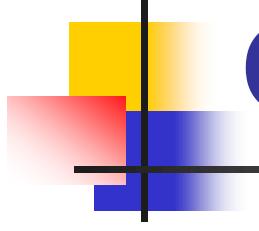


Female Reproductive System (Histology)



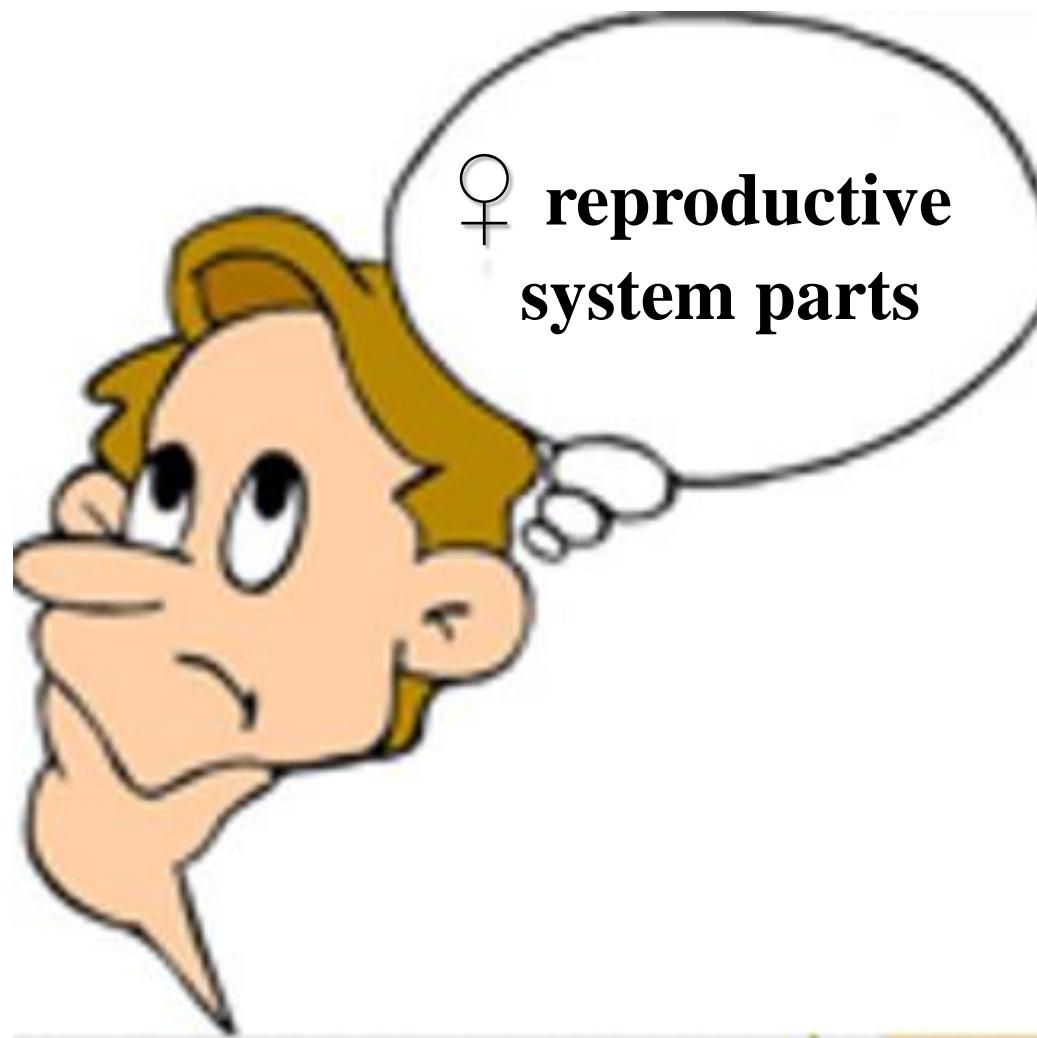
Objectives

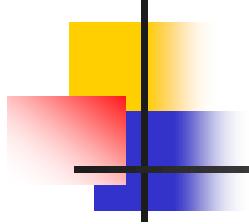
- State the main structures comprising the female genitalia

- Explain the structural adaptations to functions of following organ: ovaries, uterine tubes, uterus & vagina



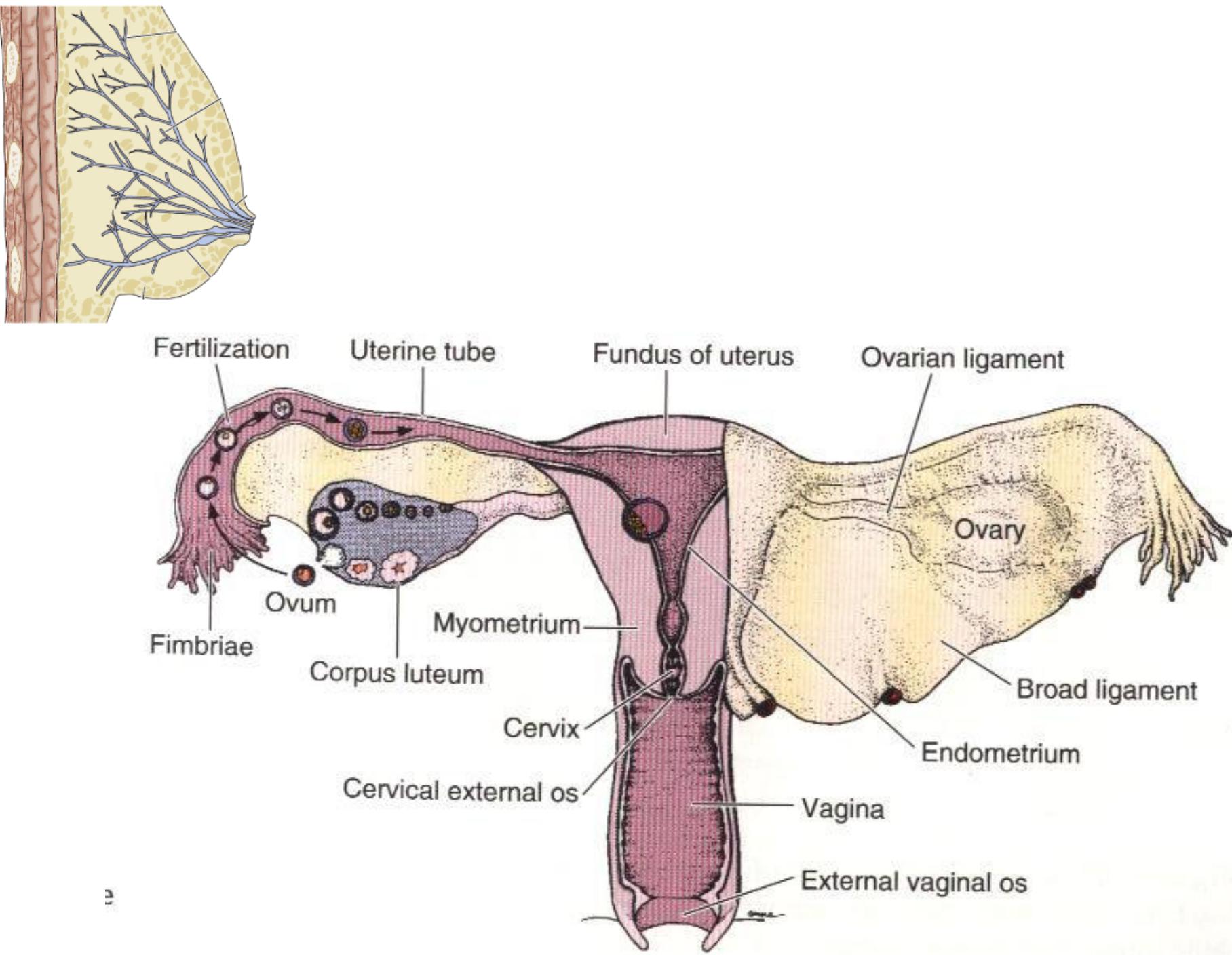
**reproductive
system parts**

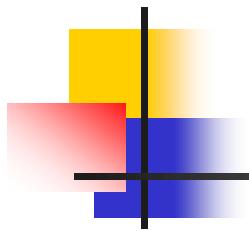




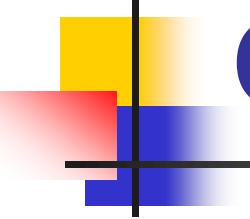
Female reproductive system consists of

- A pair of ovaries which produce female germ cells
- A pair of uterine tubes
- Uterus and vagina
- External genitalia
- A pair of mammary glands





Oogenesis



Oogenesis

Endodermal cells
(yolk sac wall)

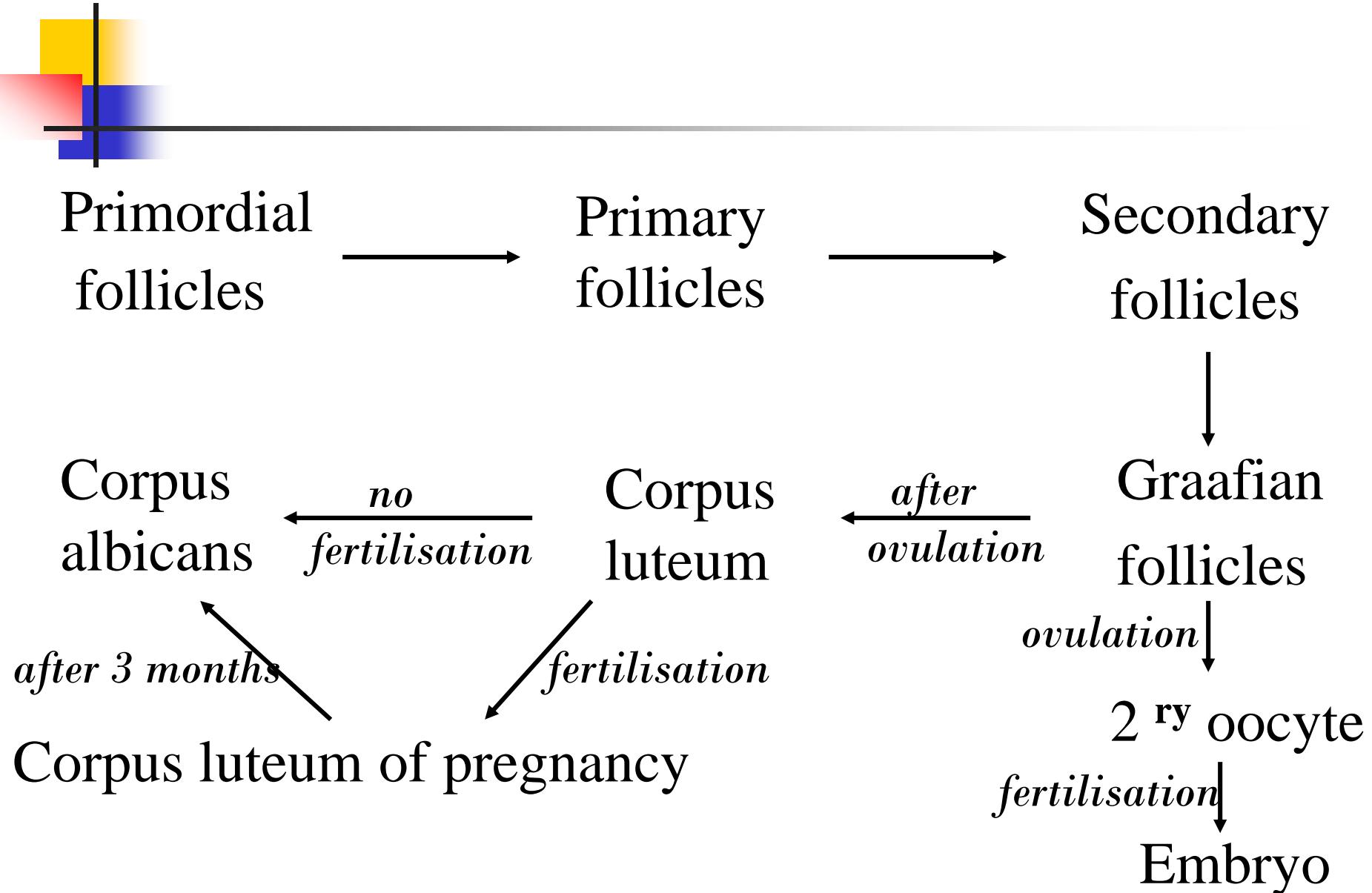
$\xrightarrow{3^{rd} \text{ week - foetal life}}$
*Migrate to
developing ovaries
(amoeboid movements)*

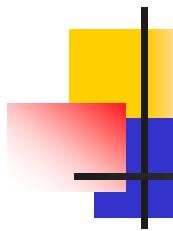
Primordial germ cells

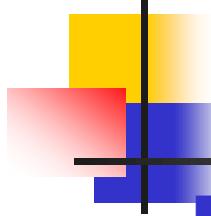
Primordial
follicles

$\xleftarrow{7^{rd} \text{ month - Encapsulated by
single layer of flattened}}$
follicular cells : granulosa cells

Differentiation
↓
Oogonia
 $\xrightarrow{3^{rd} \text{ month}}$
Mitotic divisions
 \downarrow
Clusters
Primary oocytes

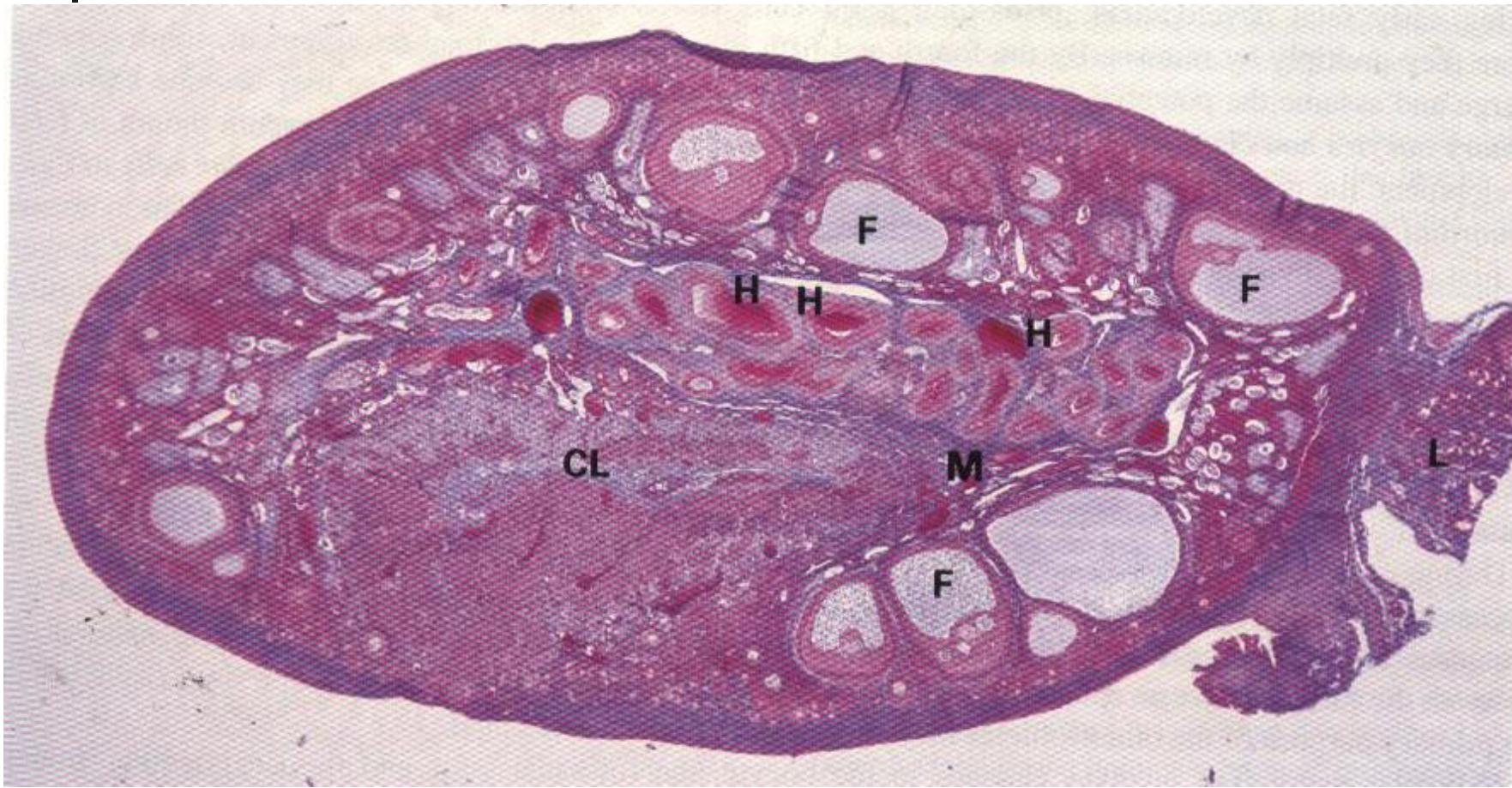


- 
- Many oogonia and primary oocytes degenerate during the 5th & 6th months of foetal life.
 - At birth there may be about 700,000 follicles in both ovaries
 - Number diminishes with age and 40,000 survive to puberty
 - Only then do the primary follicles develop into mature Graafian follicles
 - Primary oocyte have completed the prophase of the 1st Meiotic division

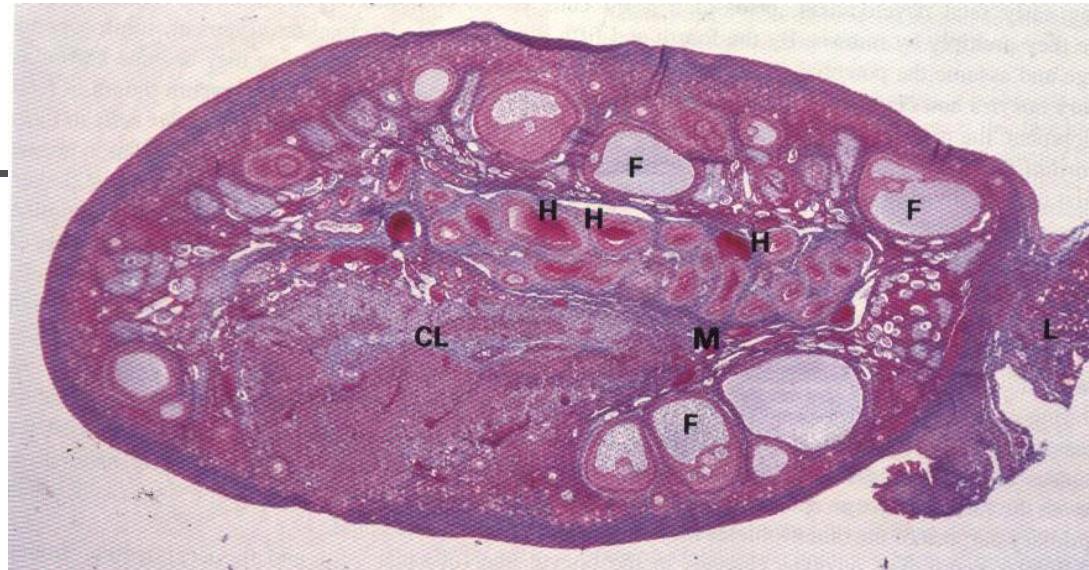
- 
- At puberty the FSH produced by anterior lobe of pituitary influence the stimulation of the ovarian follicles, then ovarian cycle begins
 - With each ovarian cycle many primordial follicles start to enlarge but one follicle reaches maturity
 - Others degenerate to form **atretic follicles**
 - One ovum normally ovulates during each ovarian cycle
 - Primordial follicles increase in size
 - flattened cells surrounding the oocyte becomes cuboidal cells known as **granulosa or follicular cells**

One cell layer surrounds the oocyte then the follicle becomes an **Unilaminar primary follicle**

Ovaries

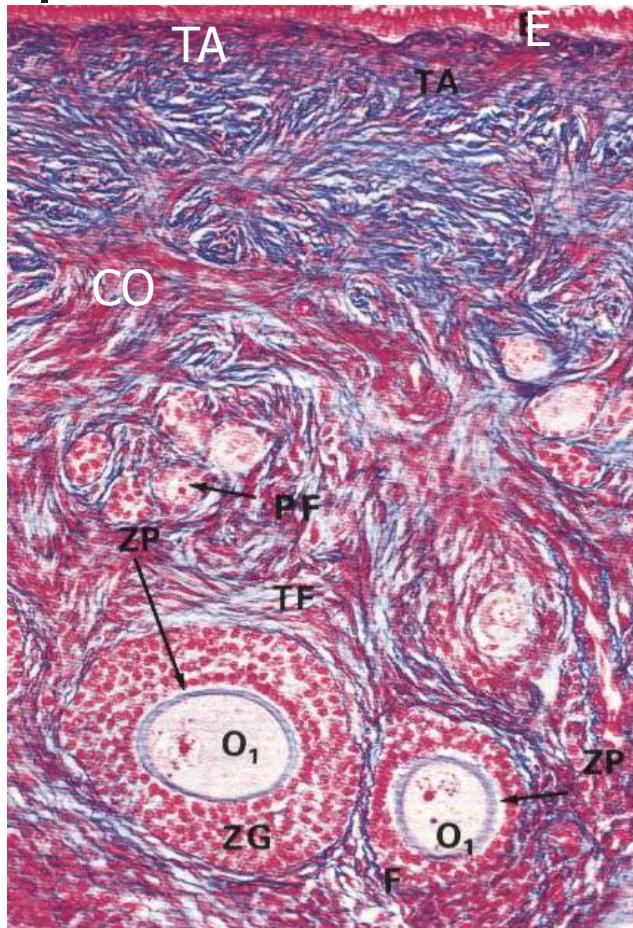


Ovaries



- Flattened ovoid bodies – lie on each side of the uterus , in relation to lateral pelvis wall
- Functions : *exocrine & endocrine*
- Histology = stroma + paranchyma
- Ovary covered by
 - specialized cuboidal epithelium*
 - no basement membrane*
 - germinal epithelium*

