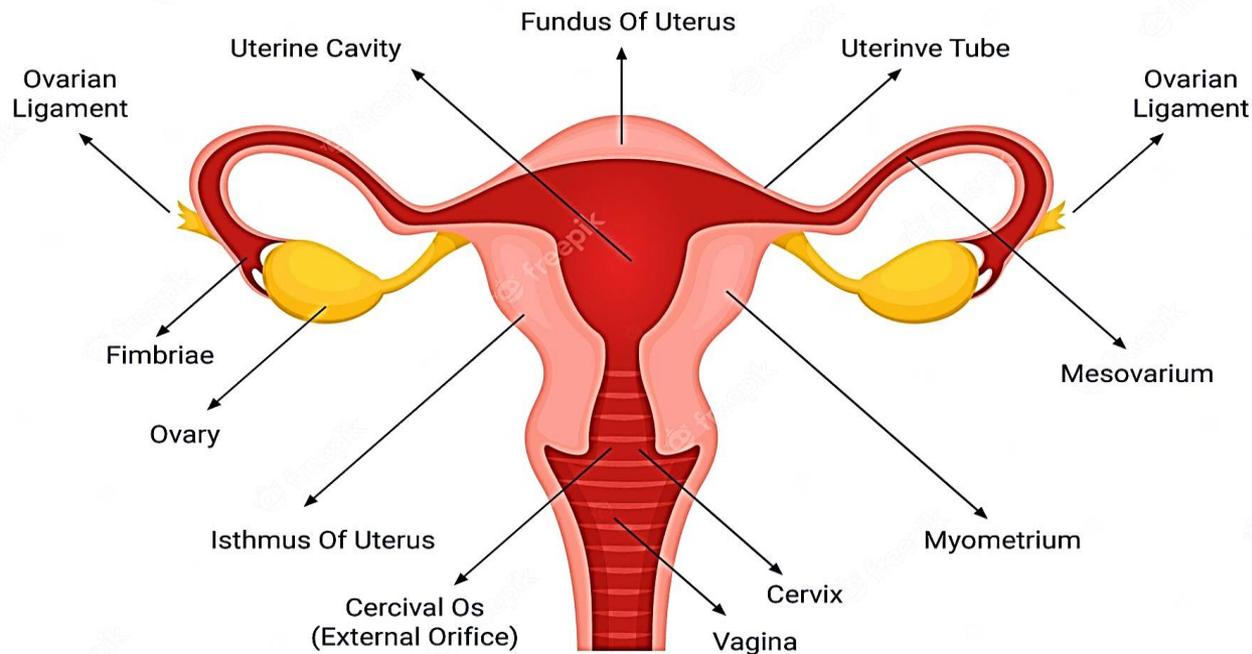


# The Female genital system

## Professor Dr. Hala El-mazar

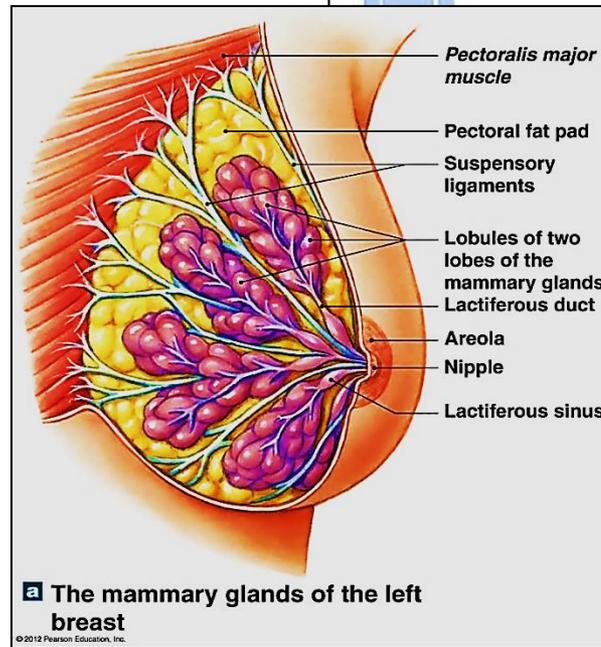
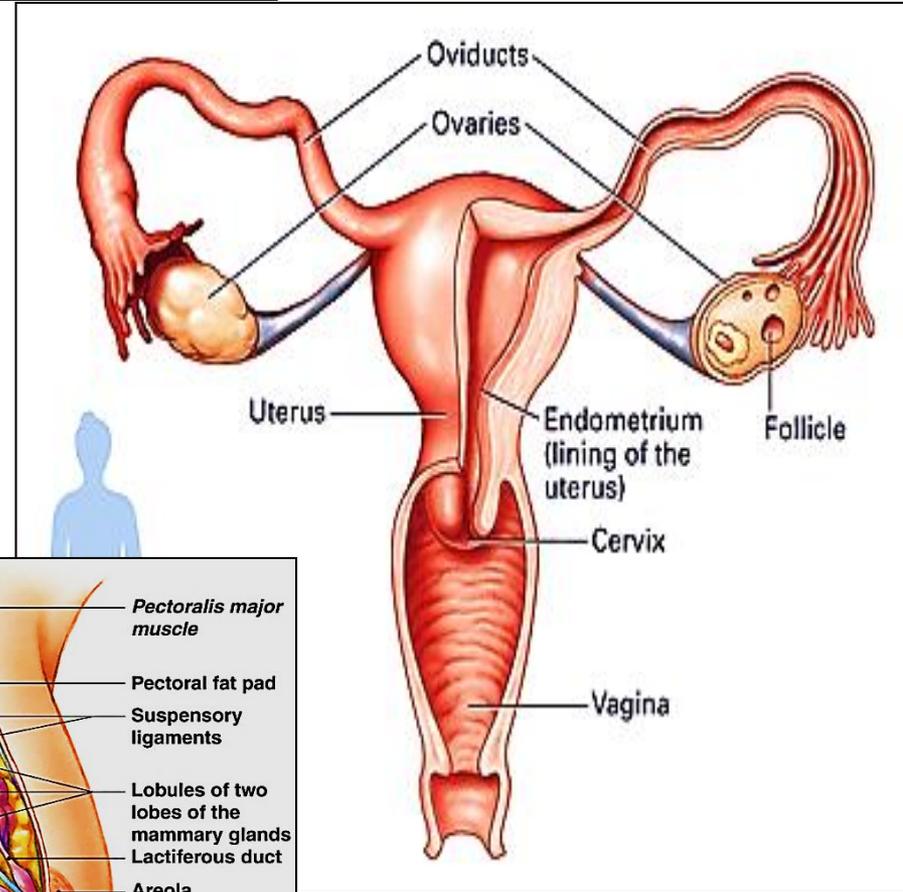


### FEMALE REPRODUCTIVE SYSTEM



# The female genital system composed of:

- 2 ovaries
- 2 Oviducts (fallopian tubes)
- Uterus
- Vagina
- External genitalia
- 2 mammary glands

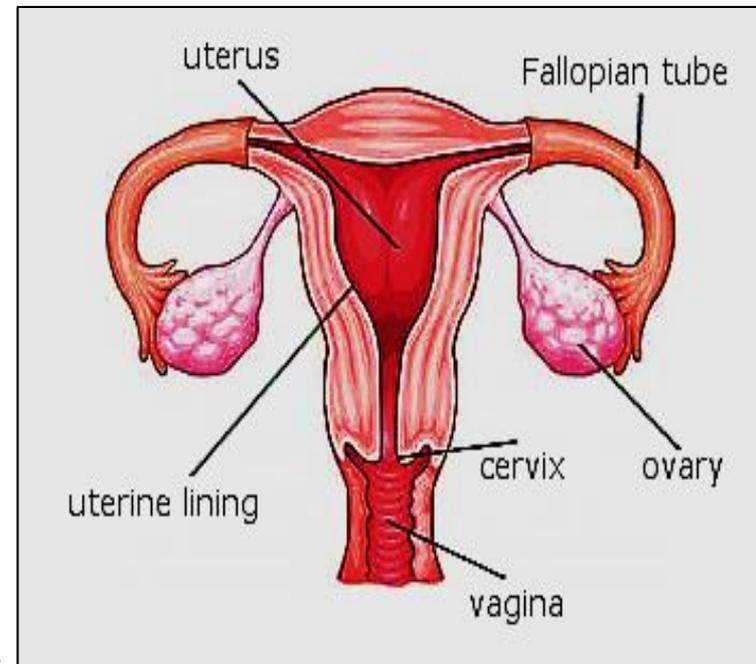


# Function of the female genital system:

1- Produce Female hormones: ovaries → secrete **estrogen & progesterone** (*endocrine function*)

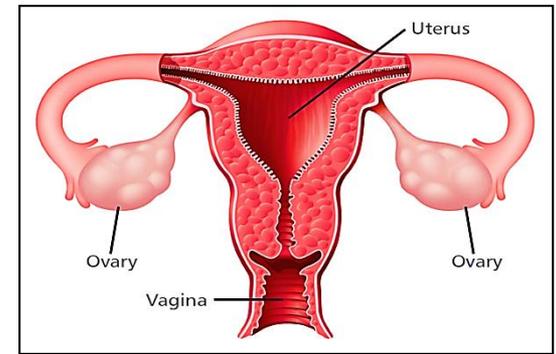
2- Produce female gametes : ovaries → [ova: oocytes]  
(*exocrine function*)

3- **Support & protect** developing Embryo in the uterus



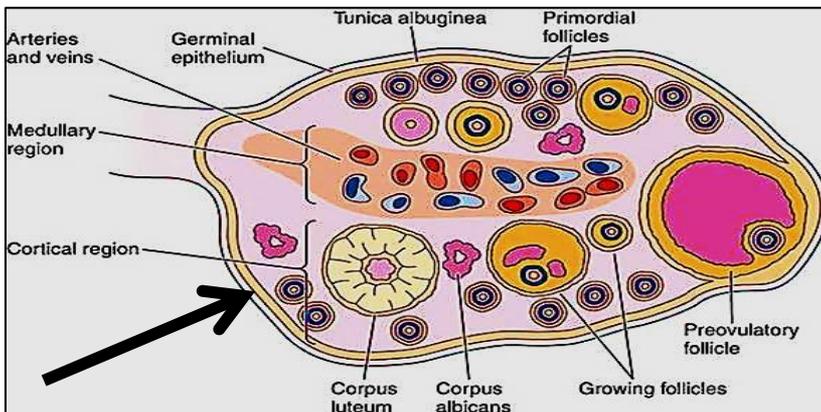
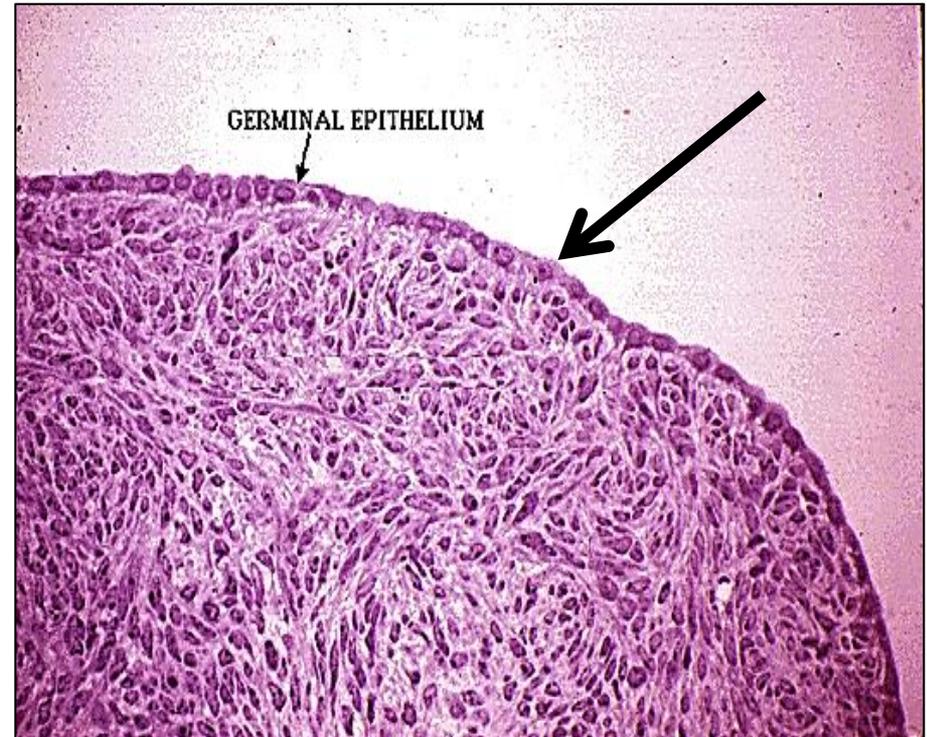
# The ovary

- Ovoid organ located in the pelvic cavity



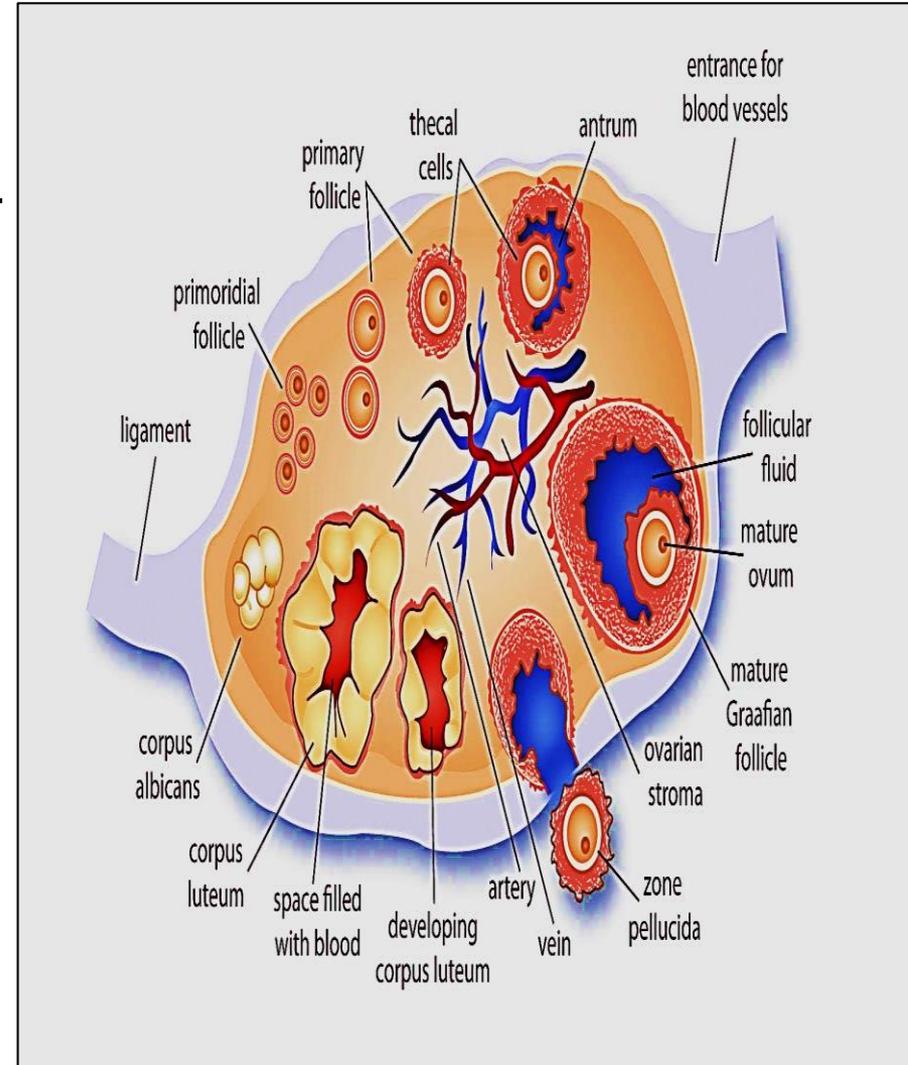
- Its outer surface is covered by a layer of **simple cuboidal epithelium** called **germinal epithelium**

