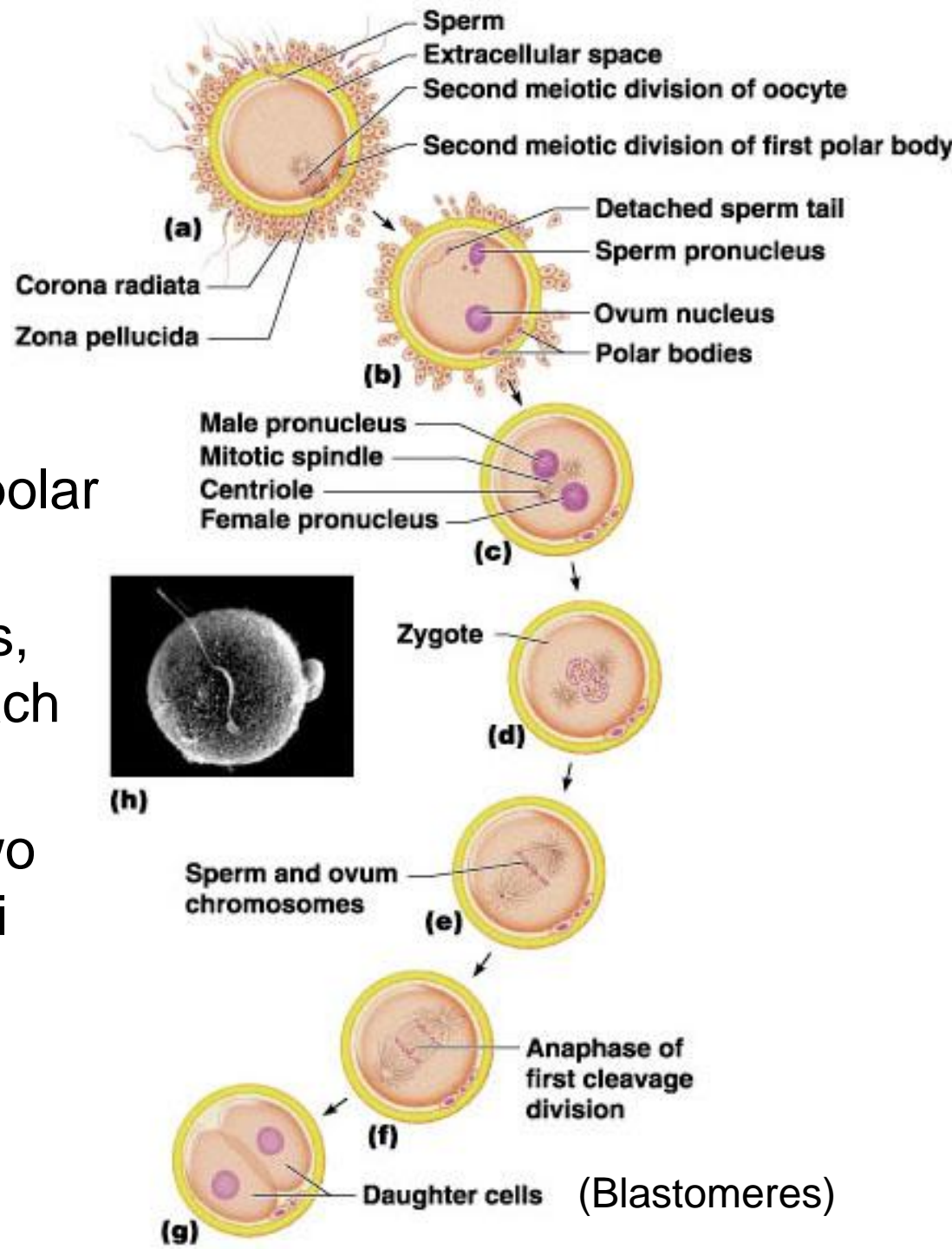
Fertilization

- 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



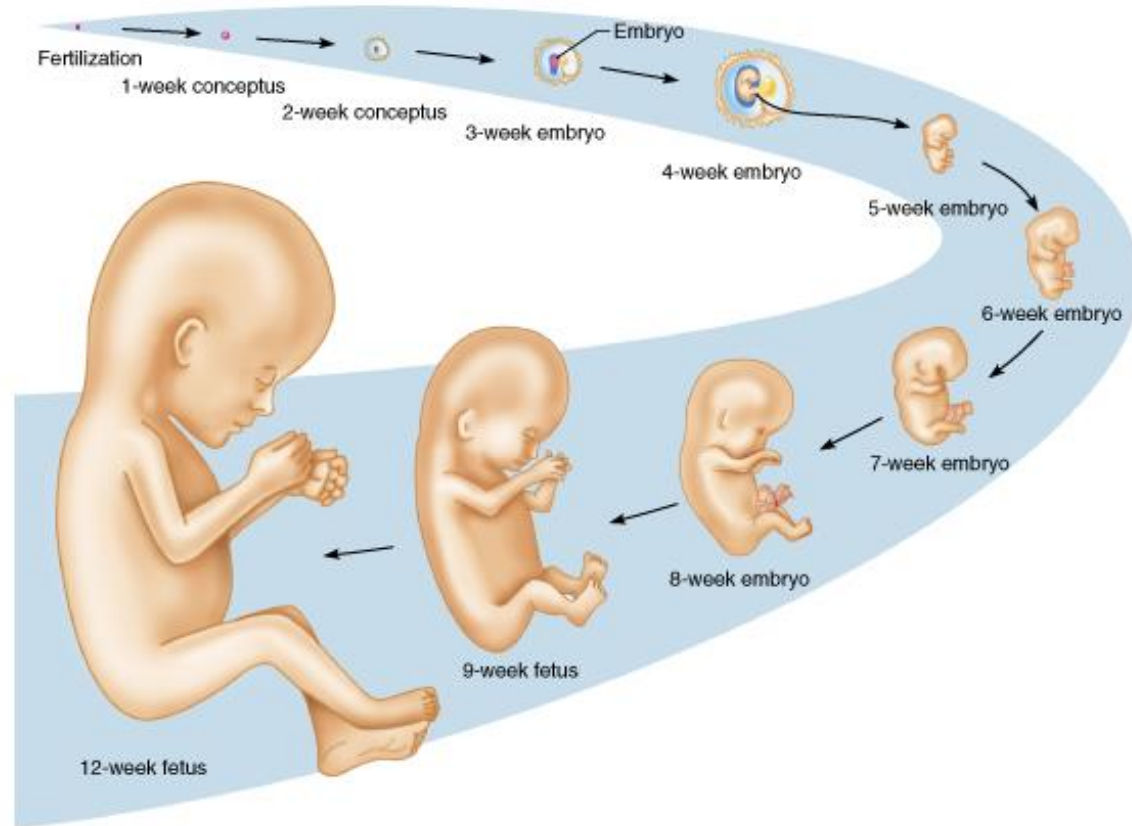