Ovaries



■ Stroma

- below the epithelium (E)
- densely arranged fibers & cells

↓
Tunica albuginea (TA)

■ Paranchyma

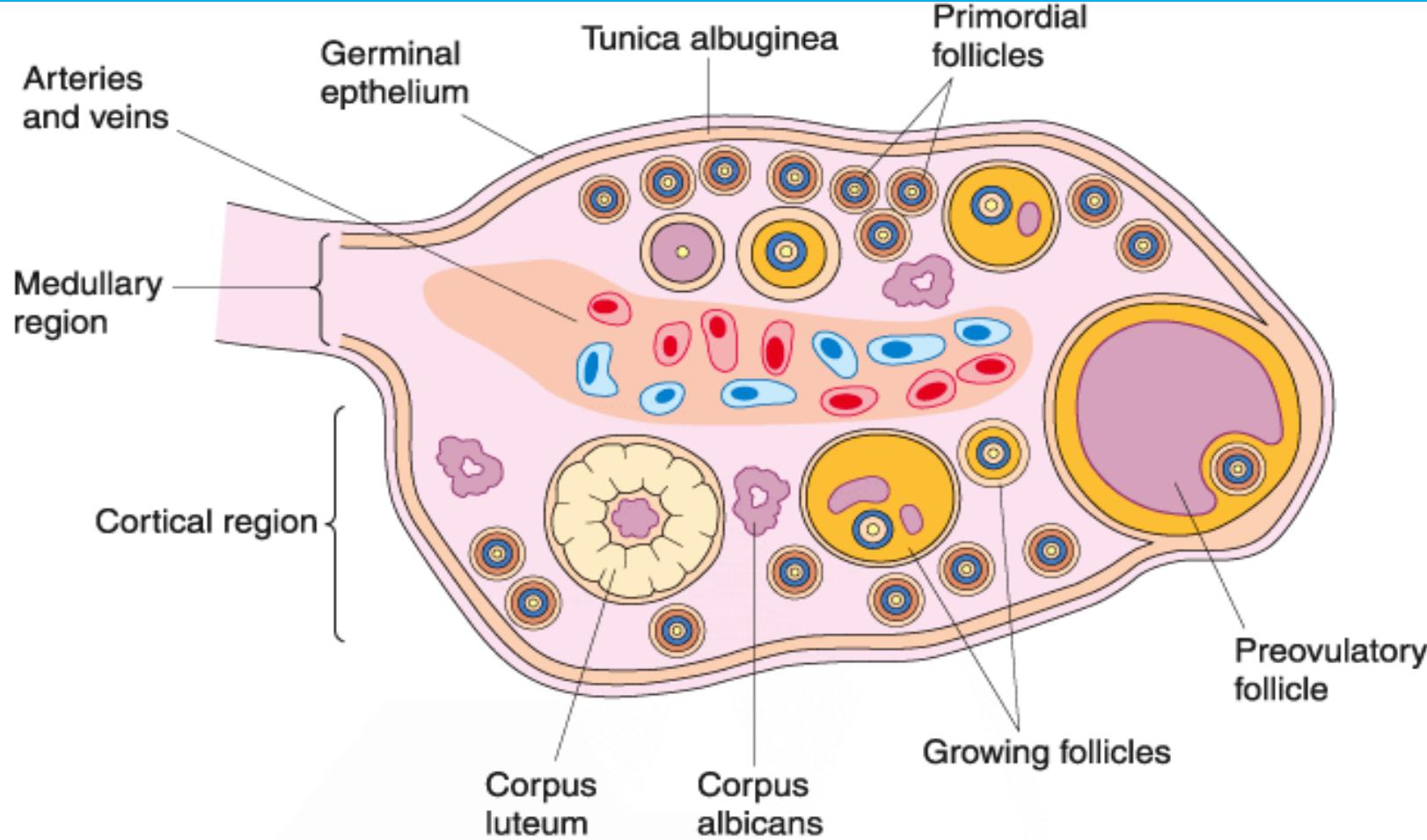
- outer cortex + inner medulla

↓
↓

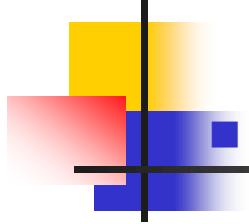
loose C.T.
blood vv
smooth mm

ovarian follicles

Ovaries



- In a section two zones seen
 - A central portion the medulla or zona vasculosa**
 - A broad outer layer -the cortex**
- Two zones blend with each other without distinct demarcation

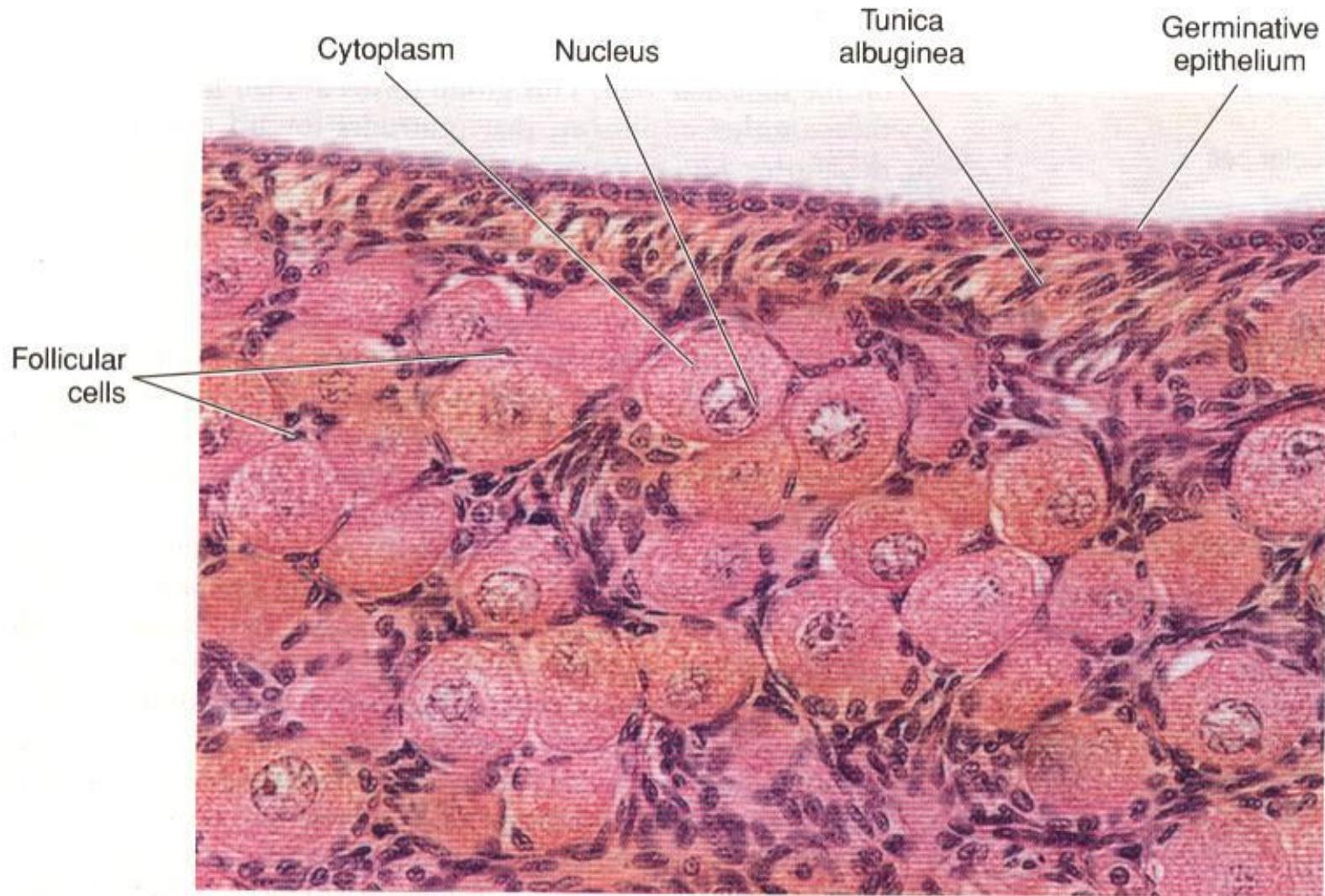


Cortex- broad peripheral layer
cellular connective tissue
characteristic epithelial structures scattered
- **ovarian follicles**

smooth muscle cells around follicles

- Medulla – loose connective tissue
numerous blood vessels
nerve fibres
lymphatic vessels
Hilus cell

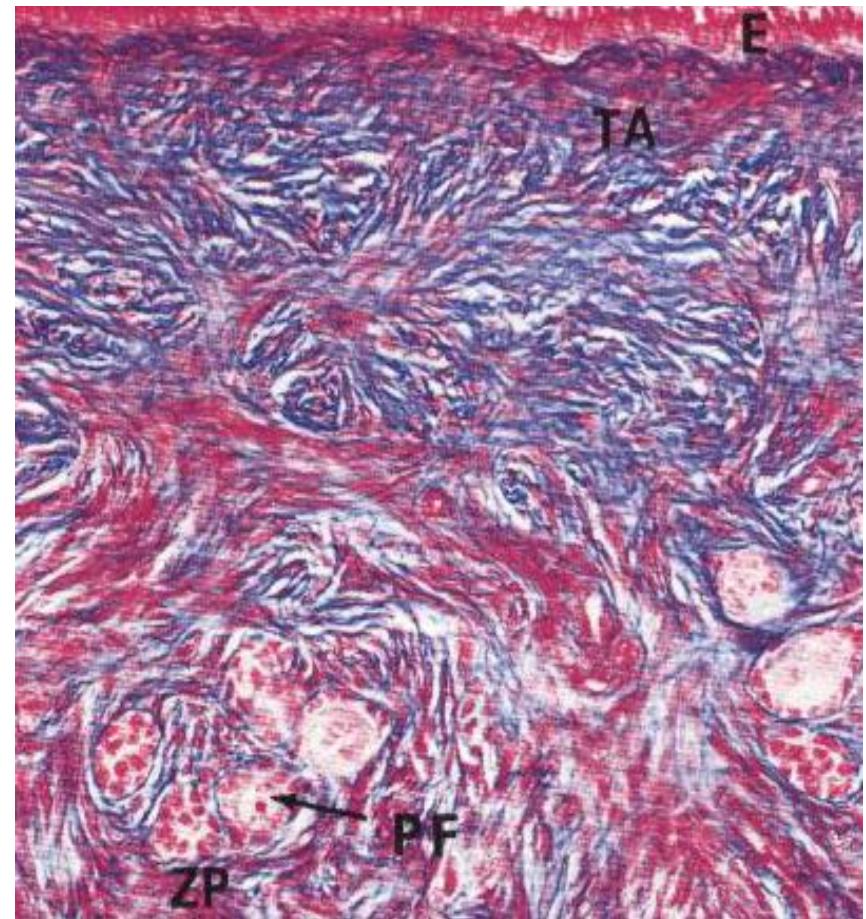
Cortical region of an ovary showing primordial follicles



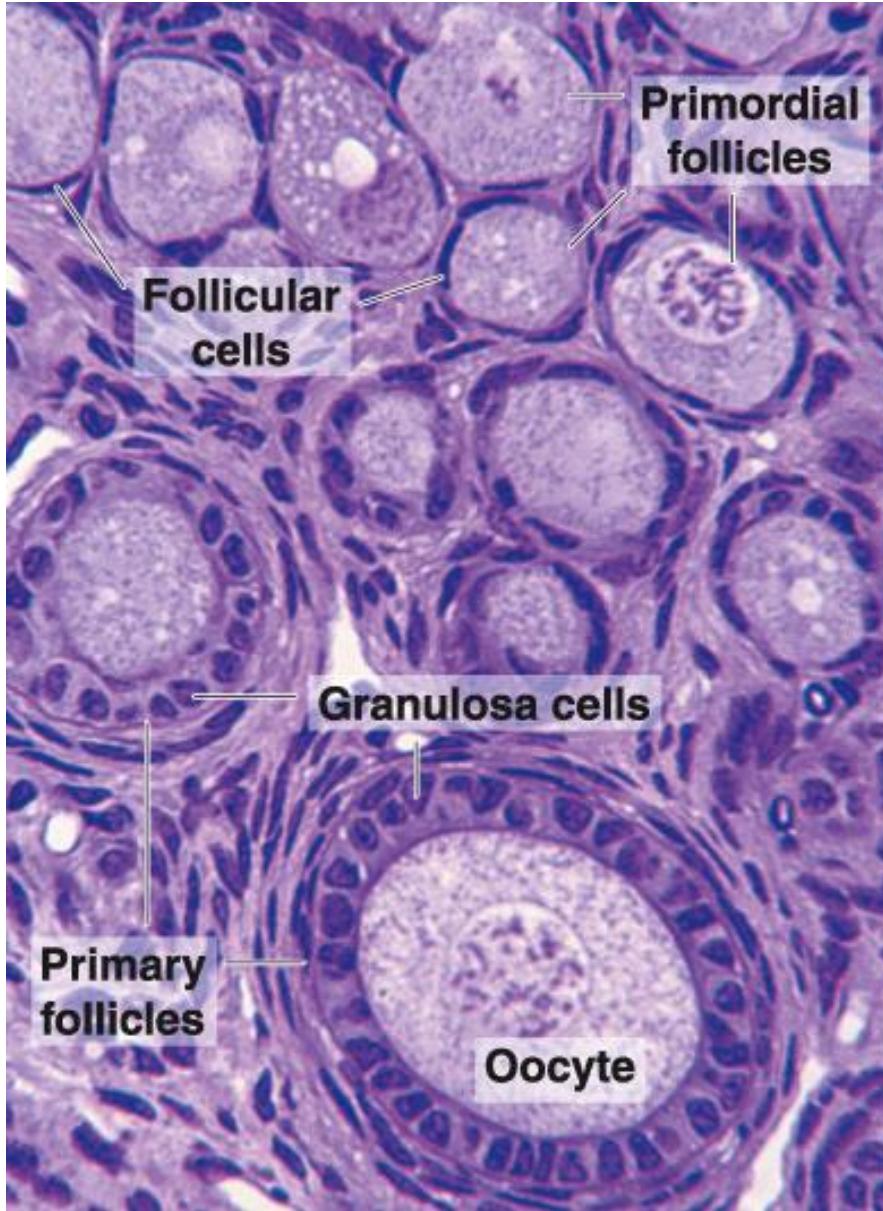
Primordial follicles

- Primary oocyte
- Single layer of flattened follicular cells
- Large eccentric nucleus
- Fine granular chromatin
- Prominent nucleolus
- Little cytoplasm

Primordial $\xrightarrow{\text{Size} \uparrow \uparrow}$ Primary
follicles follicles

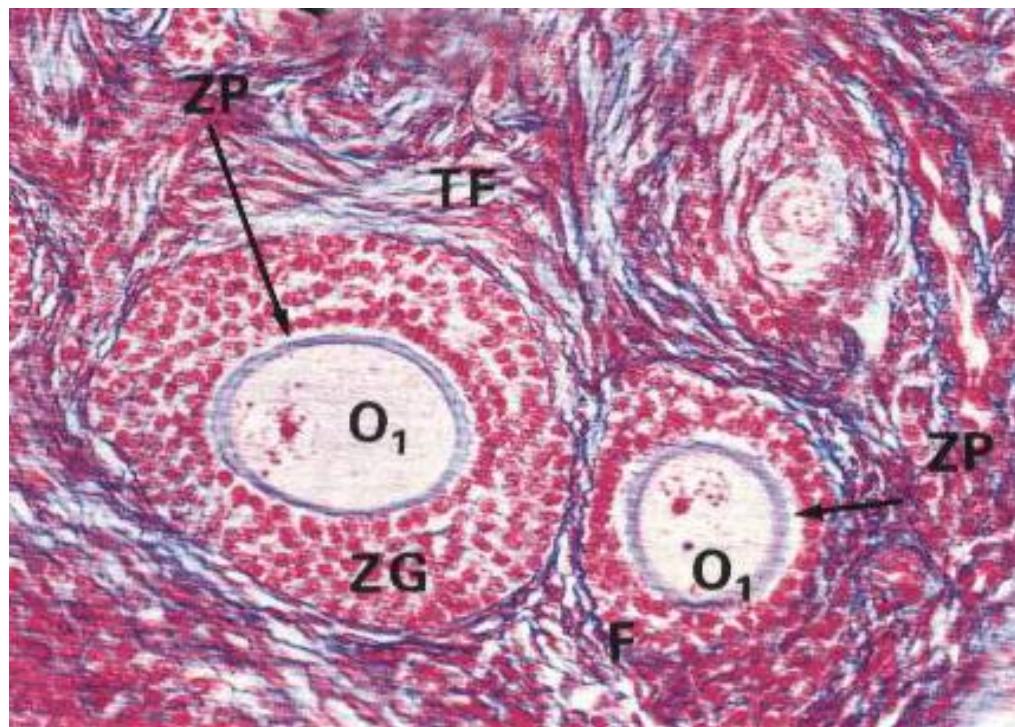


Cortical region Showing primordial & unilaminar primary follicles

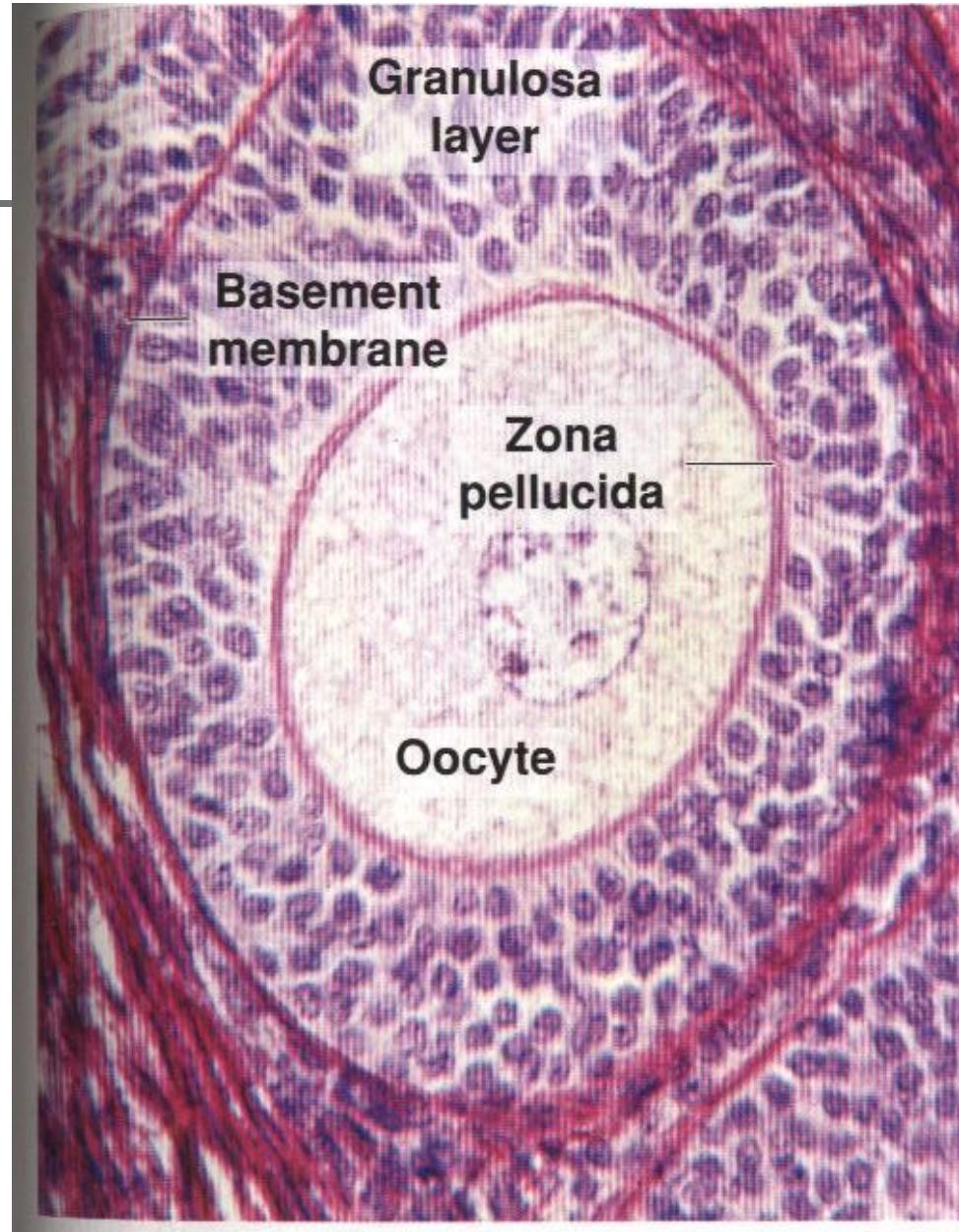


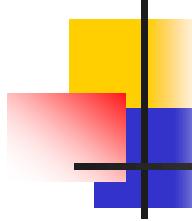
Primary follicles

- Oocyte enlarged
 - Flattened follicular cells
- mitosis* ↓
- cuboidal granulosa cells
 - Zona granulosa (ZG)
 - Zona pelluida (ZP)
 - Stromal → Theca
cells folliculi (TF)
- Basement membrane (between TF-ZG)