- The epithelium rests directly on CT **capsule of the ovary: tunica albuginea**



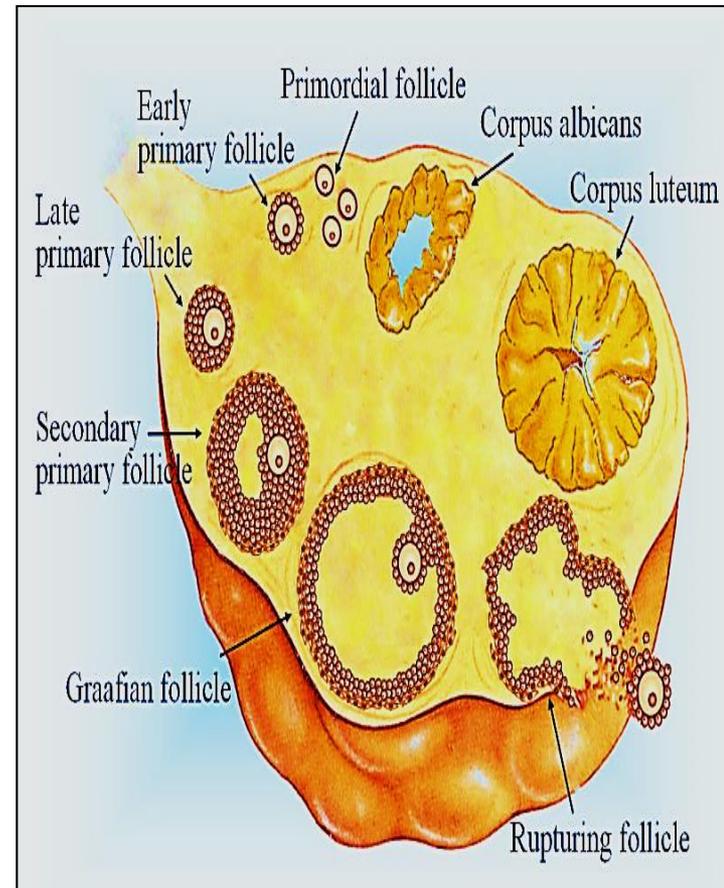
# The ovary

- Is formed : **cortex & medulla**
- **The cortex** : contains ovarian follicles at various stages of development, separated by CT contains spindle - shape stromal cells
- **The medulla**: highly vascular CT, lymphatic's , nerves



# Ovarian follicles

- Found mainly in the ovarian cortex
- Their proliferation occurs at **puberty** & under the effect of **FSH**
- Primitive germ cells called oogonia surrounded e single layer of follicular cells
- At puberty the ovaries contain about 400,000 follicles. However Only about **450** are liberated the rest become atretic



# Types of ovarian follicles

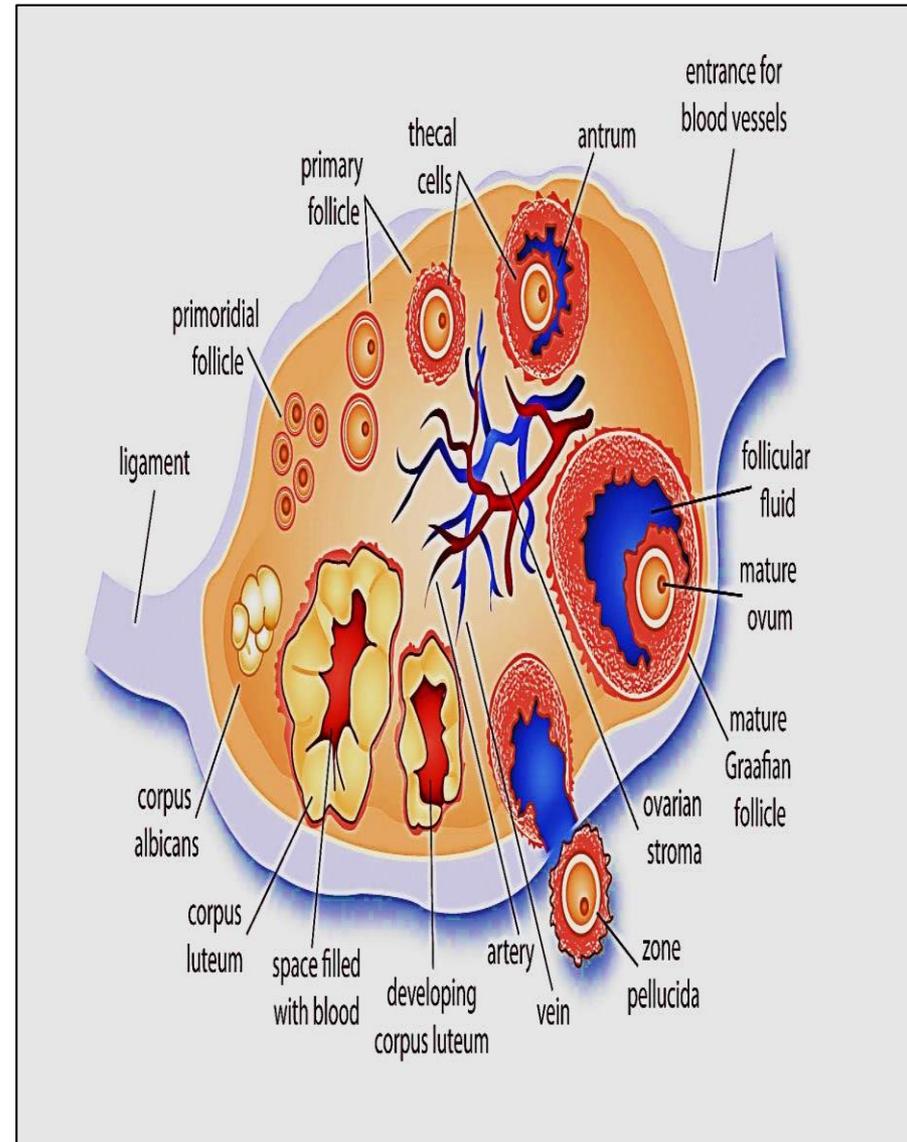
1-Primordial follicles

2- Primary follicles:  
(uni or multi-laminar)

3- Secondary follicles: antral

4- Mature Graafian follicles

5- Atretic follicles



## A- Oogenesis

Is the process of formation of female gamete, occurs before birth

### 1- Proliferation:

- During fetal development (1<sup>st</sup> trimester), oogonia in the fetal ovary divide by mitosis to give rise to a large # of oogonia ( 7 millions/ 2 ovaries)

### 2- Growth: ( 2<sup>nd</sup> trimester)

- mitotic division stops producing any more oogonia
- The oogonia will enter the prophase of 1<sup>st</sup> meiotic division & stop → then called **1ry oocytes**
- Primary oocytes will remain in arrested development in prophase of meiosis 1 until puberty

- By the beginning of **3<sup>rd</sup> trimester**, most oogonia have completed their change into 1ry oocytes which become surrounded with follicular cells

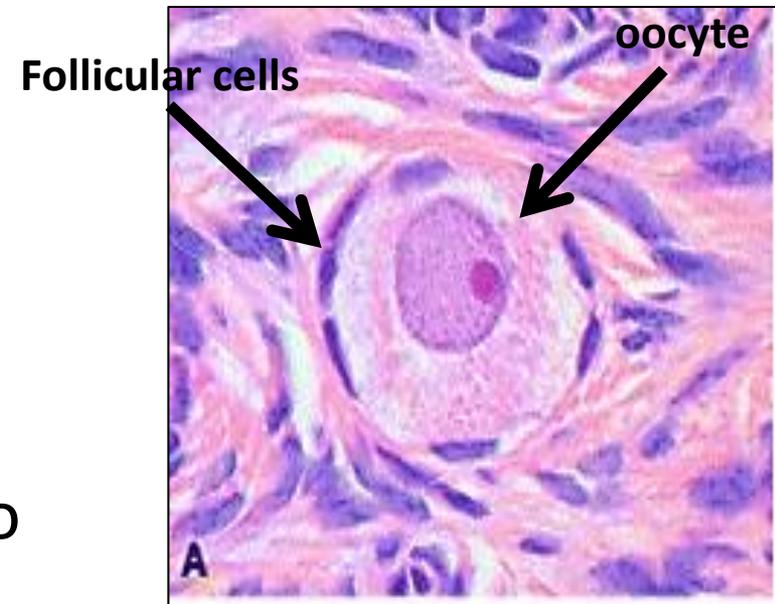
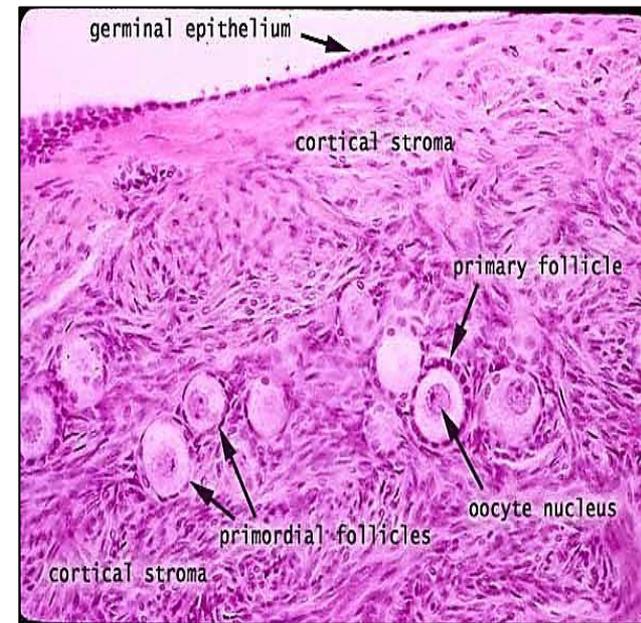
*(Ovarian follicle : oocyte surrounded by one or more layer of epithelial cells )*

### **B- Folliculogenesis (At puberty)**

- Each month, FSH cause several **Primordial follicles** to mature.
- Throughout folliculogenesis from 1ry follicle → mature follicle, oocyte is arrested in the prophase of 1<sup>st</sup> meiotic division
- **The primary oocytes resume meiosis I, just before ovulation. 1ry oocyte are diploid (2n)**

# primordial follicles

- Present in groups in *peripheral cortex*
- Formed during fetal life
- Each consists of 1ry oocyte enveloped by single layer of flat follicular cells
- Oocyte (1ry oocyte):
  - Spherical in shape
  - nucleus large contains (**diploid #**) e prominent nucleolus.
  - Organelles tend to gather close to nucleus

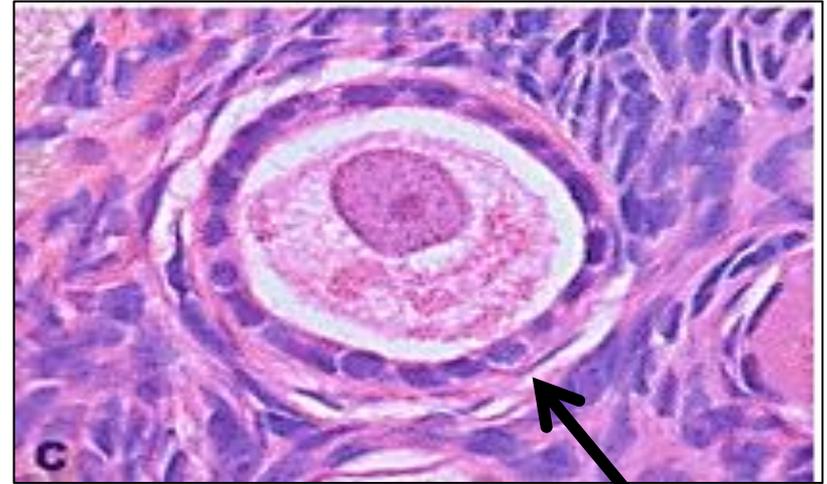


## Facts about the growth of the ovarian follicles :

- With the release of FSH at puberty small group of primordial follicles each month begins a process of follicular growth
- This involves growth of oocyte, proliferation & changes in follicular cells, proliferation & differentiation of stromal fibroblasts around each follicle
- it not true that the entire process of maturation occurs within a single menstrual cycle. Once a primordial follicle is recruited for development almost a year is required before ovulation can occur

# Primary follicle

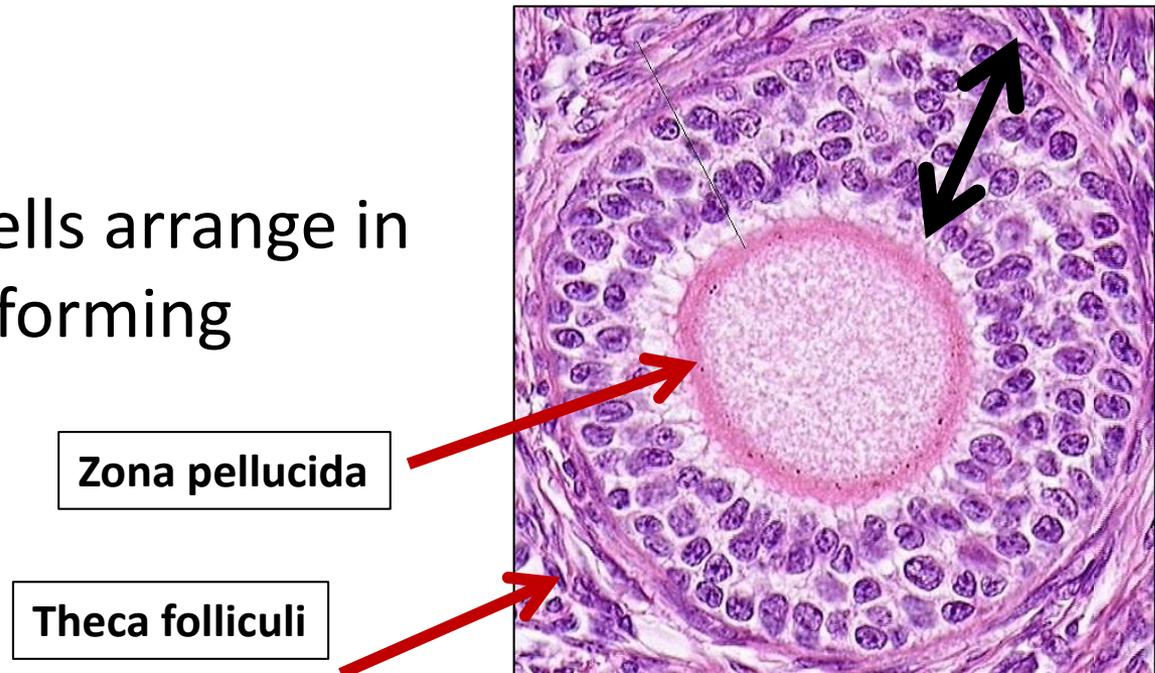
- The oocyte grows reaching a maximum diameter of about 120  $\mu\text{m}$
- Its nucleus enlarges & its mitochondria & rER  $\uparrow$
- Oocyte (1ry oocyte)  
arrested in prophase of 1<sup>st</sup> **meiotic division**



- ***The 1ry follicle are of 2 types uni-laminar & multi-laminar***
  - Uni-laminar, single layer of cuboidal cells, develops from primordial follicle
  - Multi-laminar develops from uni-laminar, by proliferation of follicular cells

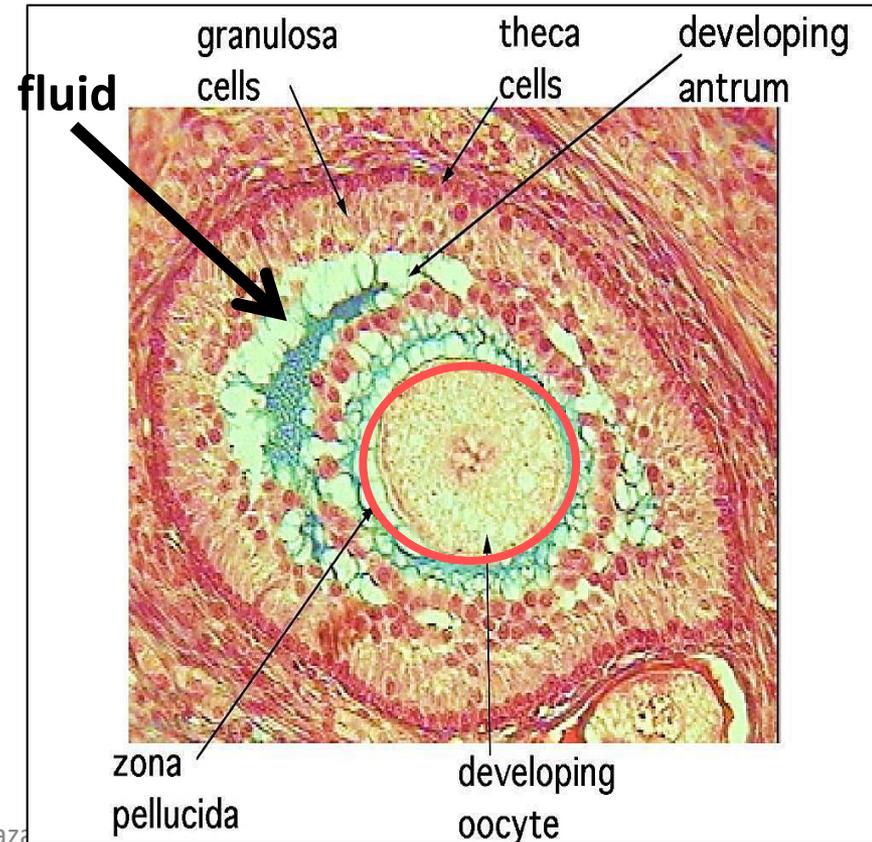
- 1ry follicle growth is FSH – Independent, local factors like epidermal growth factor stimulate its development
- The follicular cells are now called **granulosa cells**.
- Thick homogenous acidophilic layer, called **zona pellucida** formed between oocyte & the granulosa cells.