Early Events of Fertilization

- 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



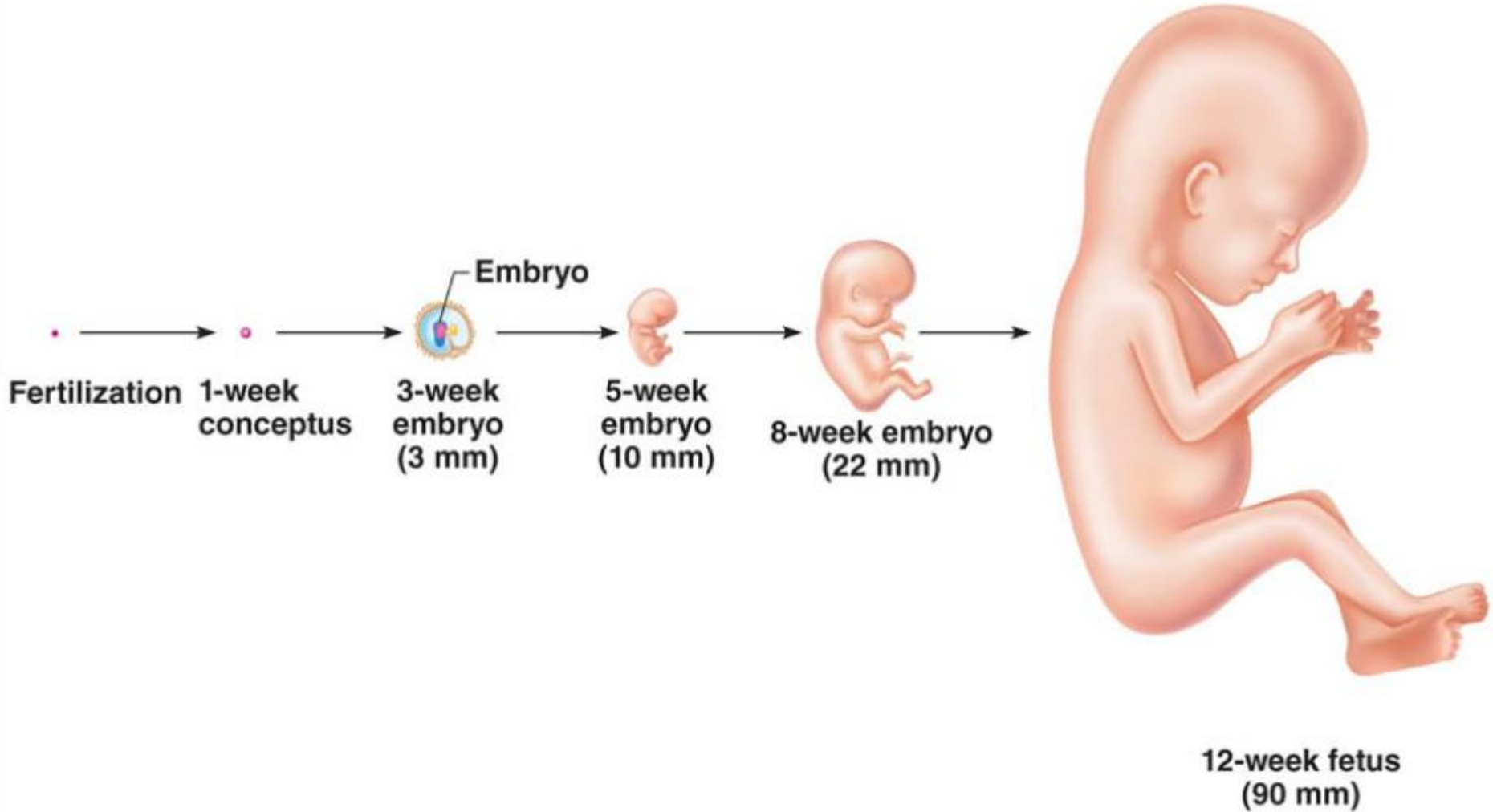
Pregnancy

