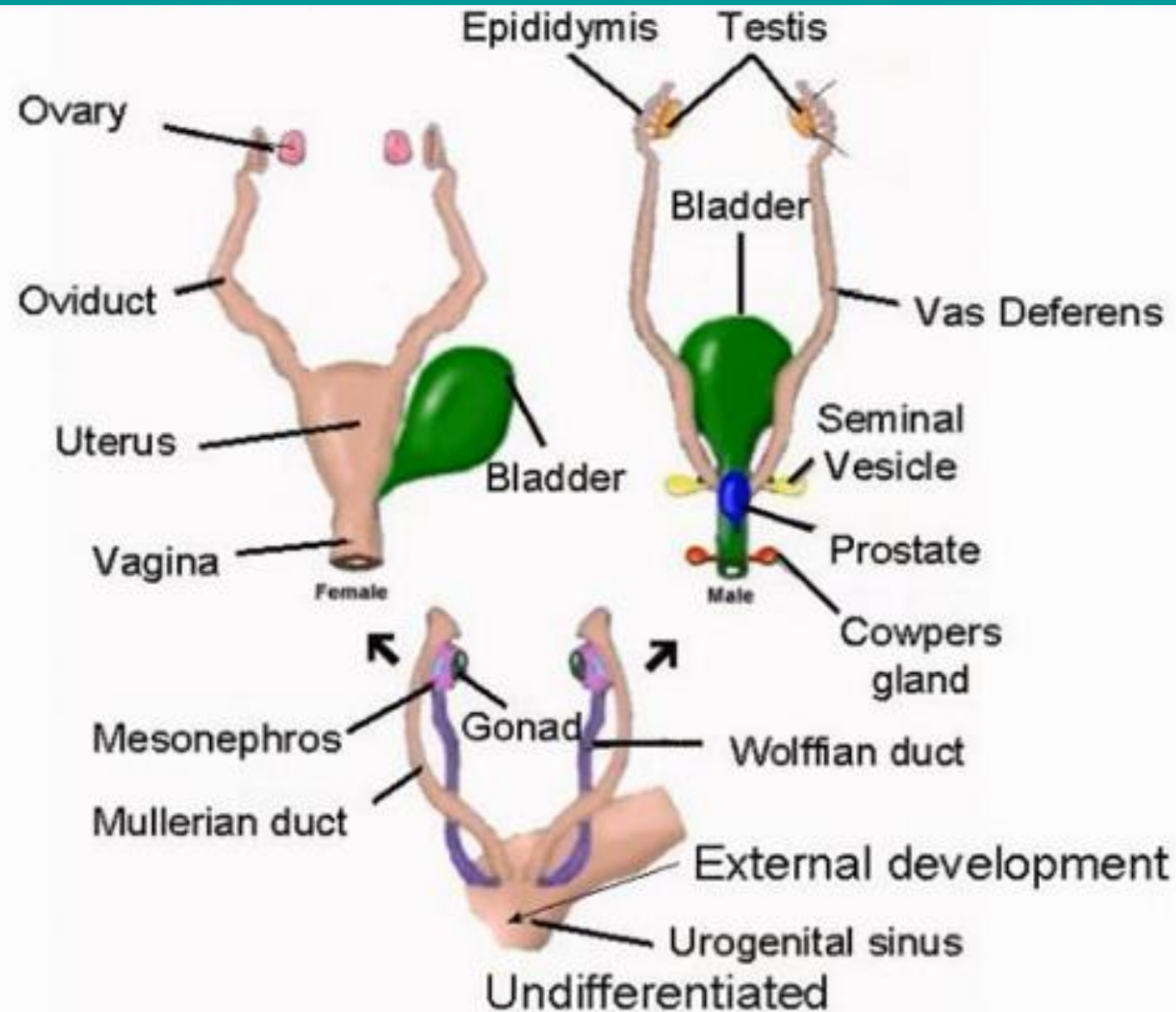


*Physiology of
Reproductive System
(females)
Part One*

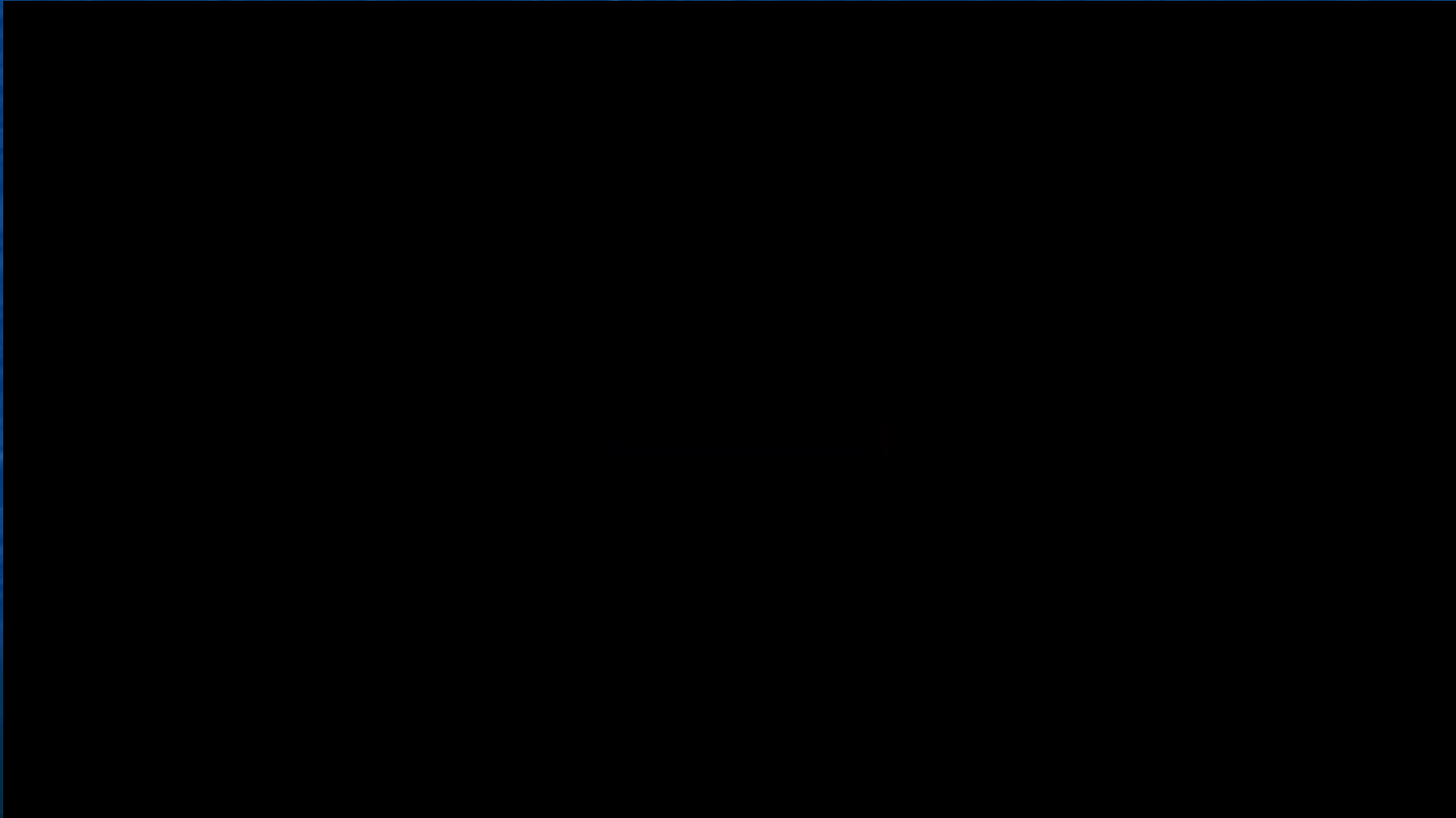
By

Dr. A. K. Goudarzi, D.V.M. Ph.D

Ontogenesis of the female genitalia



Sex Determination and Differentiation

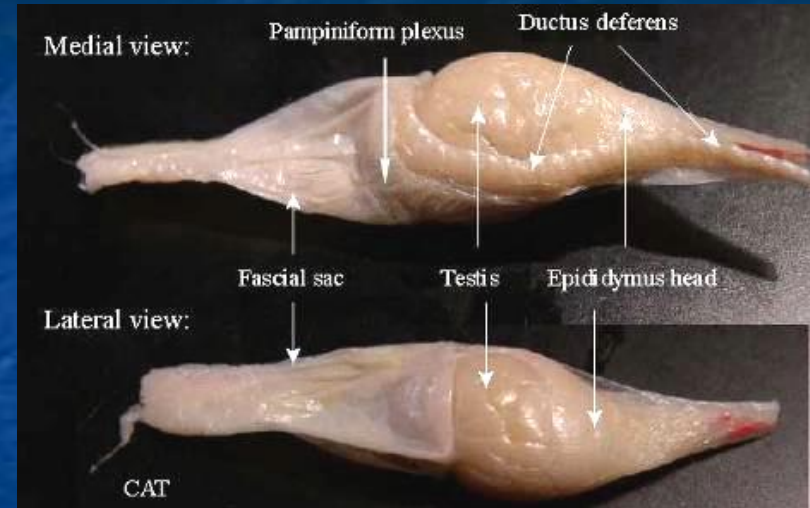


Biological Sex, Sex Differentiation

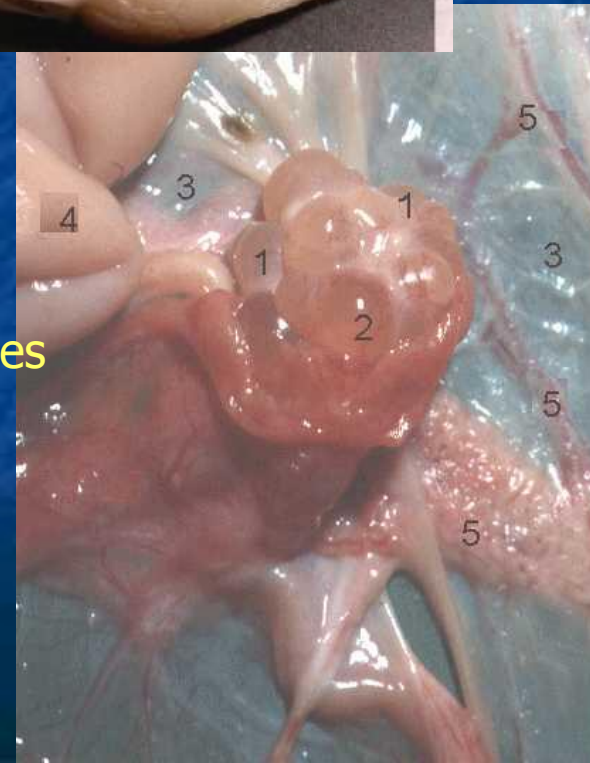


Reproductive Organs.

- ▶ **Male** and **female** reproductive are **homologous** → similar embryologic origin, structure and functions.
- ▶ Consists of gonads (**testis** and **ovary**) and **genital** tubes/**ducts**.
- ▶ Paired gonads are **cytogenic** (gametogenesis) and **endocrine** (hormones)
- ▶ Genital tubes transport gametes.
- ▶ Fertilisation and development of embryo occurs in female tubes.

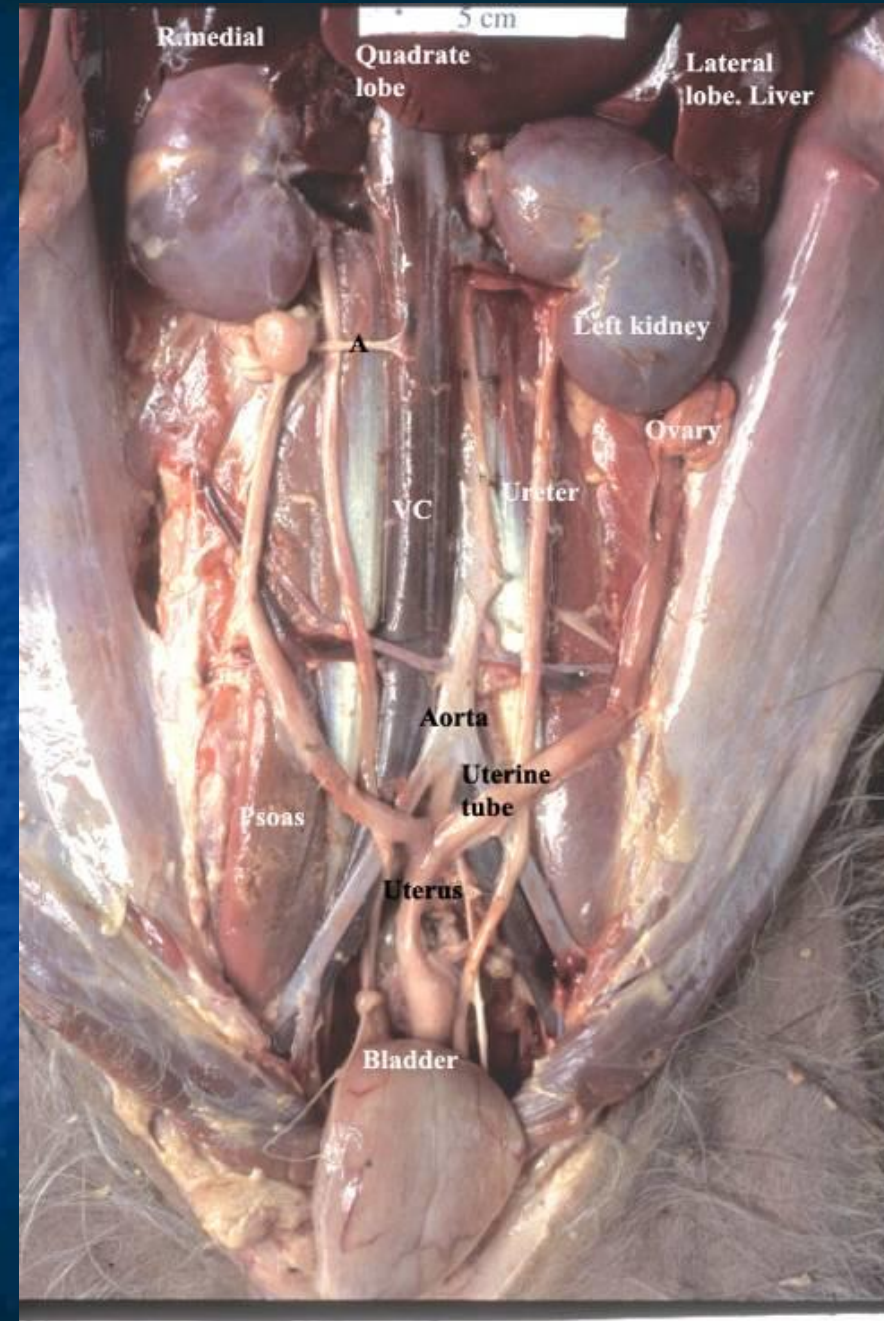


1. Developing follicles
2. Mature follicle
3. Mesovarium
4. Uterine horn
5. Blood vessels



Topography Of Female Reproductive Organs In The Bitch/dog

- ▶ In dog and cat **ovaries** remain in location of development → in dorsal part of abdomen, caudal to kidneys.
- ▶ In other domestic species, ovaries descend
- ▶ Form of **uterine tube** vary. Bilateral tubes fuse caudally, account for species differences → bicornuate
- ▶ Each uterine tube originates on the medial surface of the ovary, turns around cranial pole, course caudal along lateral ovarian surface into uterine horn.
- ▶ Long uterine horns with minimum fusion extend from T13 to caudally into body of non-gravid **uterus**. Gestation region.
- ▶ Uterus short, in caudal abdomen in nongravid bitch, extends cranially in pregnancy



Female Reproductive Organs(1)

1. **Different parts** each with **specific functions.**

- Uterine tubes → infundibulum, ampulla and isthmus.
- Uterus → uterine horn, body and cervix.
- Vagina, Vestibule, Vulva



Female Reproductive Organs(2)

2. Functional **division**.

- Ovary, organs producing gametes
- Genital tubes for transportation and storage of gametes.