- Ovarian stromal cells arrange in concentric layers forming **theca folliculi**



## Secondary (antral) follicles

- Granulosa cells start to secrete fluid which begins to accumulate in spaces between the cells (FSH- dependant)
- These fluid spaces fuse together to form a large cavity called the **antrum**
- The oocyte (1ry) enlarges & will be pushed to one side
- Theca folliculi will differentiate into:
  - **Theca interna ( inner layer)**
  - **Theca externa (outer layer)**



# Graafine (Mature) follicle

The largest , bulges from the ovarian surface & consists of:

## 1- Oocyte:

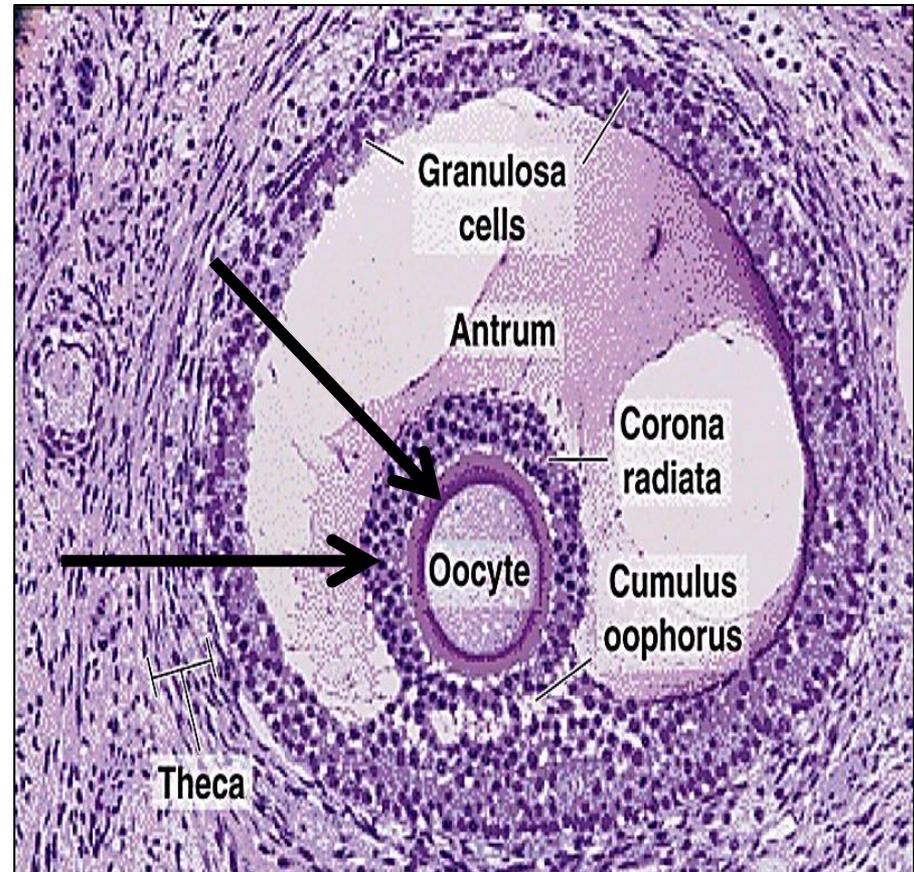
it changes to 2ry oocyte with **haploid # of chromosomes** just before ovulation

## 2- Zona pellucida:

A glycoprotein layer surrounds the oocyte

## 3- Corona radiata:

layer of granulosa cells surrounds the oocyte



#### 4- Cumulus oophorus:

A group of granulosa cells suspend the corona radiata + oocyte in follicular fluid

5- the granulosa cells inlining the cavity called membrana granulosa

#### 6- Theca interna:

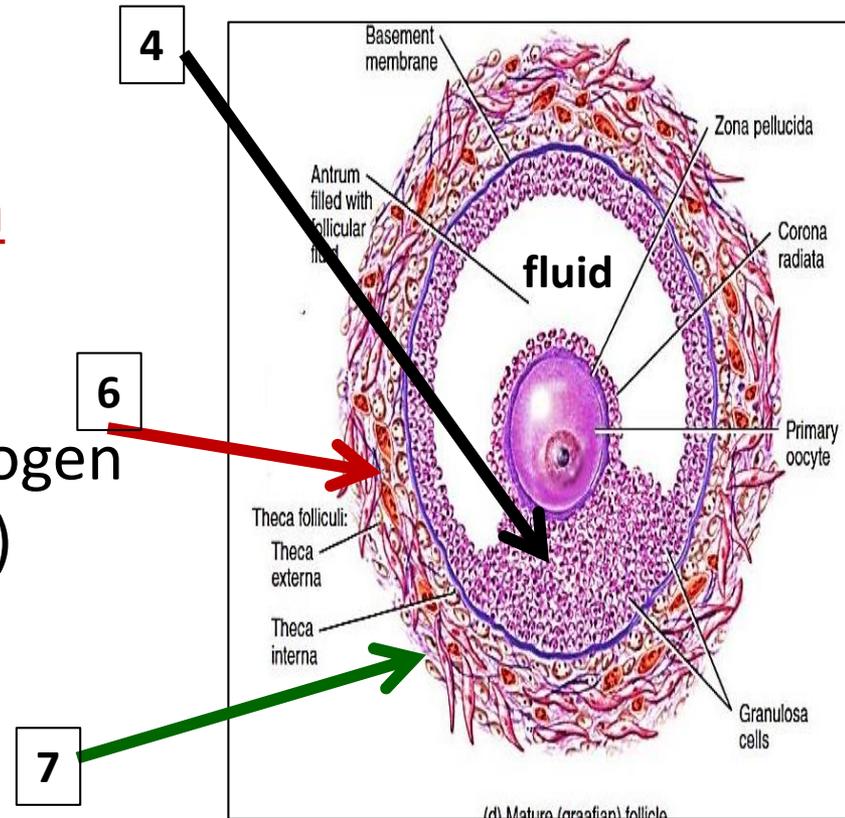
Large polyhedral cells, secrete estrogen & androgen (steroid secreting cells)

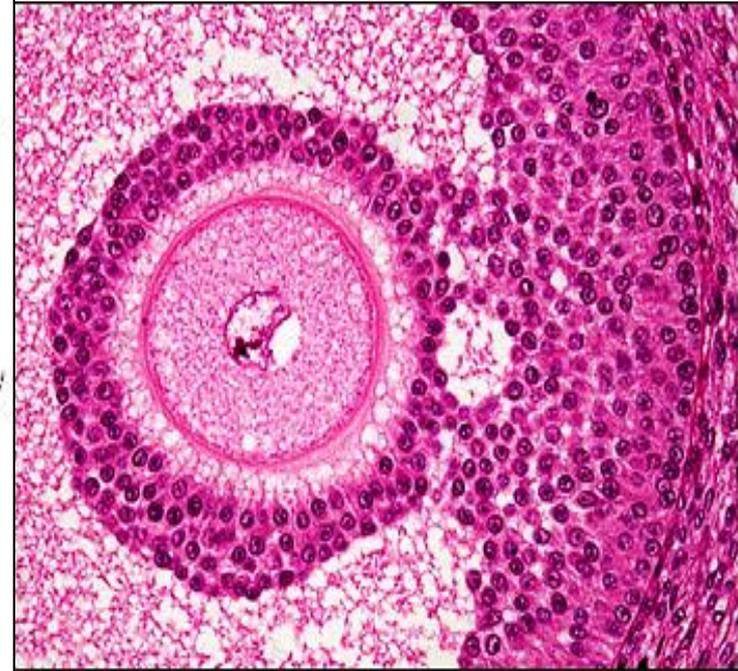
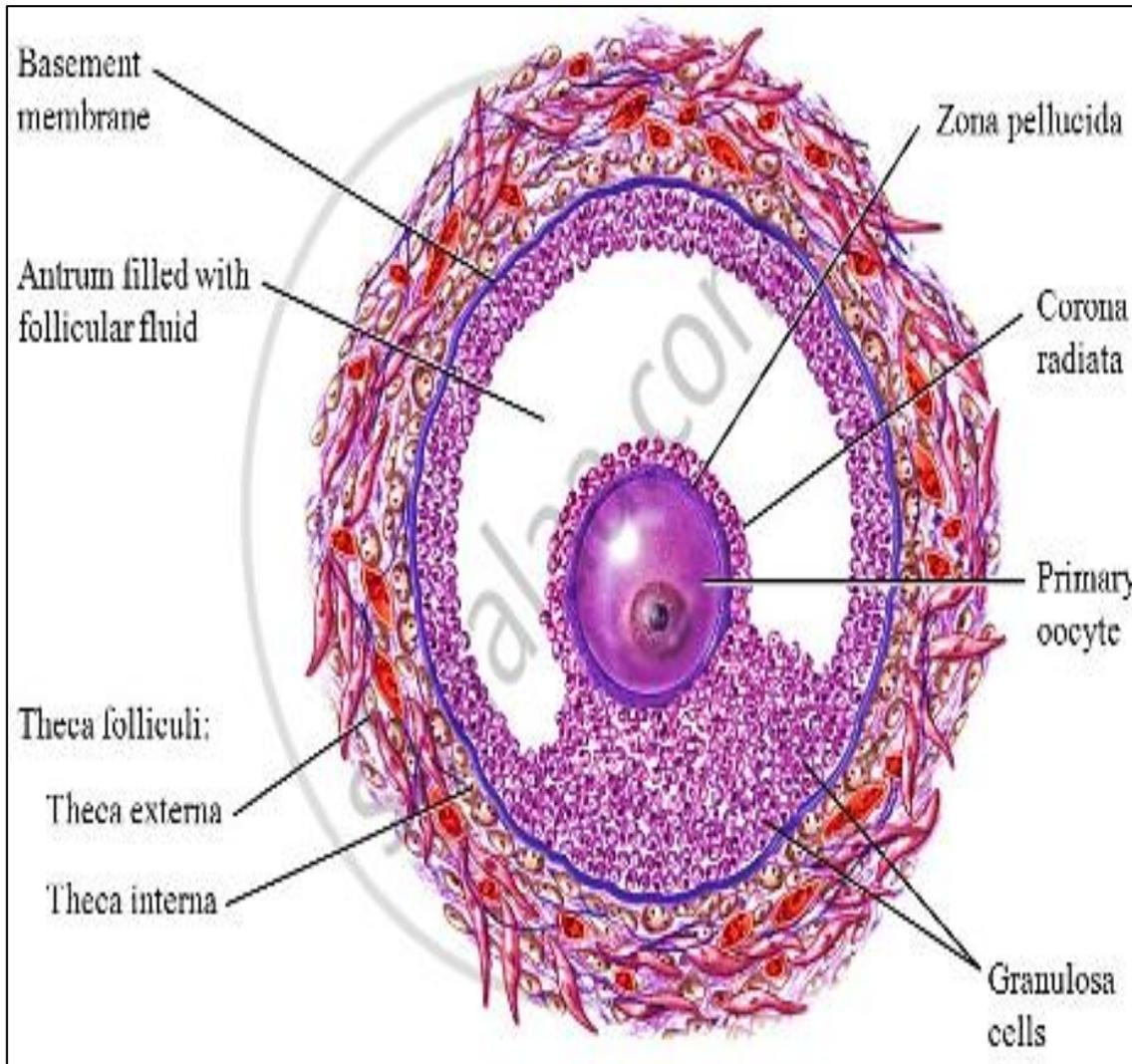
#### 7- Theca externa:

fibroblast- like layer.

Have no secretory function

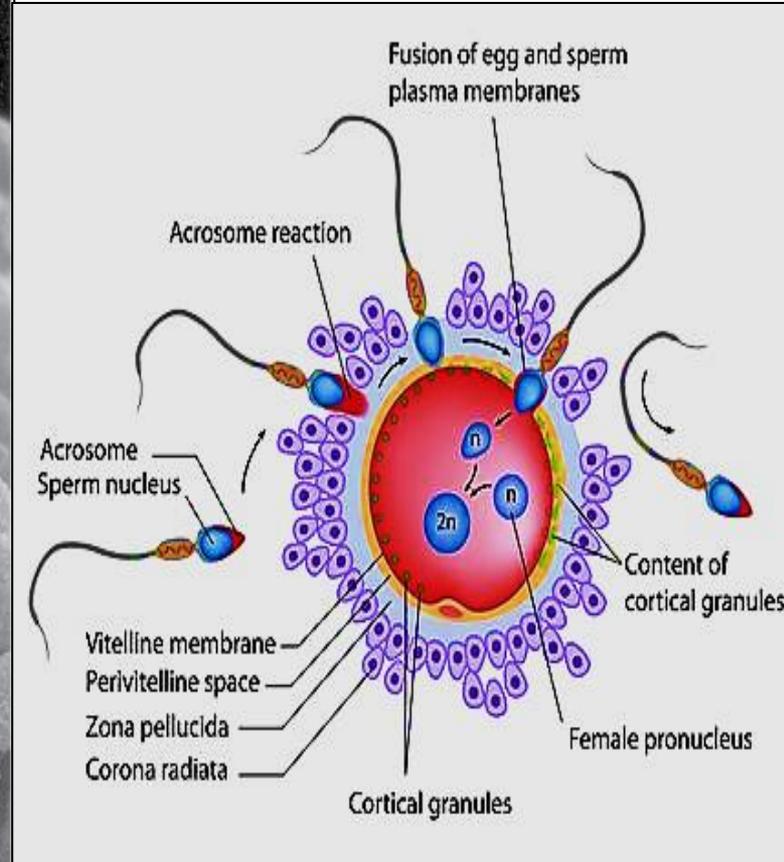
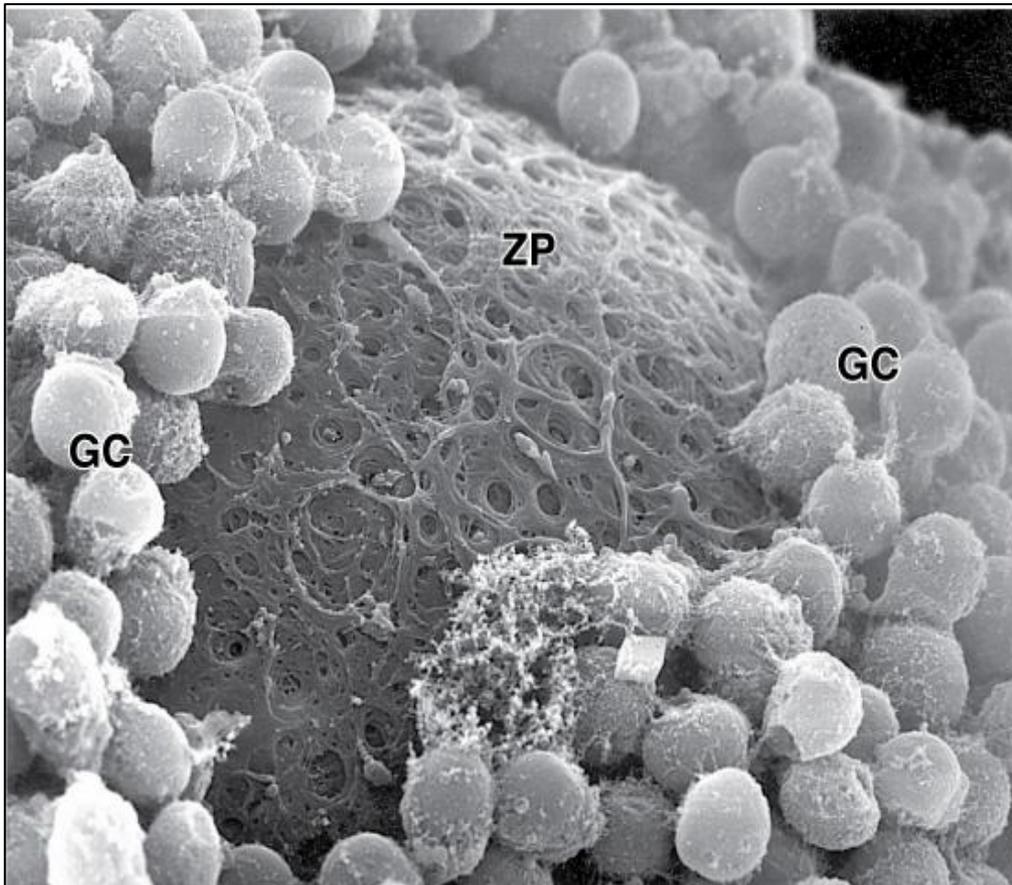
There is no clear boundary between the 2 theca layers or the surrounding stroma