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



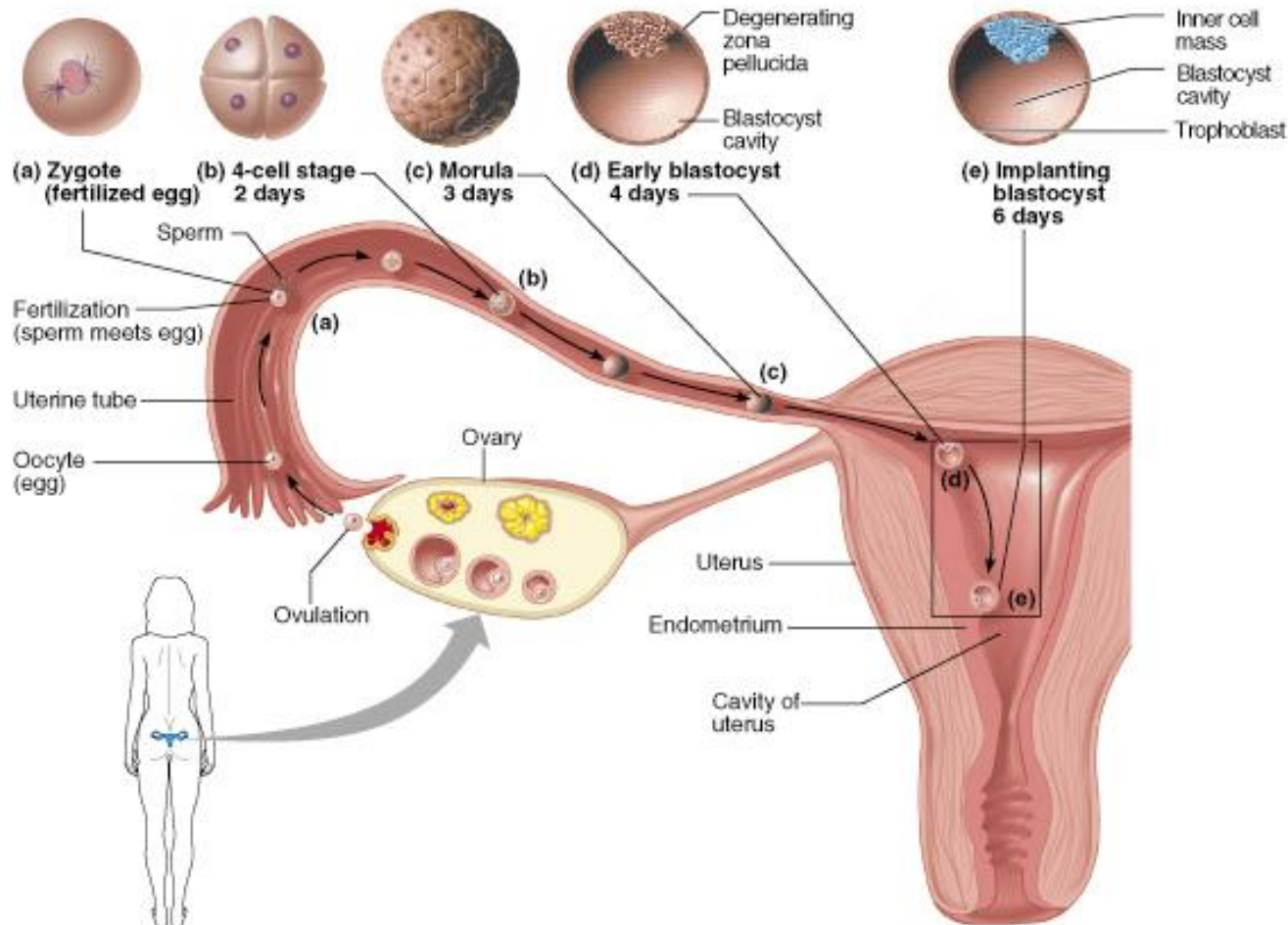
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Pregnancy