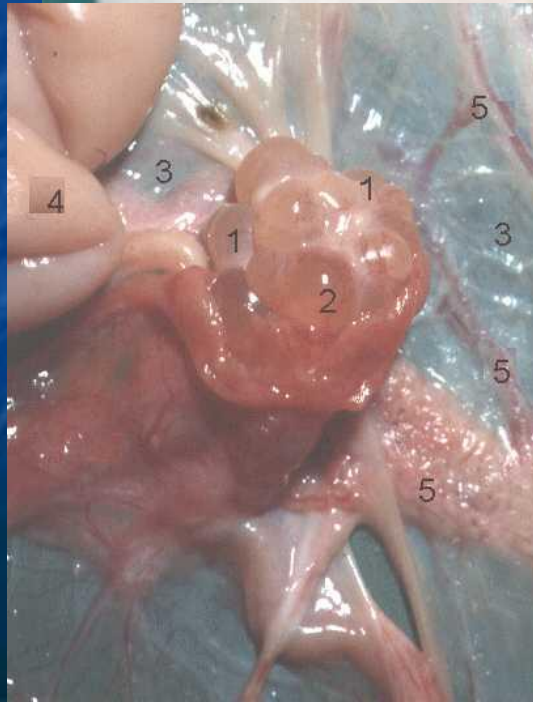
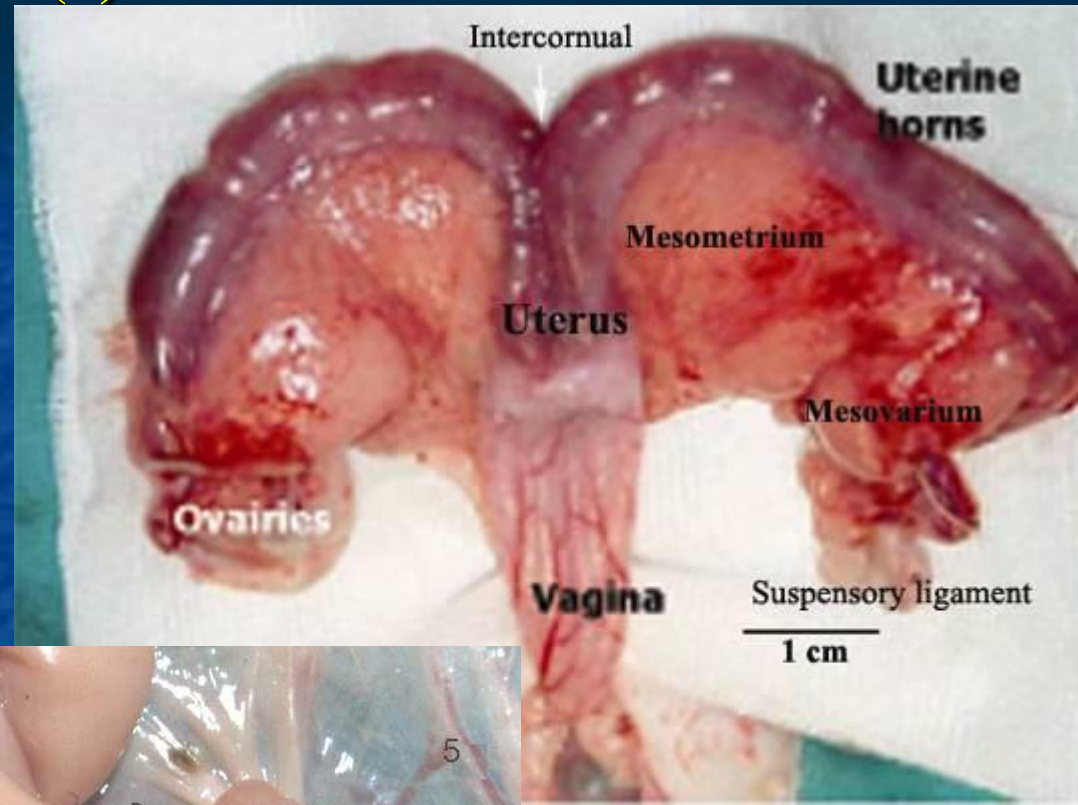
3. Transient **seasonal changes** in structure and function.

4. **Age** changes in structure

5. Ligaments → suspensory mesosalpinx, mesovarium, mesometrium (broad ligaments), intercornual

6. **Sequence** of reproduction in female → gametogenesis/folliculogenesis → ovulation →

Fertilisation → zygote → embryogenesis

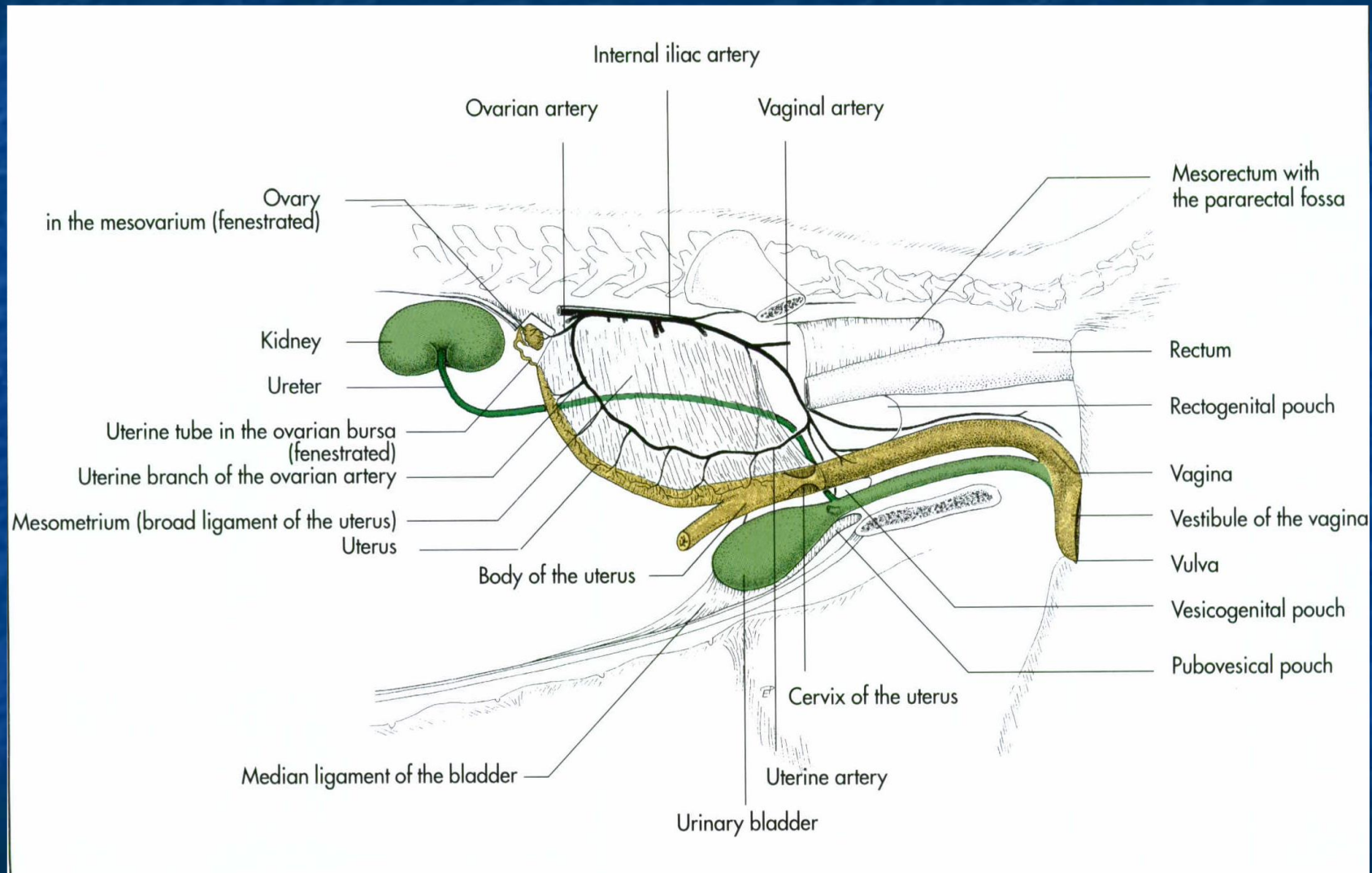


1. Developing follicles
2. Mature follicle
3. Mesovarium
4. Uterine horn
5. Blood vessels

Female genitalia organs

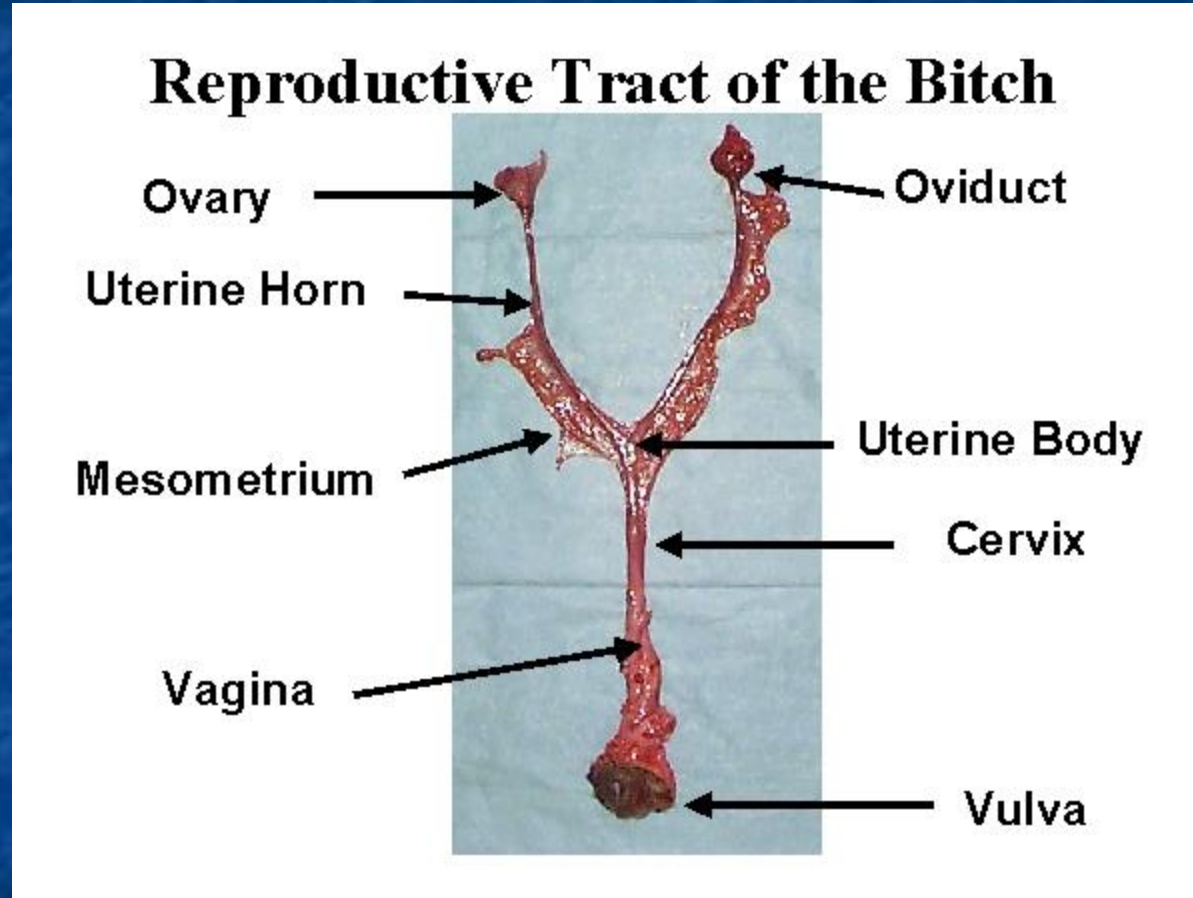
- Primary Sex Organ - ovaries
- Tubular Genitalia
 - oviduct
 - uterus
 - cervix
 - vagina
- External Portion
 - vulva

Female genitalia organs

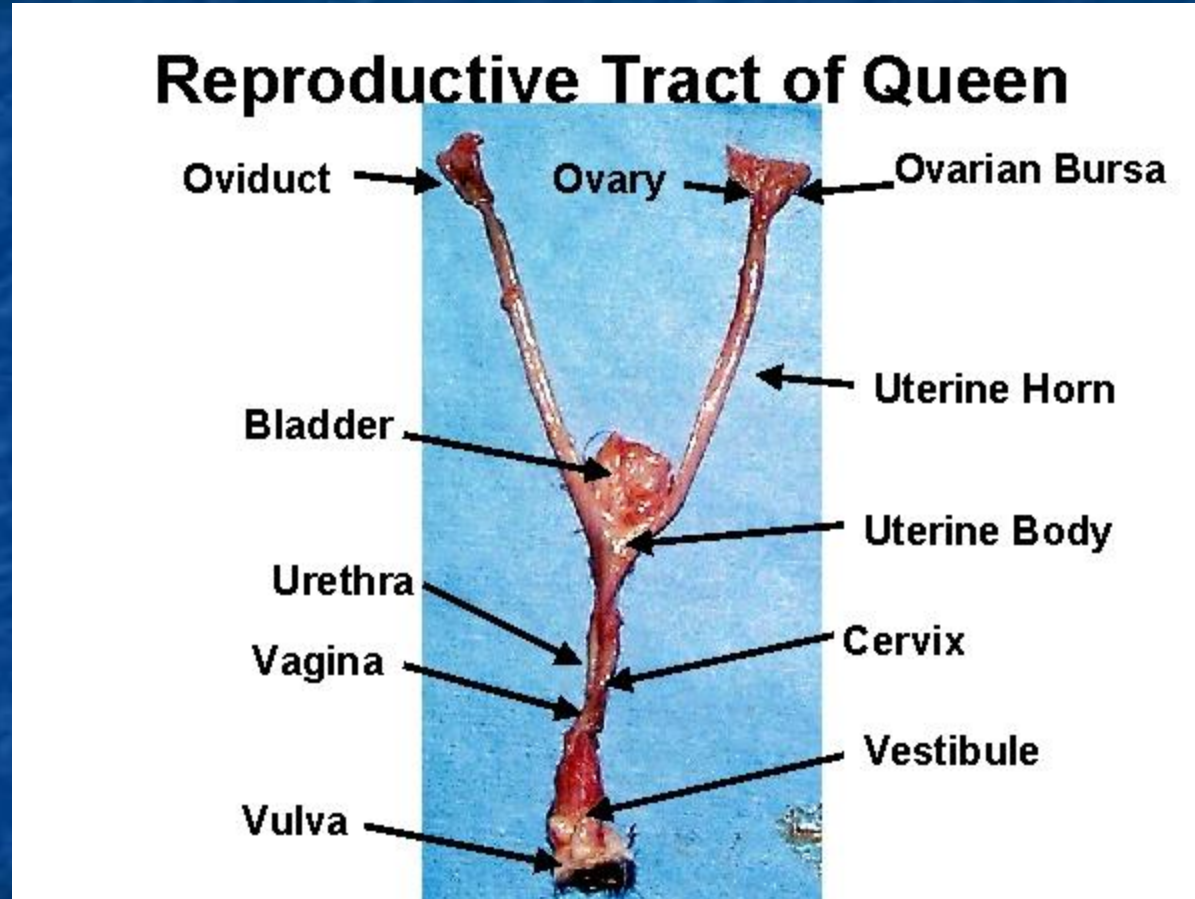


Female genital organs of the dog, schematic.