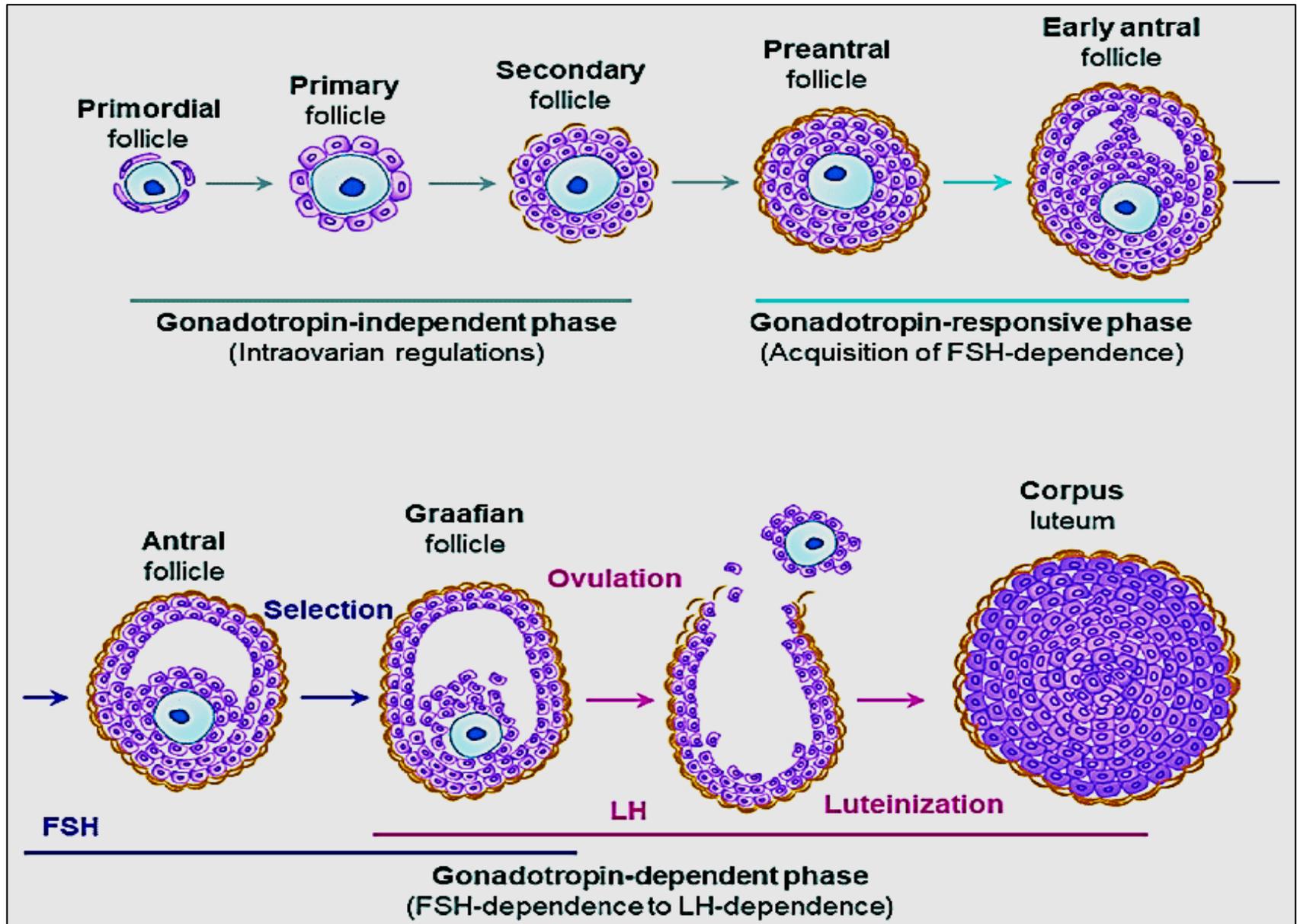
## Mature Graafian Follicle

corona radiata cells penetrate the **zona pellucida** & make contact with microvilli of membrane of oocytes via gap junctions to provide oocyte with nourishment



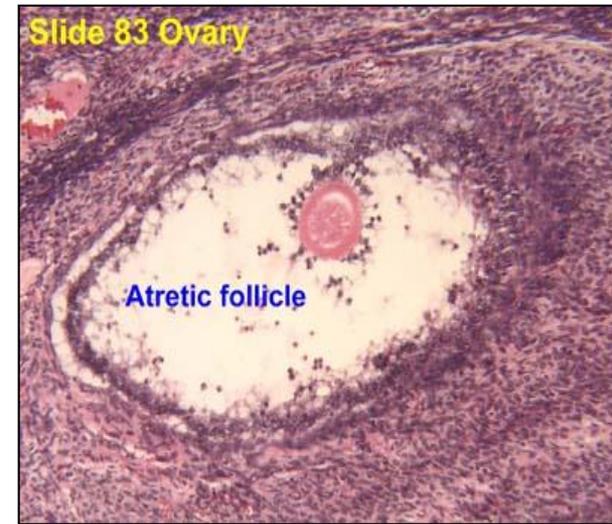
**EM picture of zona pellucida**

- Mature Graafian Follicle secretes inhibin hormone that shuts off FSH release
- Oocyte completes meiosis 1 just before ovulation
- 2<sup>ry</sup> oocyte: is the stage at which ovulation occurs
- After ovulation , 2<sup>ry</sup> oocyte enter **2<sup>nd</sup> meiotic division** ( **which will be completed only after fertilization**)
- Polar bodies: When the cell divides, all the cytoplasm and organelles stay with one of the new cells, the other cell is just DNA, and is called a **polar body and is discarded**



# Atretic follicles

- Every month about **20** 1ry follicles are activated, only **one** reach maturation & the rest become degenerate (atresia)
- Atresia occurs at any stage of follicular growth
- Characterized by death of oocyte & degeneration of surrounding cells. Macrophages invade the follicle to phagocytose it
- When large follicles ( 2ry & 3ry) degenerate → collagen scar in the ovary while the small one resorb completely

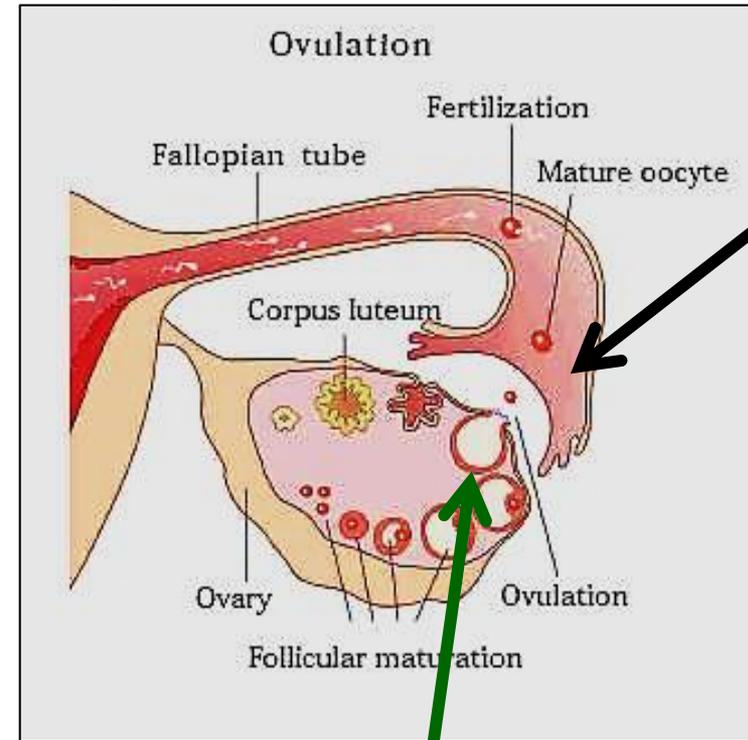


# Fate of mature (Graafian) follicles (ovulation)

- High estrogen levels → + ant. pituitary → secretes a surge of LH
- LH is the stimulus for ovulation (mid of menstrual cycle 14/28)
- The pressure of the liquor folliculi → causes a bulge in the follicle wall called stigma → which then ruptures → liberation of oocyte in the peritoneal cavity
- The liberated oocyte is surrounded by zona pellucida, corona radiata & some cumulus oophorus cells



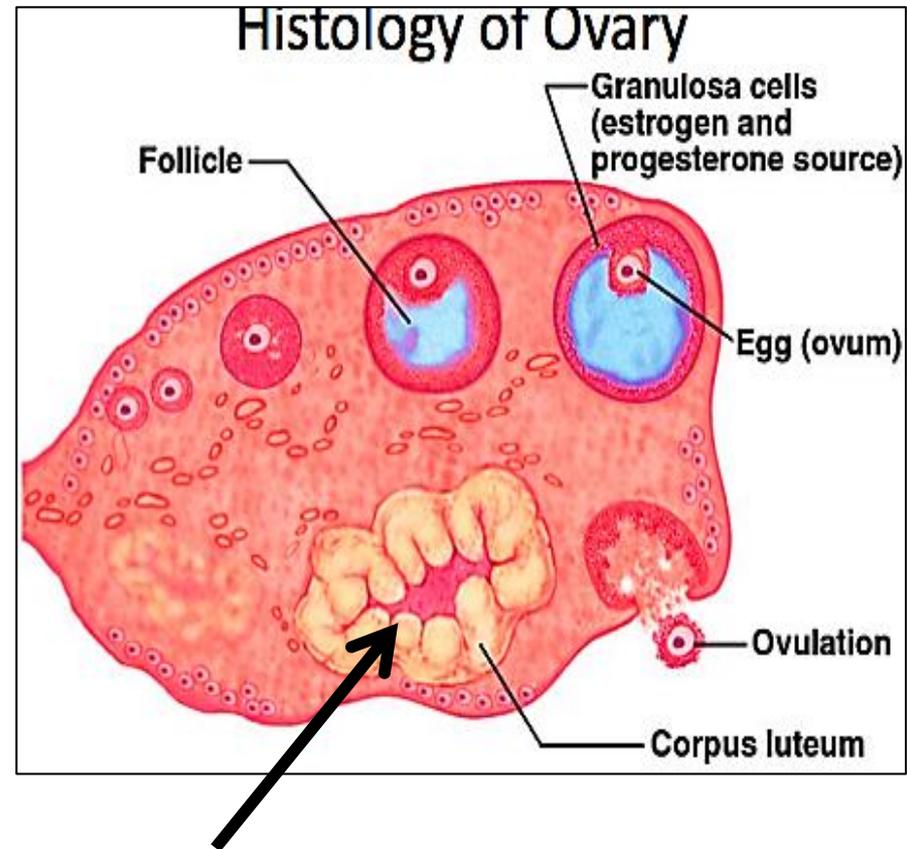
- The oocyte is then picked up by fallopian tube
- The oocyte remain viable for 24 hours after that it degenerates
- The follicular fluid + some blood from the vascular theca expelled into the peritoneal cavity



- The remaining **granulosa + theca interna cells**  
 → **corpus luteum**

# The corpus luteum

- Temporary endocrine gland
- present in the ovarian cortex after rupture of the mature Graafian follicle
- The CL produces  $\uparrow$  levels of **progesterone & moderate levels of estrogen**



## ➤ Formation & structure of CL:

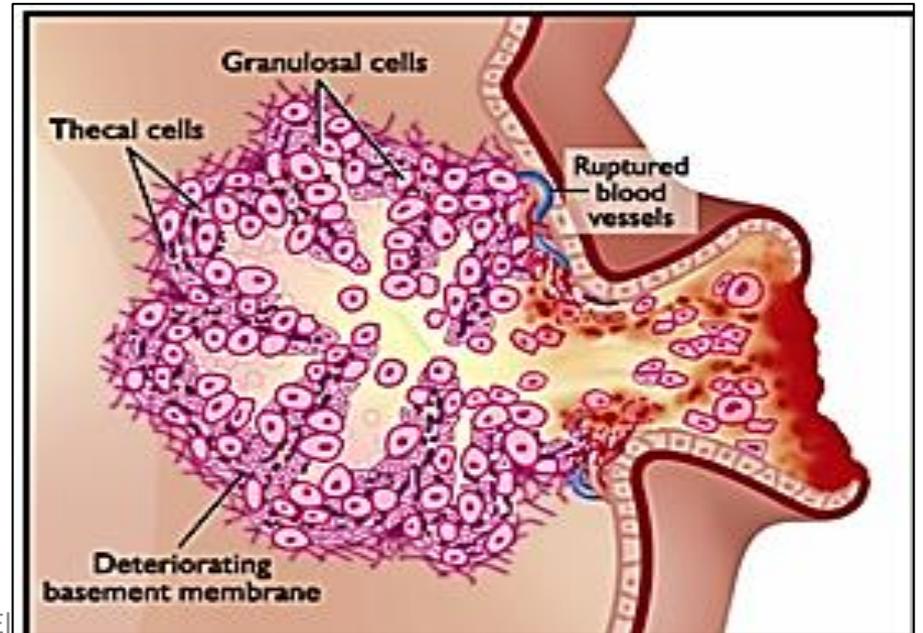
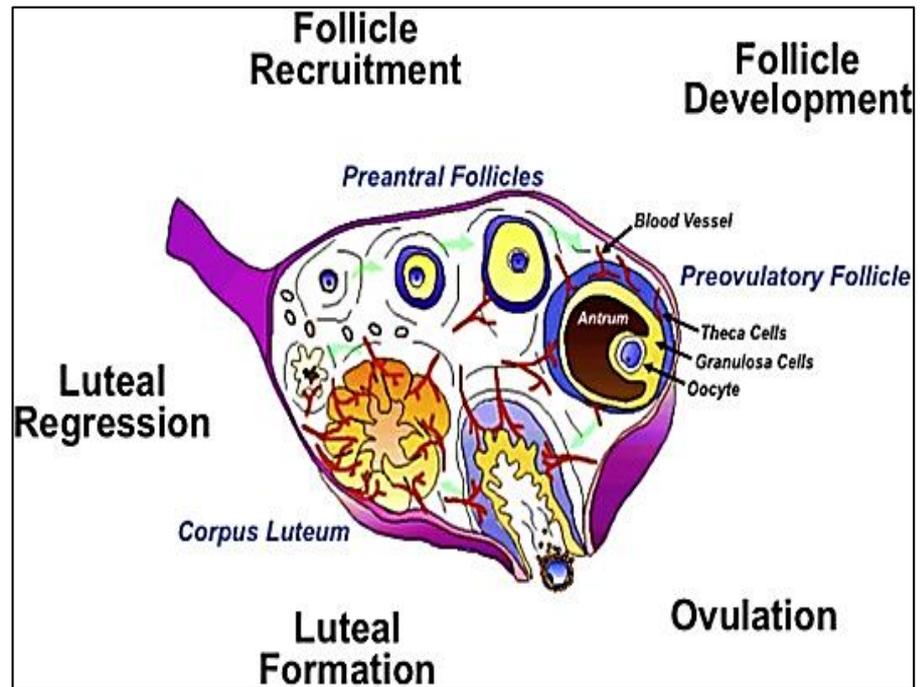
After ovulation & under the effect of LH, the granulosa & theca interna cells from the corpus luteum

- **The granulosa cells** ↑ in size, & becomes more vascularized → **granulosa-lutein cells**

➤ These cells will secrete **progesterone** hormone (↑SER)