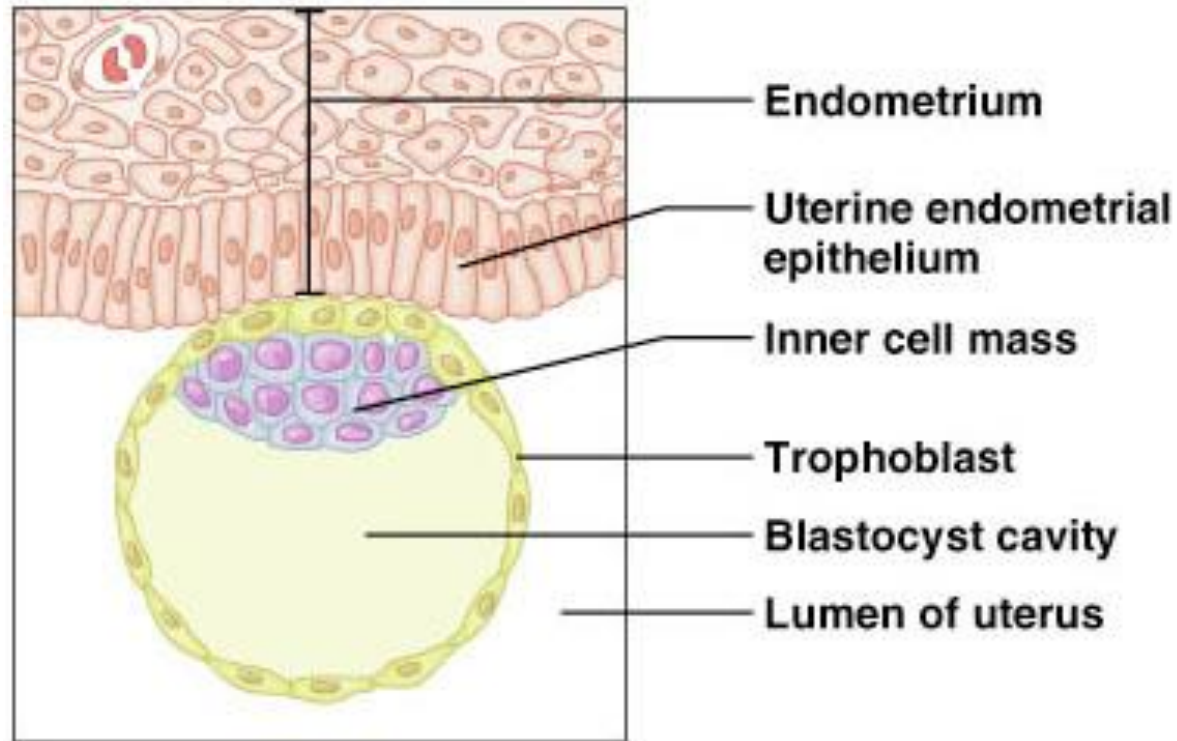


Embryonic Development: from Zygote To Blastocyst Implantation

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



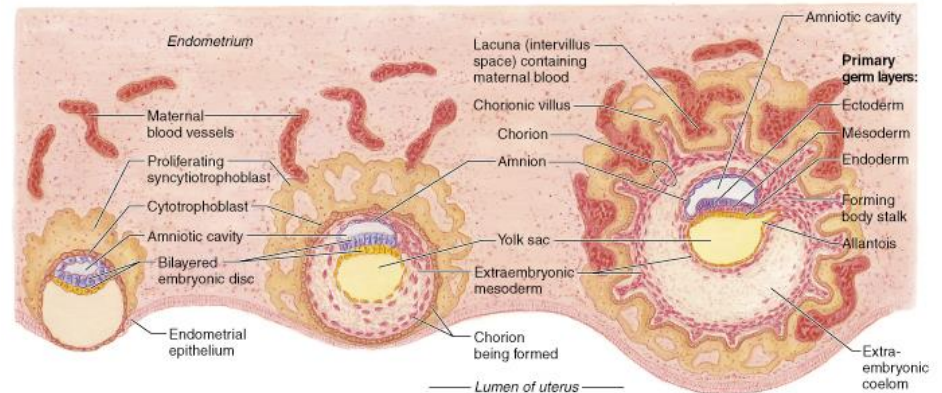
Implantation



- 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



(a) 7 1/2-day implanting blastocyst

(b) 9-day implanted blastocyst

(c) 16-day embryo