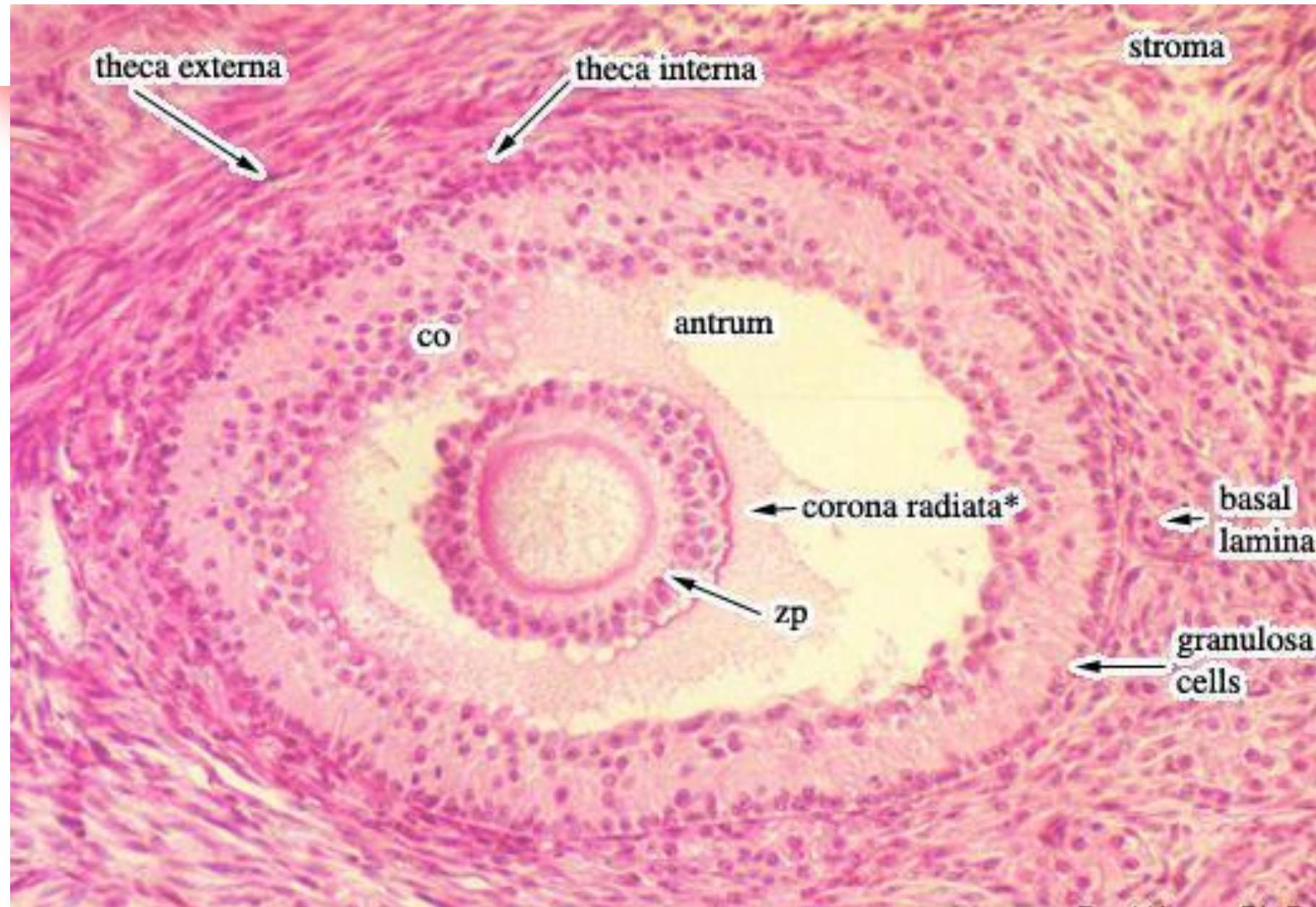


Multilaminar primary follicles

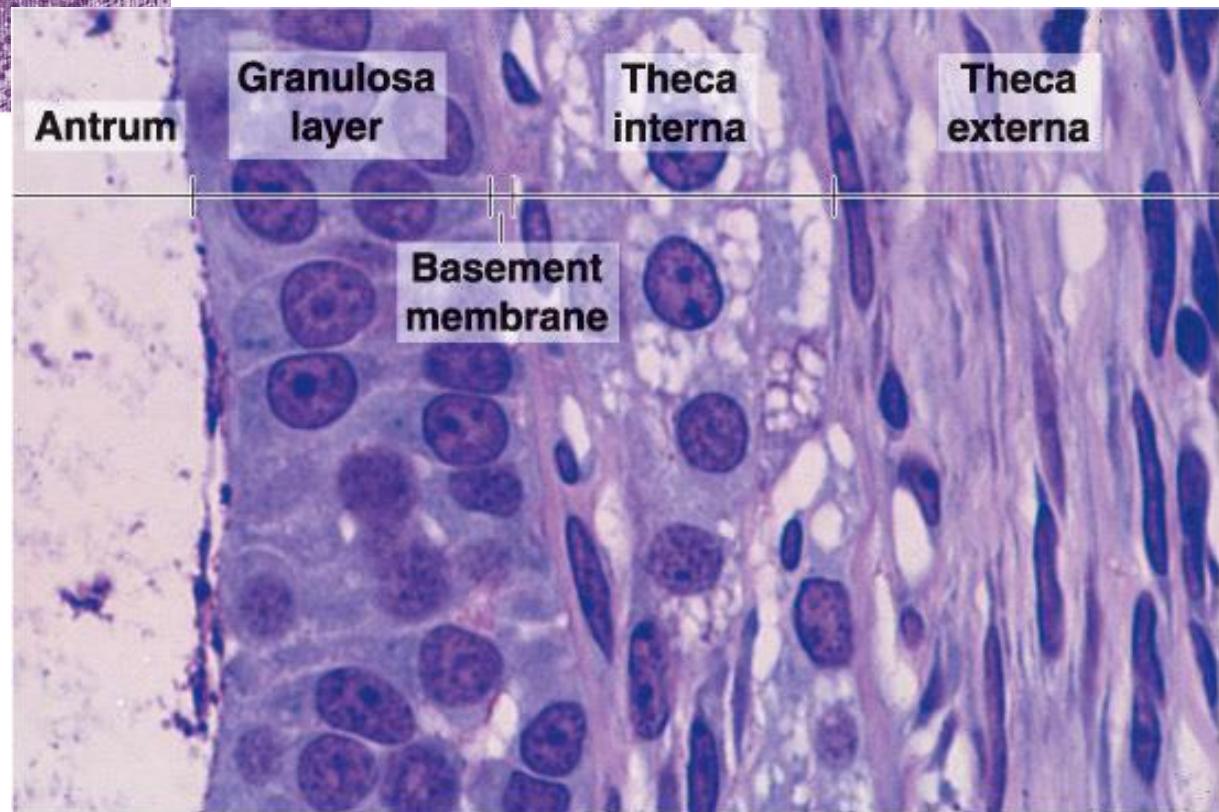
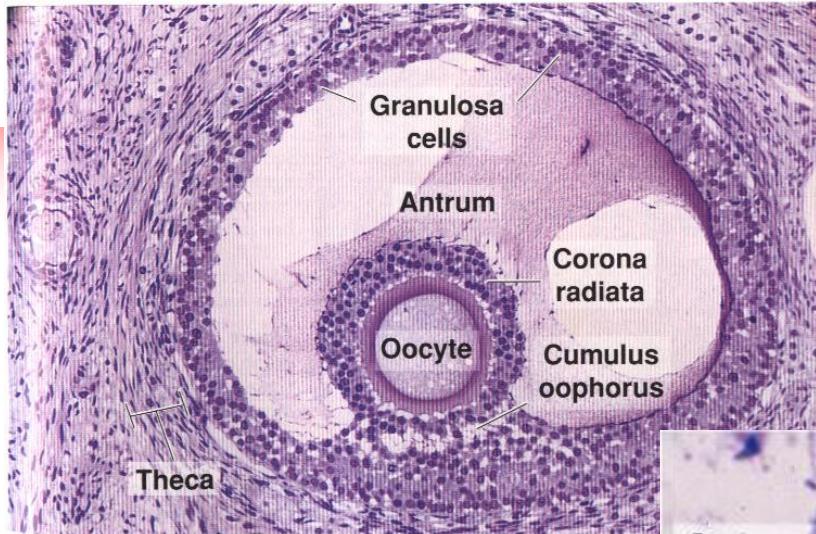


- 
- Granulosa cells divide giving rise to **multilaminar primary follicle**
 - Granulosa cells secrete a hyaline material with glycoprotein known as **zona Pellucida**
 - Irregular spaces appear among the granulosa cells
 - Spaces coalesce forming a single cavity——→ **follicular antrum**
 - filled with clear fluid——→ **liquor folliculi**
 - Granulosa cells that line the cavity are known as **membrana granulosa**
 - cells surrounding the oocyte- **corona radiata**
 - Cells which attaches the oocyte to the rest of the follicle
-**cumulus oophorus**

Secondary follicles

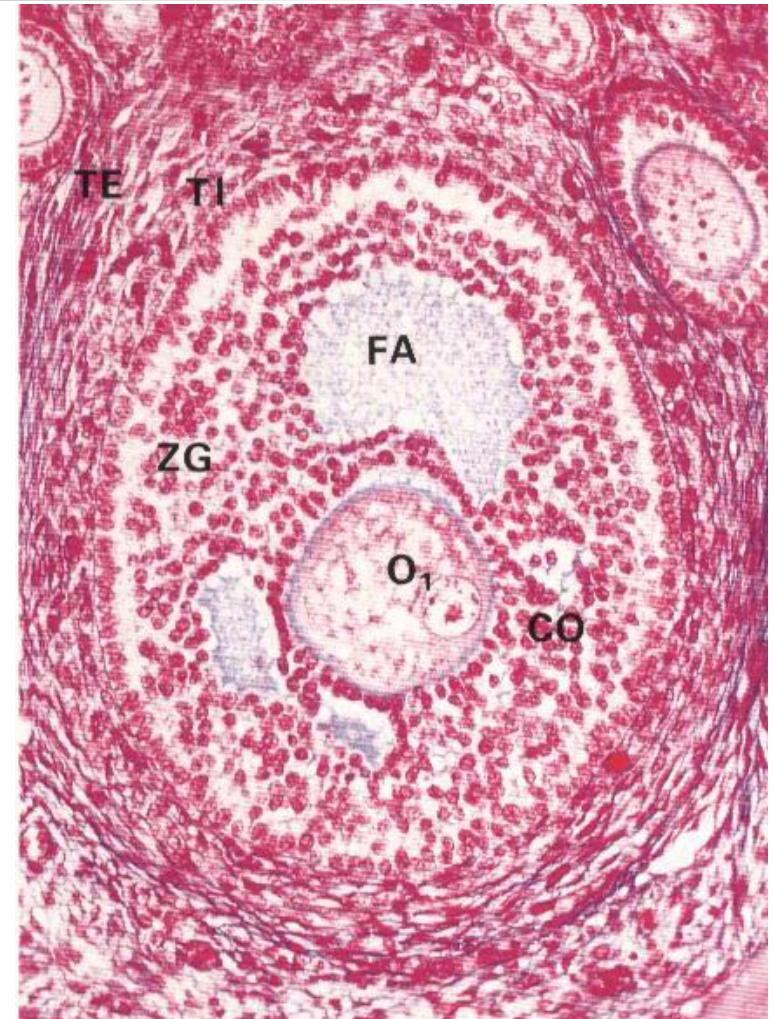


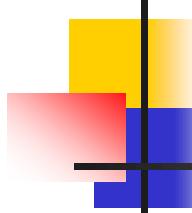
Secondary follicles



Secondary follicles

- Greatly proliferated ZG
 - Follicular antrum (FA) in ZG
 - Primary oocyte
 - Reached mature size
 - Situated eccentrically in thickened area of granulosa
- ↓
- cumulus oophorus (CO)
- Theca folliculi
 - Theca interna (TI) - endocrine
 - Theca externa (TE)

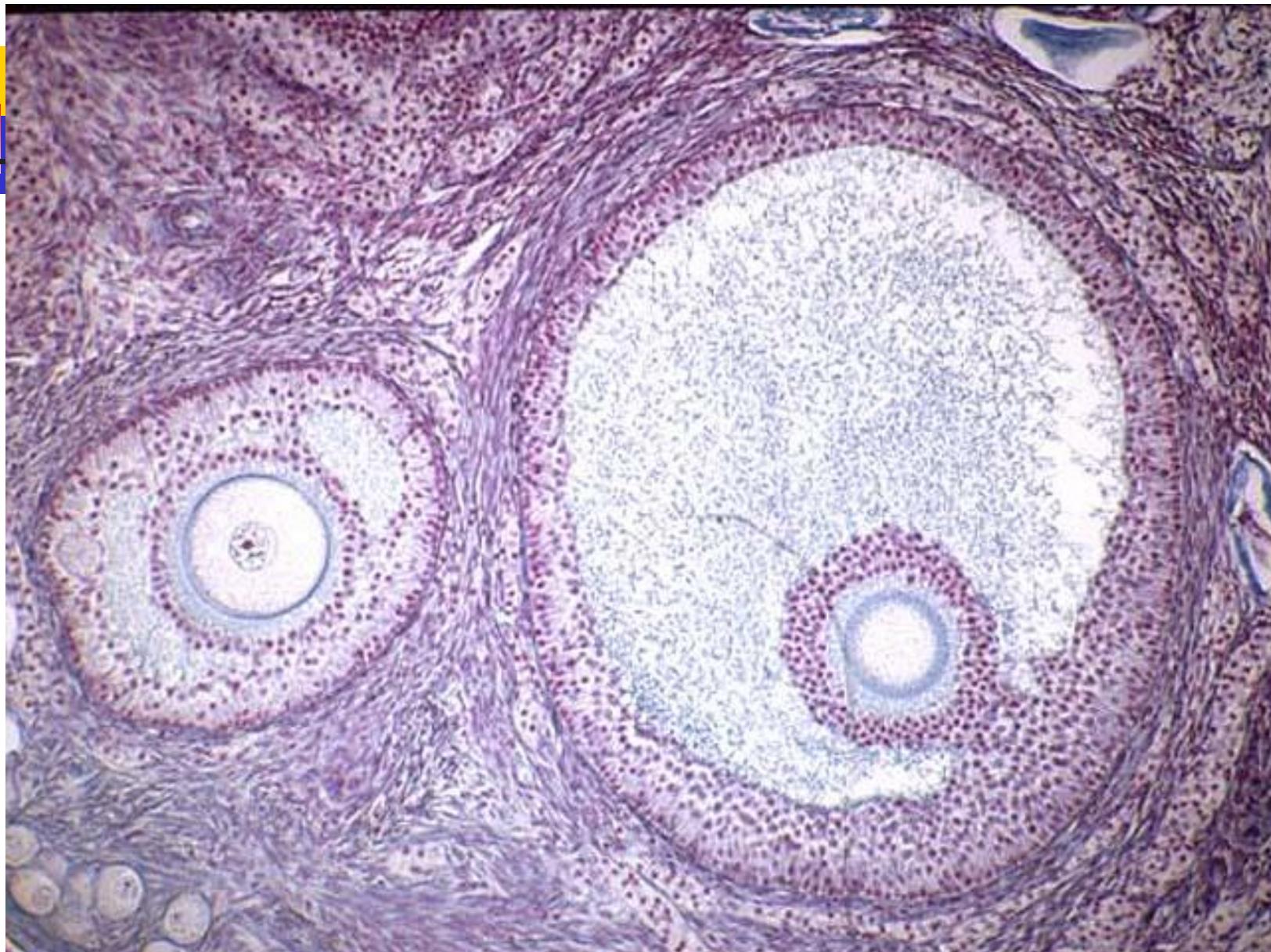


- 
- With the appearance of the follicular cavity follicle becomes a **secondary follicle**
 - While the follicle was increasing size surrounding stroma start differentiating into:
 - inner vascular cellular layer → **theca interna**
 - outer fibrous layer → **theca externa**
 - theca interna is the main source of oestrogen
 - After 10-14 days of growth,
 - follicle measures about 6-12 mm bulges from the free surface of the ovary then it is known as **Graafian follicle**

- As soon as the follicle matures, primary oocyte leaves its resting stage and resumes its first meiotic division
- Results in formation of two daughter cells of unequal size → secondary oocyte ← receives all the cytoplasm
↓
first polar body
- This division is completed few hours before **ovulation** occurs

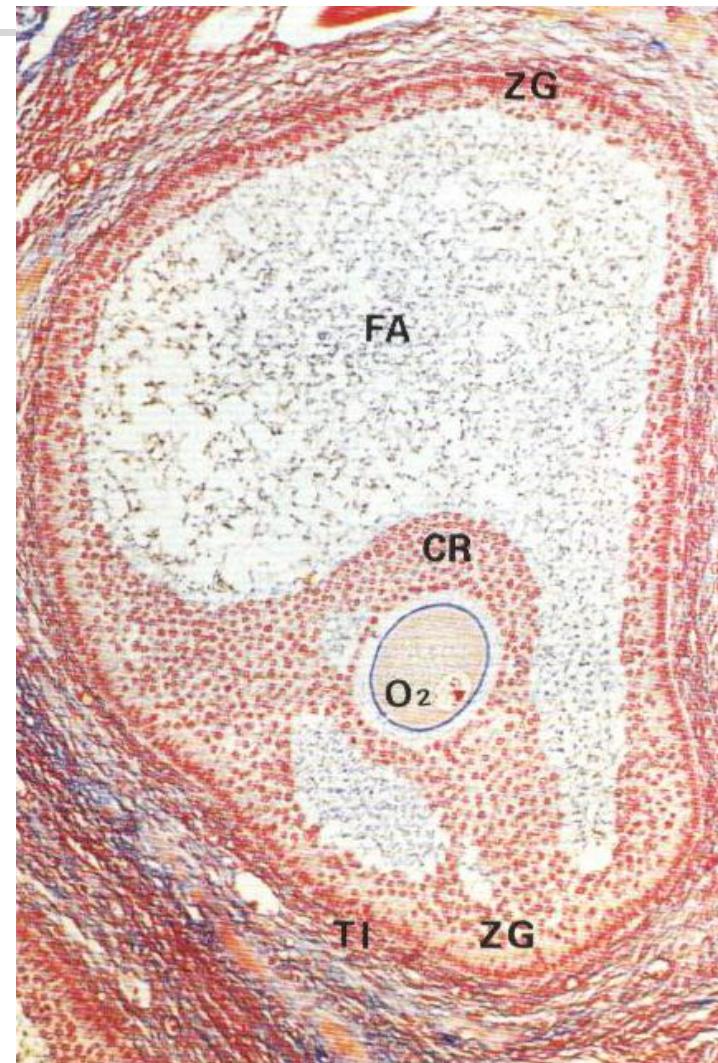
- With the Continuous accumulation of liquor folliculi
 - Tense graafian follicle ruptures and then the secondary oocyte escape into the peritoneal cavity
 - immediately after ovulation
- Under goes division and mature ovum and the second polar body are formed.
- This second meiotic division is not completed until fertilization has taken place
 - otherwise oocyte degenerates
 - mature ovum has a diameter of about $120\mu\text{m}$

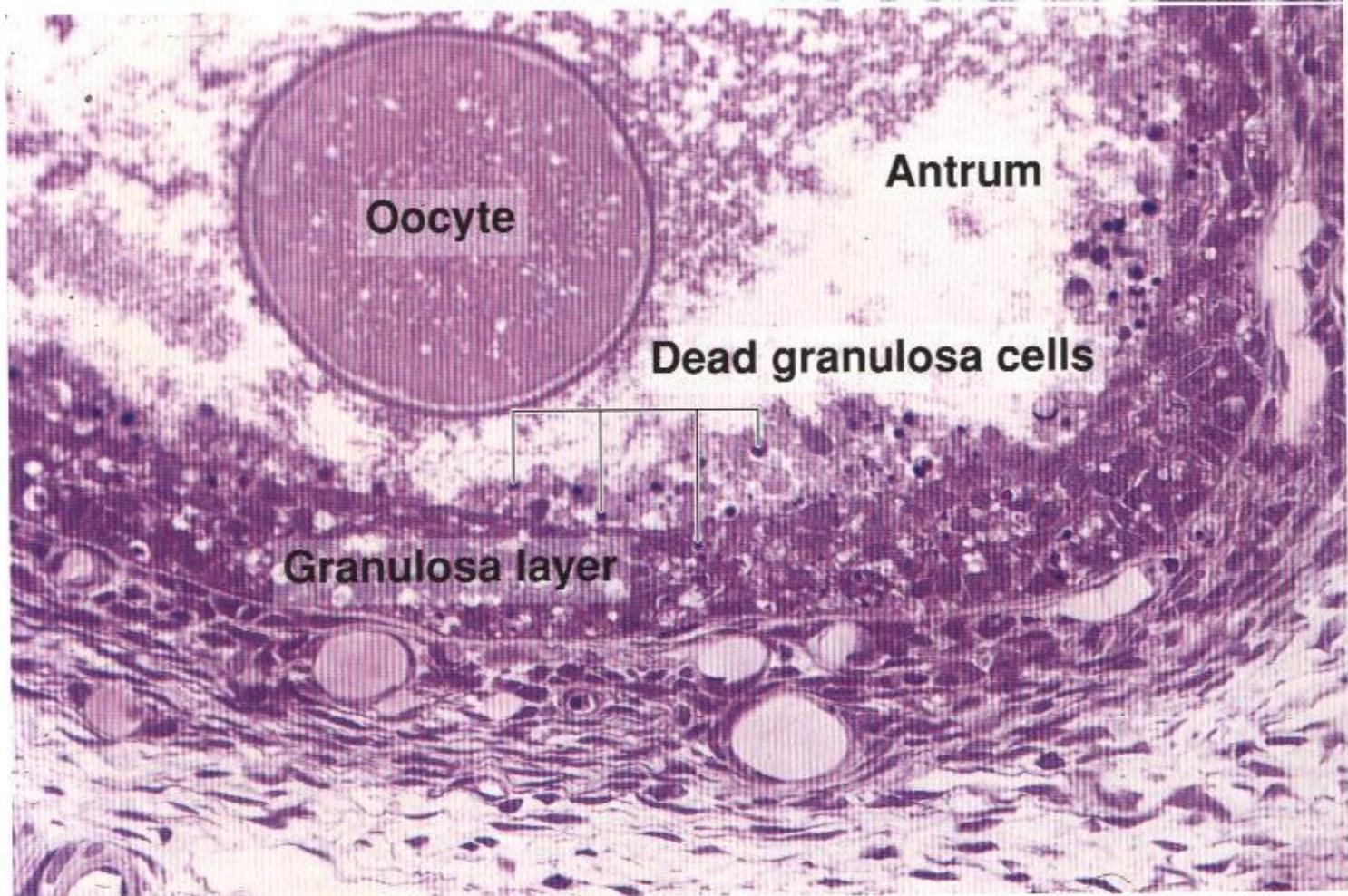
Graafian follicles



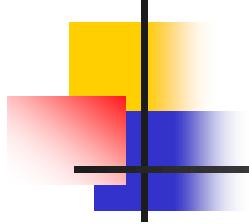
Graafian follicles

- Ovum pushed on one side
- FA enlarges markedly
- ZG becomes thin layer
- CO diminishes
- Oocyte
 - ↓ *1st meiotic division - completed*
 - ↓ *2nd meiotic division- commence*
 - 2^{ry} oocyte
- 2^{ry} oocyte surrounded by a layer
 - ↓
 - Corona radiata (CR)