Female genitalia organs



Female genitalia organs



Female genitalia organs

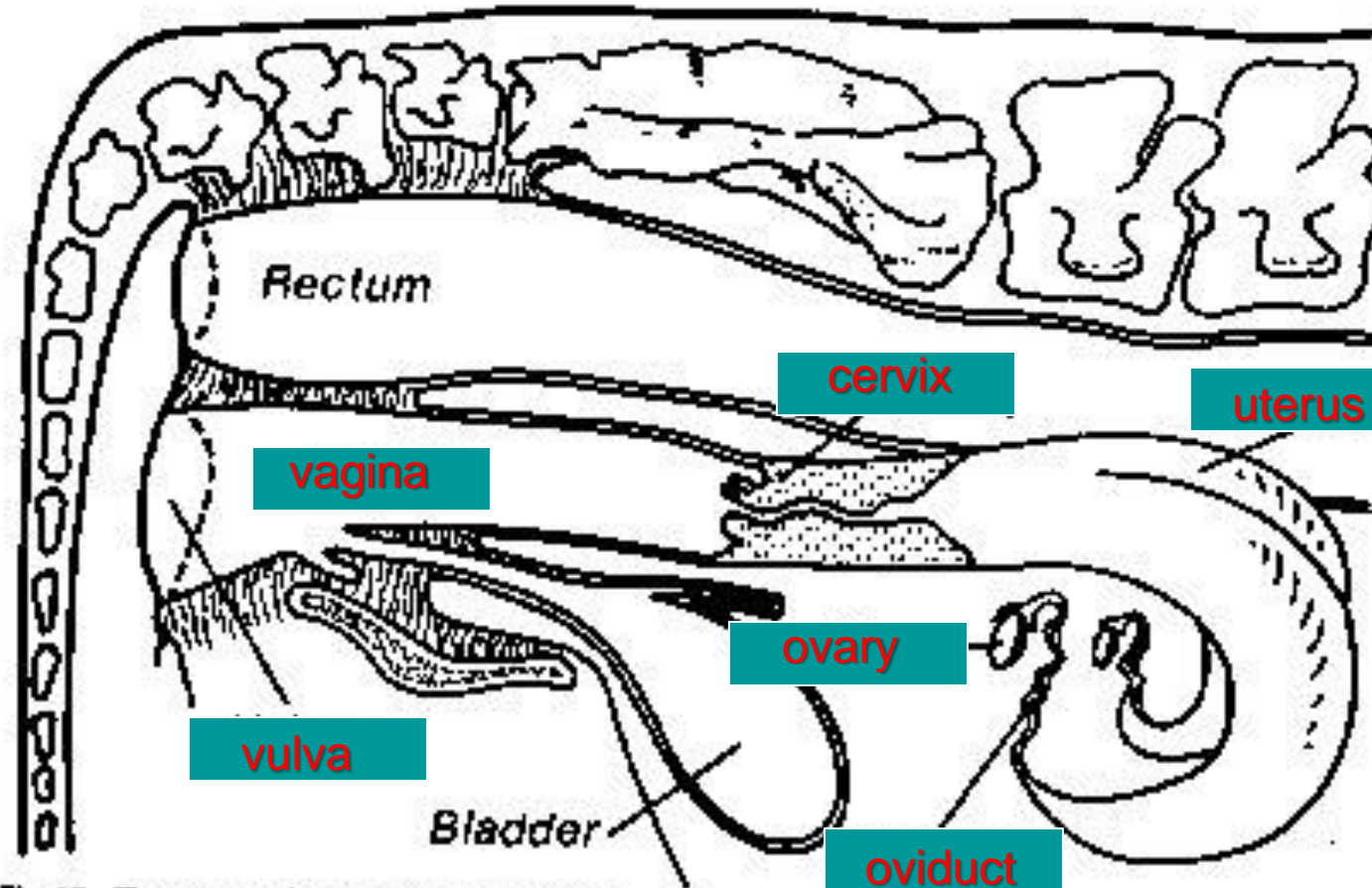
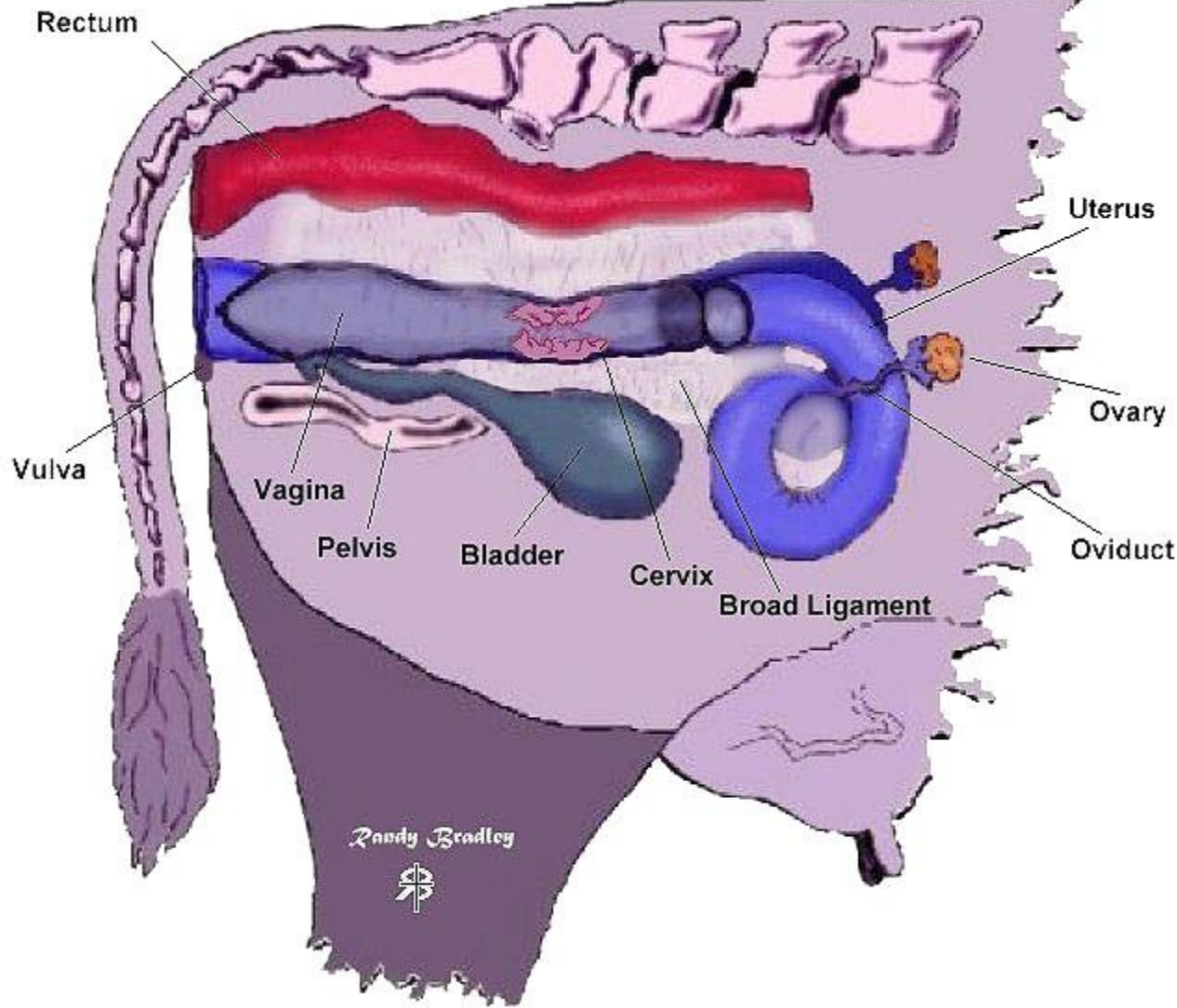
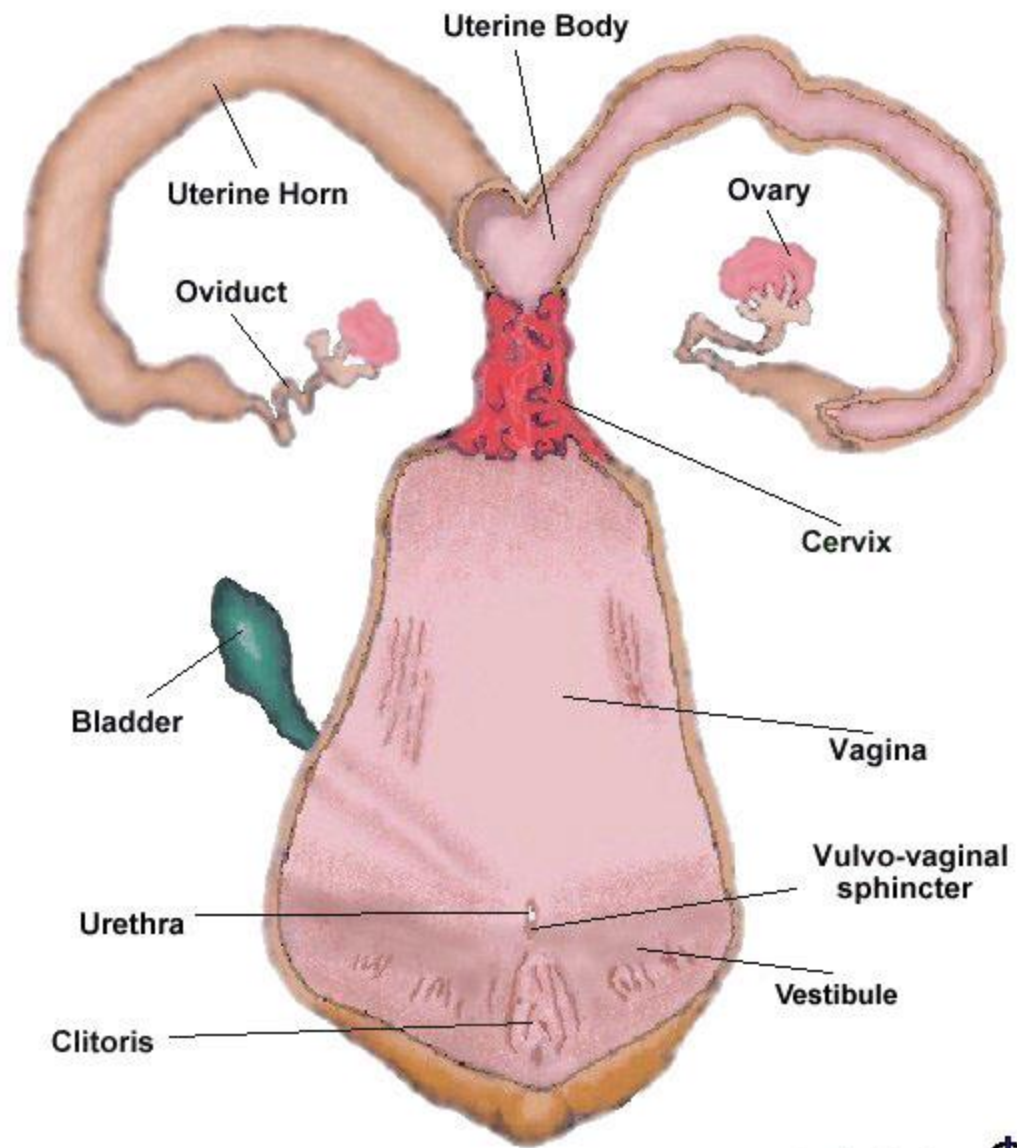


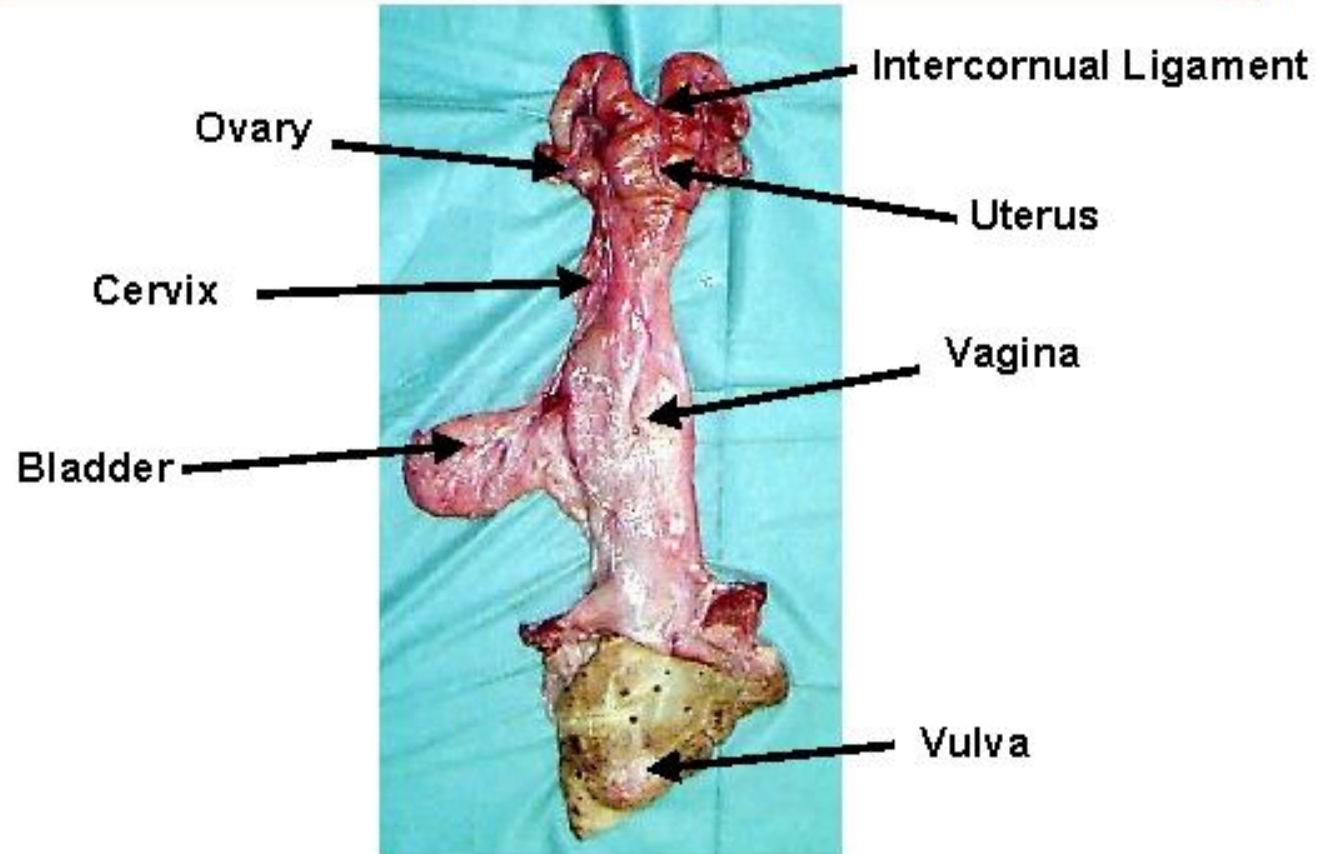
Fig. 10 The organs of reproduction in the cow.