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Placentation: Humans

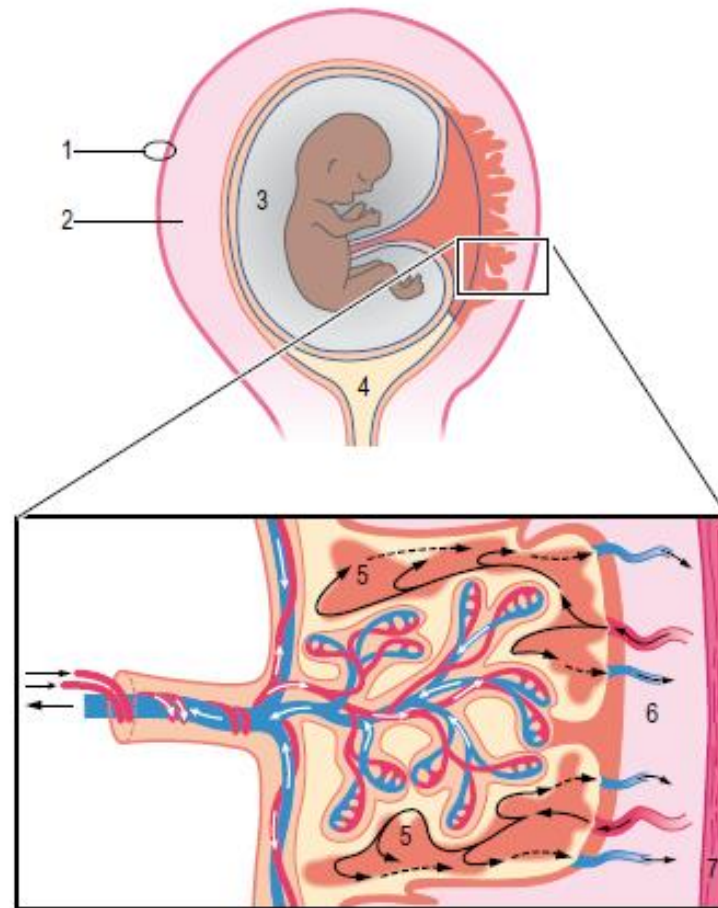
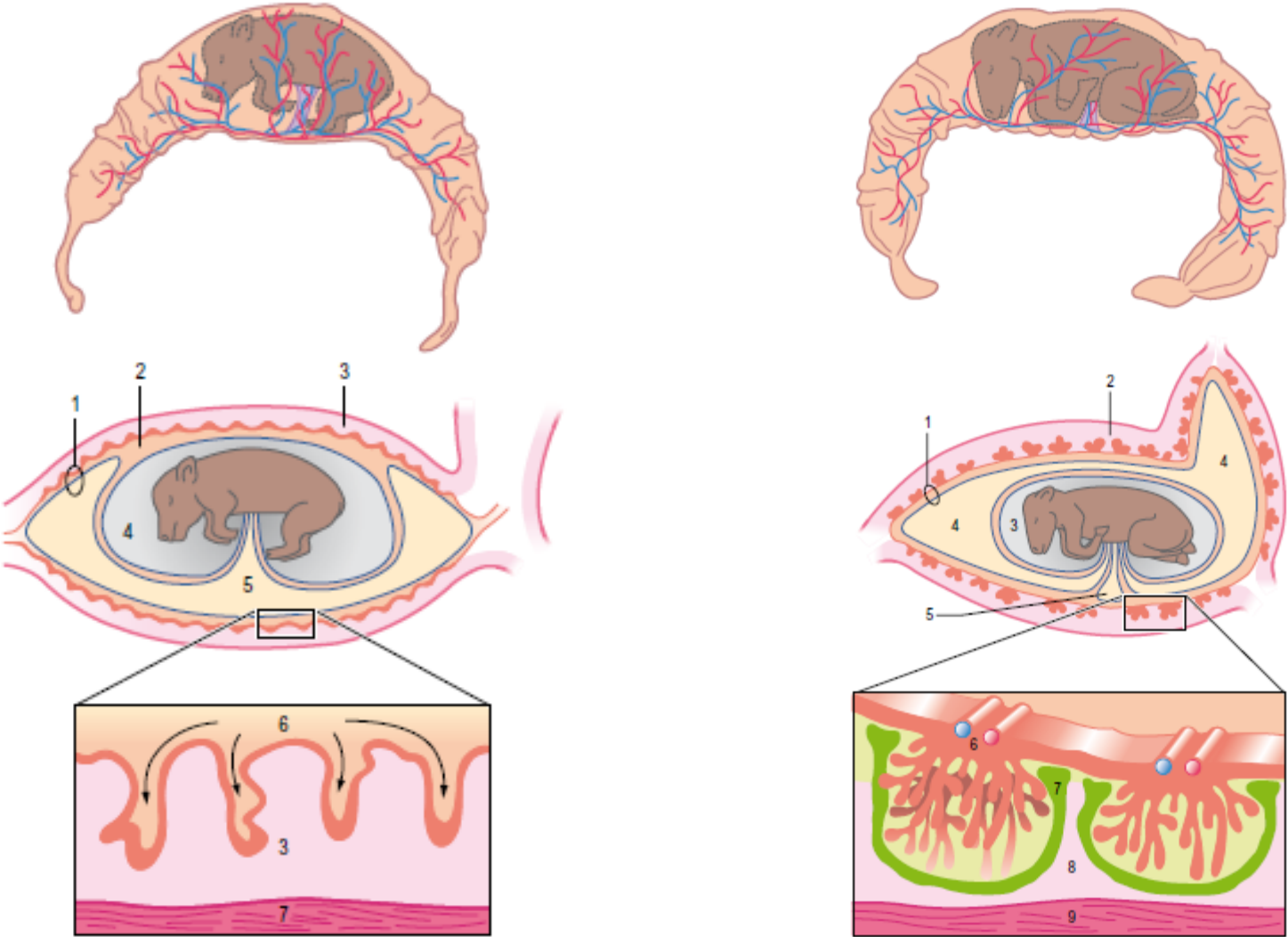


Fig. 9-14: The discoid primate placenta. 1: Perimetrium; 2: Endometrium and myometrium; 3: Amnion; 4: Uterine cavity; 5: Intervillous space with maternal blood; 6: Endometrium; 7: Myometrium.