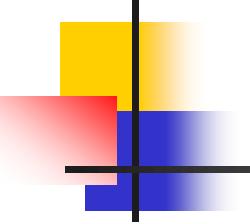




Atretic follicle- oocyte floating with in the antrum
death of granulosa cells

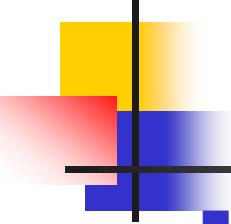


Formation of Corpus Luteum



Following ovulation, **formation of corpus luteum**

- walls of follicle collapses with release of fluid
- Wall becomes folded
- Blood flows into the cavity ————— coagulates
- Invaded by connective tissue
- Cells of membrana granulosa and theca interna enlarge
- Accumulation of lipids in the cytoplasm
- Yellow pigment appears in the cytoplasm
- Cells become **granulosa lutein cells** and **theca lutein cells** respectively

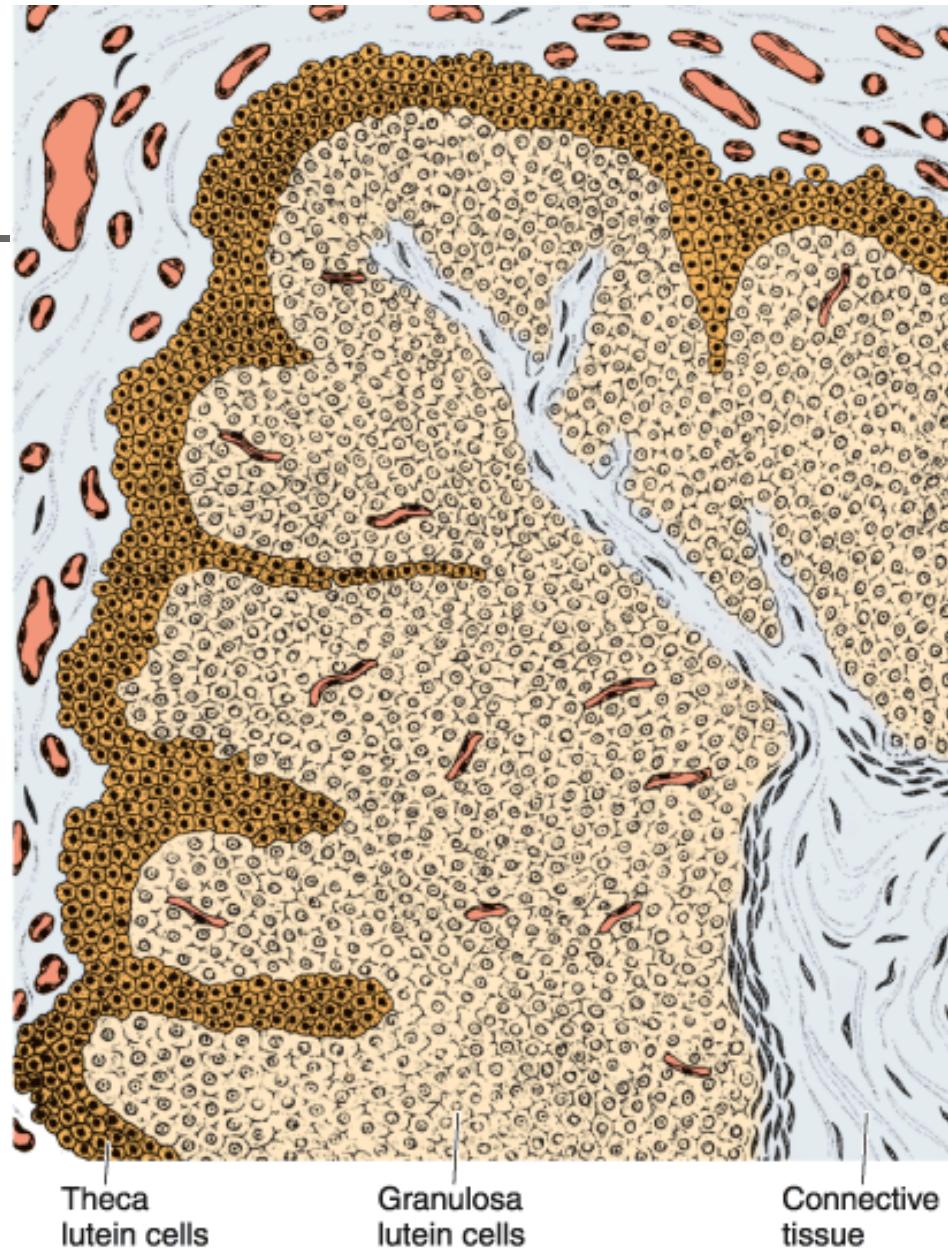
- 
- granulosa cells do not divide but they become enlarged and make 80% of the parenchyma of the corpus luteum

- Pale eosinophilic cytoplasm
- have the characteristics of steroid secreting cells
- secrete progesterone

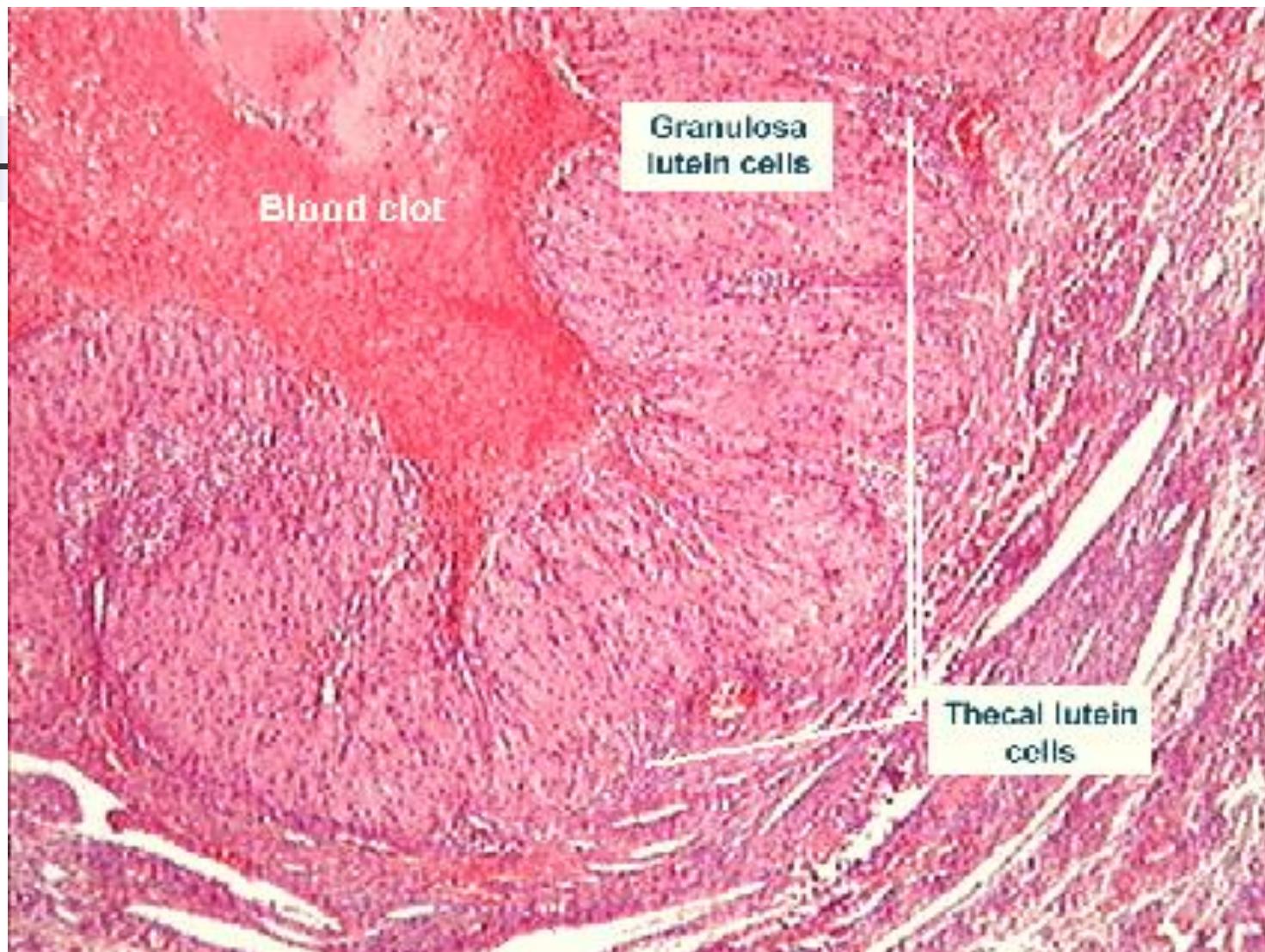
theca lutein cells are smaller

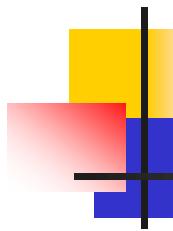
- Stain more deeply
- Located in the folds of the corpus luteum
- Blood and lymph capillaries enter and become very vascular

Corpus Luteum



Corpus Luteum

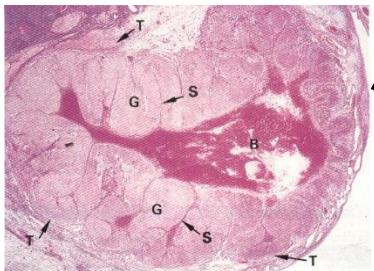


- 
- Corpus luteum continues to enlarge
 - About 10 days after ovulation if fertilization does not occur corpus luteum becomes a fibrous scar called **corpus albicans**
 - Periodic shedding of an oocyte, regular maturation of group of primordial follicles constitute the cyclic changes in the ovary known as **ovarian cycle**
 - Corpus luteum produces progesterone which is responsible for the preparation of uterine endometrium for implantation of a fertilized ovum

Fate of corpus luteum

Corpus luteum
menstruation

*Ovum not
fertilised*



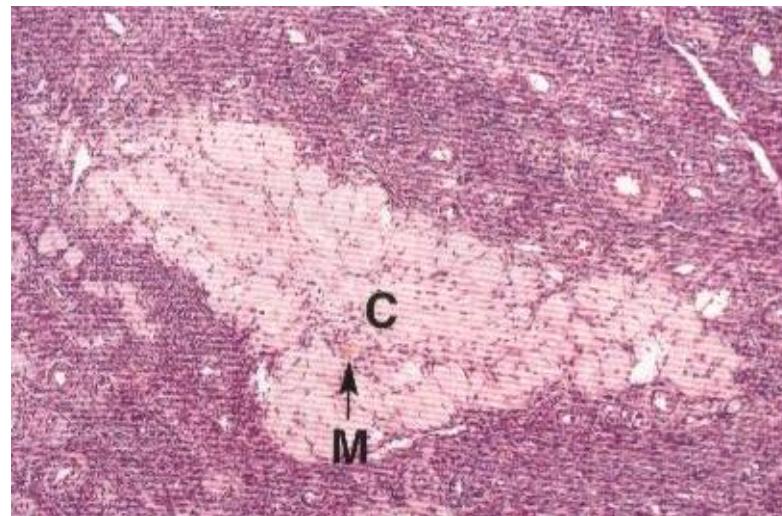
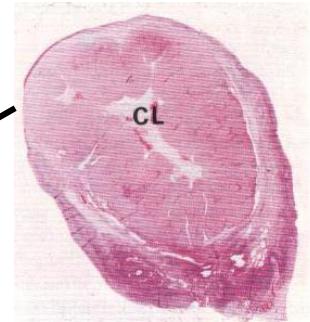
14 days

Corpus
luteum

*Ovum
fertilised*

Corpus luteum
pregnancy

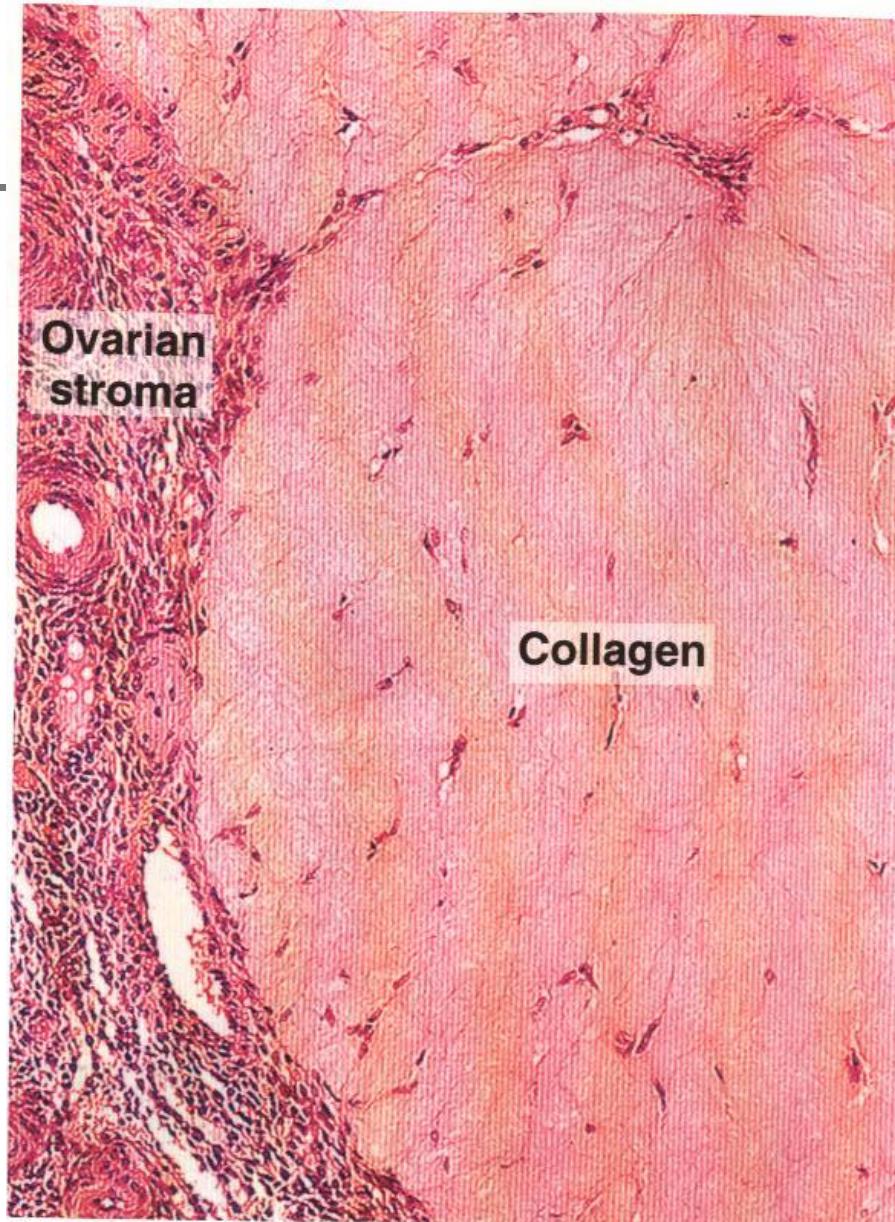
3/4 months

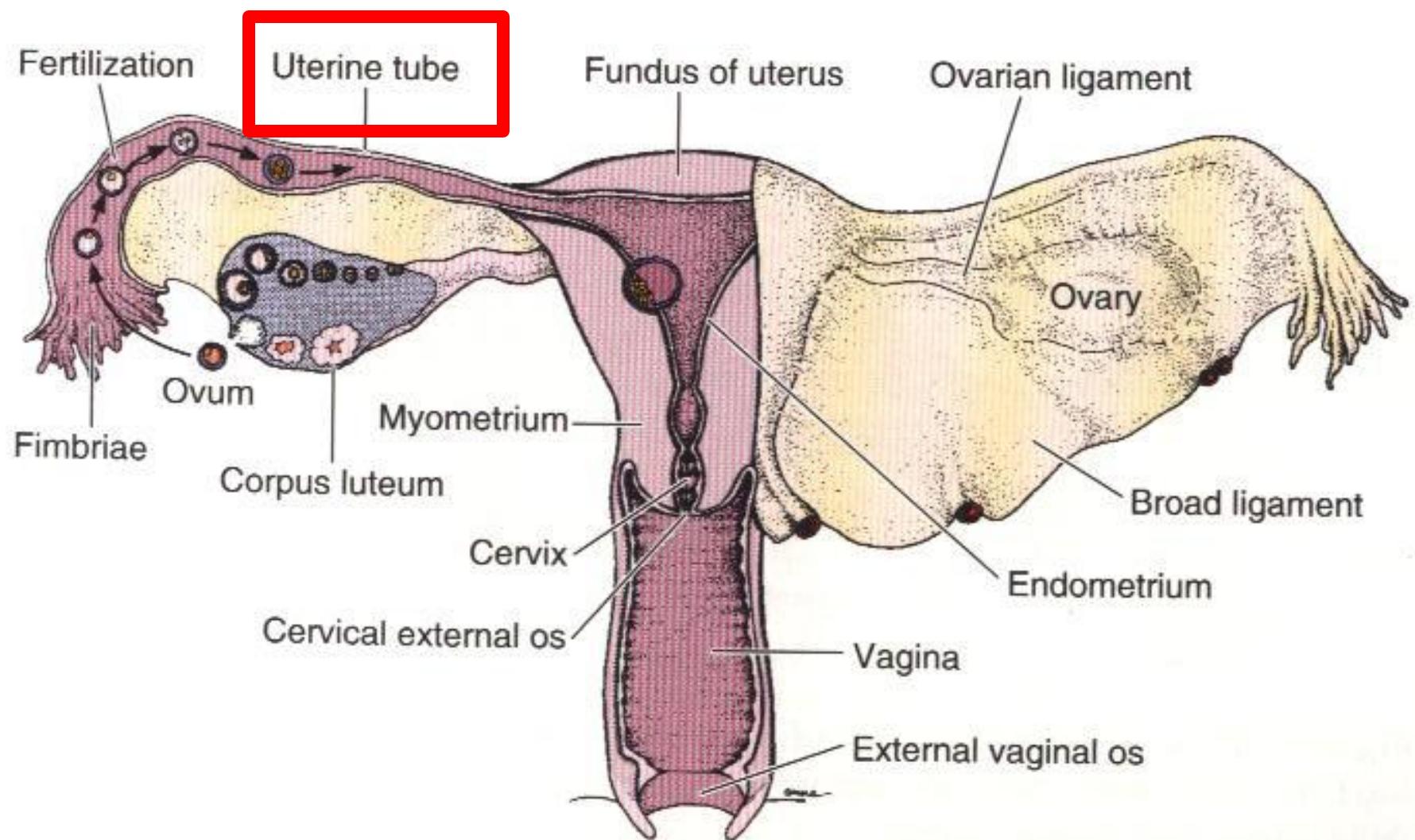


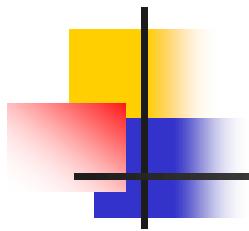
Corpus albicans

- ** Inactive mass of fibrous tissue
- ** no vascular supporting tissue

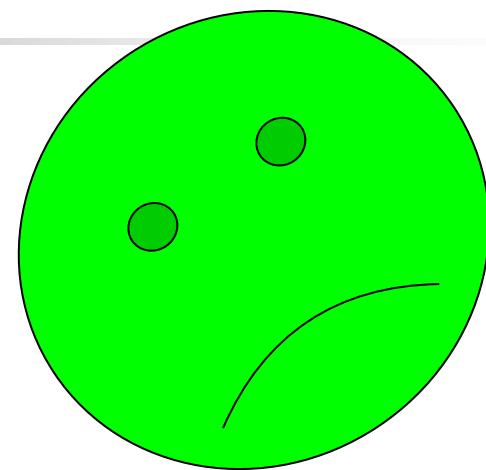
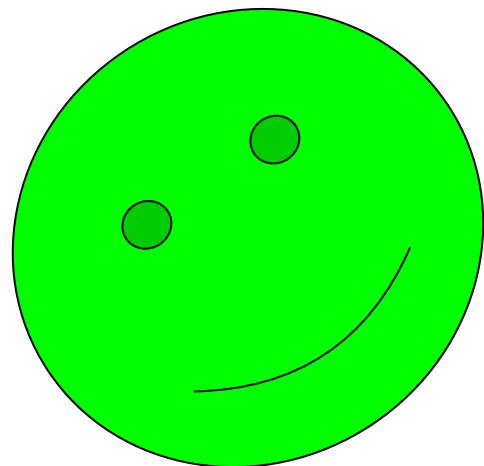
Corpus albicans