Female genitalia organs

Bovine Reproductive Tract



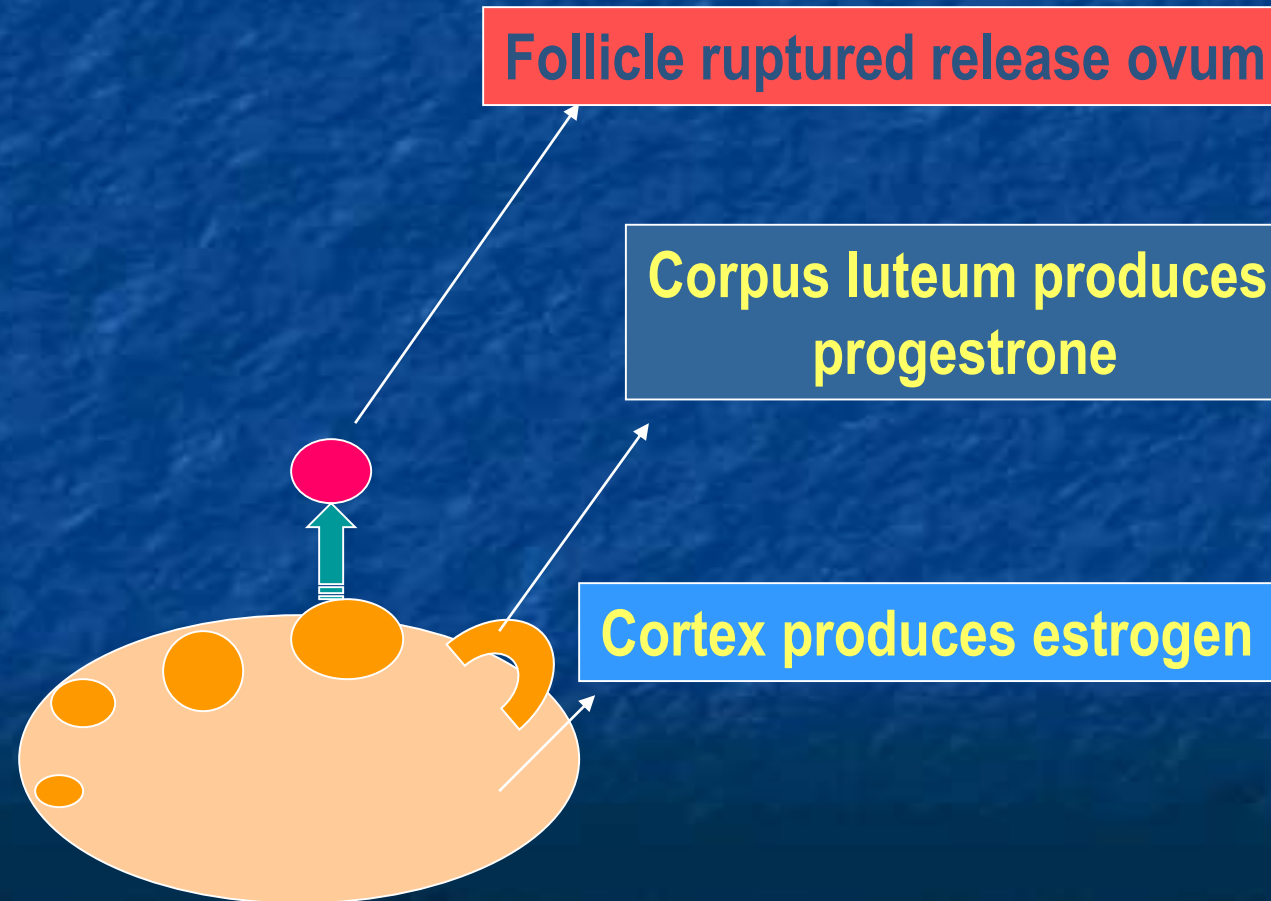
ovary

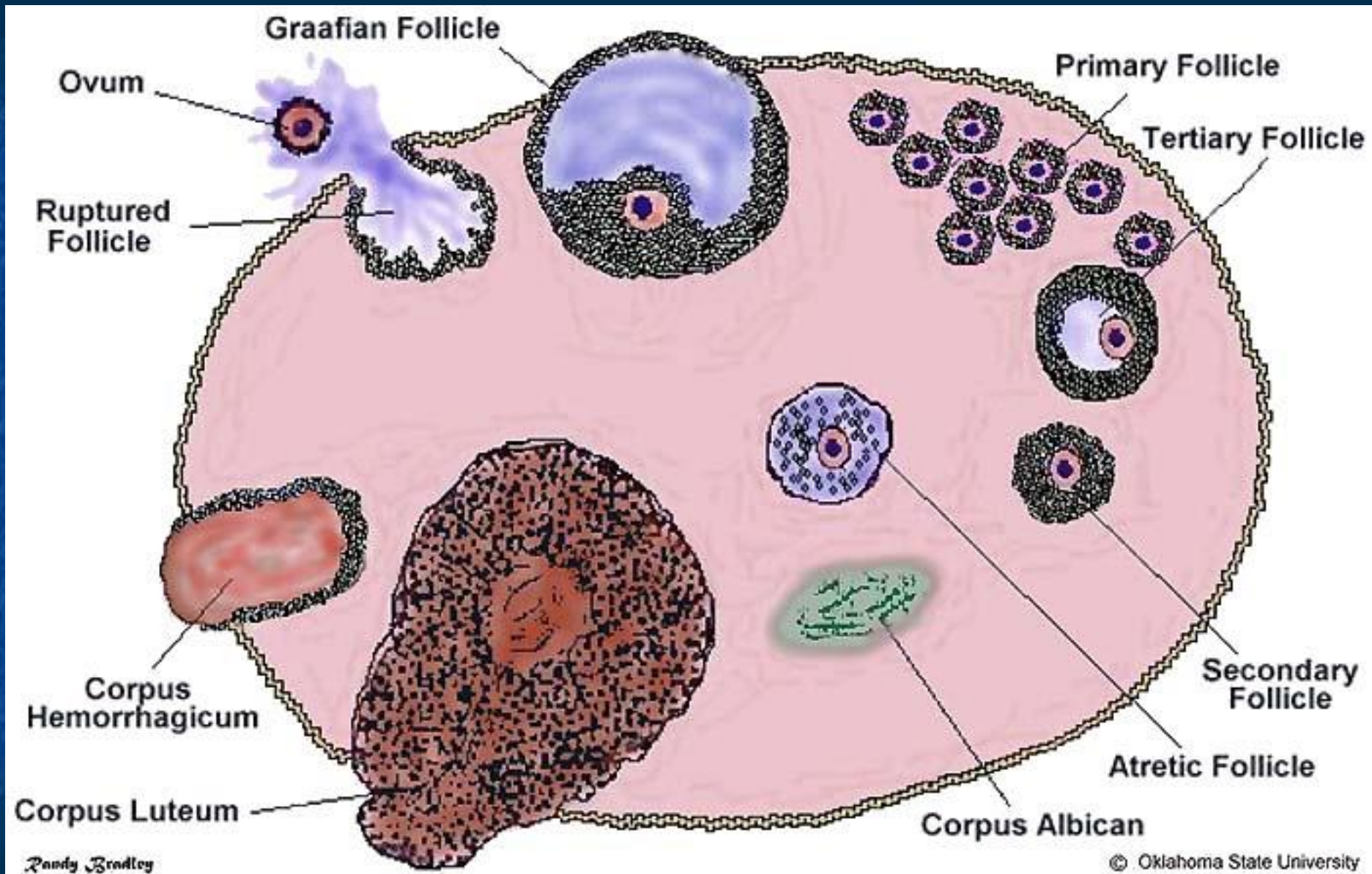
- Primary sex organ
- Paired organ in the pelvic cavity
- Size & shape of almond
- Right ovary bigger than left
- Usually near uterine horn
- Attached by ovarian ligament