Discoid Placenta

Placentation: Pigs and Horses



Diffuse Placenta

Placentation: Ruminants

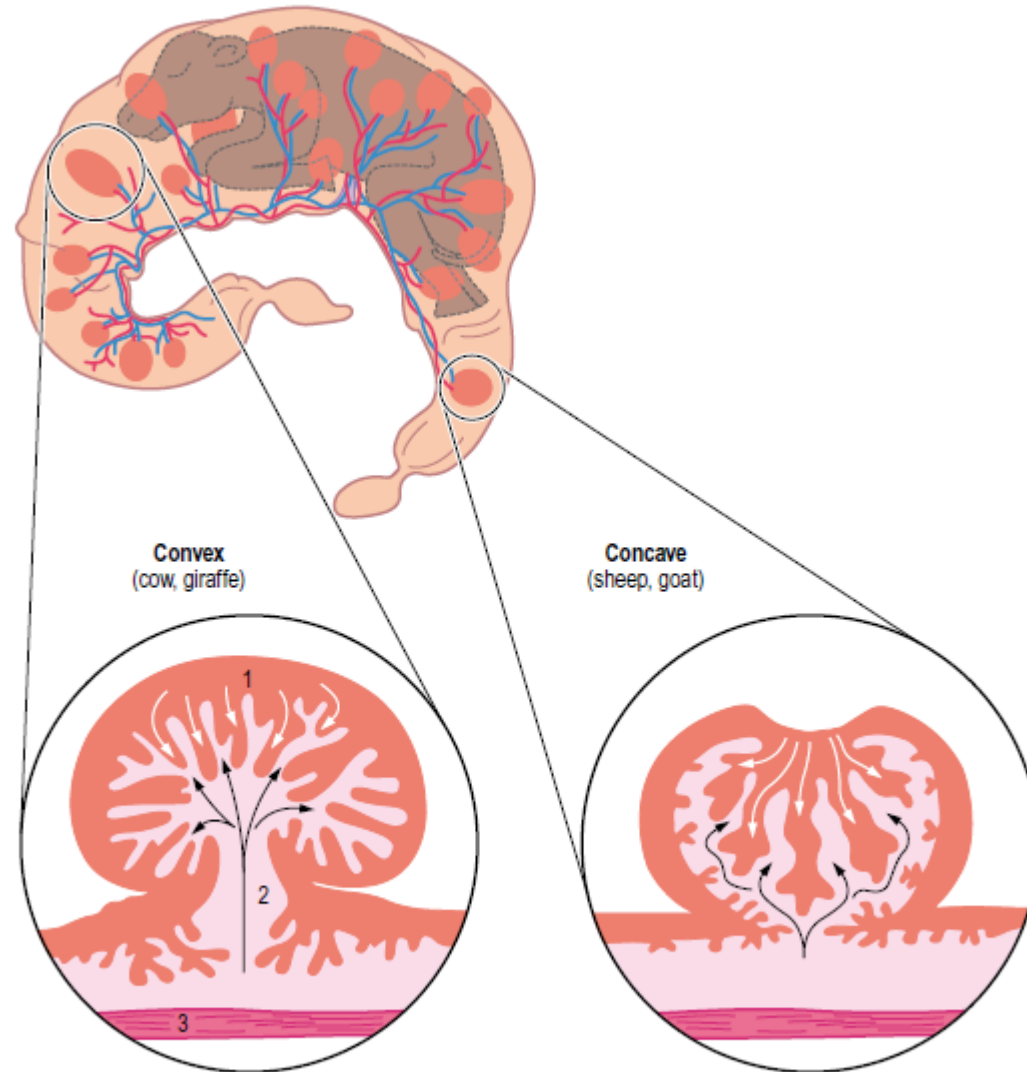


Fig. 9-6: The cotyledonary placenta of the ruminants. 1: Chorioallantois (cotyledon) forming villi; 2: Caruncle with crypts enclosing the villi; 3: Myometrium.

Cotyledonary Placenta

Placentation: Carnivores

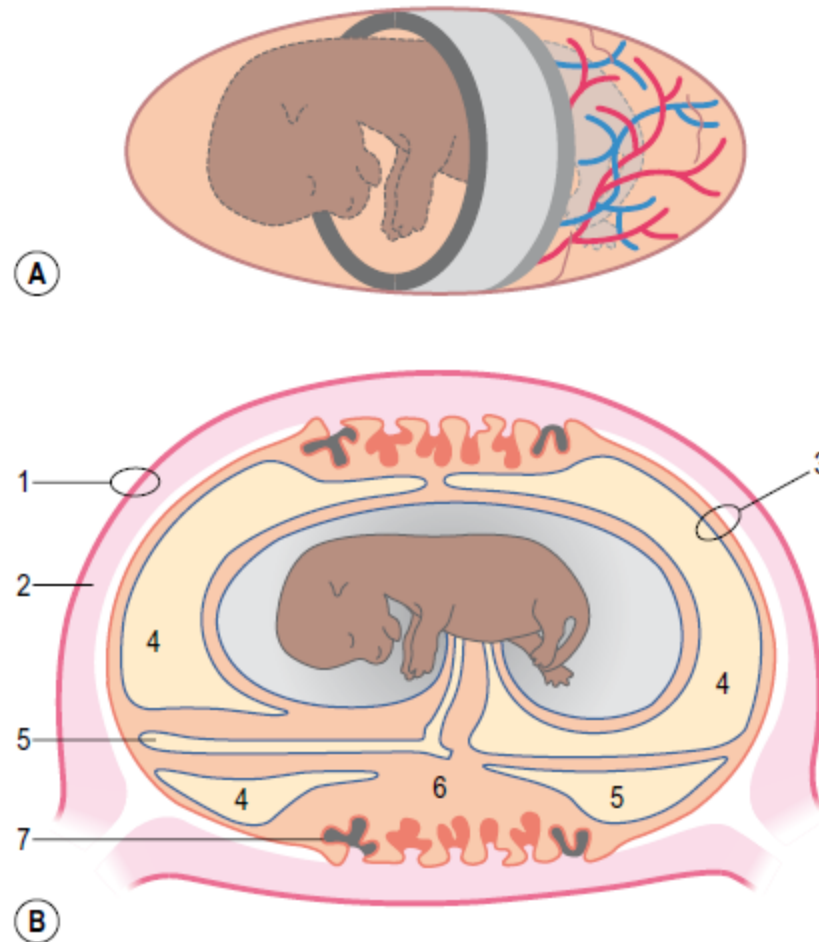
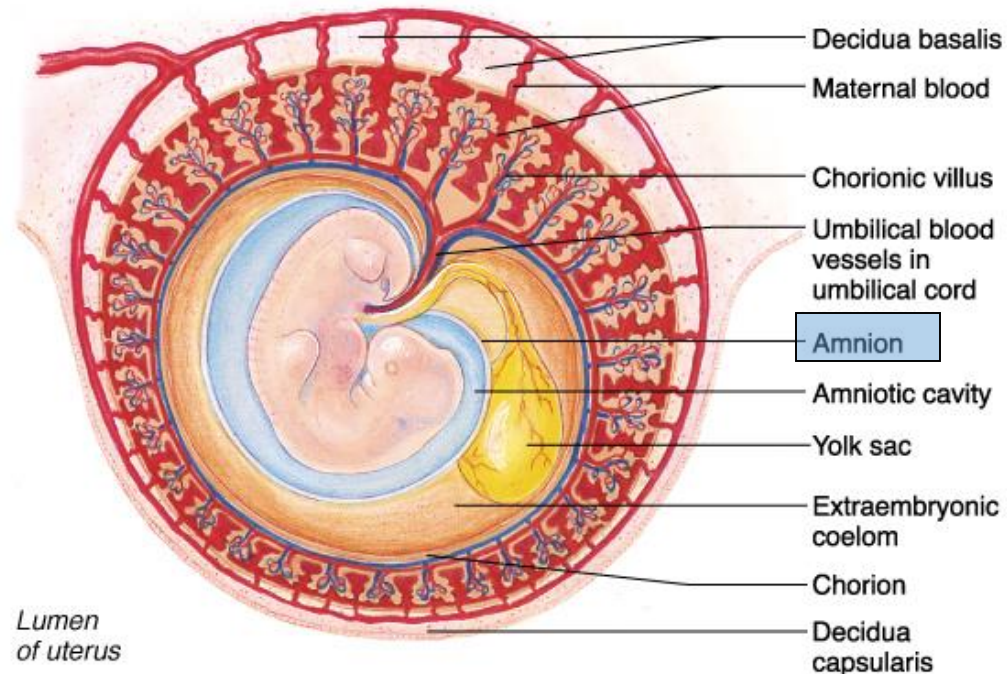