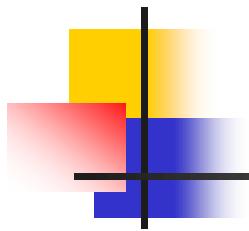






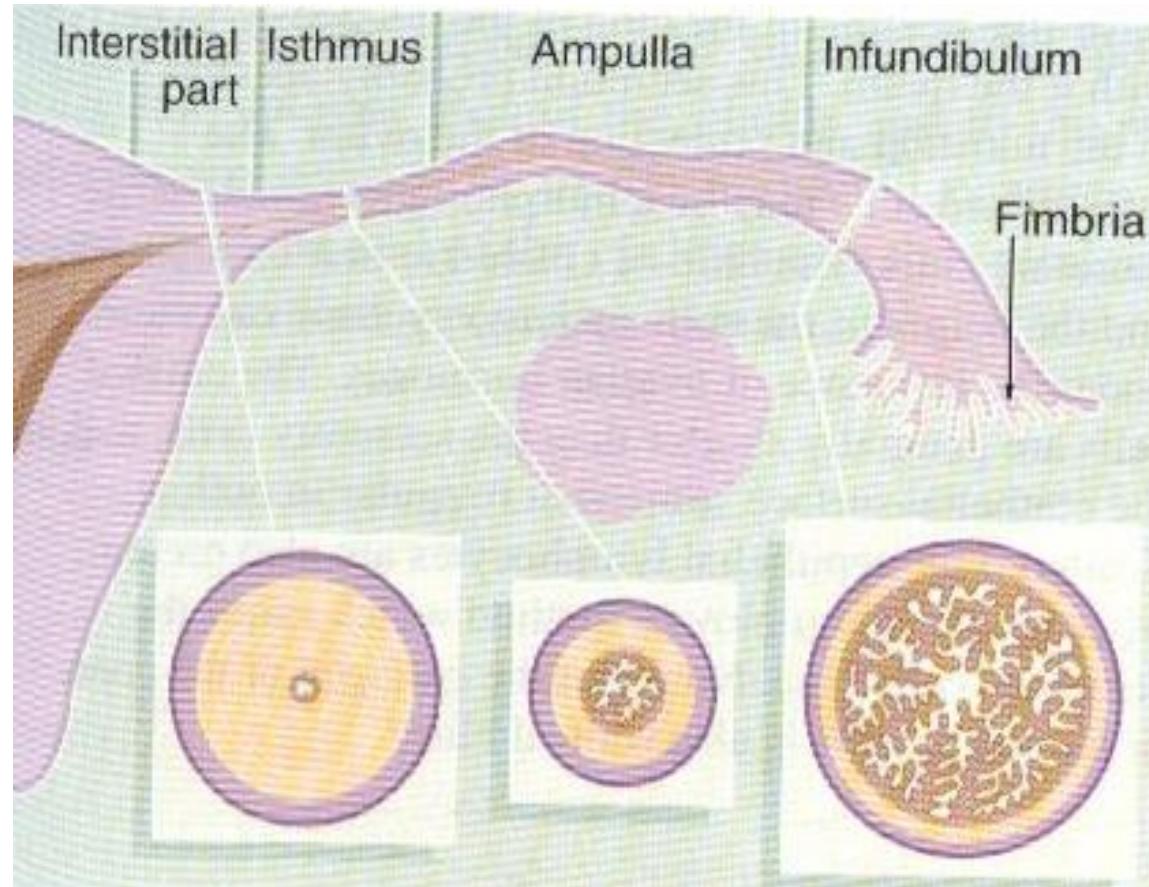
Are you awake now?





Uterine tube

Fallopian tube



Uterine tube

- Approximately 12cms. long
- Four regions of the tube are described
 1. Intra mural portion – embedded in the wall of the uterus
open by narrow uterine ostium in to the inner surface of the uterus
 2. Isthmus - Short and thick walled
 3. Ampulla – thin walled , longest part
 4. Infundibulum -A funnel shaped, fimbriated portion
- Usual site of fertilization and early development of the fertilized ovum(Zygote) → ampulla
- Wall consists of 3 coats- mucosa, muscularis, serosa

Structure of uterine tube

*** Wall made up of 3 layers

- *Mucous layer*

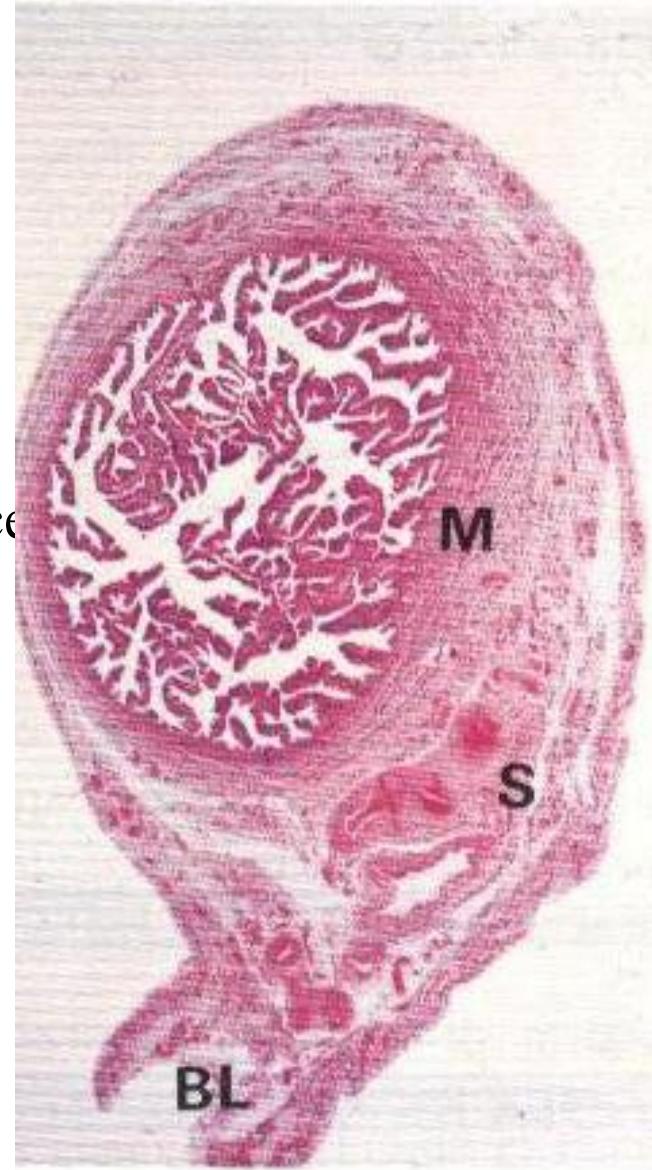
- Simple columnar epithelium
- Lamina propria (C.T. + bld vv)
(branching folds → irregular appearance)

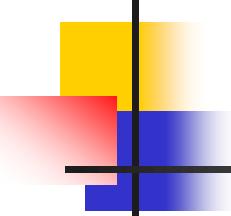
- *Muscular layer*

- Inner circular layer
- Outer longitudinal layer

- *Serous layer*

- Areolar connective tissue

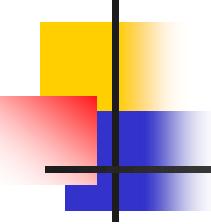




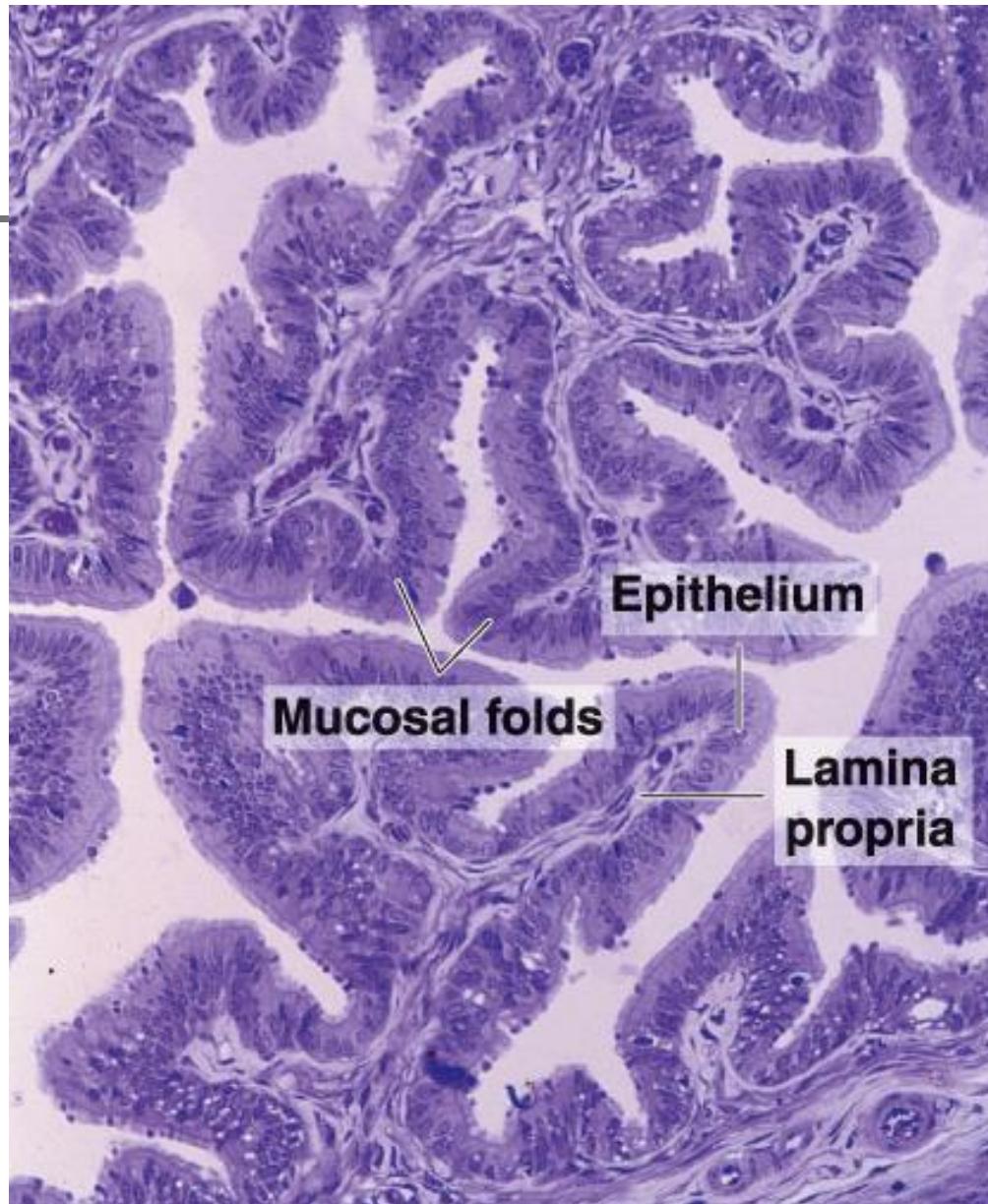
Mucosa

- several longitudinal folds with corresponding deep grooves
- Lumen is thus irregular folds progressively decrease towards the isthmus
- Epithelium simple columnar with ciliated and non-ciliated cells
- Non ciliated cells secrete nutritive substances
- Lamina propria- connective tissue is richly cellular and vascular

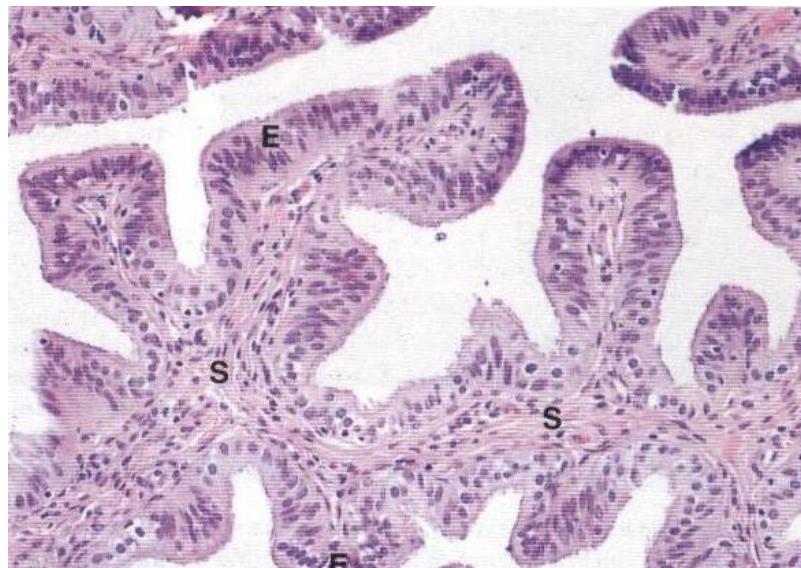
Uterine tube



*Part of the wall
of oviduct highly
folded mucosa*



Mucosa folds of Fallopian tube high magnifications



(X 150)

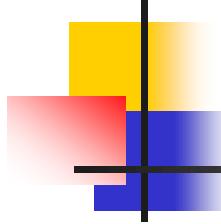


(X 600)

*** Simple columnar epithelium

*** 2 types of cells : Ciliated cells : propel ovum towards uterus

Non-ciliated cells : produce nutritious secretion



Muscularis

- Is thickest in the isthmus, gradually thins out towards fimbriated end
- Well *developed inner circular layer*, rather a *thin outer longitudinal layer*

Serosa

- Usual structure of the peritoneum – mesothelium and connective tissue

Uterus

Structure of uterus

*** Wall consists of 3 layers

- ***Mucous layer (endometrium)***

- Simple columnar epithelium
 - Lamina propria : connective tissue + tubular glands

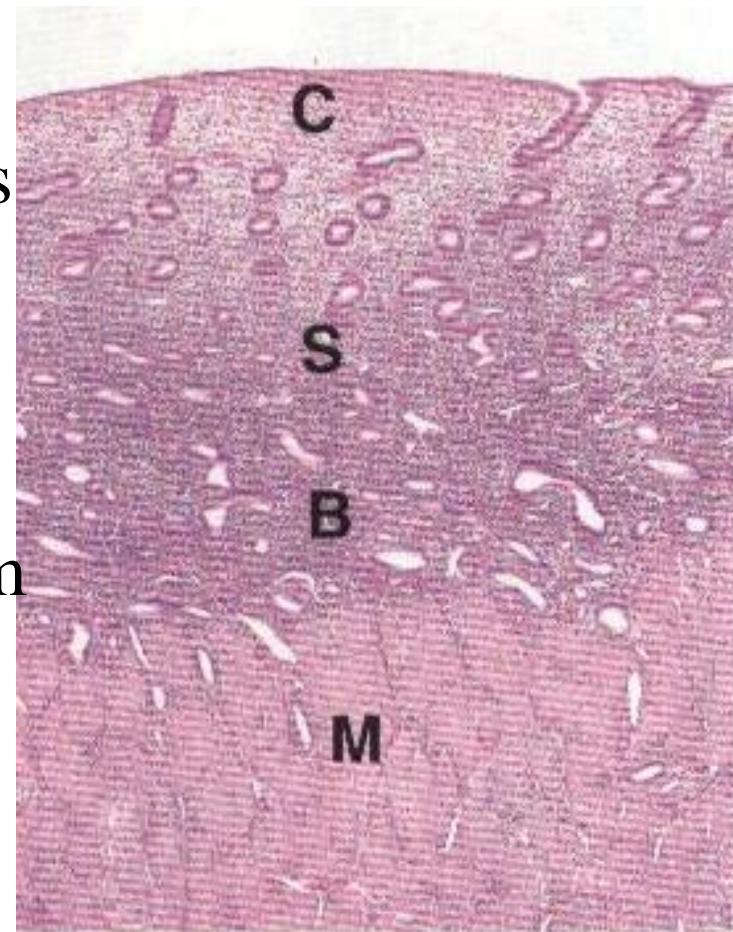
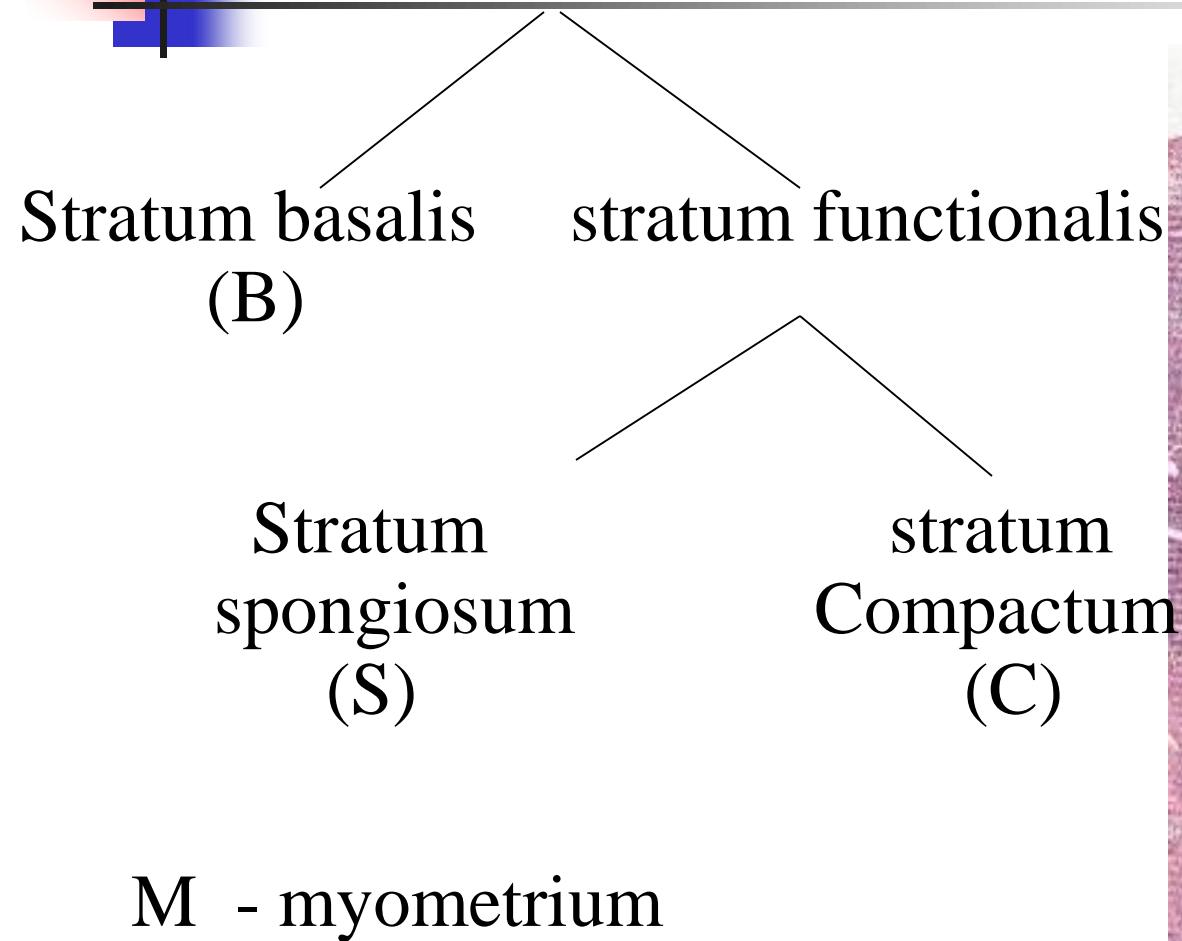
- ***Muscular layer (myometrium)***

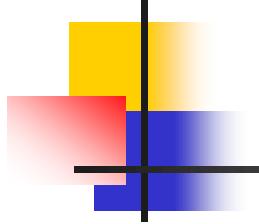
- Thick layer : rich in blood
 - Inner & outer longitudinal layers, middle circular layer
 - During pregnancy: ↑↑ in size by cell division & growth

- ***Serous layer (perimetrium)***

- Loose areolar connective tissue
 - Line by a mesothelium (peritoneal covering)