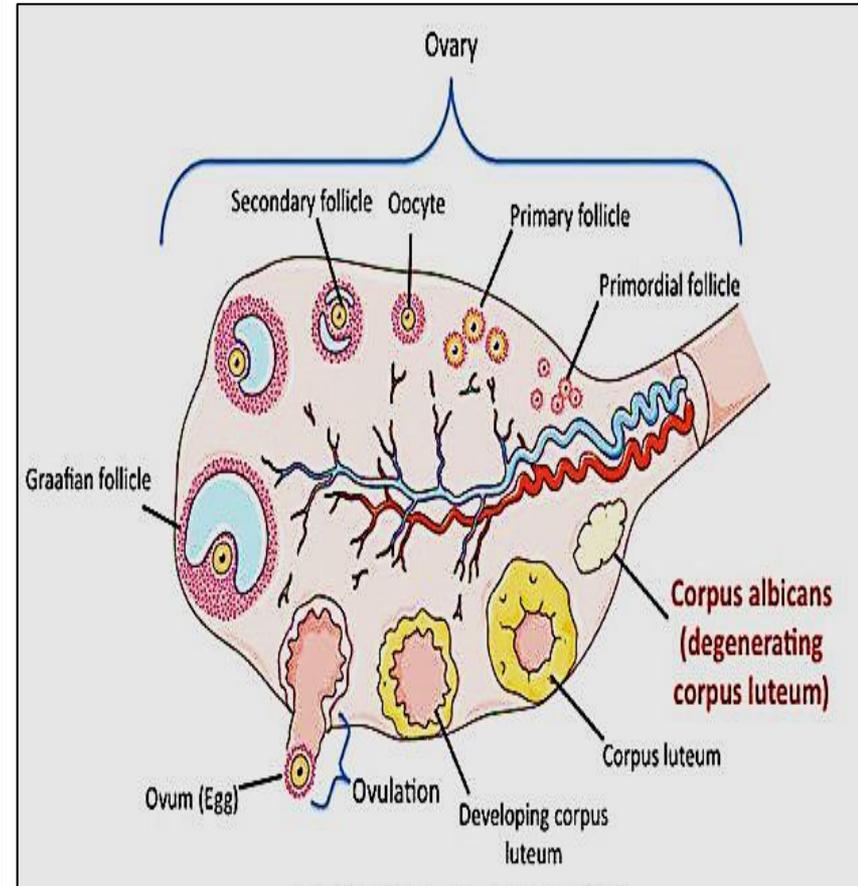
- **The theca interna cells** are smaller in size & deeply stained → **theca lutein cells**

➤ These cells will secrete **estrogen** hormone (↑SER)

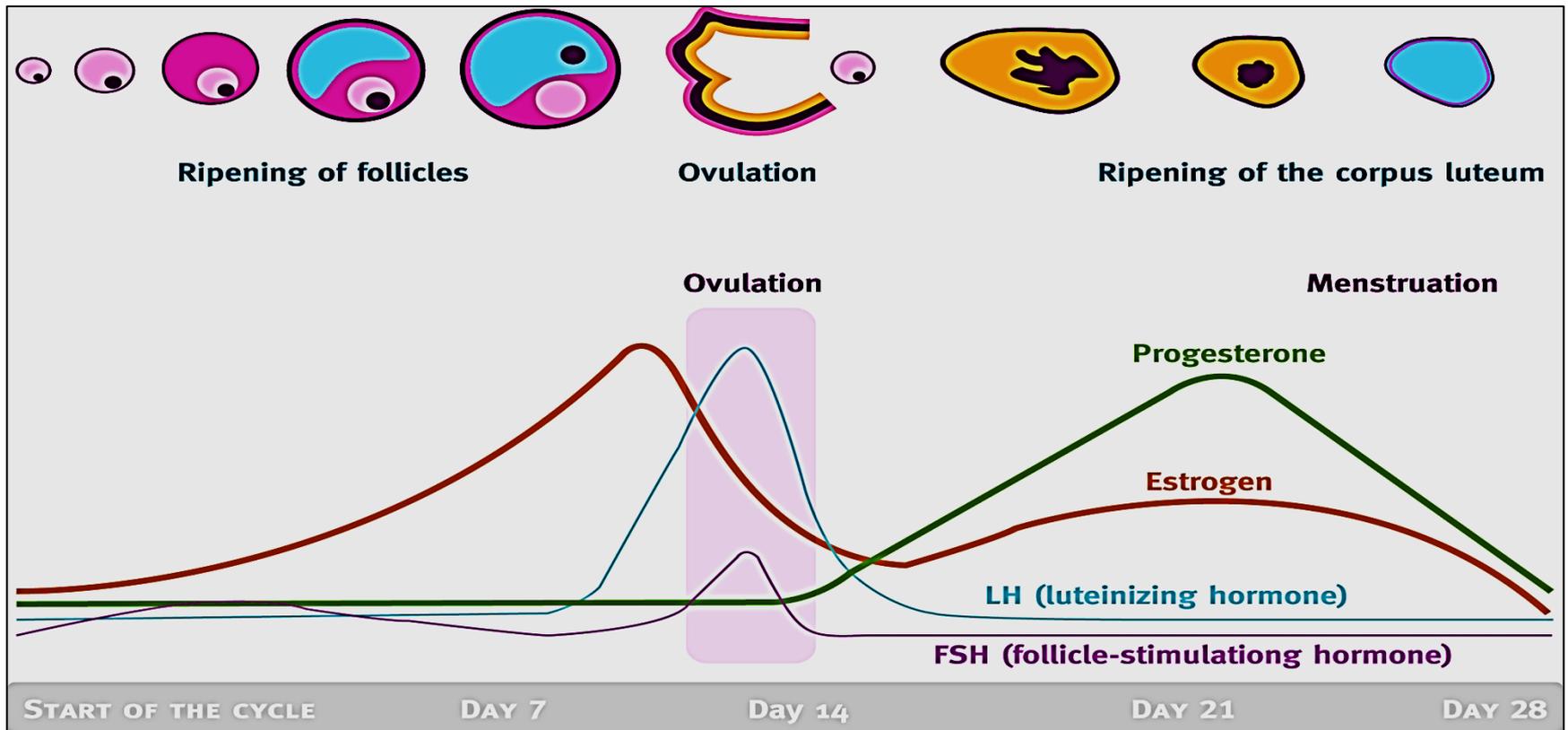


# Fate of corpus luteum

- Depends on the possibility of pregnancy
- High levels of LH stimulate the corpus luteum to secrete **progesterone** for 10 -12 days
- In the absence of pregnancy → corpus luteum undergo apoptosis → progesterone levels ↓ → leads to menstruation & CL under go degeneraton then called **corpus albicans**



- When the corpus luteum degenerates → ↓ estrogen & progesterone in blood → ↑ FSH secretion
- This stimulates the growth of another group of follicles & beginning of another cycle

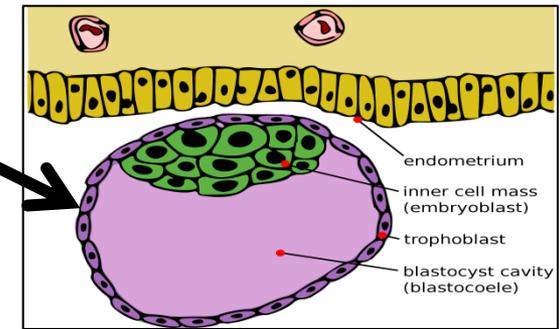


# Corpus luteum of pregnancy



- If pregnancy occurs → the trophoblast cells of the implanted embryo → produce **human chorionic gonadotropin** (HCG, similar in action to LH) → maintain corpus luteum & promotes its growth

- CL will secrete **progesterone** & **estrogen** to maintain the uterine mucosa until the placenta become fully functioning.



- This called **corpus luteum of pregnancy** & lasts for about 8 weeks gestation → degenerate → corpus albicans

# Fallopian tubes (oviducts)

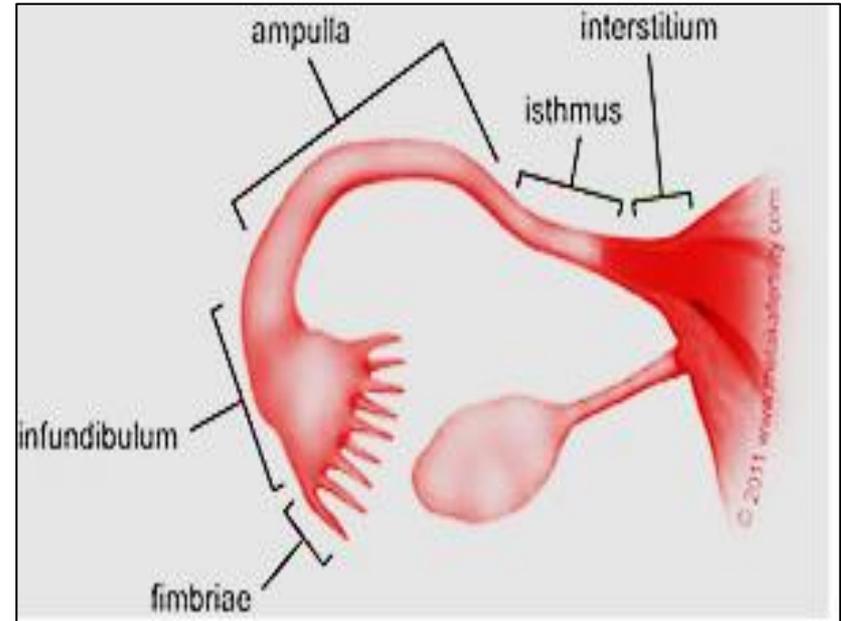
- muscular tubes, receive the ovulated oocyte and provide a site for fertilization

## Composed of:

1- **Interstitium** which open into the uterus

2- **Isthmus**: narrow short segment

3- **Ampulla** expand segment where fertilization occur



4- **infundibulum** contains fingerlike projections called **fimbriae**

# The wall of the oviduct is formed of 3 layers

## 1- mucosa:

- Highly folded
- Simple columnar consists of :  
**ciliated & secretory (Peg cells)**

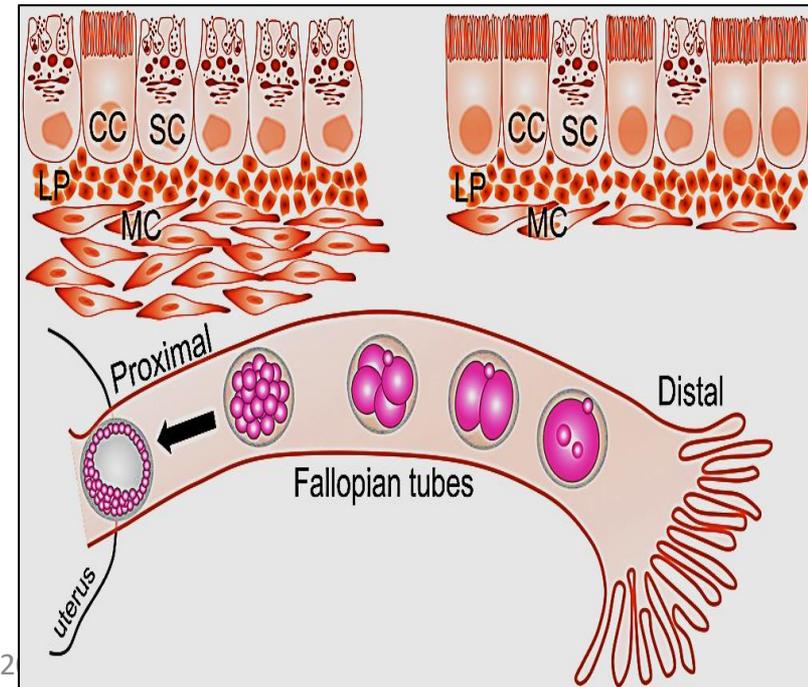
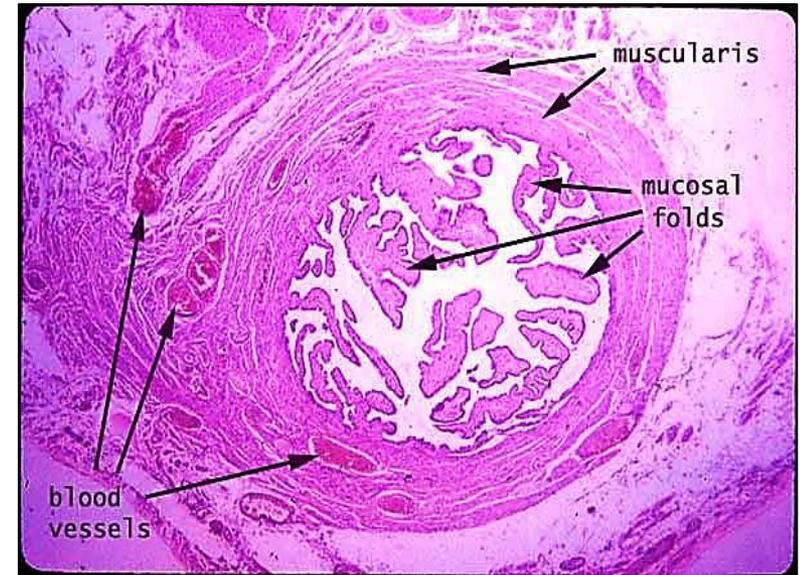
Cilia beat toward the uterus

**Peg cells** : Its secretion is rich in nutrient & cytokines that lubricate the tube & aid in capacitation of spermatozoa

## 2- musculosa :

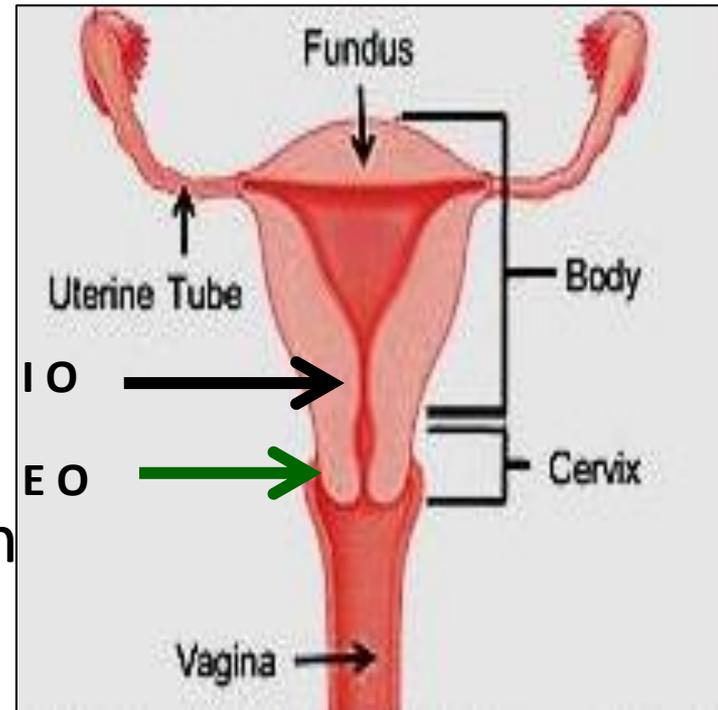
- IC & OL layers
- Their peristalsis play major role in pushing the ovum

## 3- Serosa:



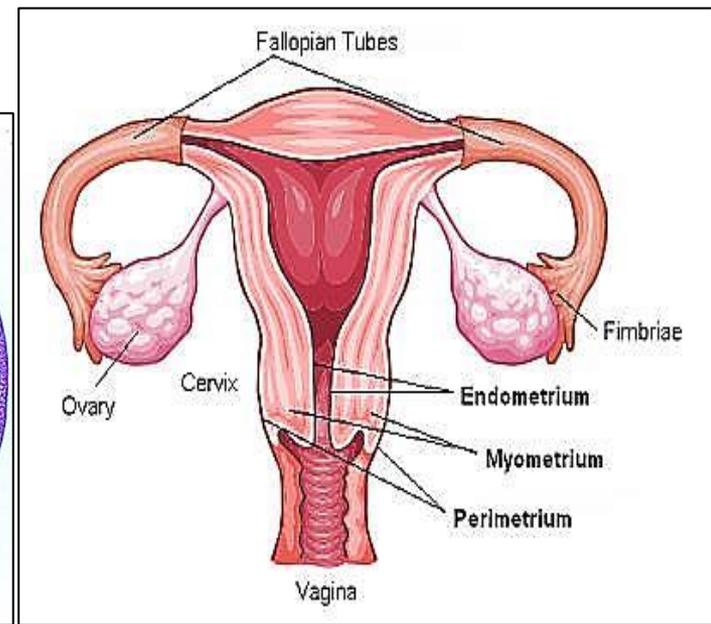
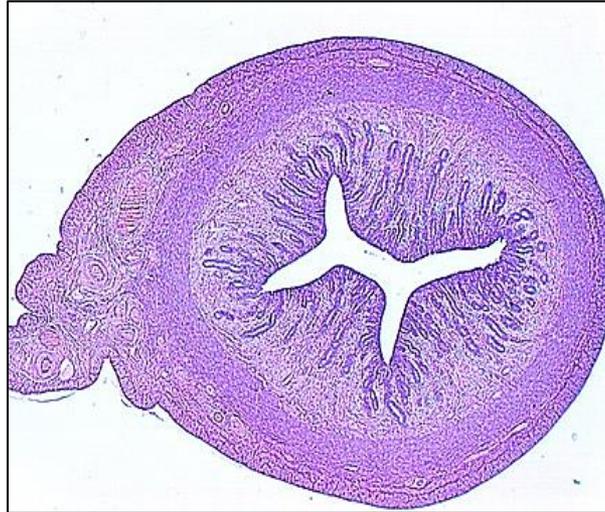
# The uterus