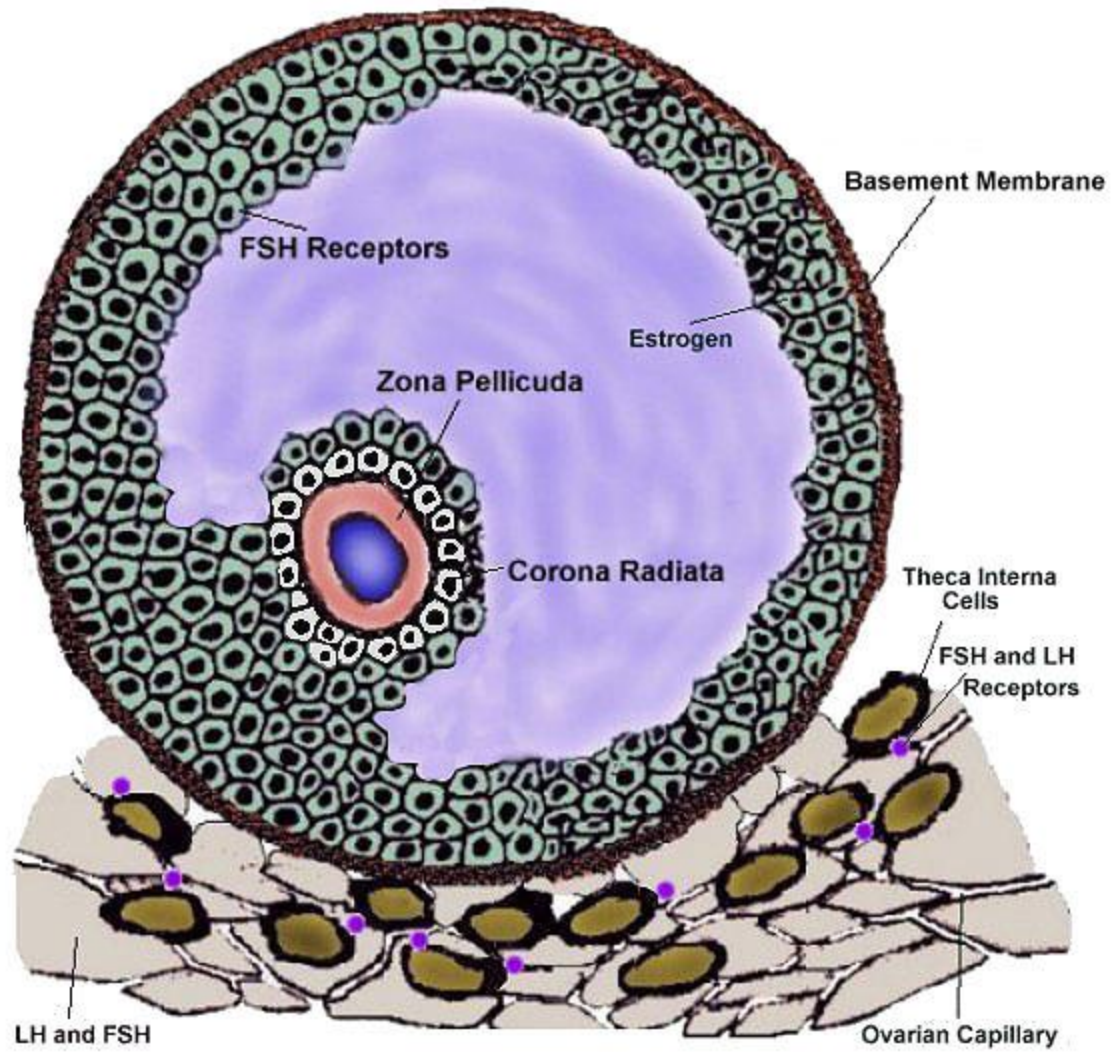


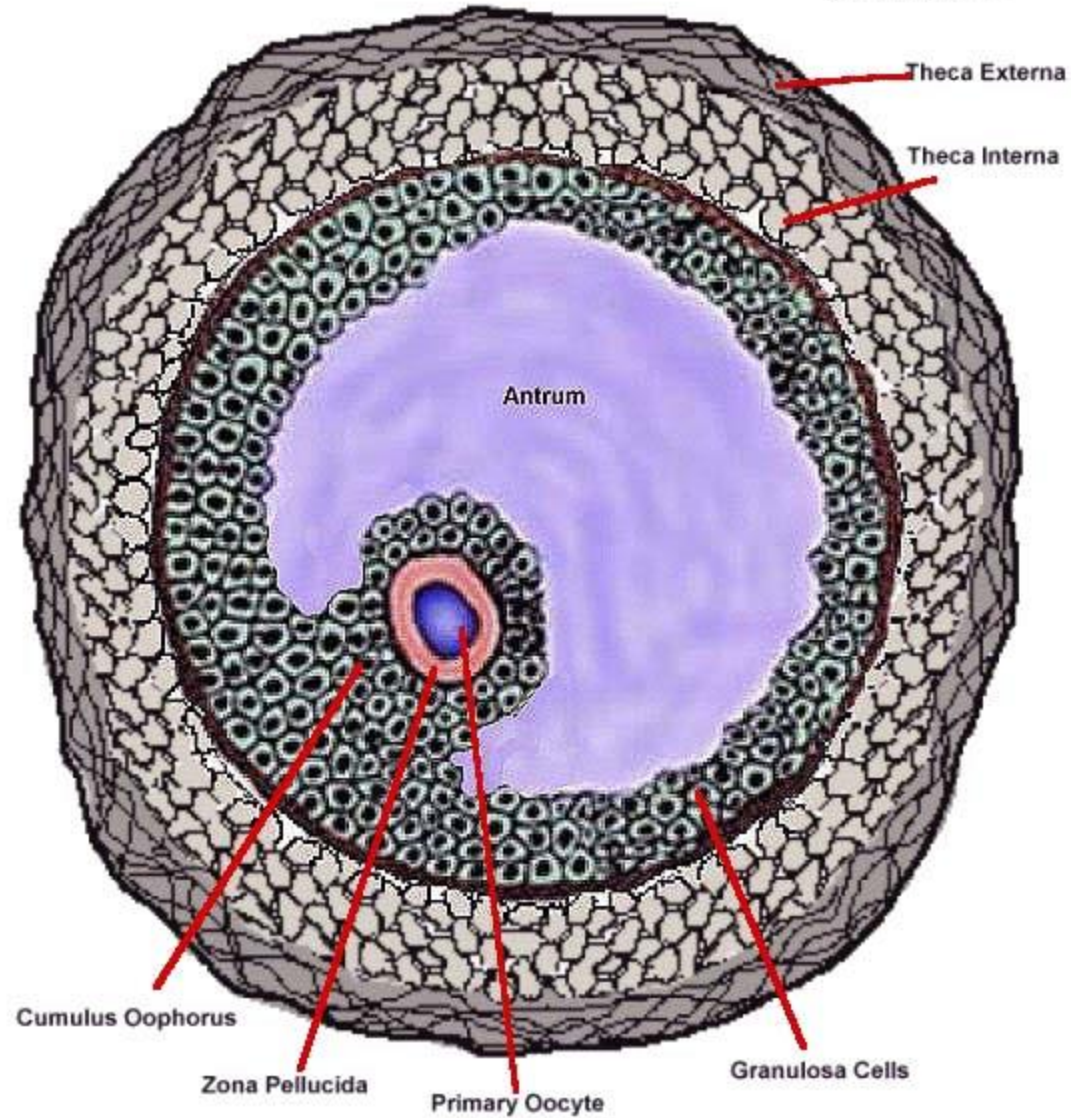
ovary

- Germinal epithelium – produces ova
- Produce female hormones

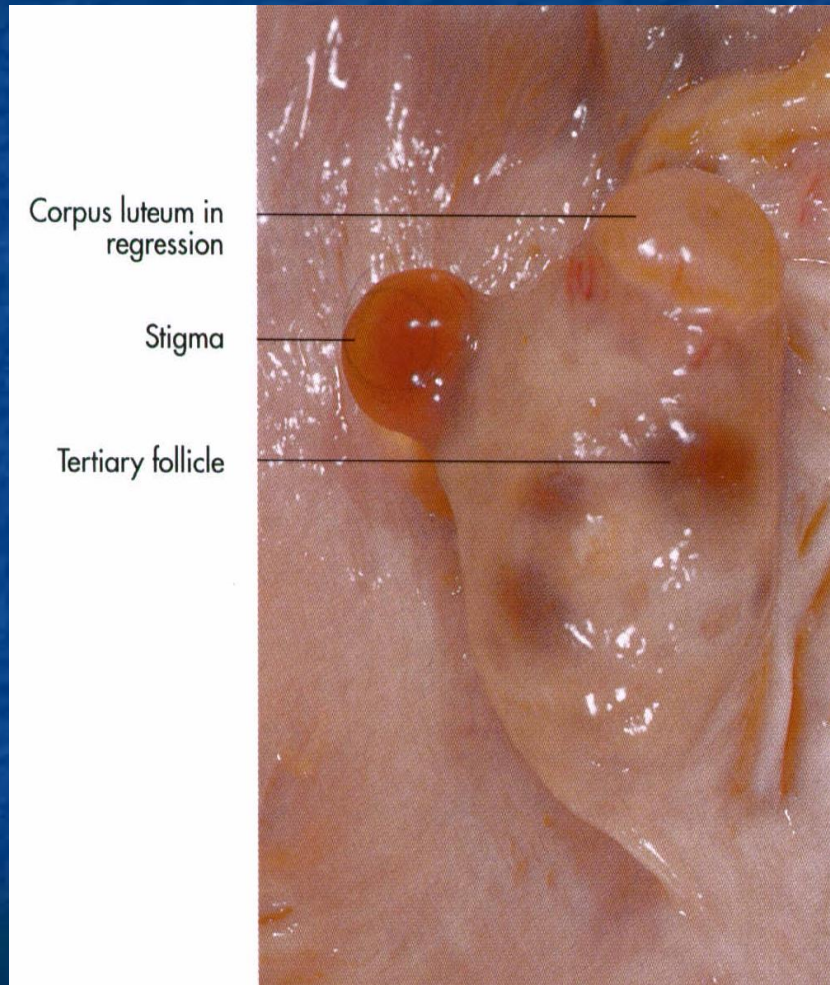




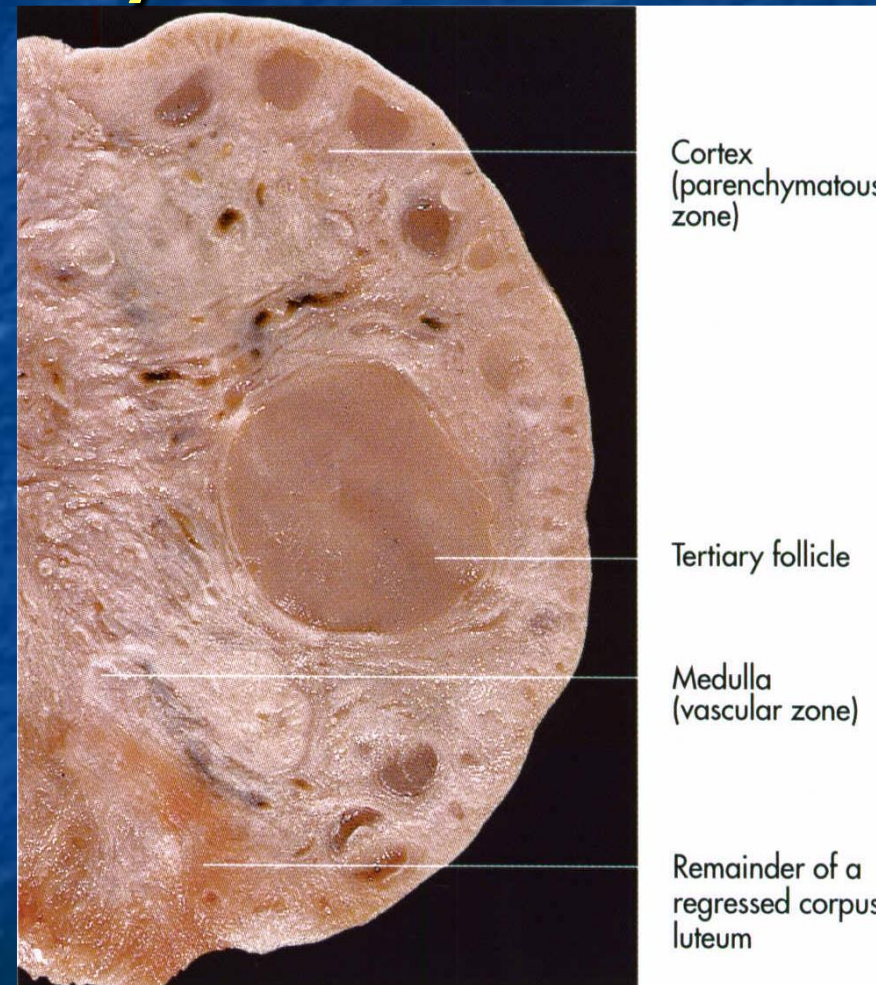




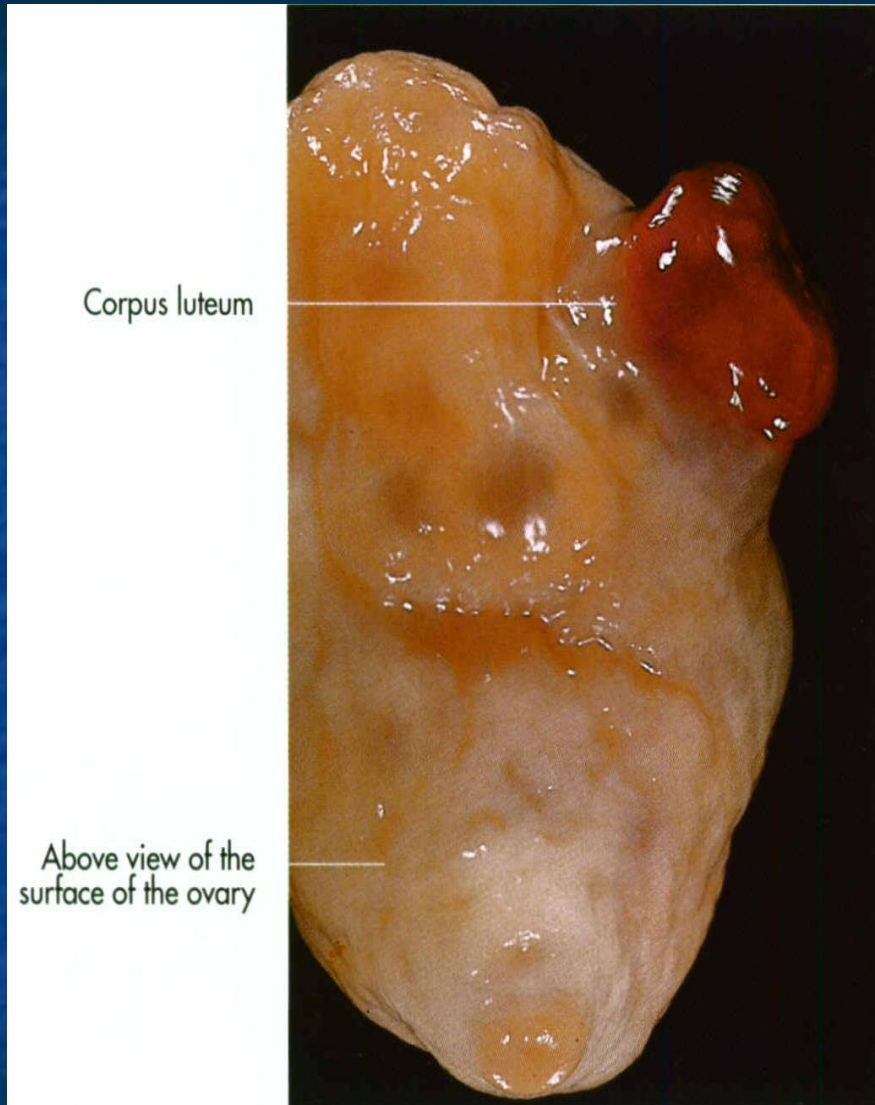
ovary



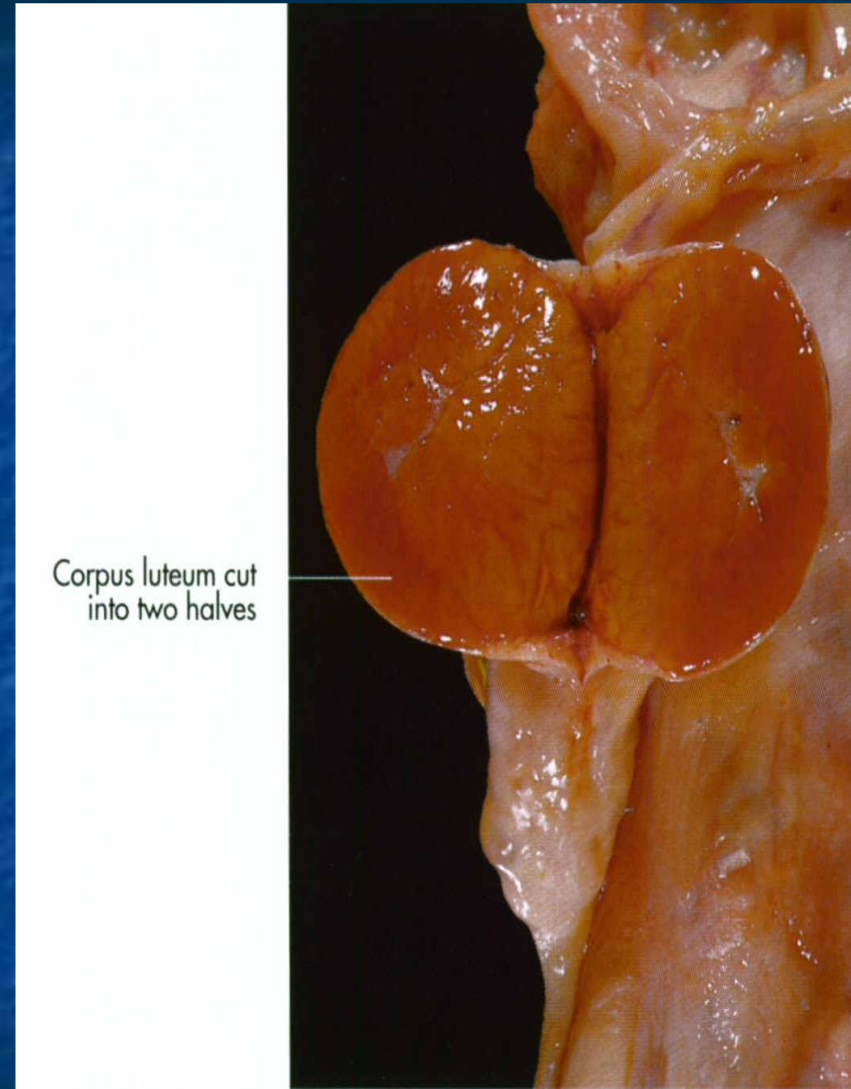
Bovine ovary with a Graafian follicle ready to rupture.



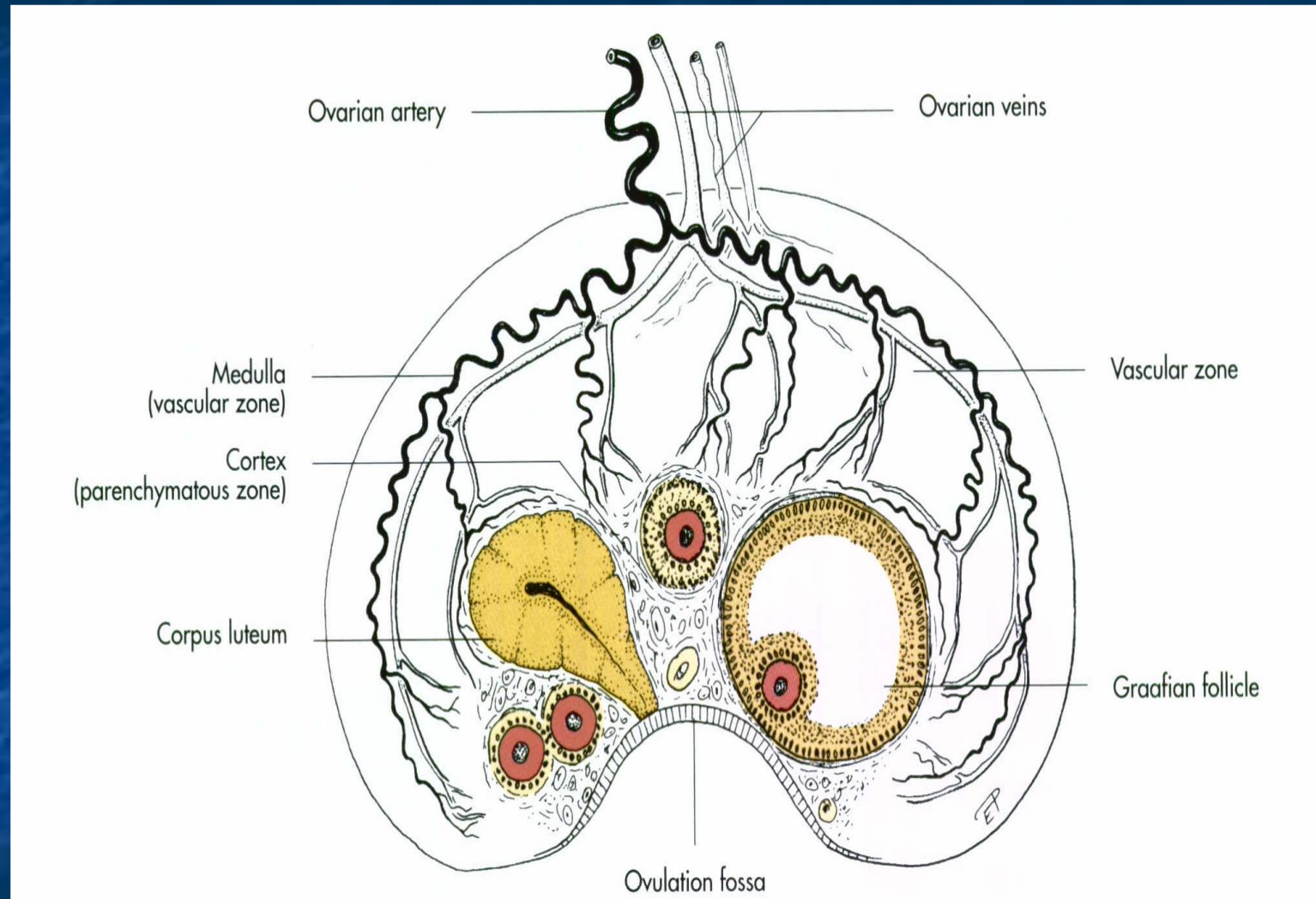
Section of the ovary of a cow



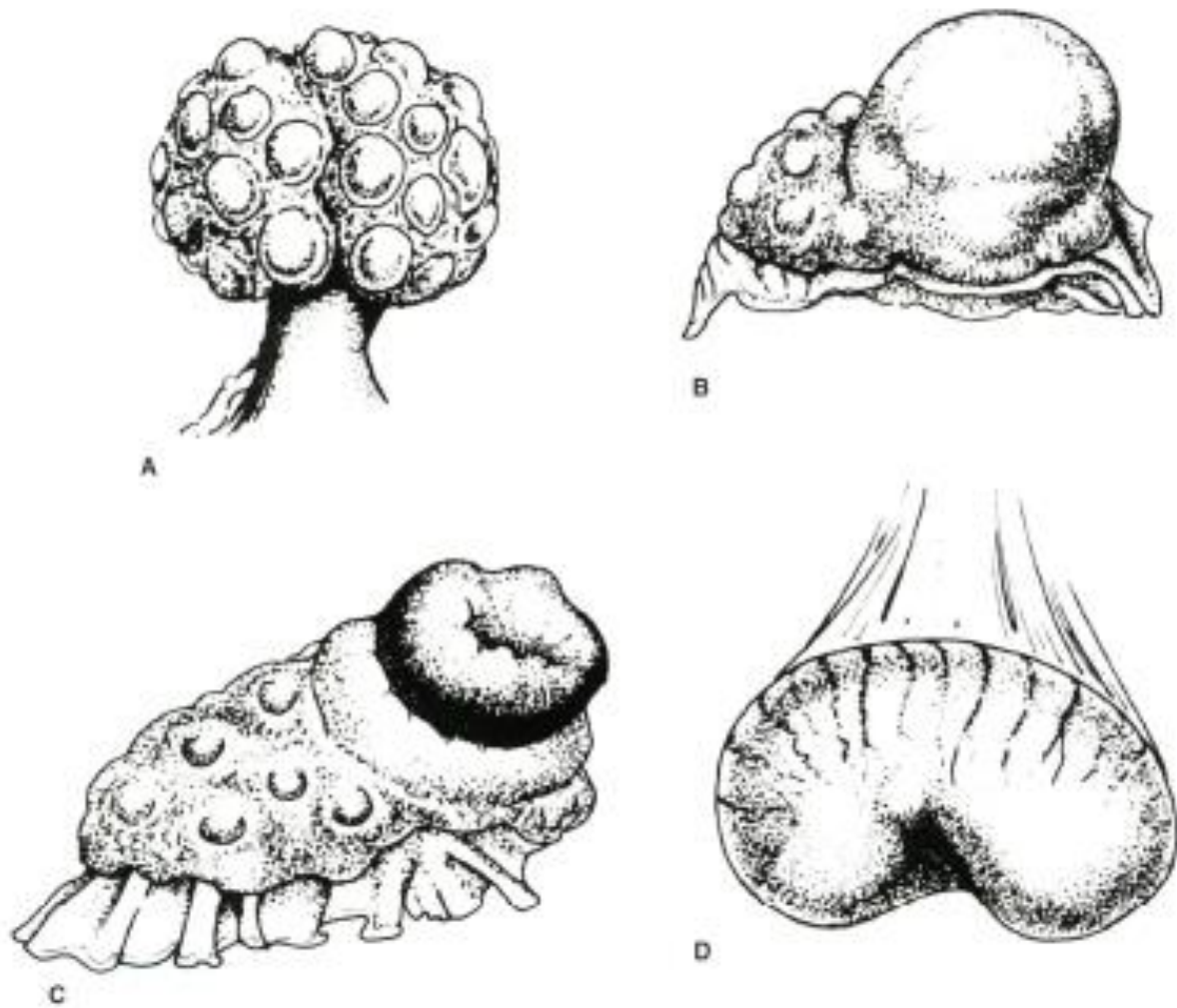
Corpus luteum of a cow two days after ovulation.