Endometrium





Endometrium

- Undergoes cyclic changes

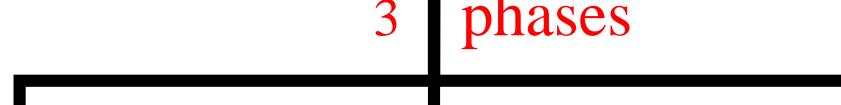


menstrual cycle



cycle that take place from one bleeding to another in a women

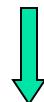
3 phases



Menstrual Proliferation Secretory
phase phase phase

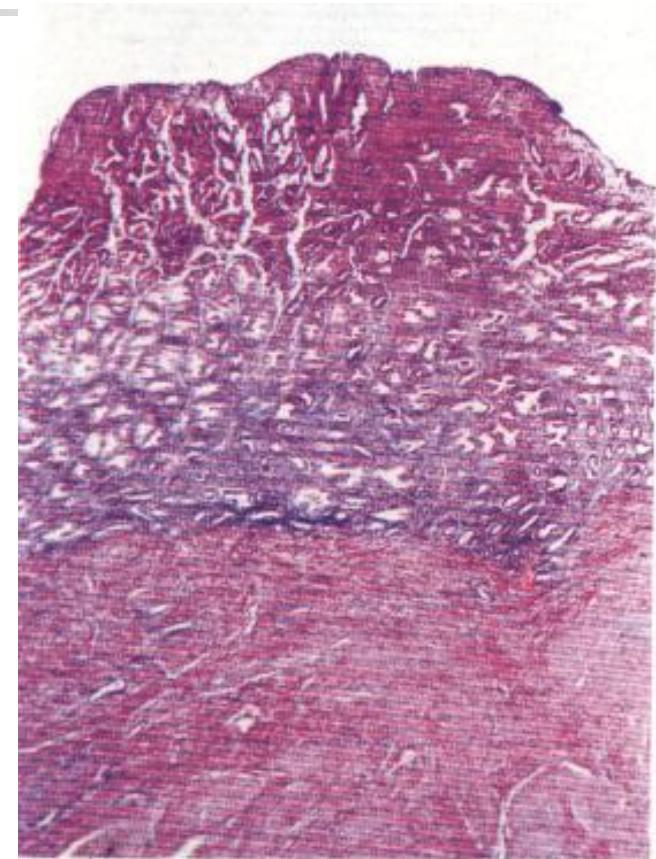
Menstrual phase

- First 4/5 days
- Bleeding take place
- Breakdown of stratum functionale



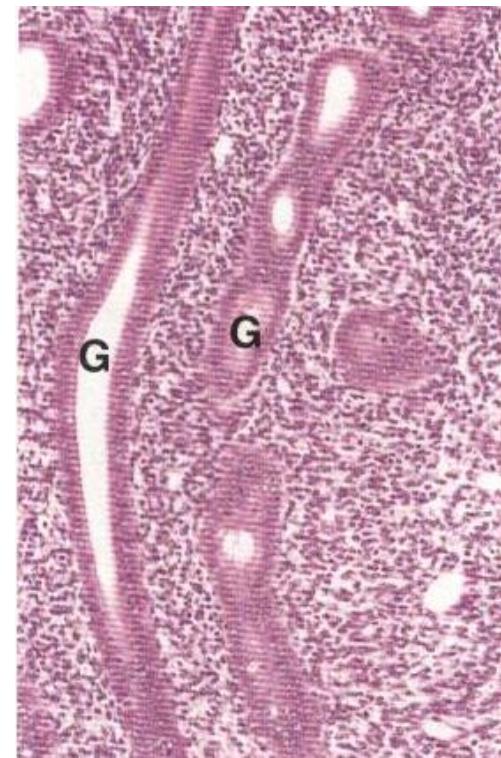
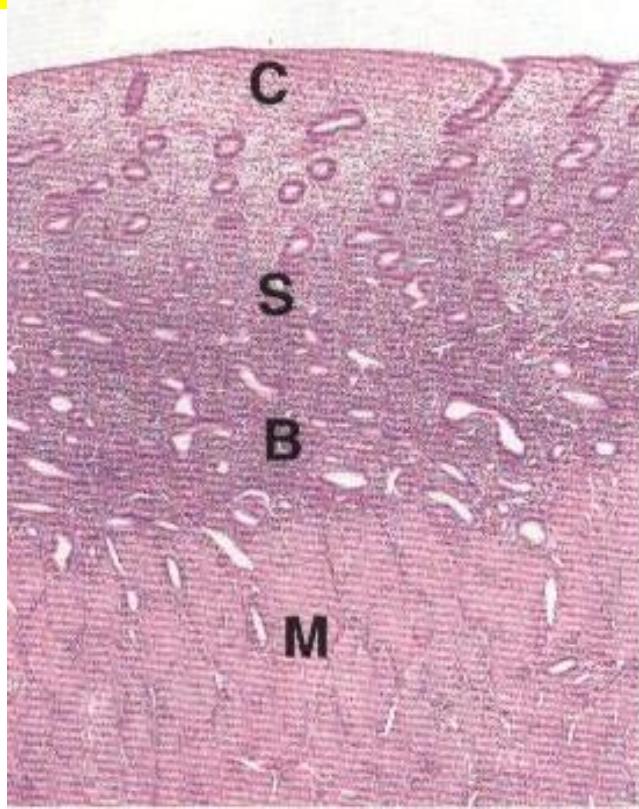
menses

- Blood
- Glandular epithelium
- Stromal elements



Endometrium: onset of menstruation

Proliferative phase - *Early phase*

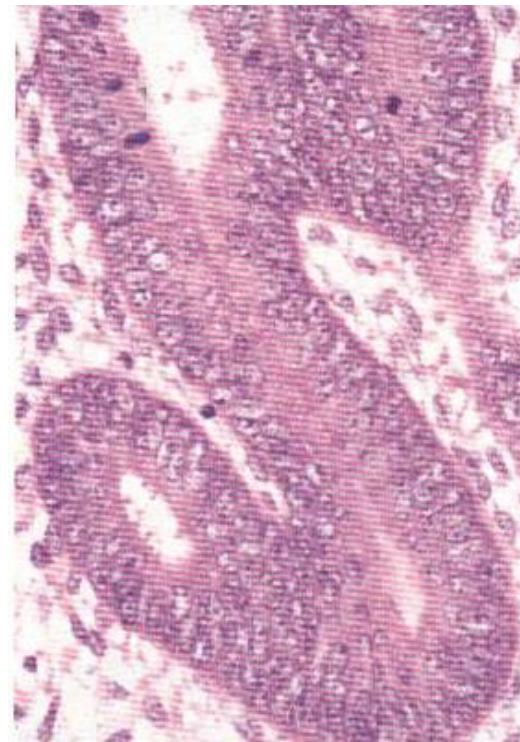
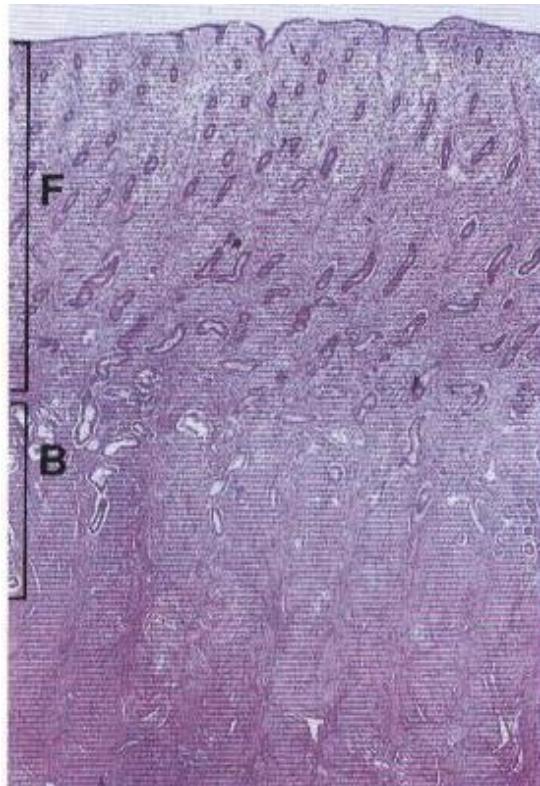


** Last for about 9 days

** Thickness of endometrium ↑↑ & blood vv ↑↑

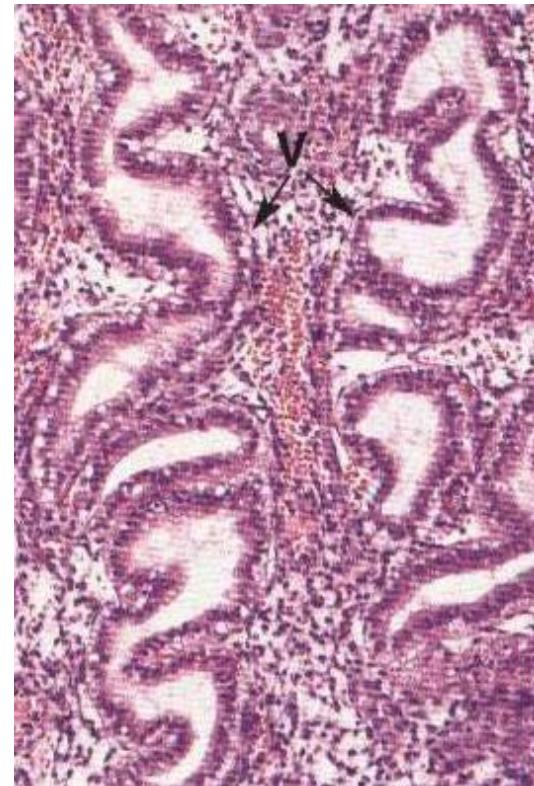
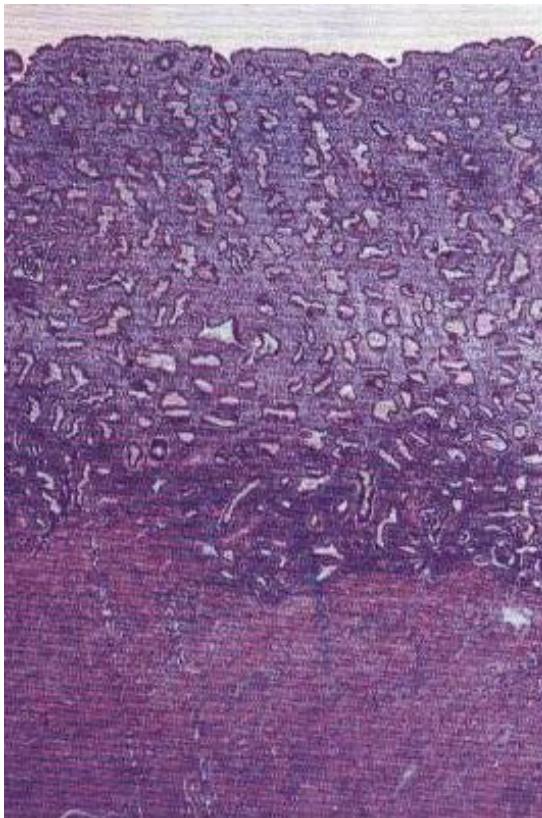
** Uterine glands become straight narrow, empty & ↑↑ length

Proliferative phase - *late phase*



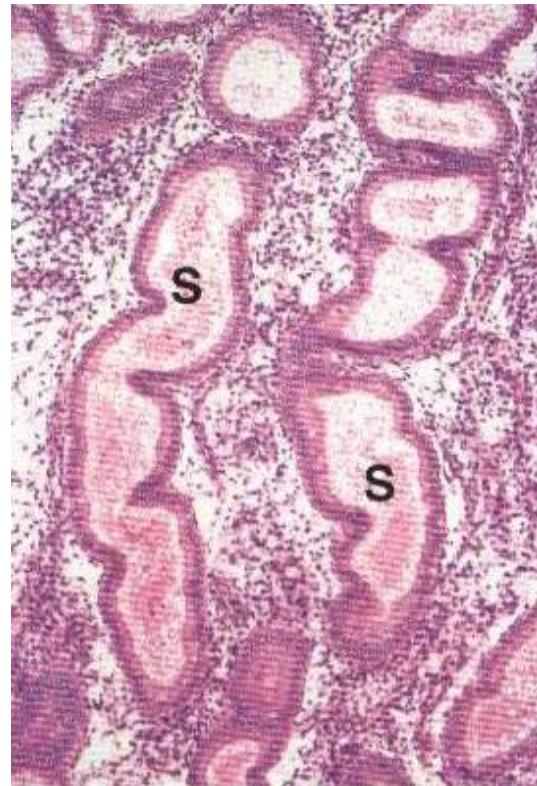
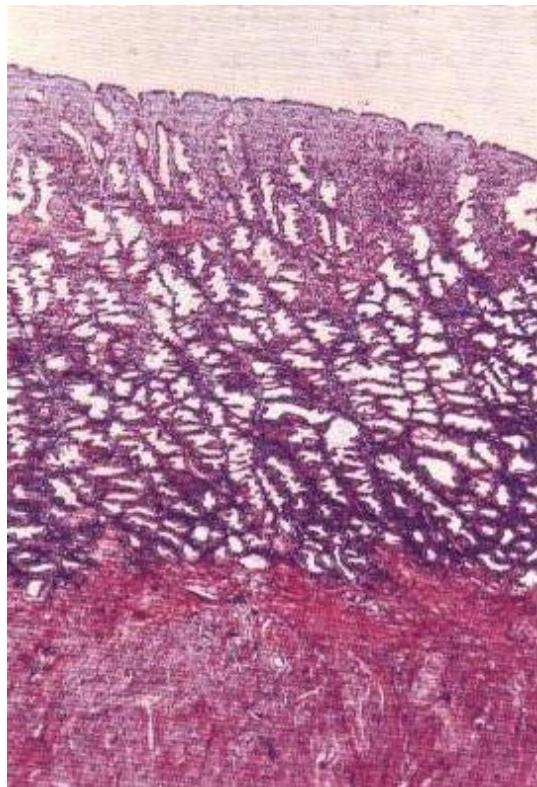
- ** Glands - extend to open onto endometrial surface
- ** Endometrium has doubled in thickness
- ** Tubular glands - somewhat convoluted

Secretory phase - *Early phase*



- ** Endometrium approaches maximum thickness
- ** Glands – irregular corkscrew appearance / coil
- ** Glycogen accumulates to form vacuoles at cell base

Secretory phase - *late phase*



- ** Glands - saw tooth appearance, wide luman
- ** Glands contain thick glycogen rich secretions (S)

Vagina

Vagina

■ *Mucous layer*

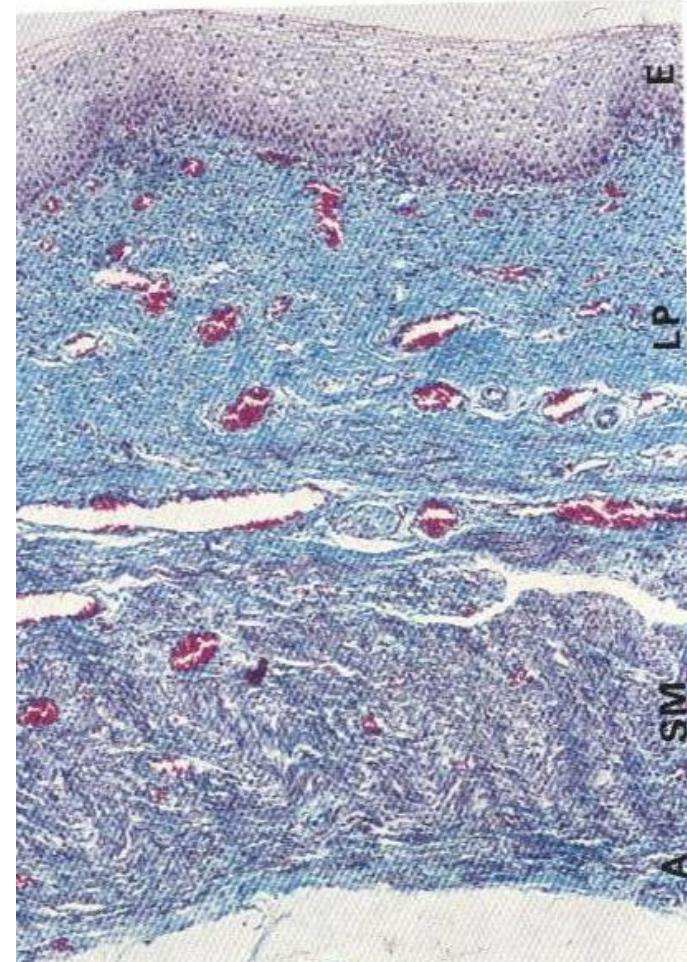
- Stratified squamous epithelium
- Lamina propria
(elastic fibers, bld vv, no glands)

■ *Muscular layer*

- Inner circular layer
- Outer longitudinal layer

■ *Adventitia*

- *Dense connective tissues – strong wall*
- *Elastic fibers – elastic wall*
- *Extensive venous plexus, lymphatics & nerves*



Vagina

Superficial cells of vaginal epithelium

↓
estrogen

Glycogen

Commensal ↓
bacteria

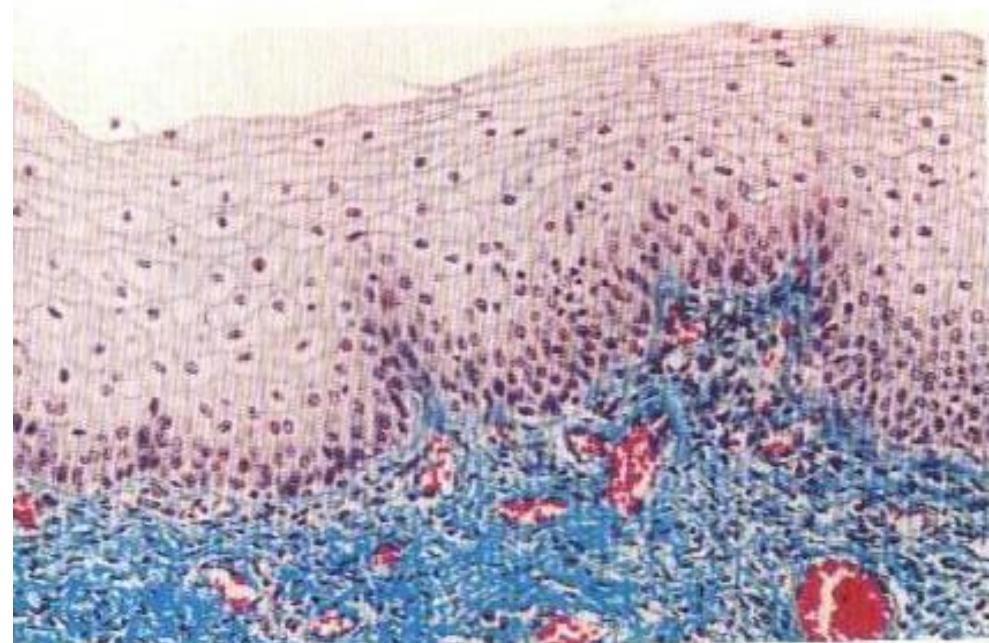
Lactic acid

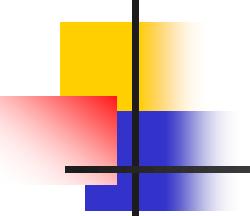
↓

Low PH

↓

Protection against pathogenic microorganism





Placenta

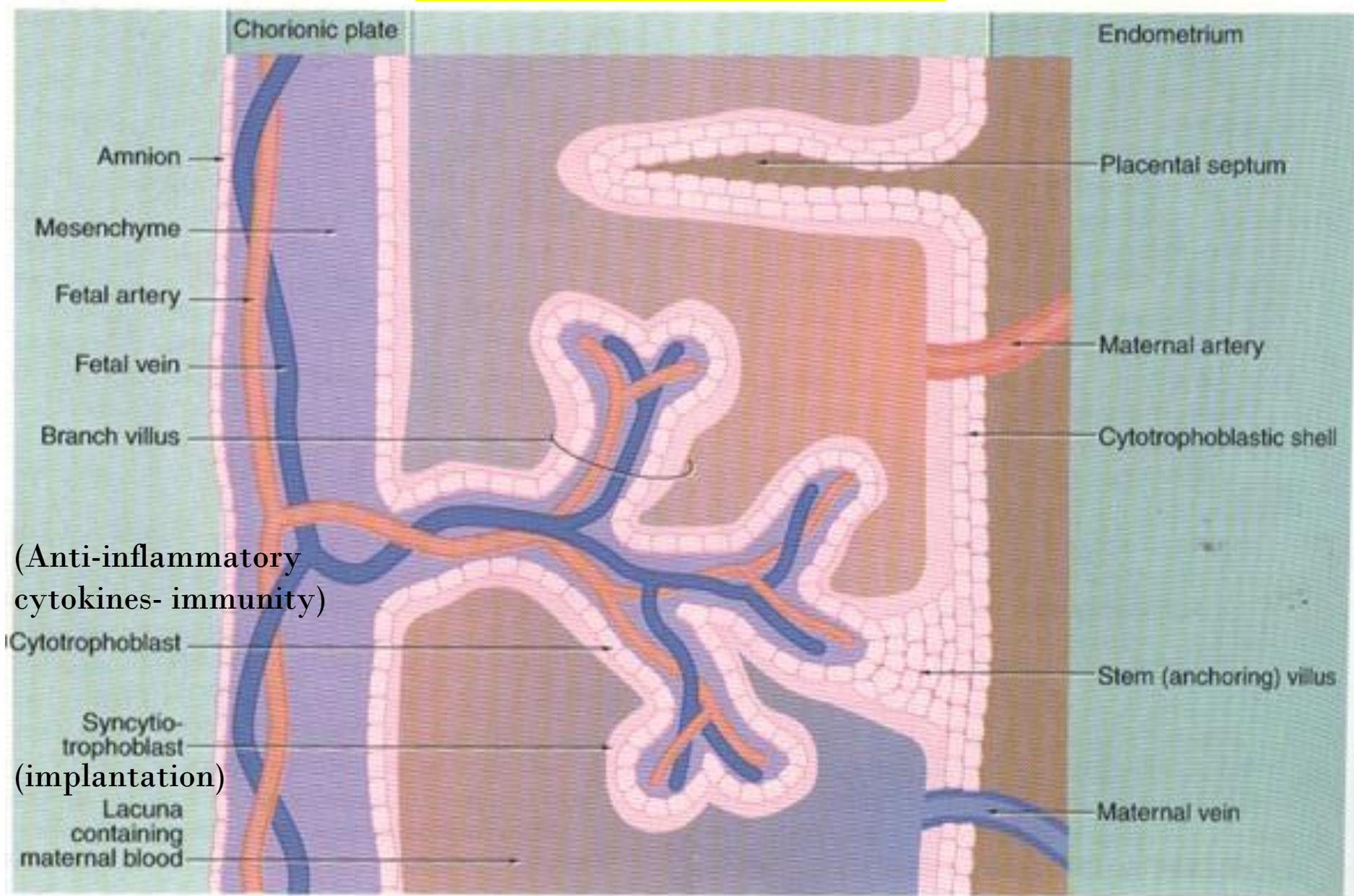
- Temporary organ
- Site of physiological exchanges between mother & fetus
- Consist of
 - Fetal part (chorion)
 - Maternal part (decidua basalis)