- Pear shaped organ
- **Fundus**: dome shaped region
- **Body**: Major portion of the uterus
- **Cervix**: cylindrical part extends from the internal os & ends at external os



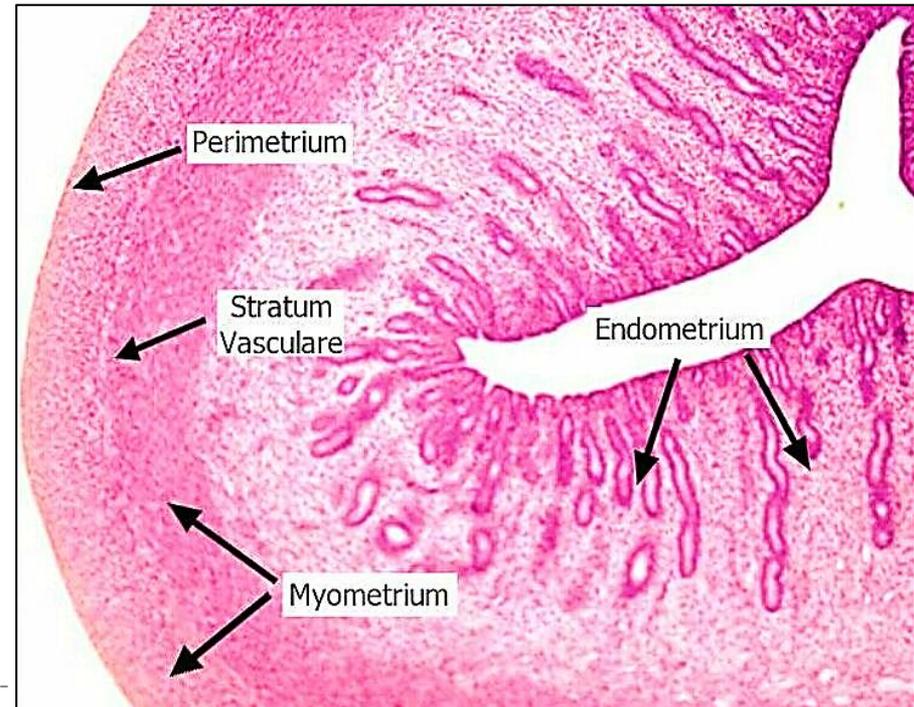
# The uterine wall consists of 3 layers:

- Endometrium
- Myometrium
- Perimetrium



## ➤ Endometrium (mucosa)

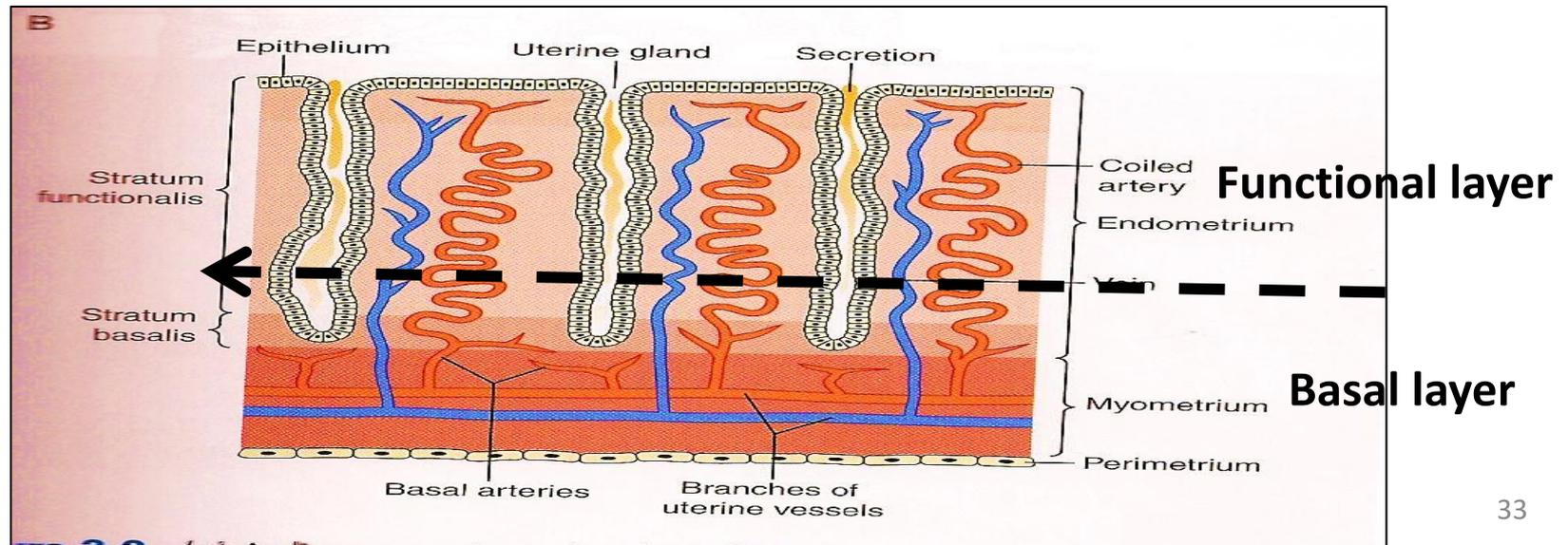
Lined with simple columnar epithelium partially ciliated & contain simple tubular glands (endometrial glands)

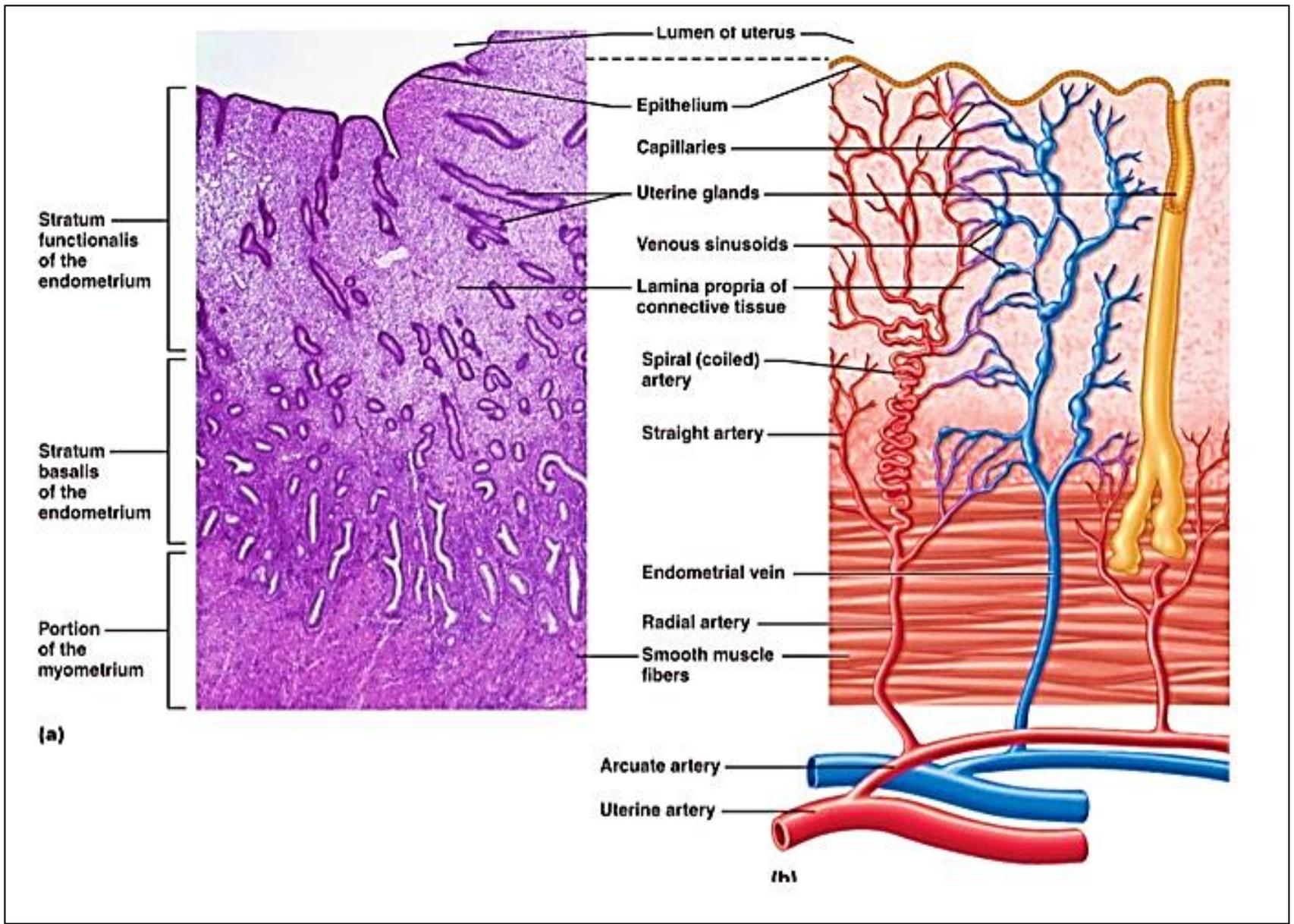


Endometrium composed of 2 layers:

Functional layer superficial layer (spiral /coiled arteries) undergoes cyclic changes during menstruation (i.e. proliferative & secretory uterine phases)

Basal layer: deeper & adjacent to myometrium. It remains mostly unchanged during menstruation & consider as the reserve part (straight arteries)





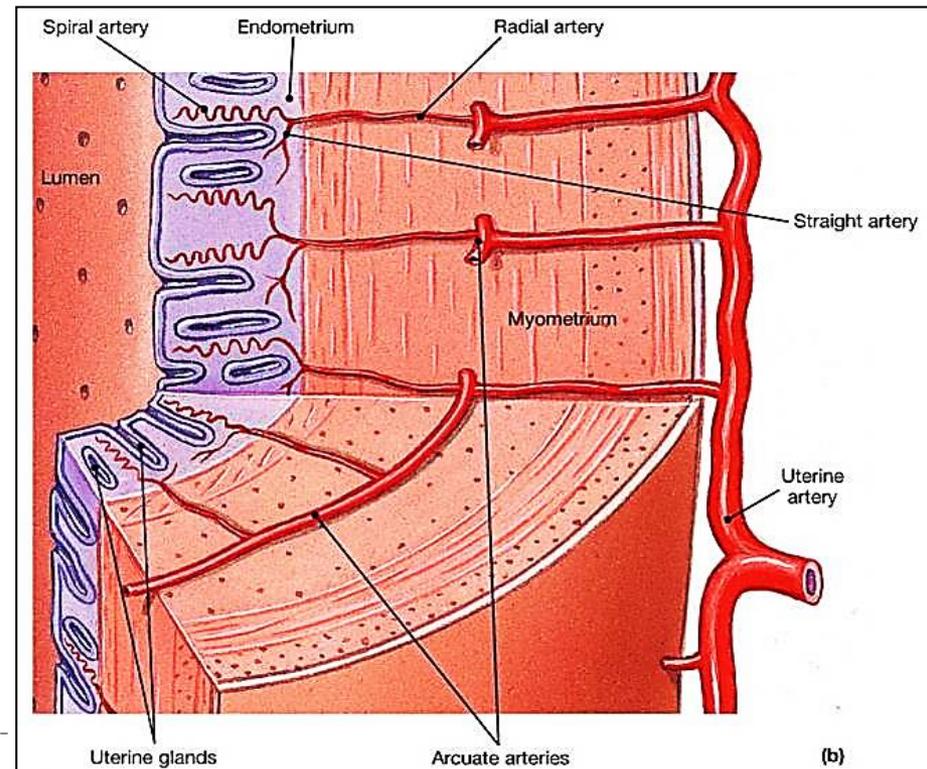
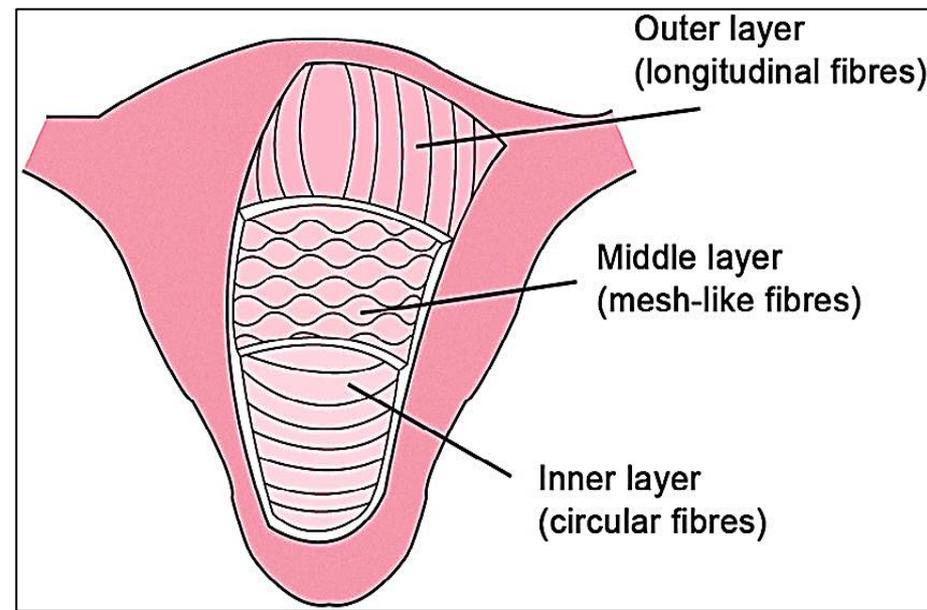
## Blood supply of the wall of the uterus

## ➤ Myometrium:

Is the thickest layer,  
Composed 3 layers of smooth muscles:

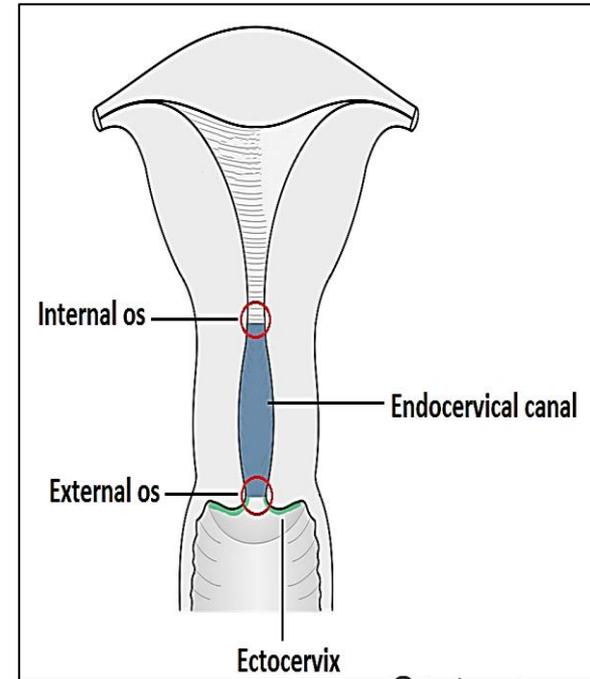
- outer longitudinal
- Middle thick, mesh like fibers, richly vascularized
- Inner circular
- Uterine muscles during pregnancy undergoes hyperplasia & hypertrophy

➤ Perimetrium: CT & peritoneal mesothelium



# Cervix of uterus

- Is the lower cylindrical part of the uterus (endocervix)
- Its mucosa lined with **simple columnar mucus secreting epithelium** & contain **branched cervical glands**
- external os: junction between cervix & vagina, lined e **stratified squamous epithelium**



# Cervical glands

1- Branched mucus glands

2- Not significantly affected by Menstruation

3- cervical secretions are **watery** at time of ovulation to allow the passage of sperms to uterus



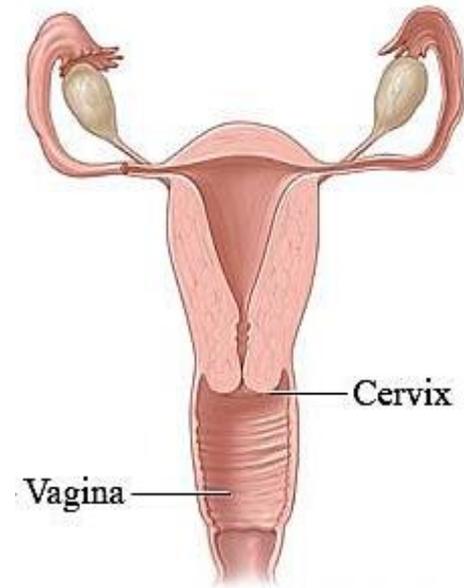
4- Proliferate during pregnancy & secrete **viscid mucus** to prevent passage of microorganisms