Corpus luteum graviditatis in a pregnant cow, dissected in halves



Section of the ovary of the mare, schematic.



■ **FIGURE 15-4** Ovarian differences resulting from species morphology and functional changes. **A)** Sow ovary (berry shaped). **B)** Cow ovary (almond shaped) with ripening follicle. **C)** Cow ovary with fully developed corpus luteum. **D)** Mare ovary (kidney shaped) with ovulation fossa (indentation on the lesser curvature). (From Dyce KM, Sack WO, Wensing CJG. *Textbook of Veterinary Anatomy*. 3rd Ed. Philadelphia: WB Saunders, 2002.)

Structure Of Ovary

▶ **Surface epithelium** → **germinal epithelium (GE)**, continuous with the mesovarium.

▶ **Integrity** of the germinal epithelial covering periodically **broken** at **ovulation** and in continuous stage of damage, repair and regeneration.

▶ **Tunica albuginea** → dense fibrous capsule.

▶ The **cortex**, a broad peripheral zone with ovarian follicles in various stages of development and **corpora lutea**.

▶ **Hierarchy** of ovarian follicles

→ primordial, primary, secondary, graafia

▶ **Medulla** is characterised :

--stroma, large blood, lymph vessels, loose collagen, elastic and reticular fibres, sparse innervation by sympathetic nerves

-- stroma influences follicular maturation and ovulation by transport of hormones

--the medullary structure continues with the mesovarium

4 → graafian follicle. 5 → interstitium

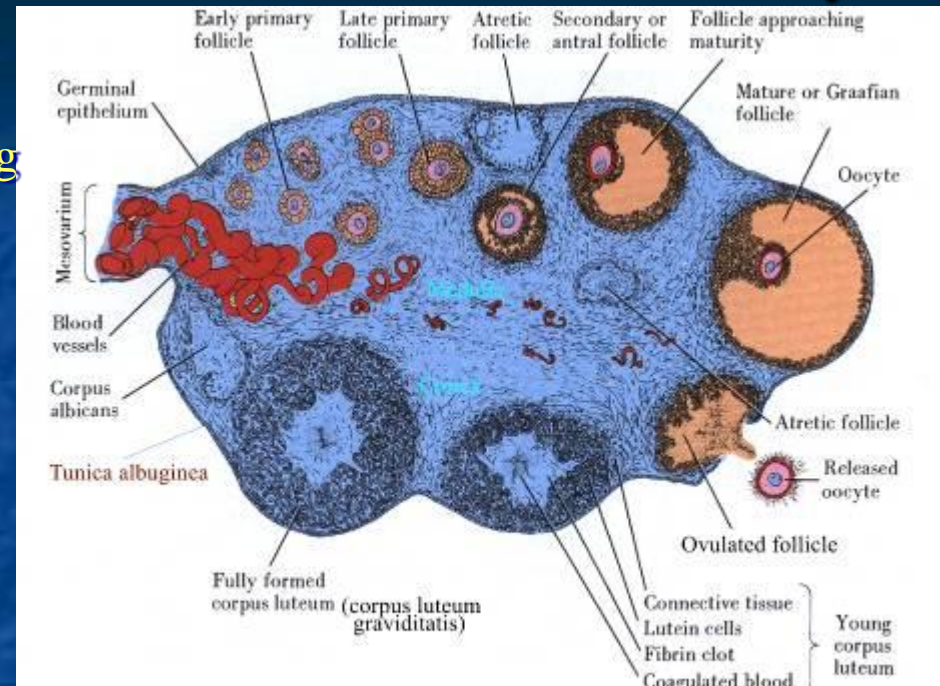
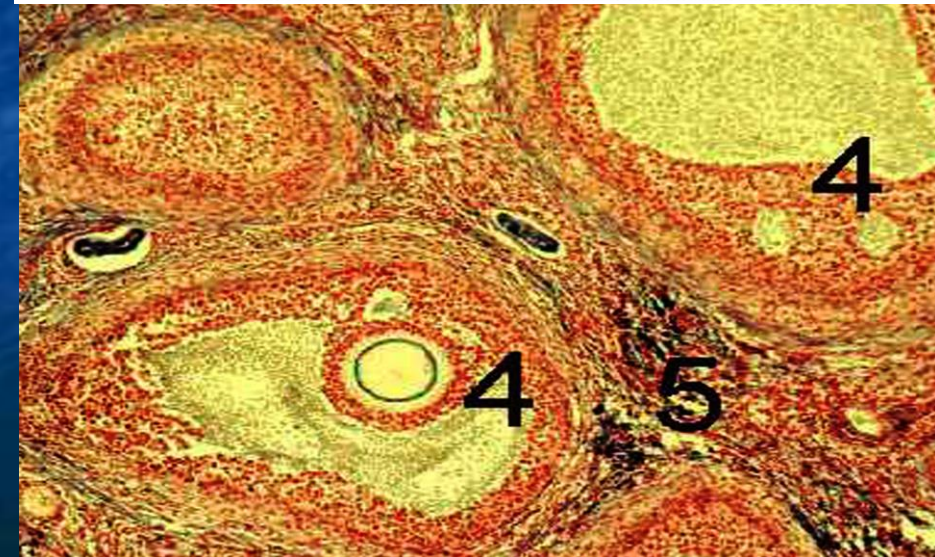


Fig.14 Schematic drawing of a section through the ovary. Highly coiled blood vessels are present in the hilum and medullary regions. (Kaye & Pawlina, 2003)



Follicular Hierarchy

► Dependent on:

1. **Dimensional** criteria. Size

2. **Morphological** criteria

--thickness of the theca and granulosa layer

--degree of vascularisation

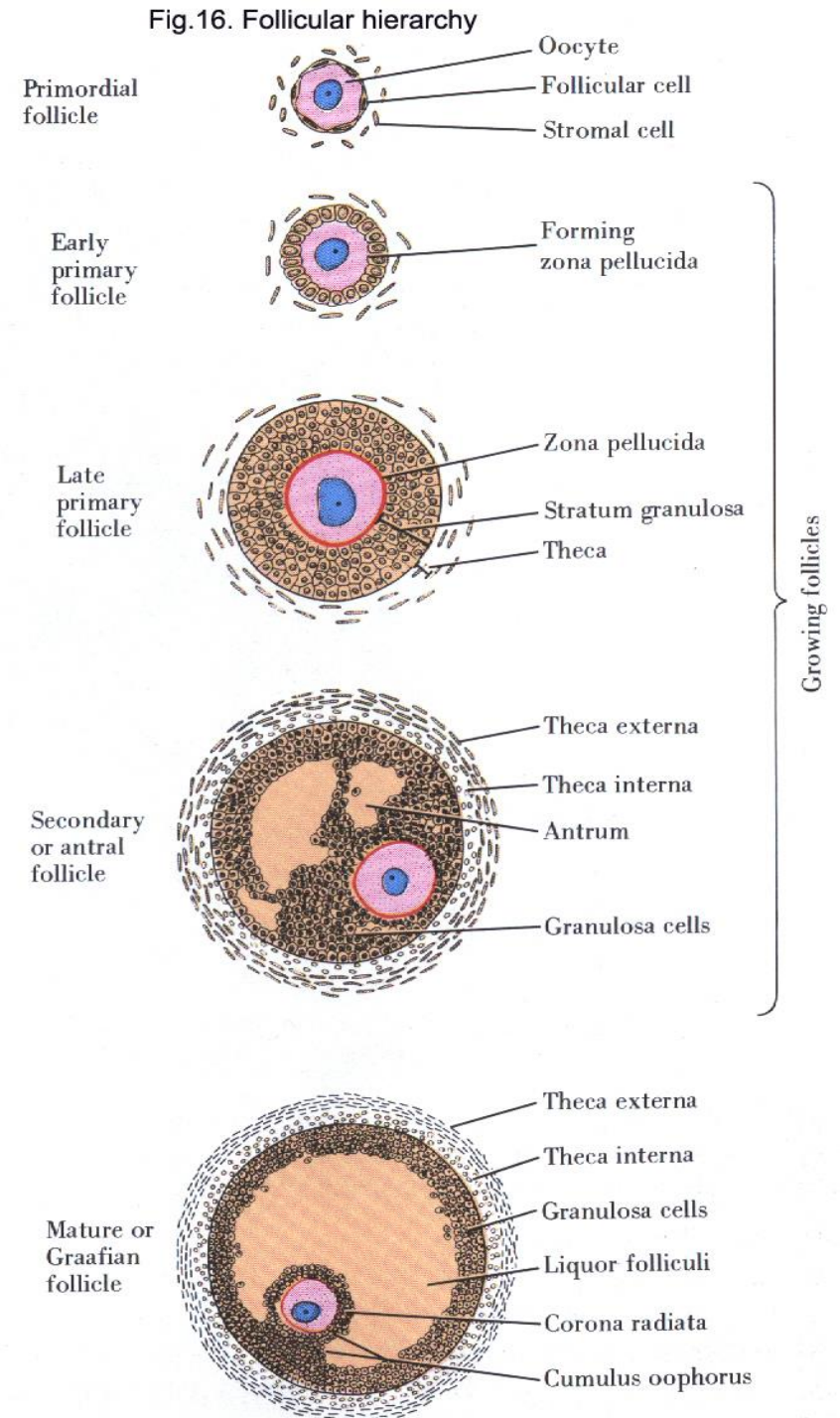
--position of antral cavities

--degree of vascularisation

--quantity of muscle fibres and interstitial tissue.

3. Normal **functional** follicles e.g. corpus luteum

4. **Atretic** follicles



▶ **Primordial follicles** in fetal ovary, → develop, fertilised or atretic.

▶ **Follicular growth** controlled Follicle Stimulating hormone(FSH) and estrogen

--Primary **oocyte** are surrounded by single or many layers of **cuboidal** epithelium resting on basement membrane.

▶ **Early Primary follicle** → **single** layer follicular cells. become oestrogenic → estrogen is mitogenic → cells proliferate.

▶ **Late Primary follicle. Granulosa** layer becomes stratified.

Theca cells and **zona pellucida**(ZP) form

▶ **Secondary Follicle**, larger follicles with **more receptors** **Corona radiata** forms around the oocyte,

--**Granulosa** cells proliferate and **secrete** follicular fluid which accumulate in the intercellular clefts

▶ **Graafian/preovulatory follicle** → **dominant** follicles with more **FSH** receptors

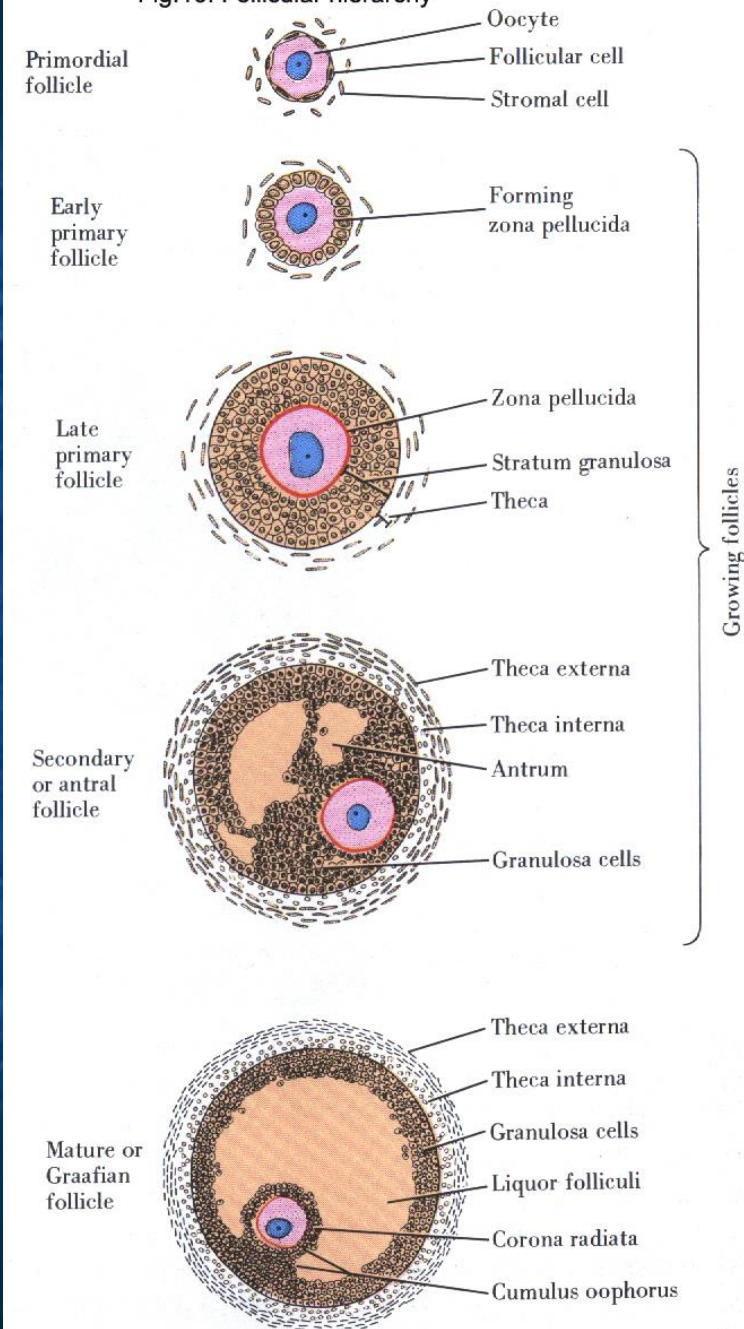
--Intercellular spaces coalesce and expand to form a single **antrum** filled with follicular **liquor** → contains **nutrients** and hormones.

--**Granulosa** cells become distributed into a peripheral **parietal** layer, the radially oriented **corona radiata** and **cumulus oophorus** .

--the **CR** support and accompany the oocyte at **ovulation**. Ovum devoid of CR do not fertilise.

Follicular Hierarchy

Fig.16. Follicular hierarchy



▶ **Formation** and **development** of ova and occurs in two stages. Gonocytes migrate into the fetal gonad-->undergo mitosis and induced into meiosis(MIF).

The Oocyte

▶ Meiosis I arrested in **prophase I**, forms primary oocyte.