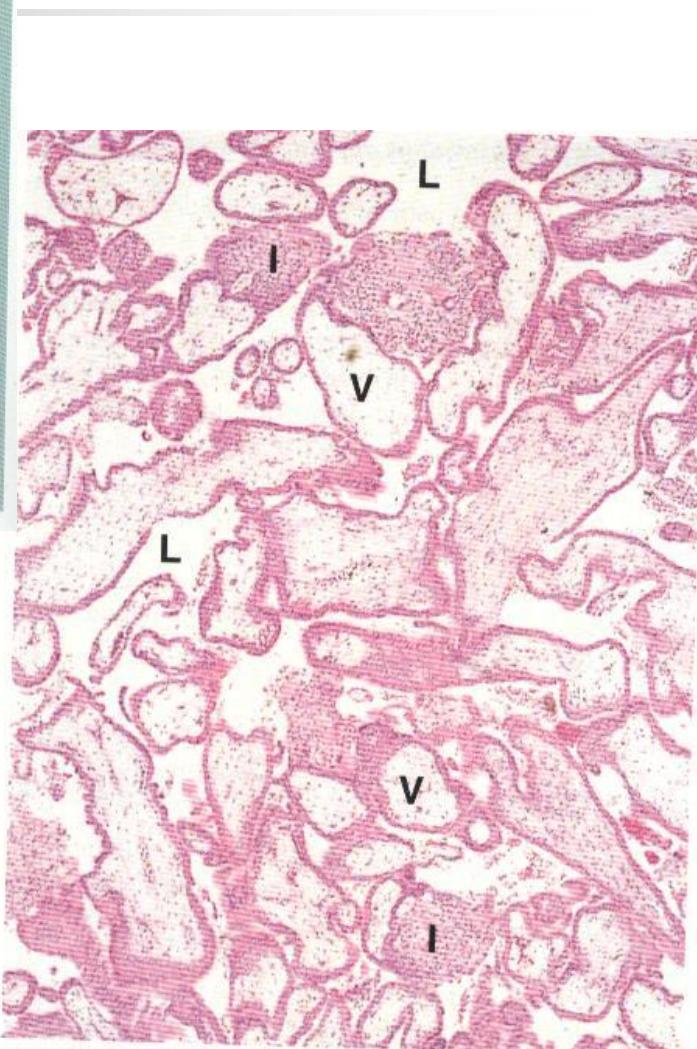
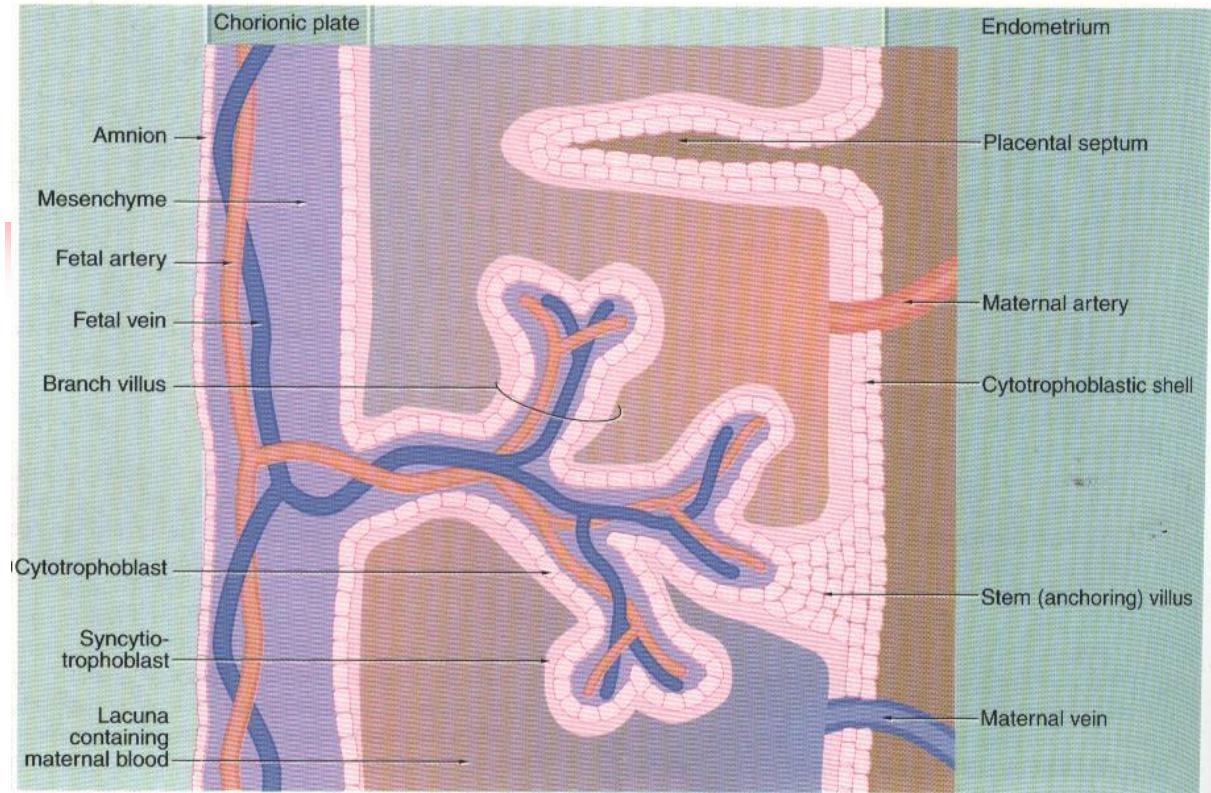
*** chorion has chorionic plate & Villi (V)

Projected  into

lacunae (L) – space filled with maternal blood of decidua basalis

Placenta

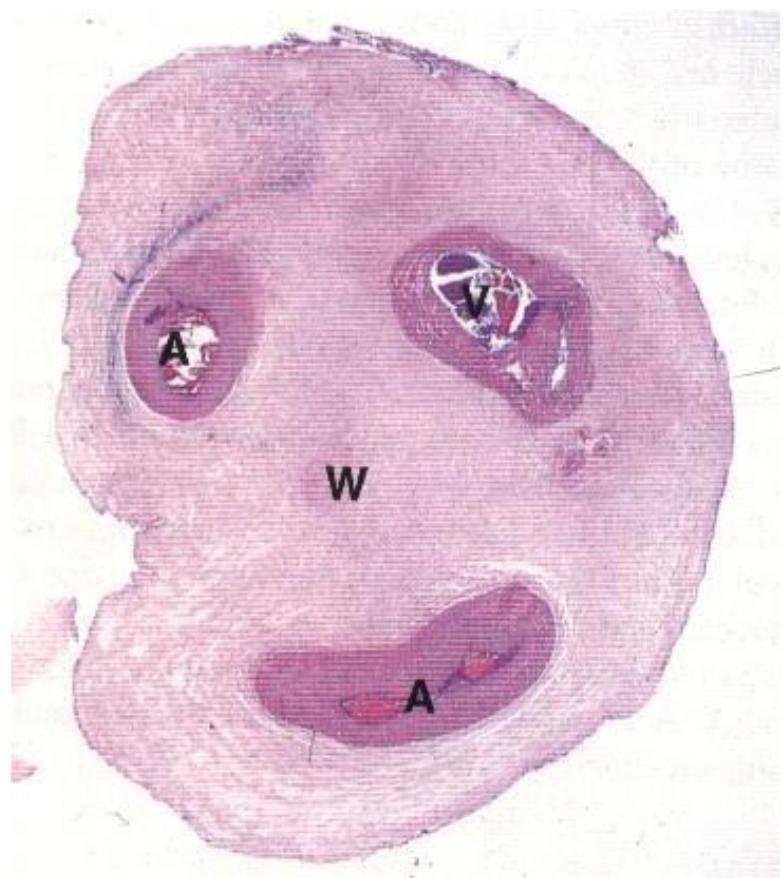




(a)

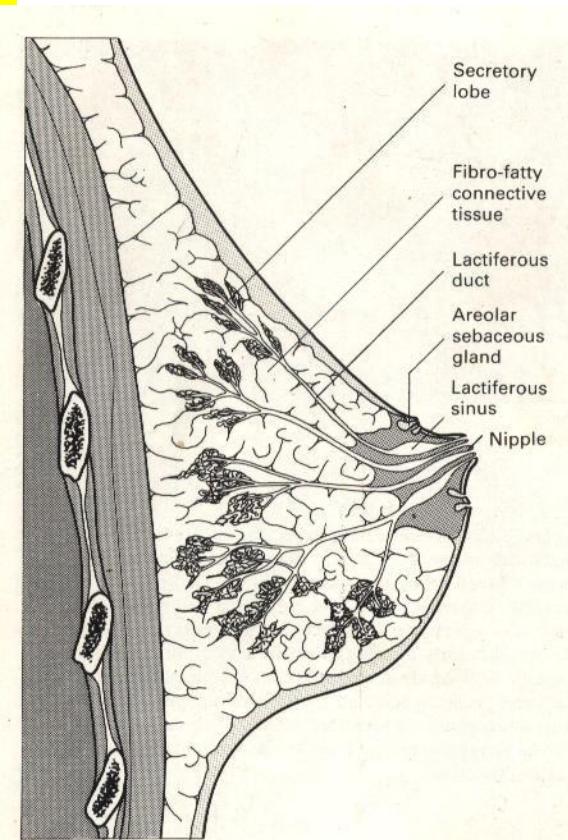
Umbilical cord

- Connection between the fetal & placental circulation
- Center of $\xrightarrow{\text{Give rise}}$ umbilical cord
- Two umbilical arteries (A)
- One umbilical vein (V)



Mammary gland

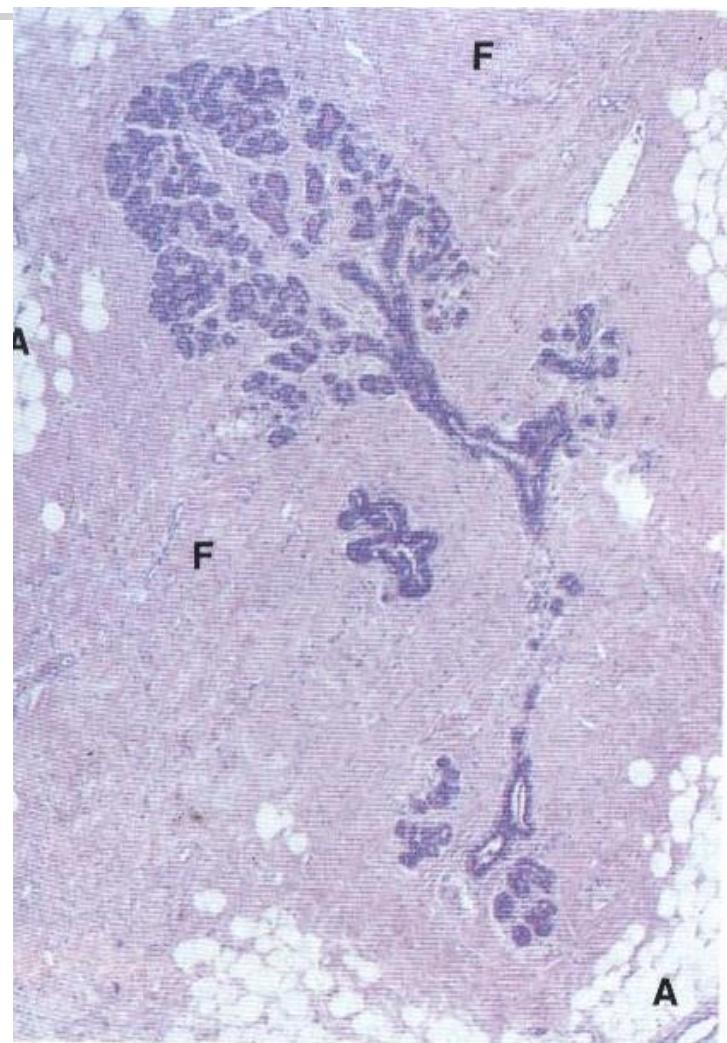
- Secrete milk to nourish newborns
- Compound tubuloalveolar type
- 15-25 lobes
- Lactiferous ducts
- Nipple- smooth mm & pigmented skin
- Lobes → lobules : Alveolar duct system
 - : Interlobular tissue



mainly Fibrous

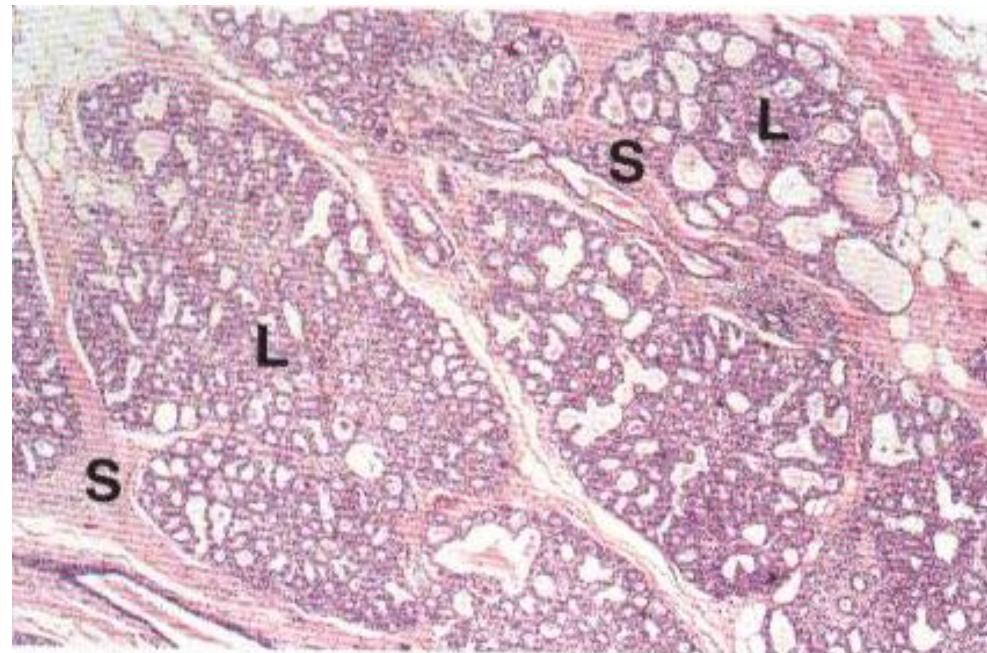
Breast - non pregnant women

- Extensive branching duct system
- Ducts- line by cuboidal or low columnar cells
- Dense fibrous interlobular tissue (F)
- Adipose tissue (A)



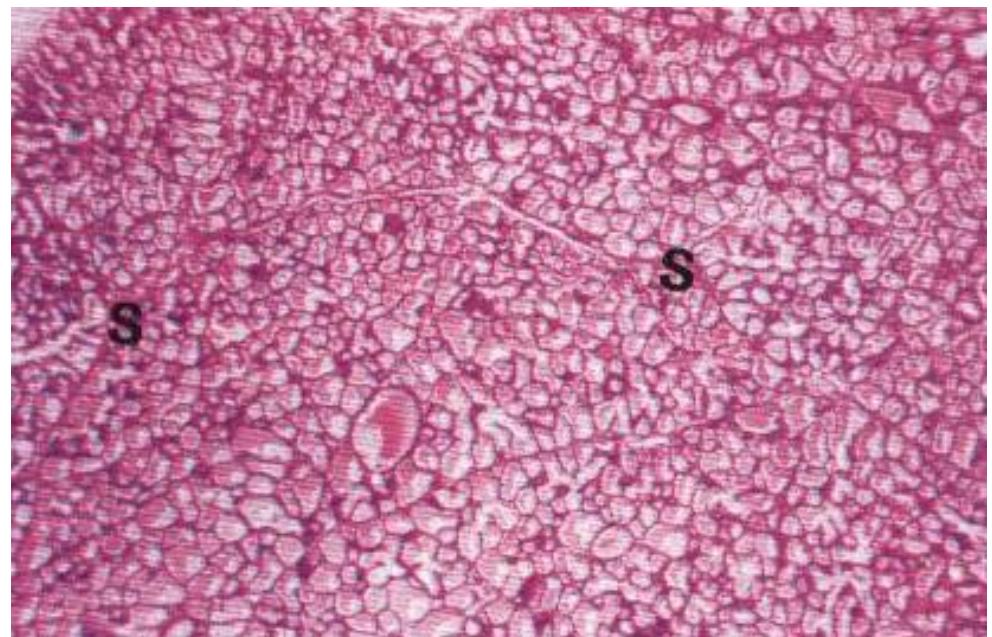
Breast – pregnancy

- Alveolar duct epithelium
 - ↓ Proliferation
 - Secretory alveoli
- Expanded lobules (L)
- Prominent septa (S) of interlobular tissue



Breast – lactating

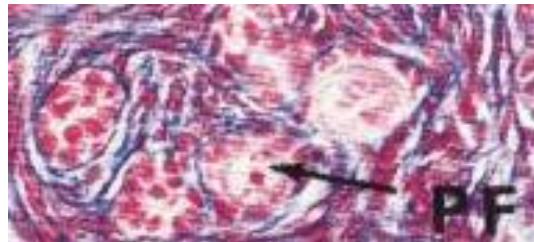
- Alveoli distended with milk
- Thin septa (S) of interlobular tissue
- Alveoli & lumen of the duct may contain a fatty secretory product



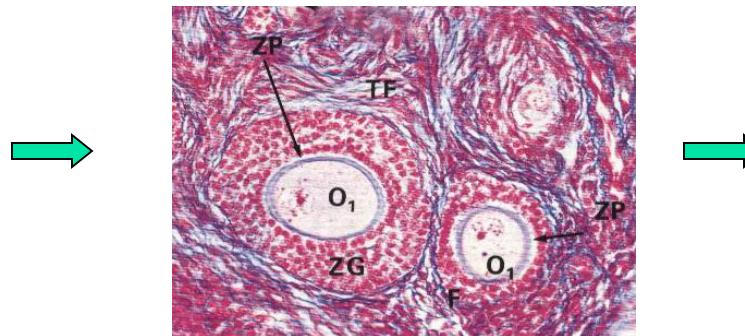
Summary

■ Ovary

- germinal epithelium, stroma, paranchyma



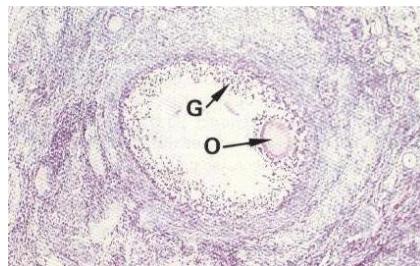
Primordial
follicle



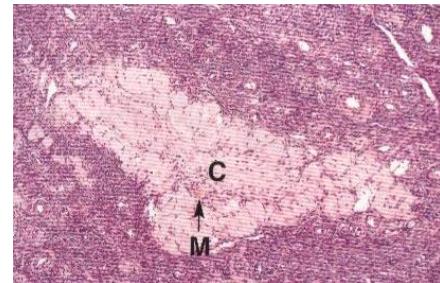
Primary follicle



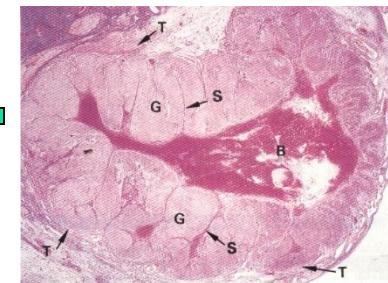
secondary
follicle



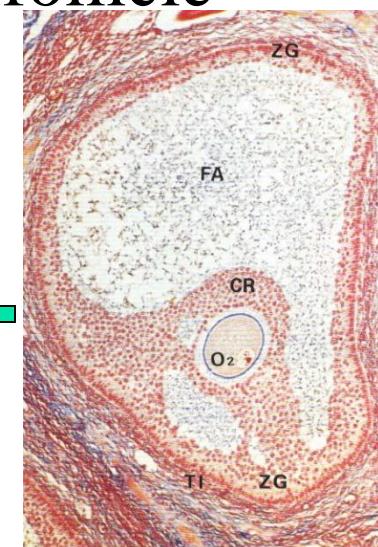
Atretic
follicle



Corpus
albicans

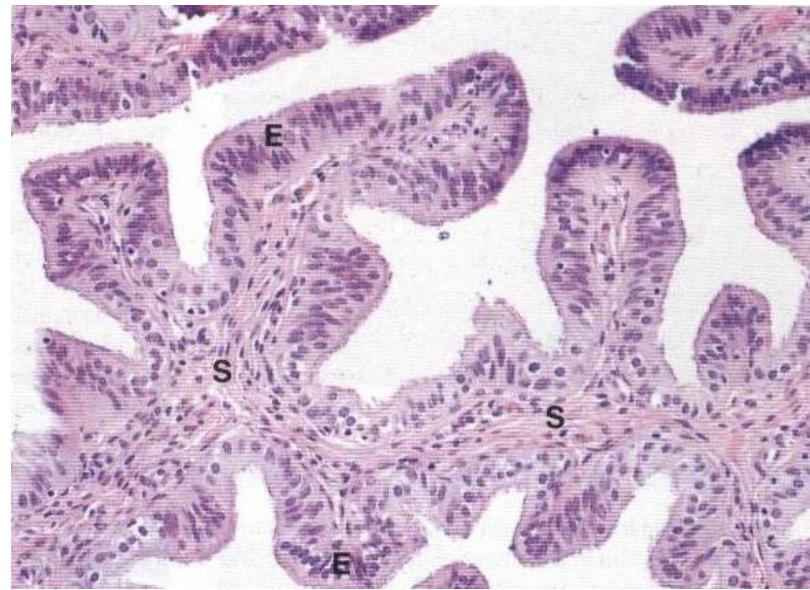
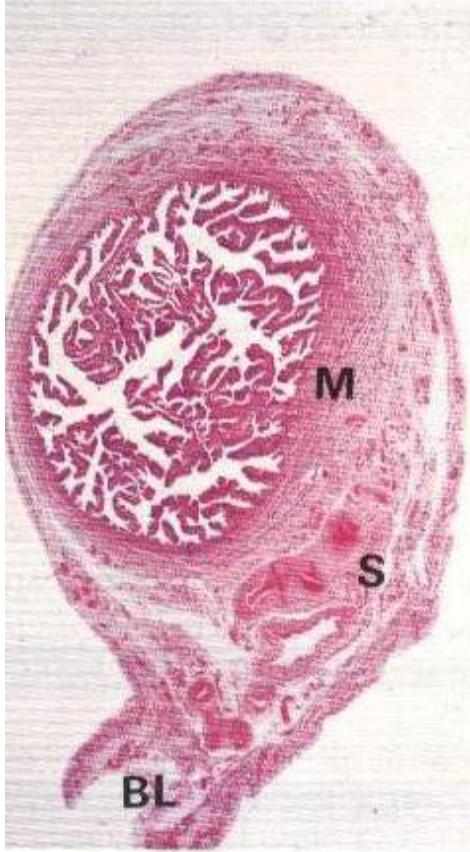


