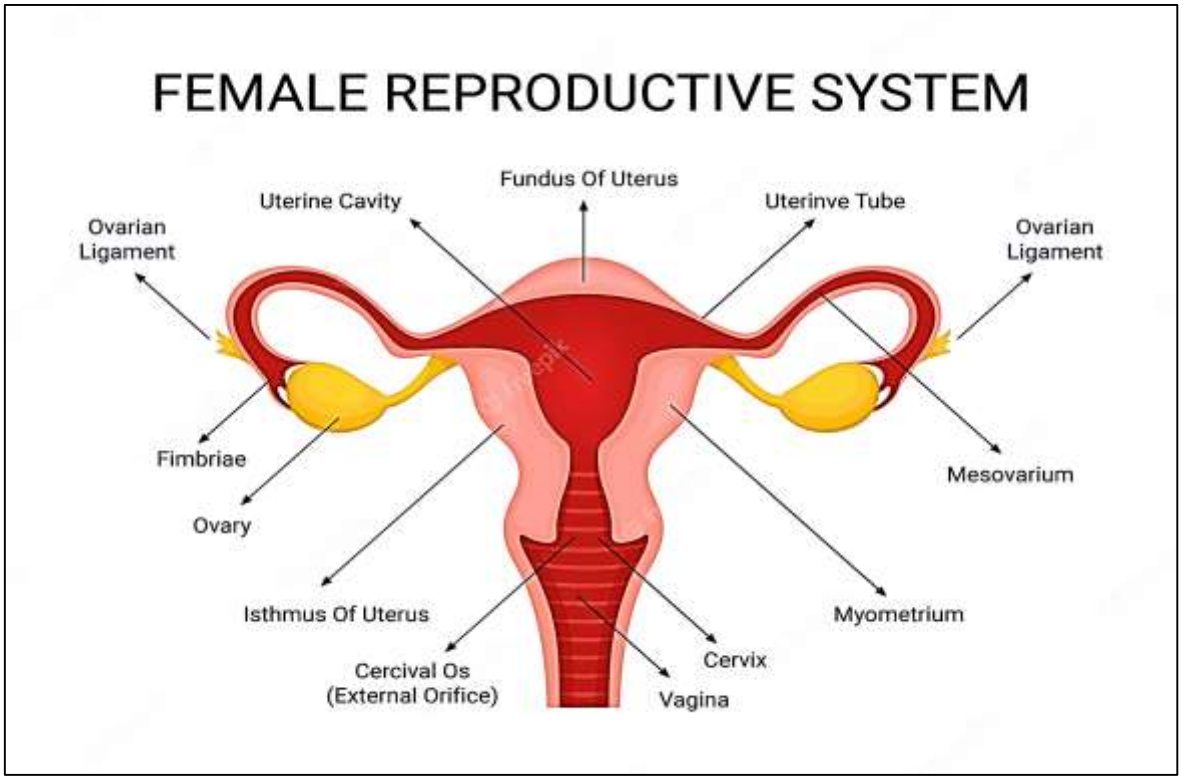
The Female Genital System

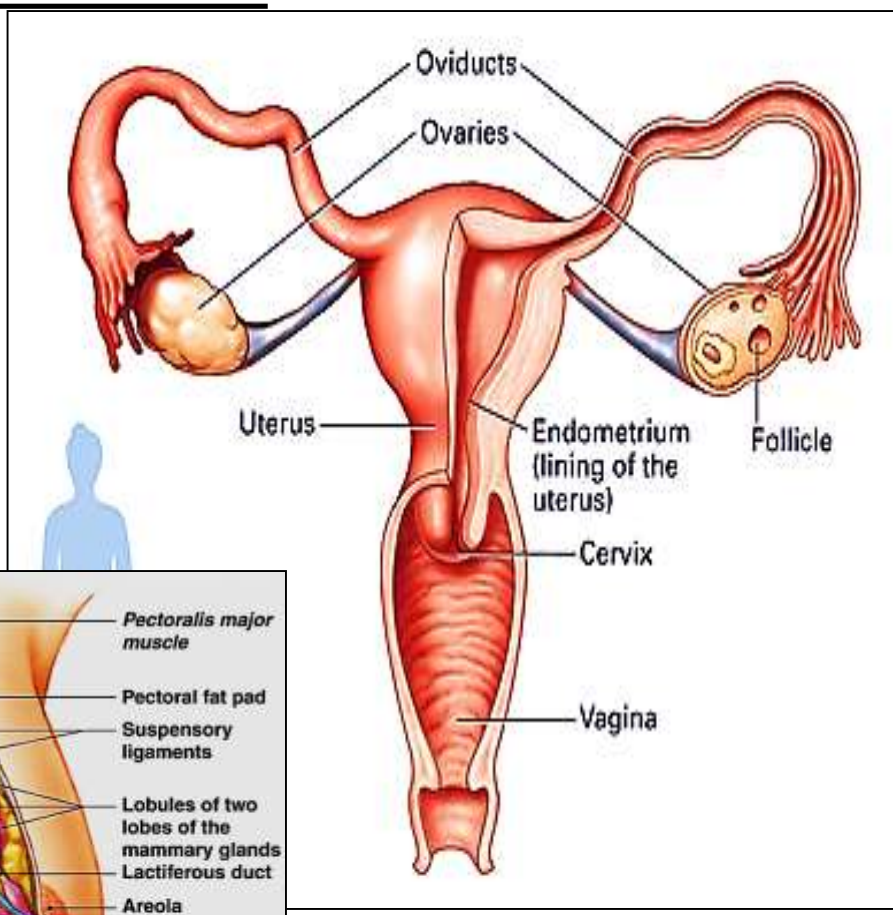
Medical students / Third Year

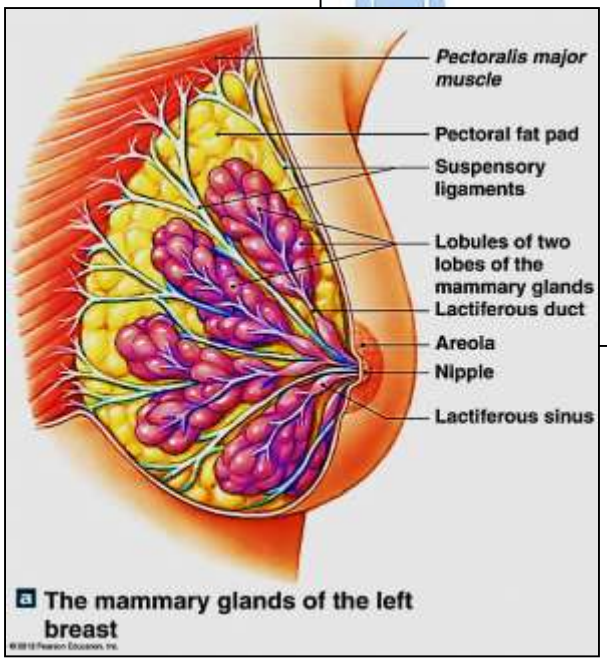