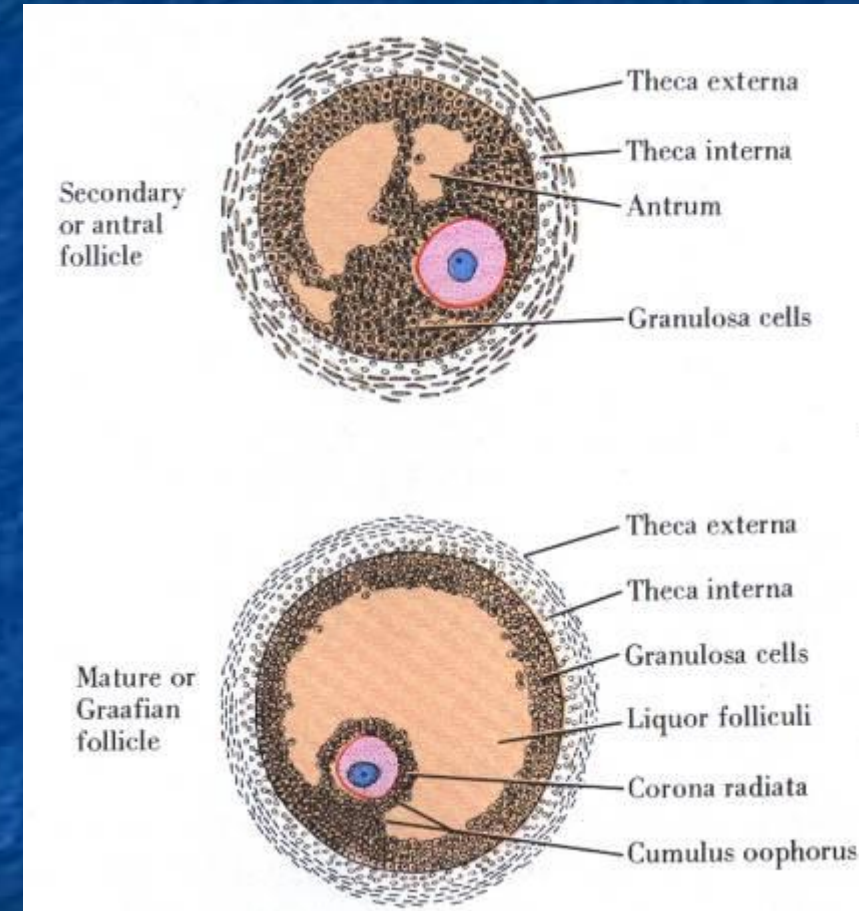
▶ **Puberty**-->FSH,LH,secretion leads to follicular development and oocyte maturation.

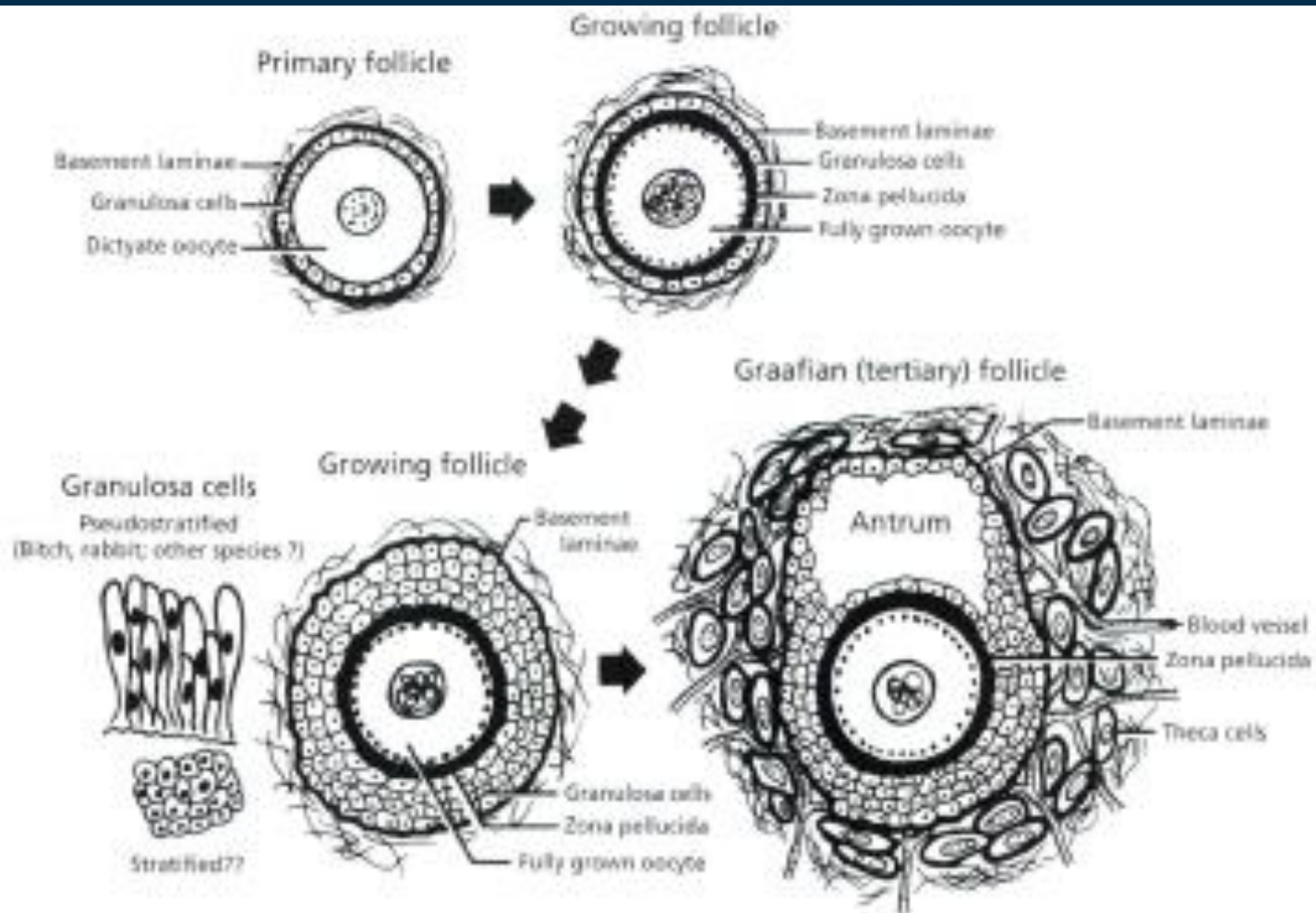
▶ **Hormonal** influence-->growth of oocyte-->completion of meiosis I in graafian follicle forms secondary oocyte.

▶ **Meiosis II** completed in pre-ovulatory follicles in most species. In bitch completion is post-ovulatory or at fertilisation.

▶ **folliculostatin/inhibin synchronises** events in **ovulation**.

--**co-ordinates** growth and maturation of oocyte and granulosa cells.



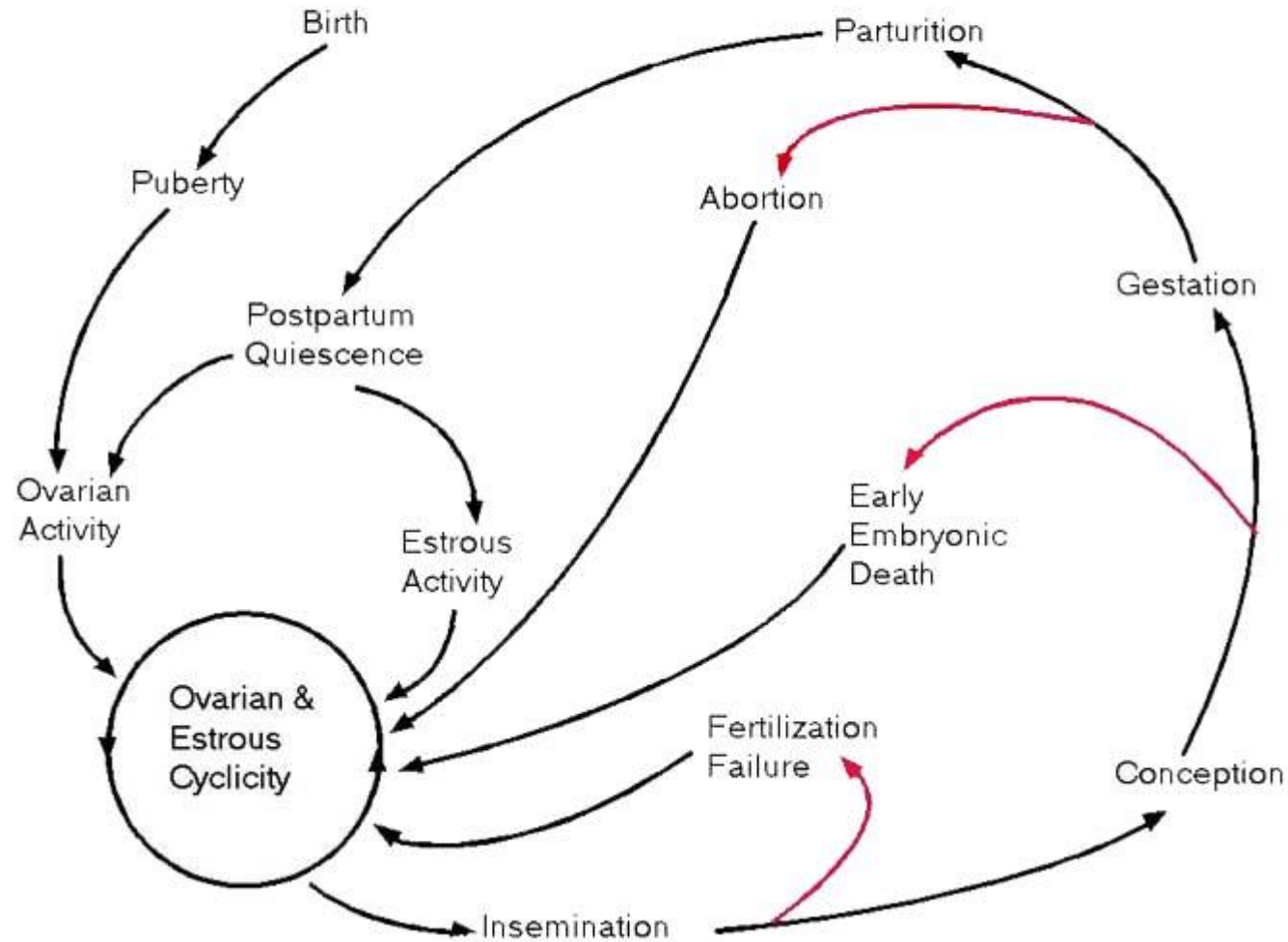


■ **FIGURE 15-5** Development of an ovarian follicle from its primordial (primary) form to a graafian follicle. Growing follicles are those that have begun growth from the resting stage as primordial follicles but have not developed thecal layers or an antrum. (From Pineda MH. Female reproductive system. In: Pineda MH, Dooley MP, eds. *Veterinary Endocrinology and Reproduction*. 5th ed. Ames, IA: Iowa State Press, 2003.)

Oogenesis, Formation of Graafian Follicle and Corpus Luteum



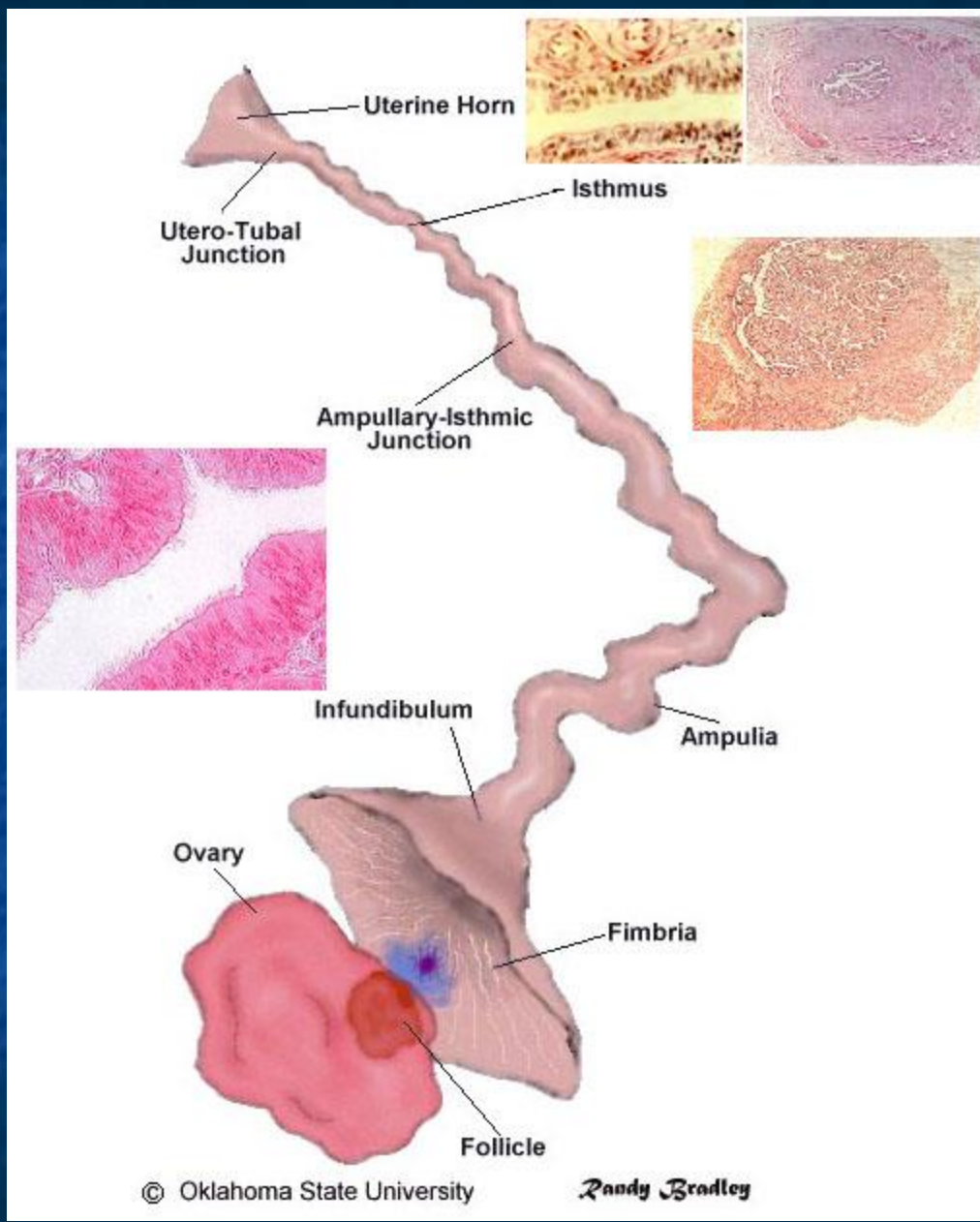
Schematic of Bovine Reproductive Cycle (Female)



Oviduct (uterine tube , salpinx)

- Receive & transport oocytes to the uterus
 - Convey the sperms to meet oocytes
 - Each tube suspended by mesosalpinx
 - Three distinct :
 - *Infundibulum* with fimbria (get the egg)
 - *Ampulla* (more flagella and secreting cells)
- Ampulla – Isthmus junction (AIJ) (fertl. Occ)
- *Isthmus* (less fla. And sec. cell)

Utero-tubal junction (UTJ)