Fig. 9-12: The zonary placenta of the bitch. 1: Perimetrium; 2: Endometrium and myometrium; 3: Chorioallantois; 4: Allantois; 5: Yolk sac; 6: Chorioallantois forming lamellae in the placental zone; 7: Marginal haematoma.

Zonary Placenta

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

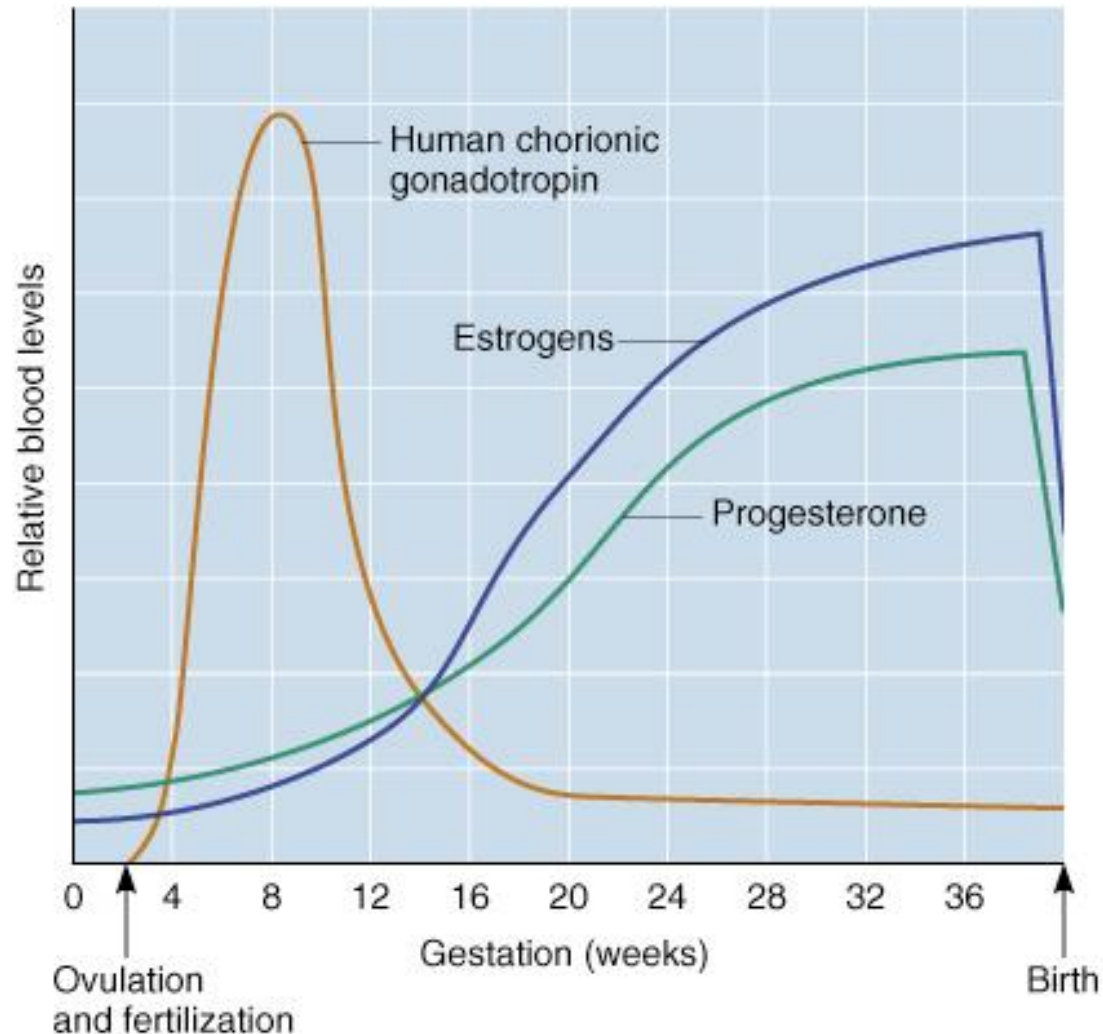


(d) 4½-week embryo

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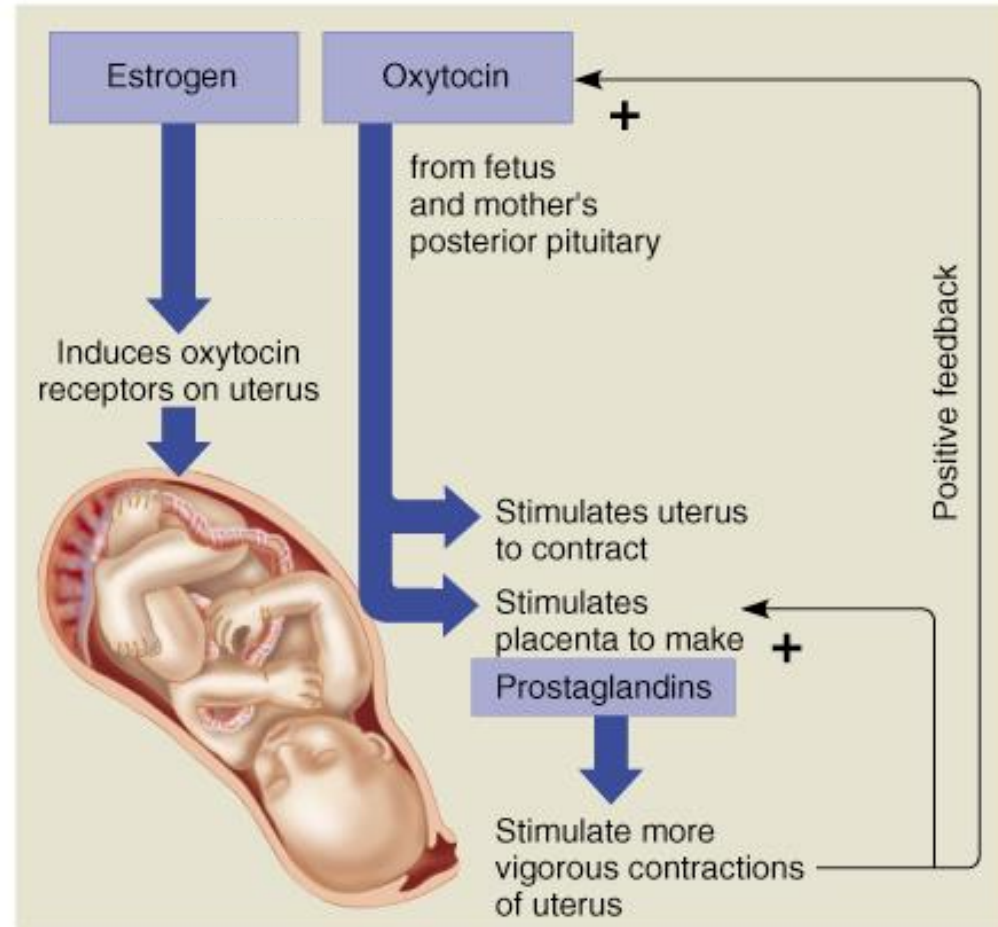
Placenta in humans produces hCG, estrogen, progesterone, etc.

- 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



Regulation of Parturition (birth)

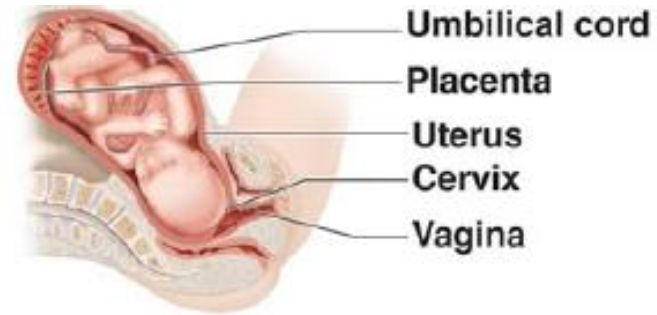