5- Cervical dilatation (ripening) before labor is due to intense collagenolysis, which promote its softening & normal labor

# The vagina

It is a fibro-muscular canal

Wall consists of 3 layers: Mucosa, muscularis, adventitia



**Epithelium** : stratified squamous epith.

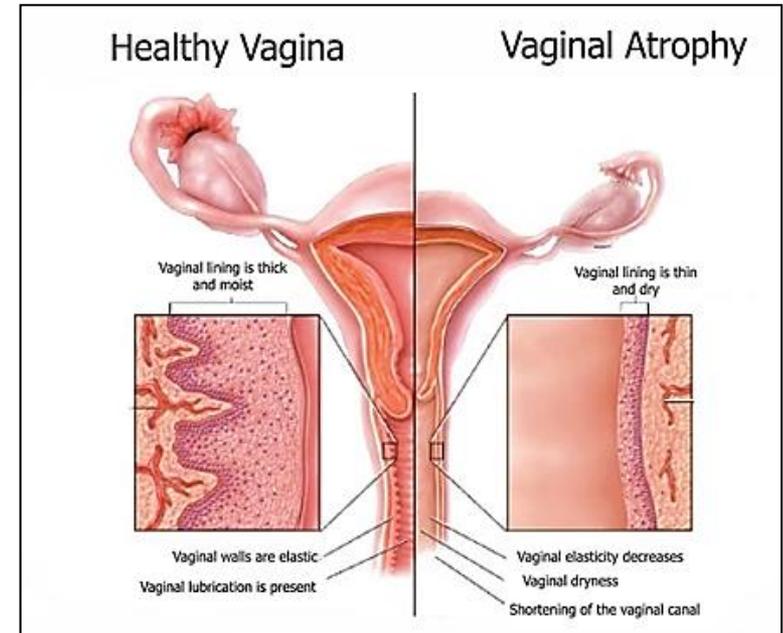
- The epithelium synthesizes & accumulates ↑ glycogen (estrogen effect)
- Normal bacteria in vaginal lumen  
→ glycogen → lactic acid  
→ acidic pH of vagina (protective barrier)



**Musculosa** : formed of IC & OL smooth ms. fibers

**Adventitia**: dense CT rich in elastic fibers

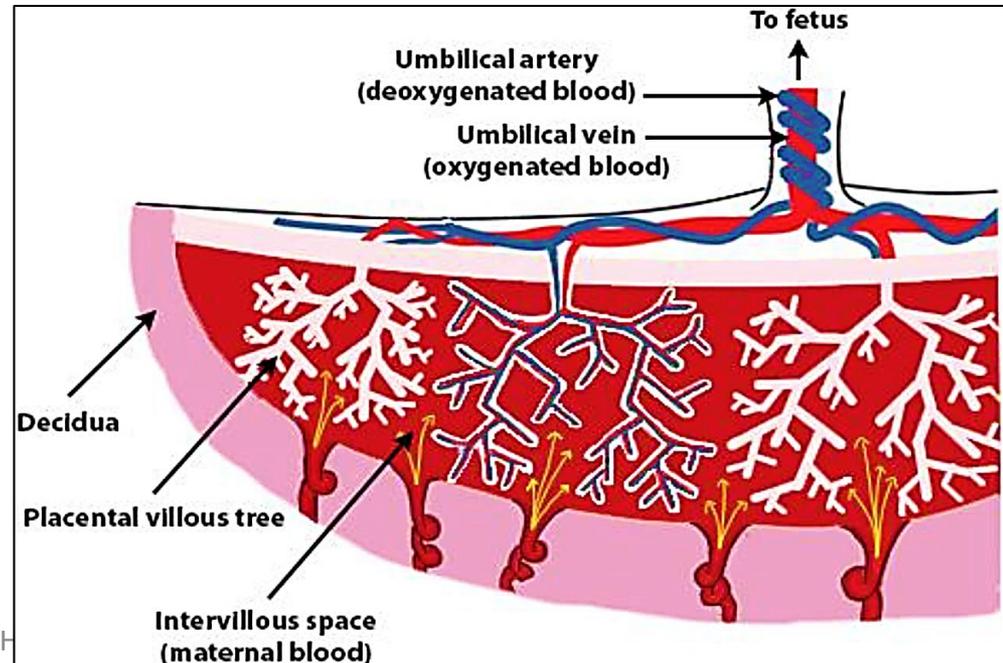
- The elasticity of the vagina is due to large number of elastic fibers in mucosa & adventitia



- The mucus in vagina comes from cervical glands . The vagina contains **No glands**

# The placenta

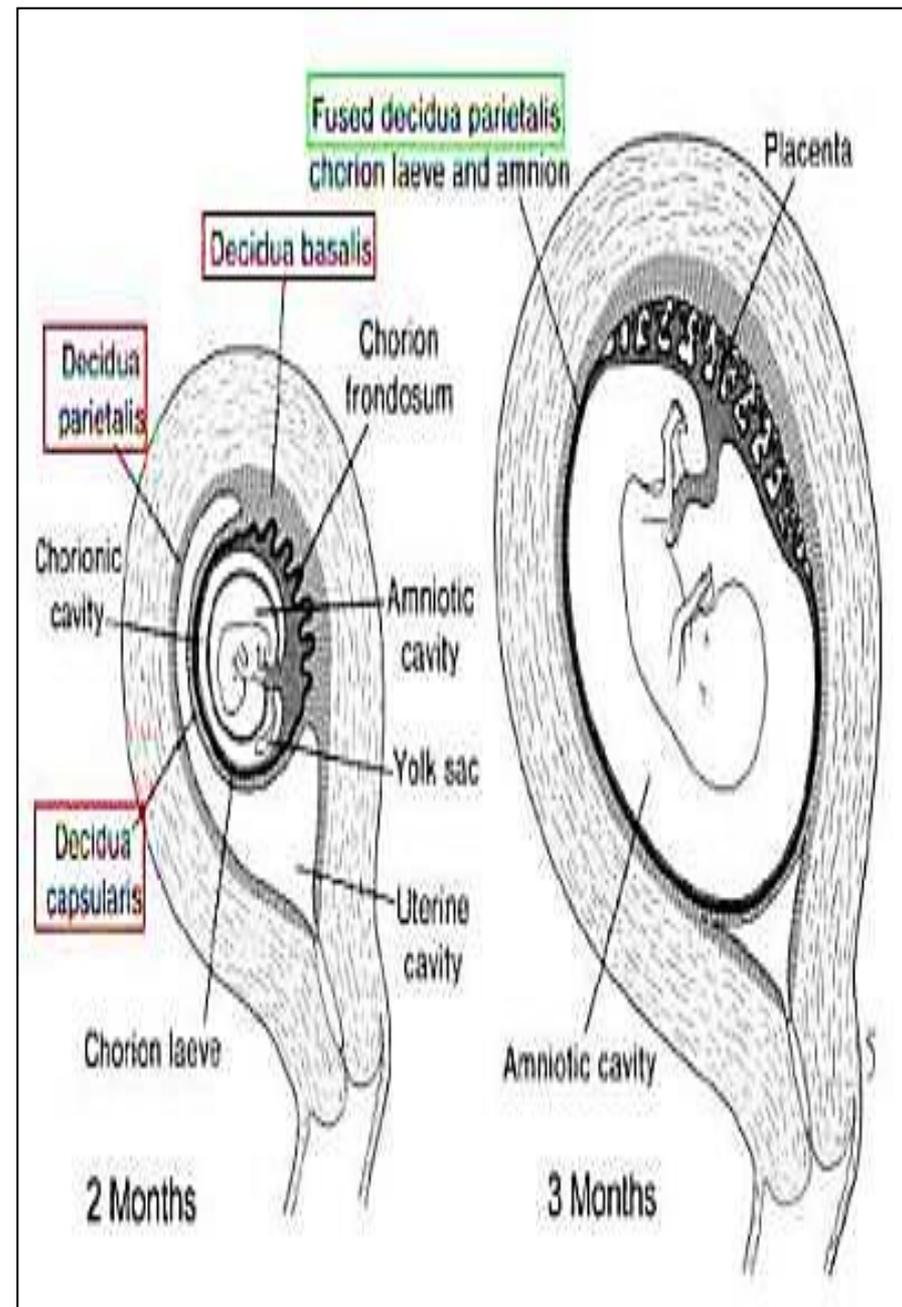
- Is disc shaped endocrine organ, forms during implantation
- It consists of 2 parts: maternal & fetal
- Function :
  - Is the site of exchange between the mother & fetus
  - 1. Nutrition & respiration
  - 2. Removal of waste
  - 3. Secretion of hormones

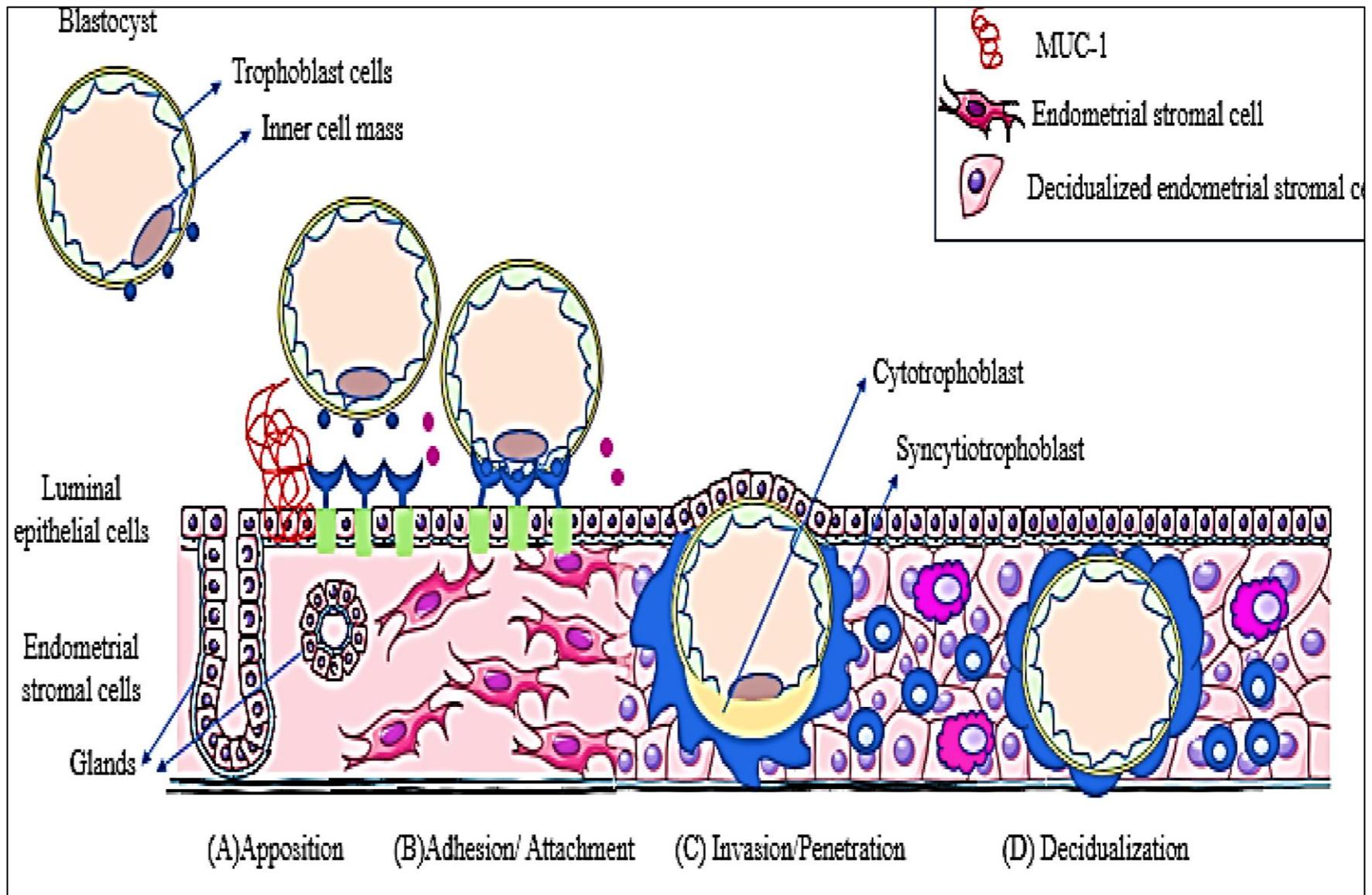


## A- maternal part (**decidua basalis**):

The decidua (endometrium) is divided into:

- **Decidua basalis:** between embryo & myometrium (most imp)
- **Decidua capsularis:** between embryo & lumen of uterus
- **Decidua parietalis :** endometrium lining the rest of uterine cavity

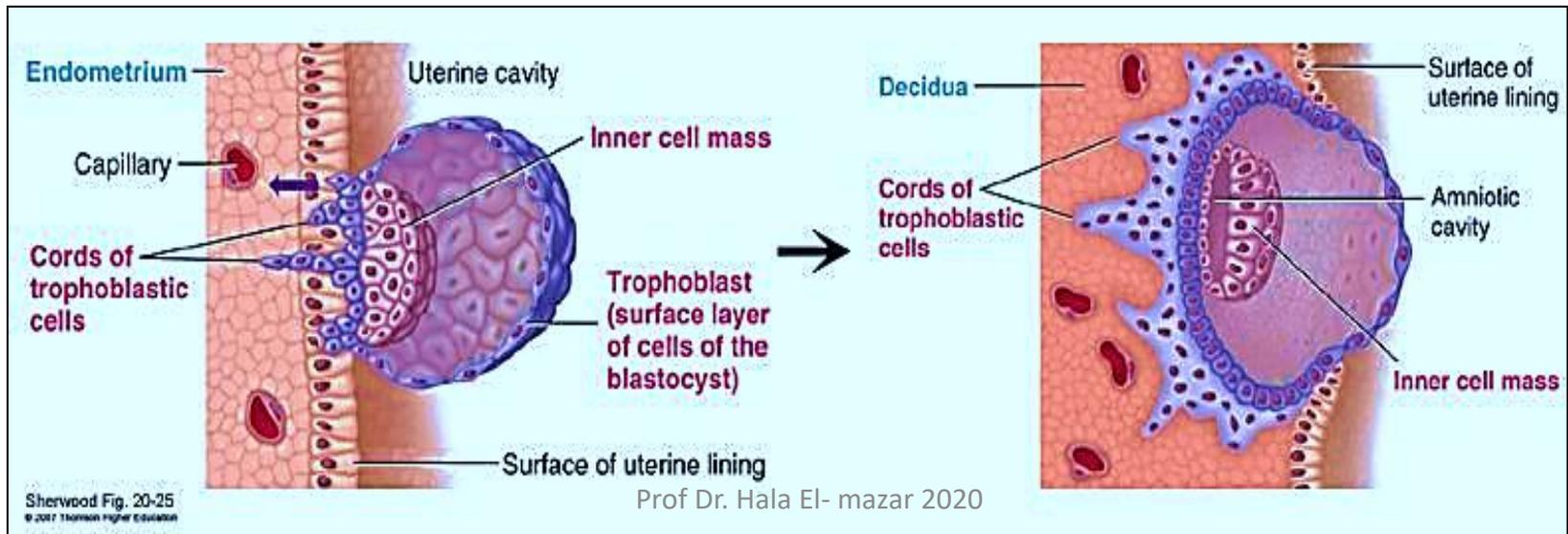




# Implantation of blastocyst

## B- fetal part( **chorionic villi**):

- Finger- like projections from the outer wall of blastocyst (**Trophoblast**) allow the embryo to invade the uterine wall
- By day 9 after fertilization the embryo is completely embedded in the endometrium
- The villi branch & embed in the decidua basalis
- The villi are separated by inter-villous spaces which contain maternal blood



Each chorionic villus consists of:

1- Central core: contain fetal BV

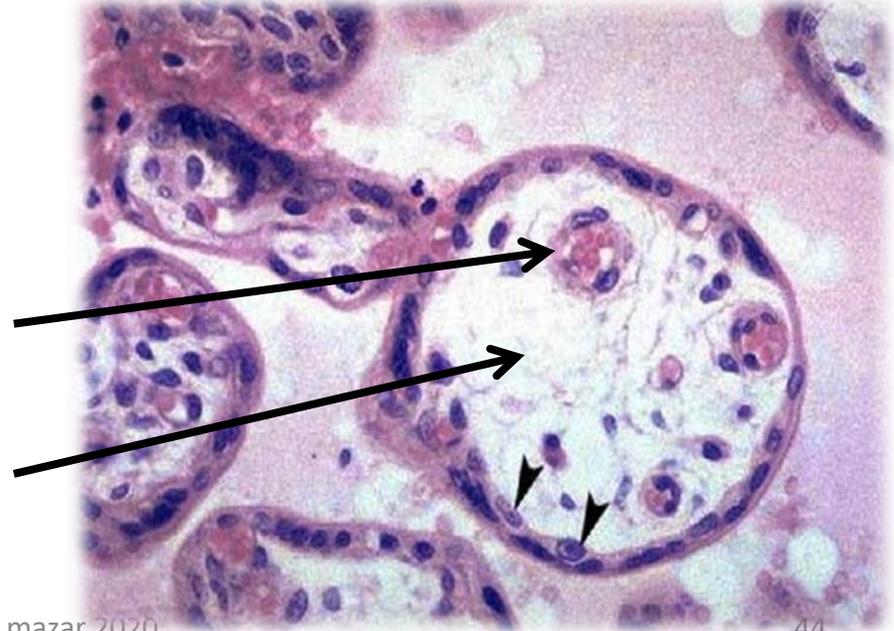
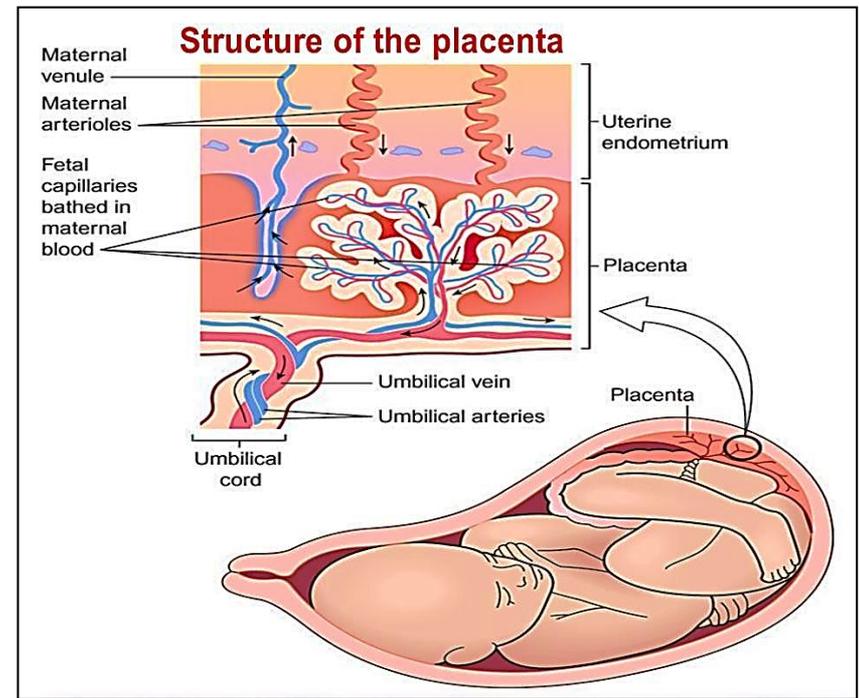
2- Trophoblast: epithelial

Covering formed of 2 layers:

- **cytotrophoblast**: inner layer (Arrow heads)
- **Syncytiotrophoblast**: outer layer

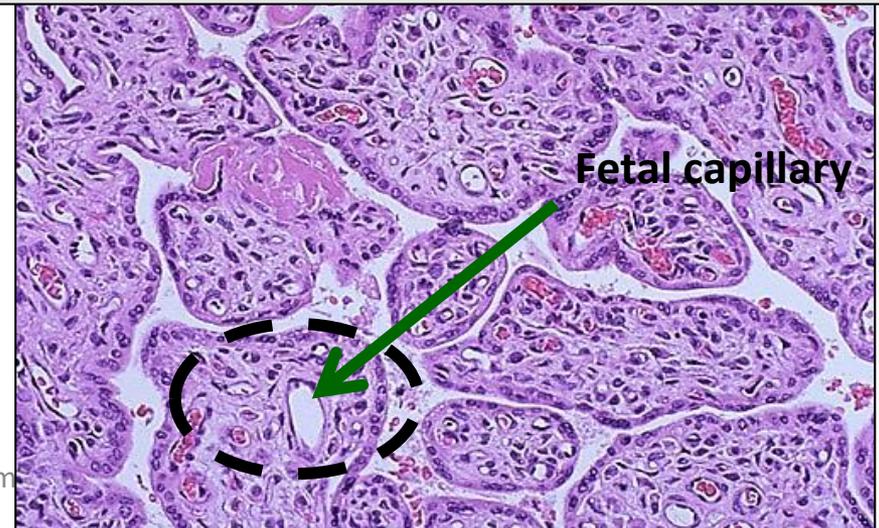
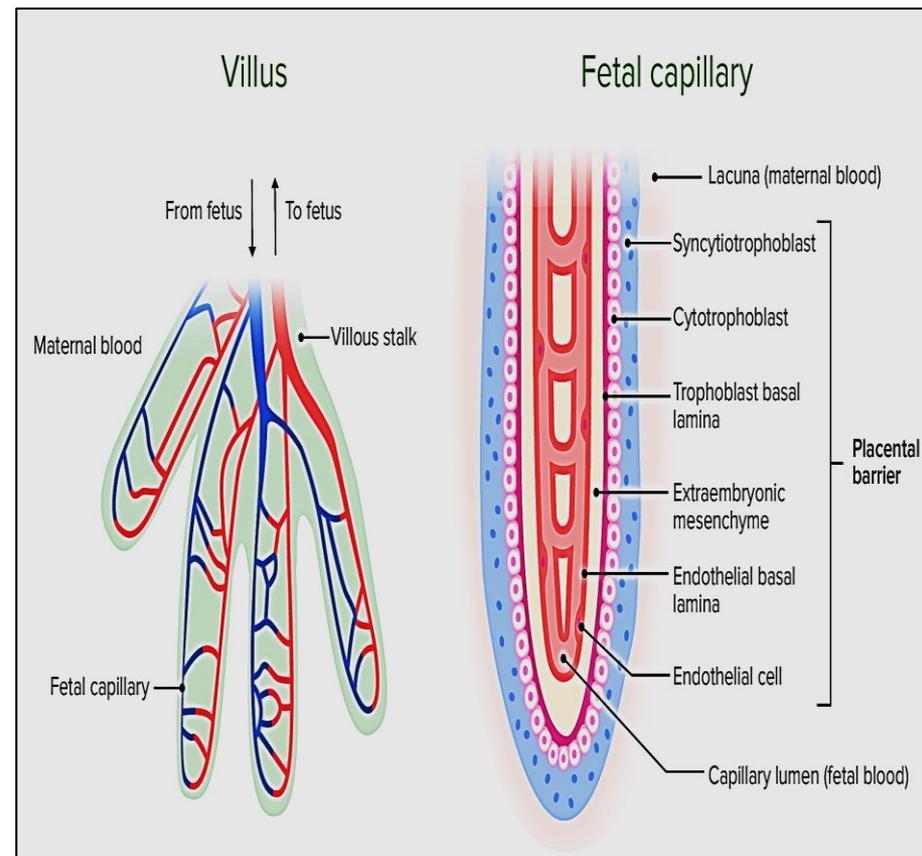
Fetal capillaries

Extra embryonic mesenchyme



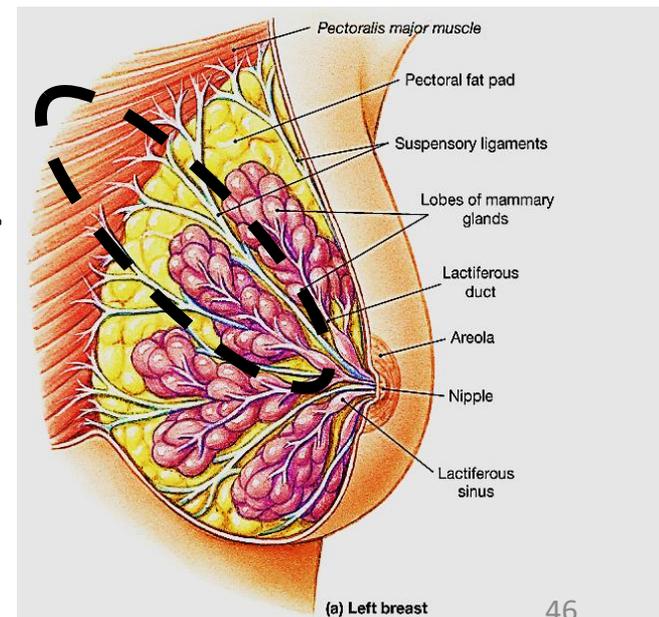
# The placental barrier:

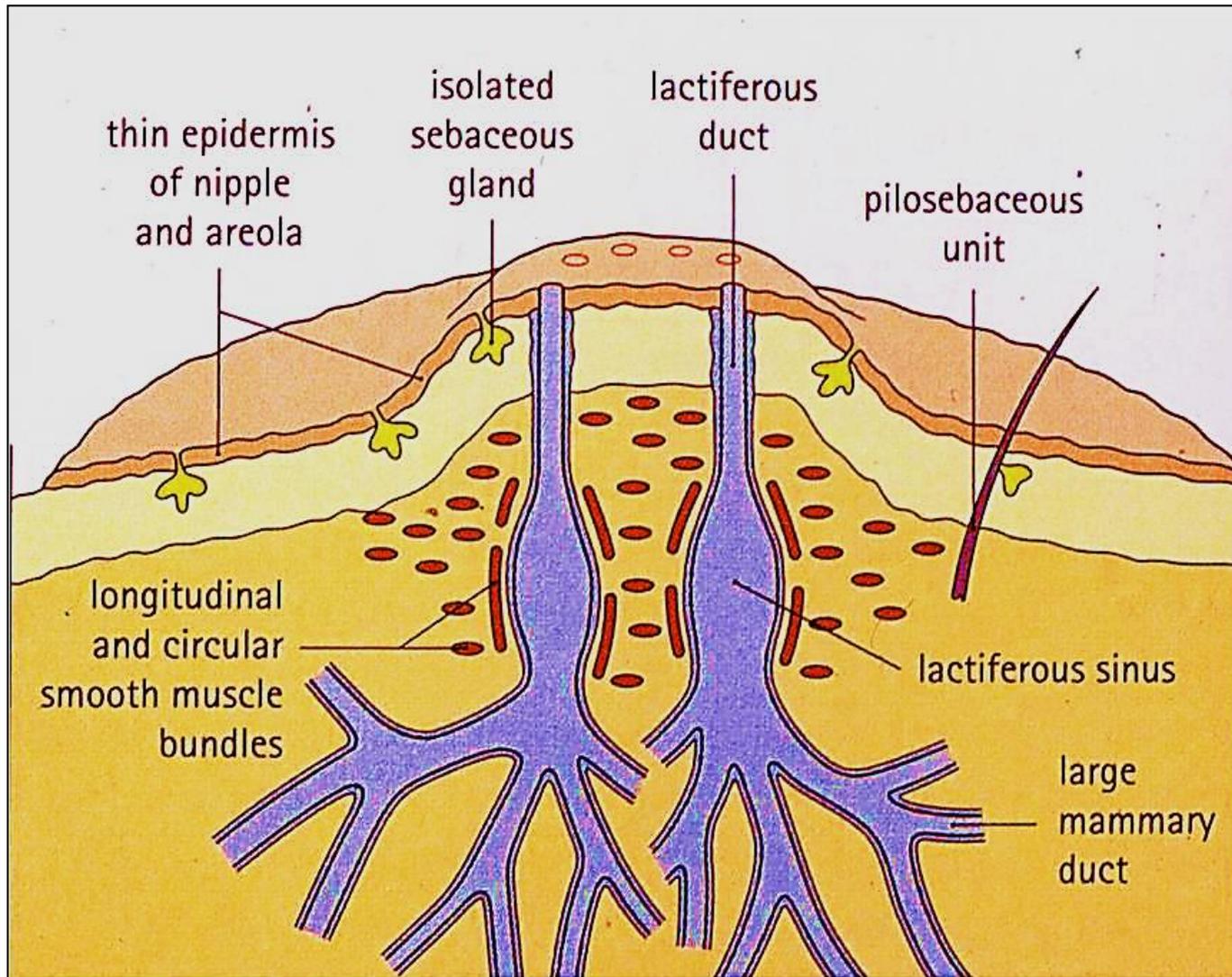
- Barrier that separate blood in the fetal circulation from blood in maternal circulation
- Is composed of:
  1. Endothelium of fetal capillaries
  2. Basal lamina of fetal capillary endothelium
  3. Basal lamina of cytotrophoblast
  4. Cells of Cytotrophoblast
  5. Cells of Syncytiotrophoblast



# The mammary gland

- An exocrine, compound tubulo-alveolar gland
- Each mammary gland consists of 15- 25 lobes separated by CT rich in fat cells
- Each lobe has a main lactiferous duct that open separately into nipple
- breast structure differs to whether
  - Resting ( non-pregnant)
  - Lactating





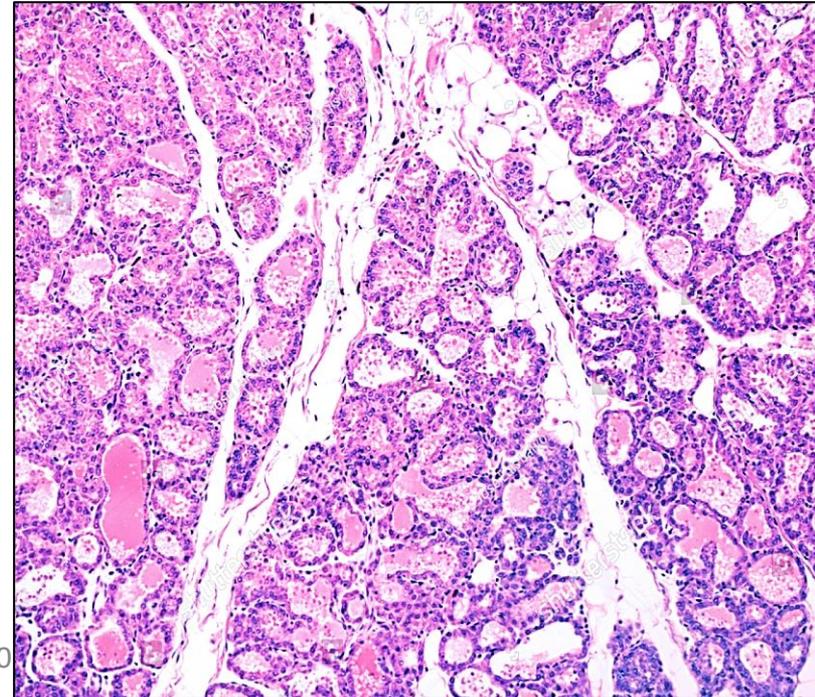
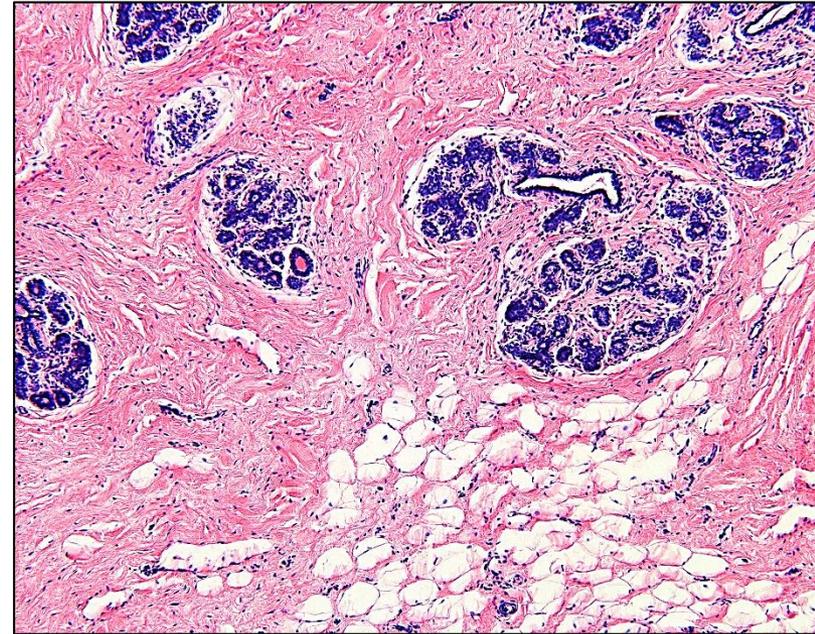
## Lactiferous ducts

## A- resting state:

- Each lobe consists of several **branching ducts**, embedded in abundant, thick loose CT
- No secretory units

## B- lactating state:

- Stimulated by several hormones
- Lobules contain **ducts & secretory acini** separated by thin CT septa
- The acini lined by simple columnar cells surrounded by myoepithelial cells



# Thank you