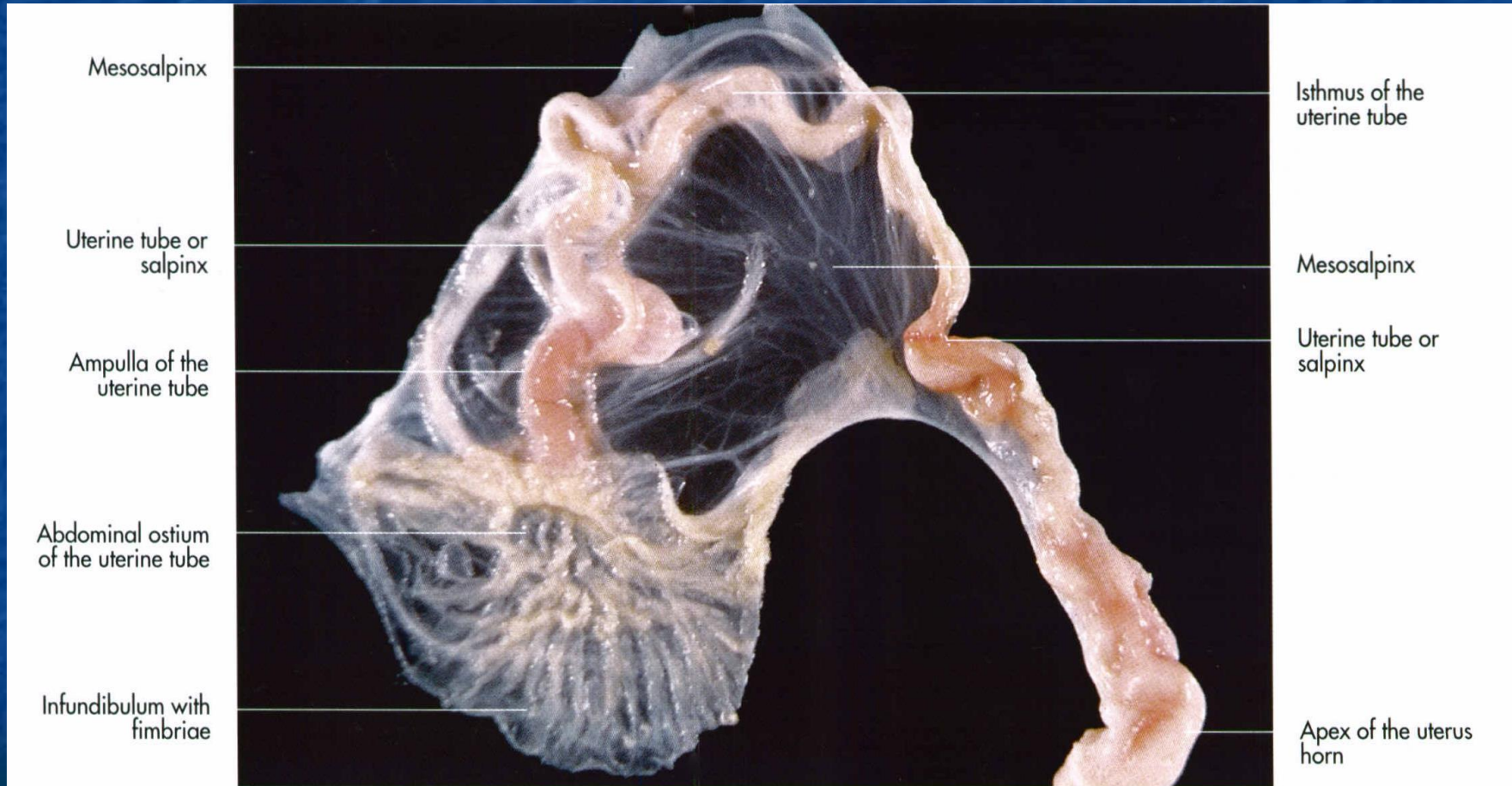


Oviduct (uterine tube , salpinx)

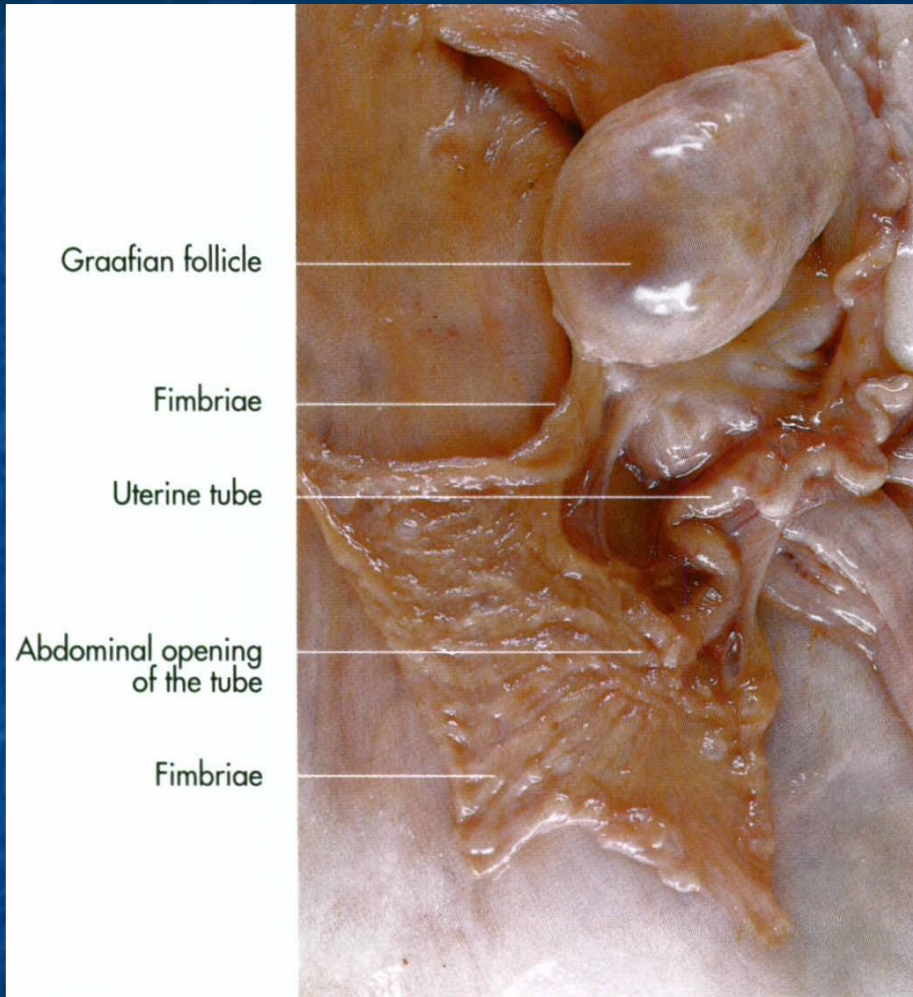


Epithelial Lining of Uterine Tube

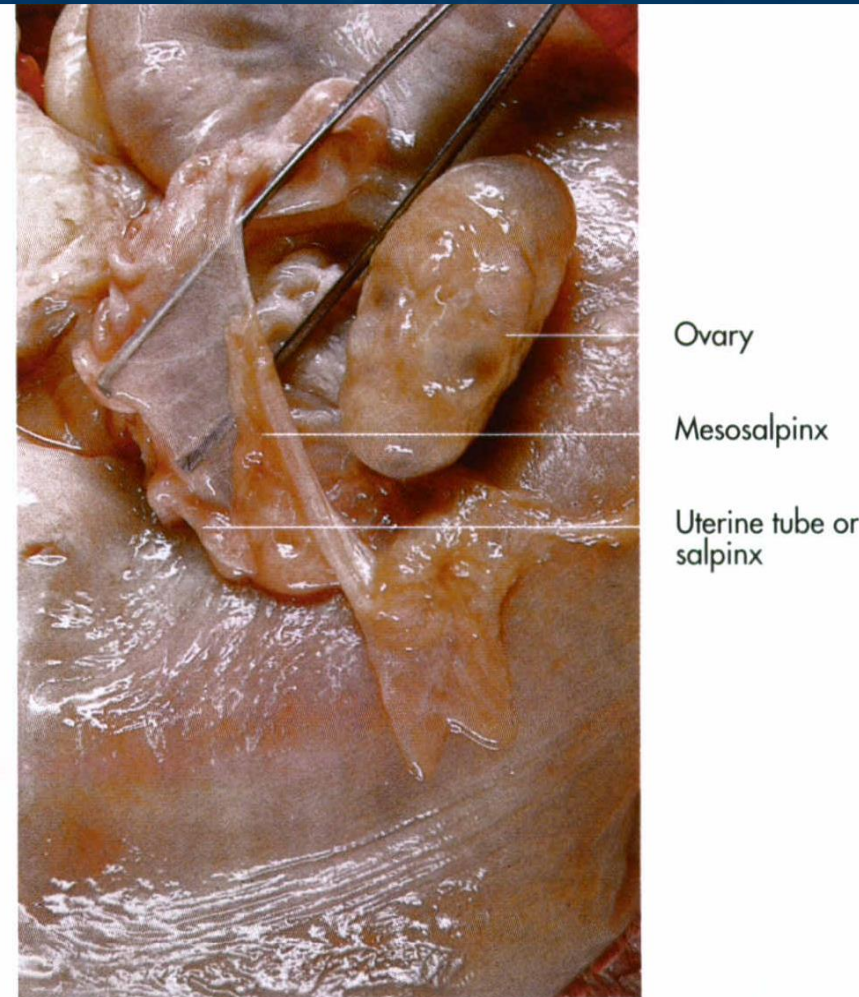
Oviduct (uterine tube , salpinx)



Uterine tube of a cow.



Ovary and uterine tube of a cow.



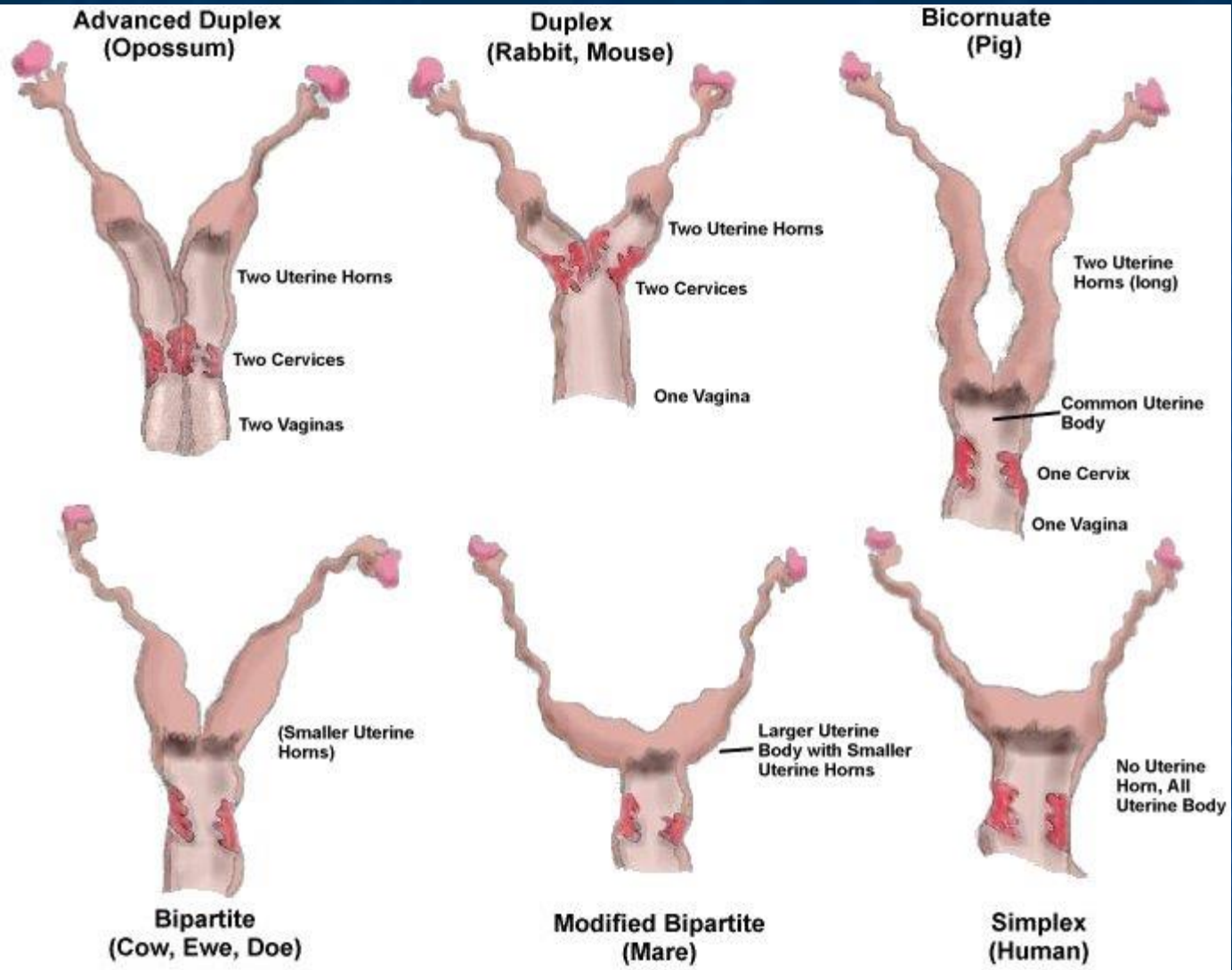
Ovary, uterine tube and ovarian bursa of a cow.

Oviduct (uterine tube , salpinx)

- Capacitation of sperms
- Meeting of sperms & oocytes (muscle contractions , movement of villi in isthmus)
- Nutrition of zygote (2 to 5 days) by secreting pyruvate , phosphoanol pyruvate lactate , protein , . . .
- Effect of estradiol : increasing mov. & sec. (inhibition of entering zygote to uterus)
- Effect of progestrone : decreasing mov. & sec.

Uterus

- Three distinct : (horn , body , cervix)
- Different types :
 1. Duplex (2 cervices , 2 horns) in rat , mice , rabbit and guinea pig
 2. Bicornuate (1 cervix , small body) in pig
 3. Bipartite (1 cervix , larger body , septum) in cow , sheep , bitch , queen & *mare*
 4. Simplex (large body , small horns) in primates



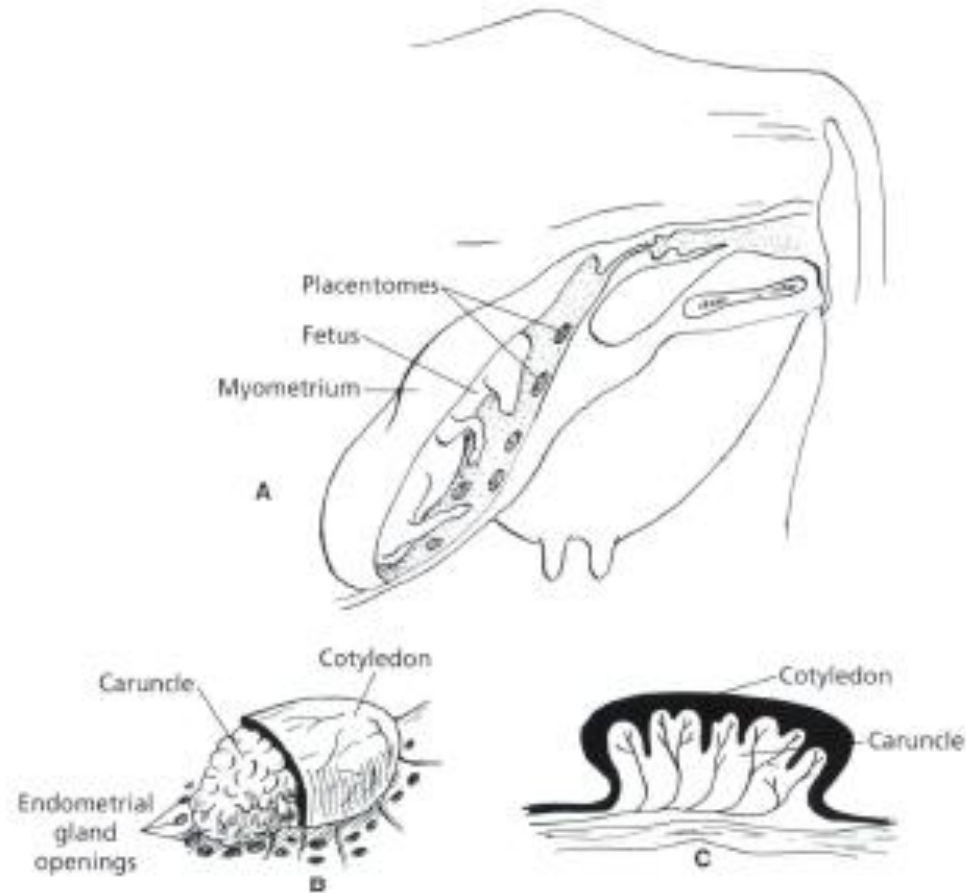
Uterine wall

- Mucosal layer (endometrium)
 - Muscular layer (myometrium)
 - Serosal layer (perimetrium)
-
- Effect of estradiol : increasing blood vessels and partially secreting cells
 - Effect of progesterone : thickening the wall and increasing the secreting cells

Uterine wall



Histological section of the uterus of a sheep



■ **FIGURE 15-7** Relationship of the bovine fetal placenta to the maternal endometrium. **A)** View of fetus within the uterus showing multiple placentomes. **B)** Magnification of a placentome that is surrounded by a number of endometrial gland openings. Only a part of the fetal cotyledon is shown so that the underlying maternal caruncle and endometrial gland openings can be visualized. **C)** Cross section of a placentome. The contribution by the fetal placenta is known as the cotyledon, and the maternal contribution is known as the caruncle.

Endometrium



Placentome of a cow, formed by the separated fetal cotyledone and the maternal caruncle.