- Labor and Delivery are regulated cooperatively by hormones and the NS



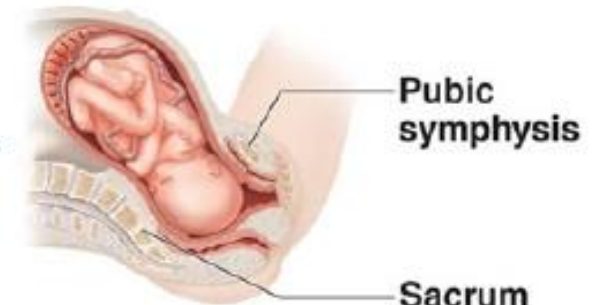
Parturition

- Dilation → Expulsion of Neonate → Expulsion of Placenta
- Eventually conscious motor commands add the “push” for delivery

1a Early dilation.
Baby's head engaged;
widest dimension is
along left-right axis.



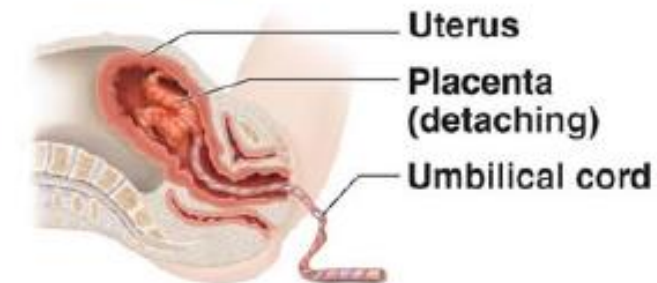
1b Late dilation.
Baby's head rotates so
widest dimension is in
anteroposterior axis (of
pelvic outlet). Dilation
nearly complete.



2 Expulsion. Baby's
head extends as it is
delivered.



3 Placental stage.
After baby is delivered,
the placenta detaches
and is removed.



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