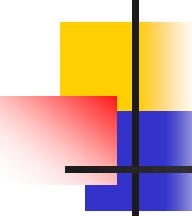
Corpus
luteum



Graafian follicle

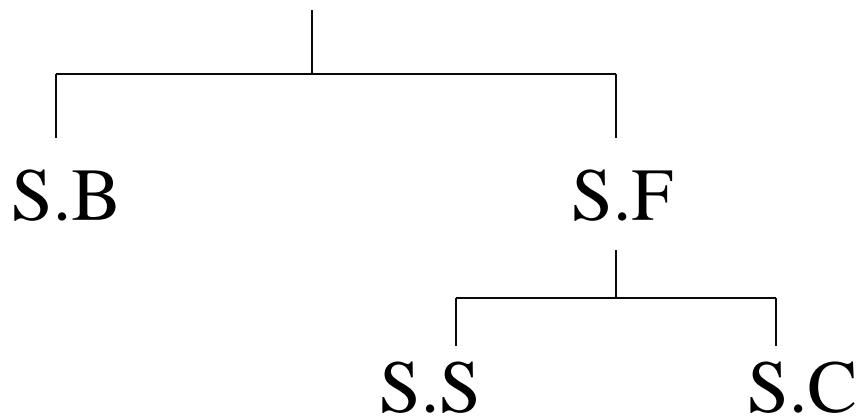
uterine tube





uterus

- Mucous layer
endometrium
- Muscular layer
myometrium
- Serous layer
Perimetrium



***Lamina propria varies with the phases of the menstrual cycle.

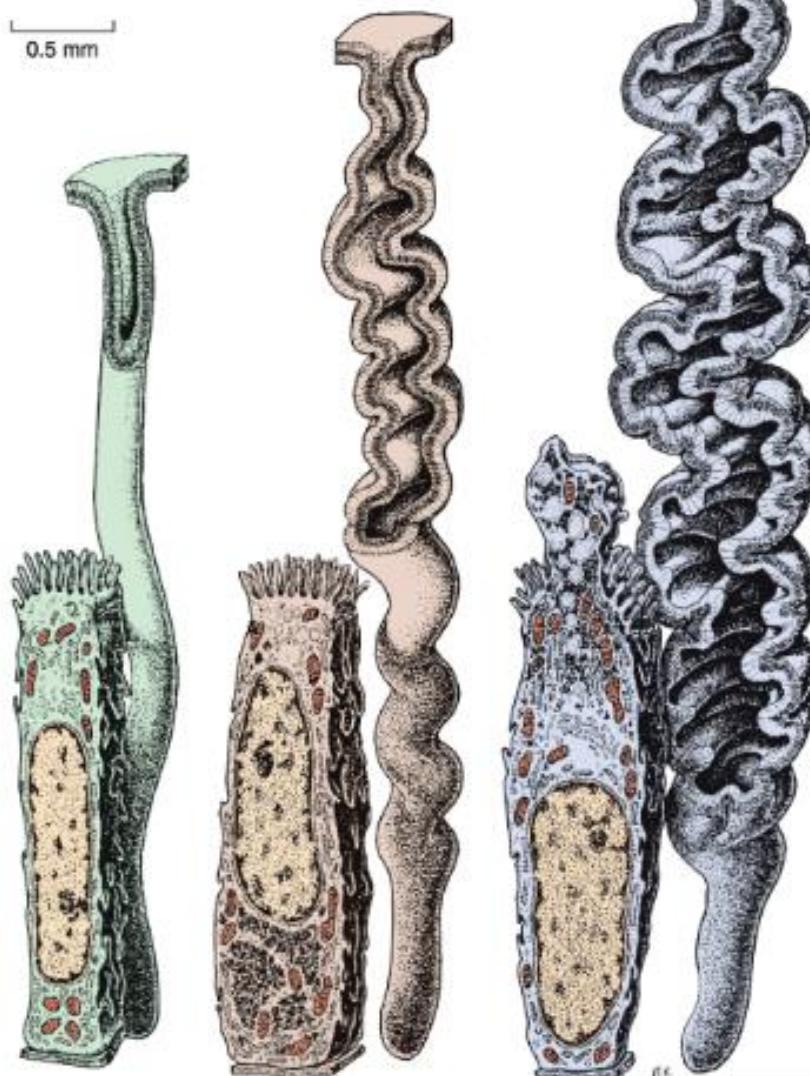
Menstrual phase

Proliferation phase

Secretory phase

uterus

0.5 mm



End
of
proliferative
phase

Day 14

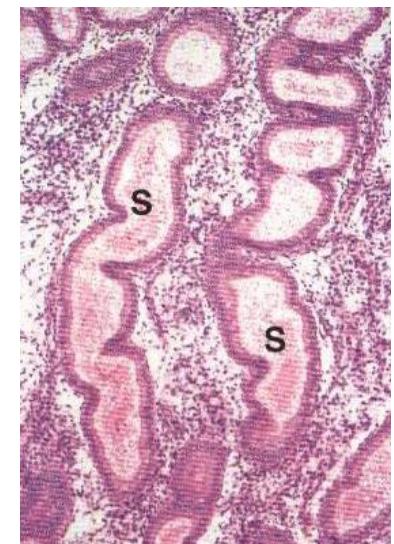
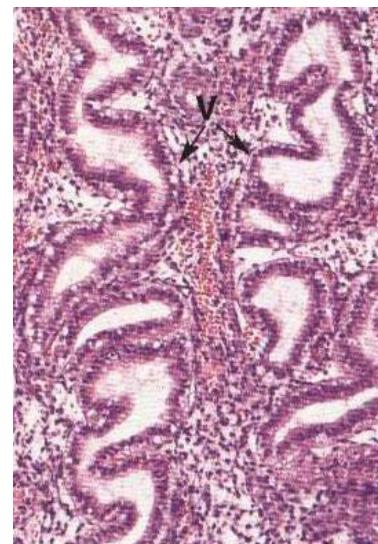
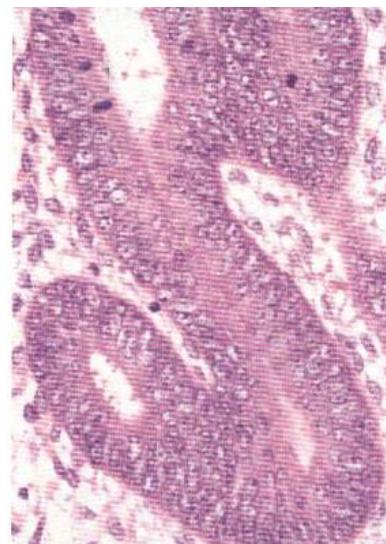
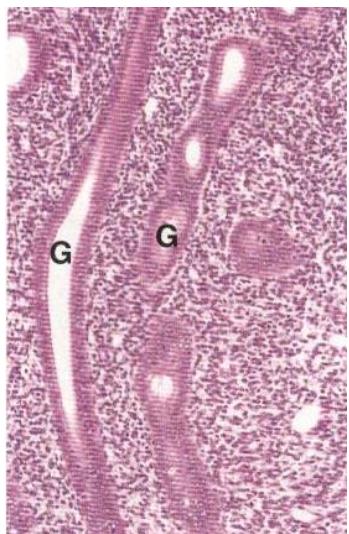
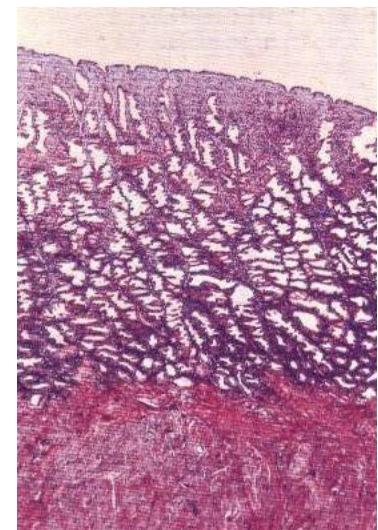
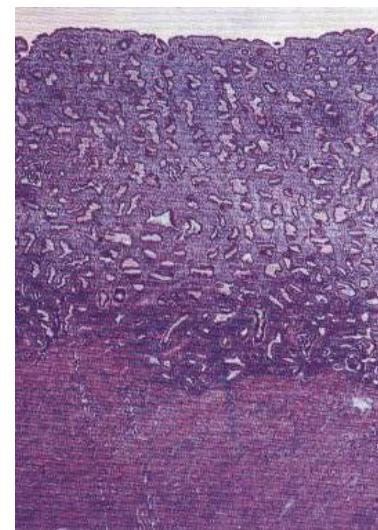
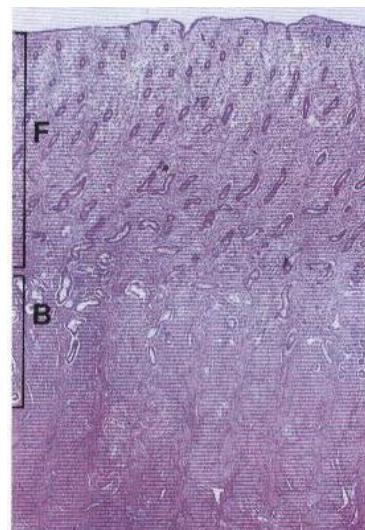
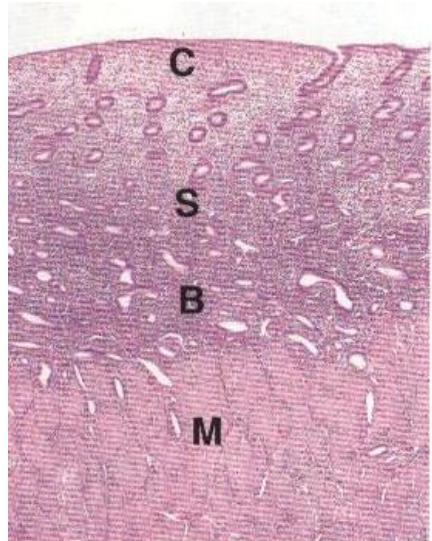
Initial
secretory
phase

Days 15–21

Late
secretory
phase

Days 22–28

5 μm



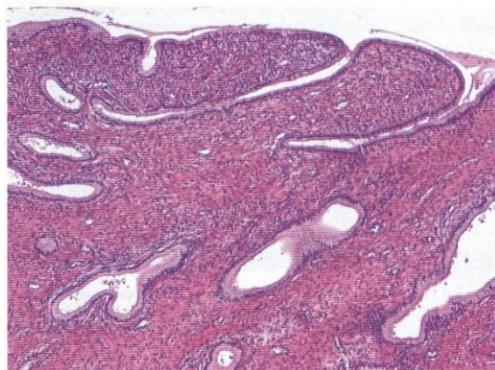
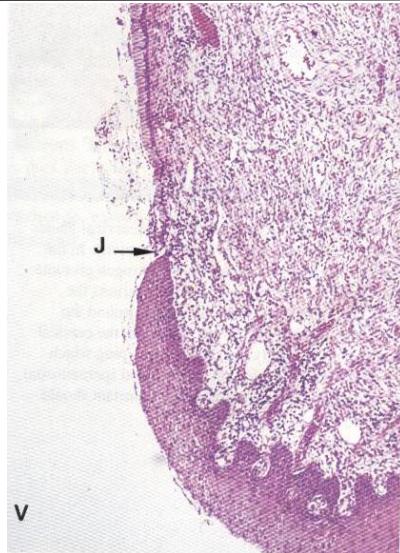
Proliferative
Early

Proliferative
Late

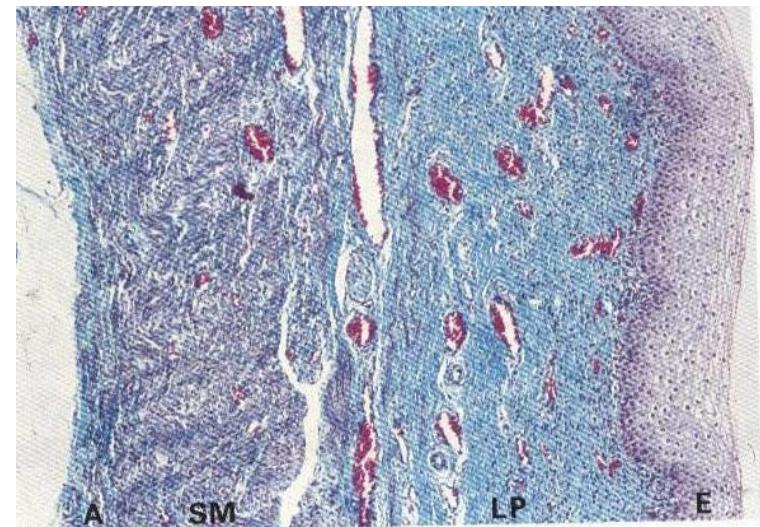
Secretory
Early

Secretory
Late

Uterine cervix

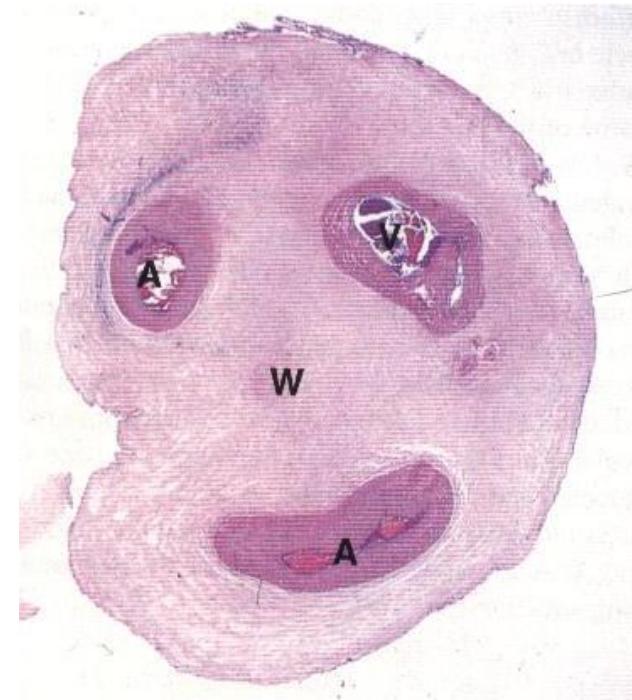
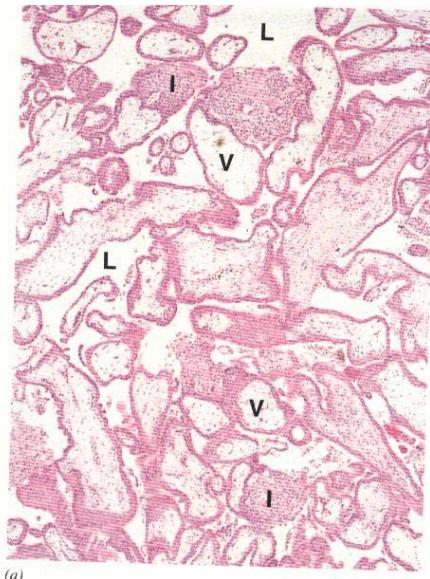
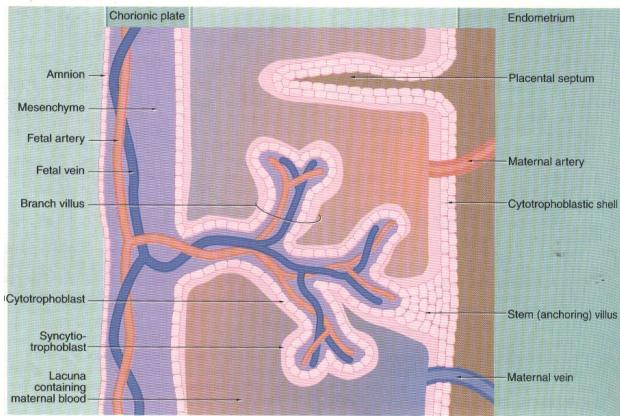


Vagina

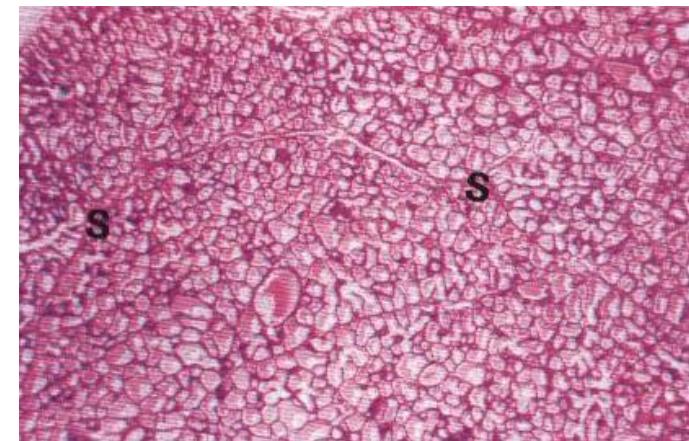
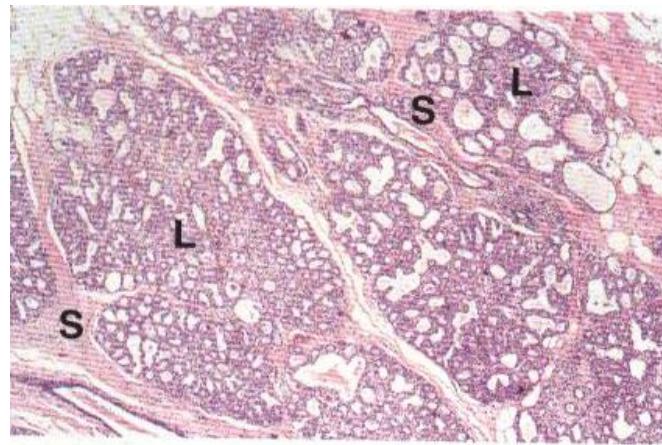
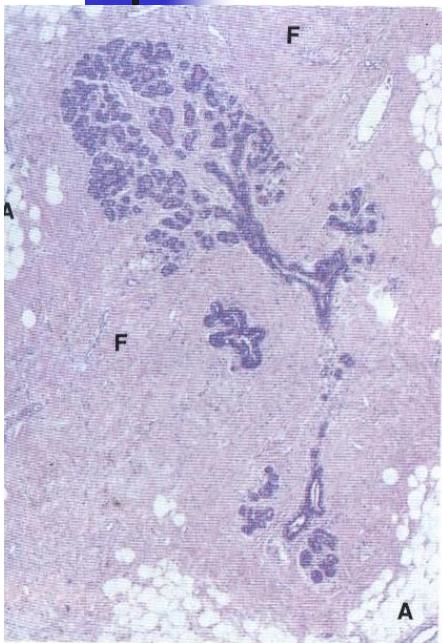


Placenta

Umbilical cord



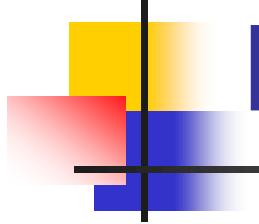
Mammary gland



**non pregnant
women**

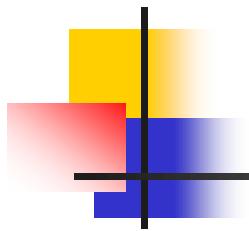
pregnancy

lactating



References

- Burkit, H.G, young, B. (1993). Wheaters functional histology. 4 th ed., london:Churchill livingstone
- Junqueira, L.C., Carneiro (1998). Basic histology. 9 th ed., stamford: Appleton & lange



at thank you