Professor Dr. Hala El-mazar



The female genital system composed of:

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



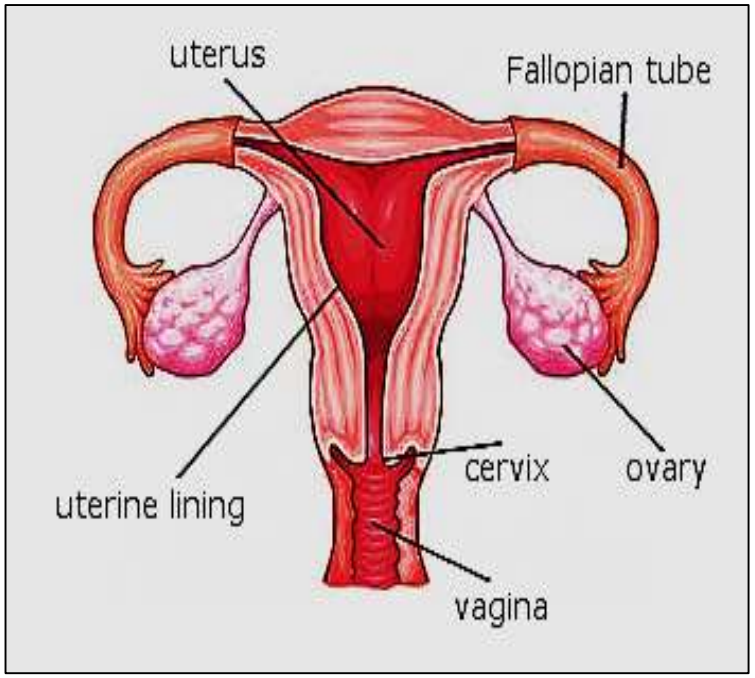


Function of the female genital system:

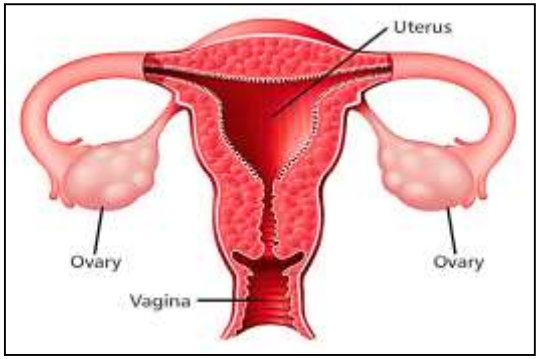
1- **Produce Female hormones**: ovaries→ secrete **estrogen** & **progesterone** (*endocrine function*)

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

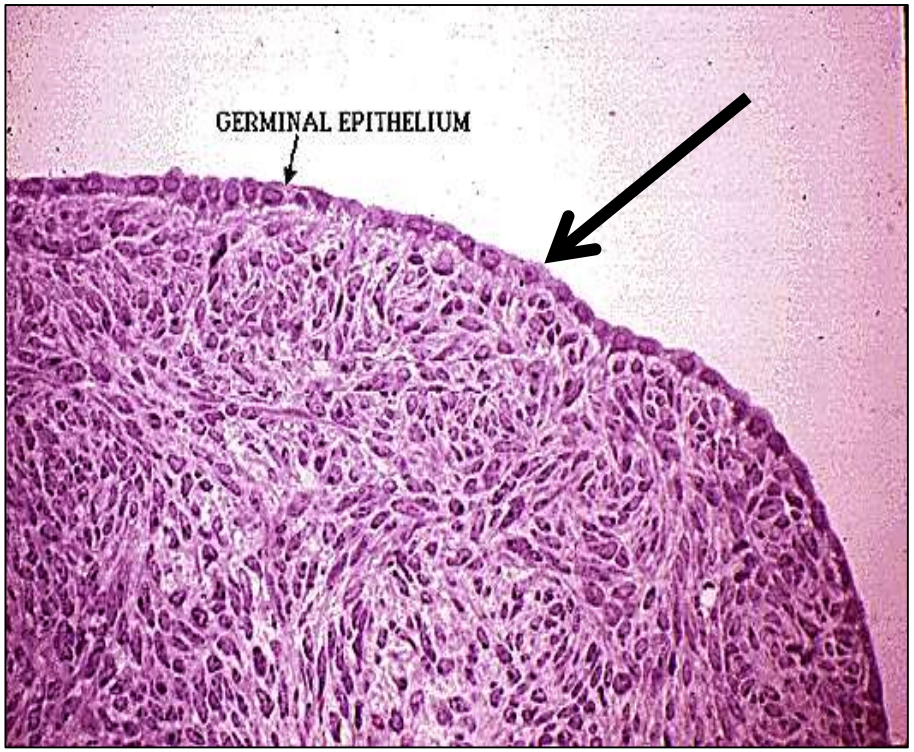
3- **Support** & **protect** developing Embryo in the uterus



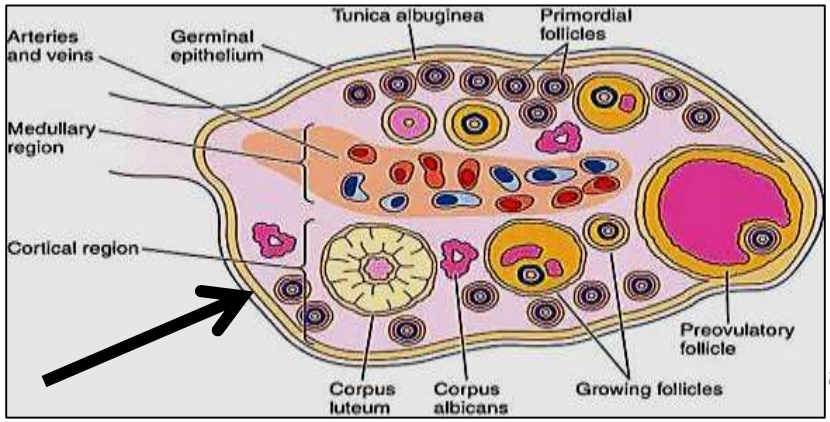
The ovary



- 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

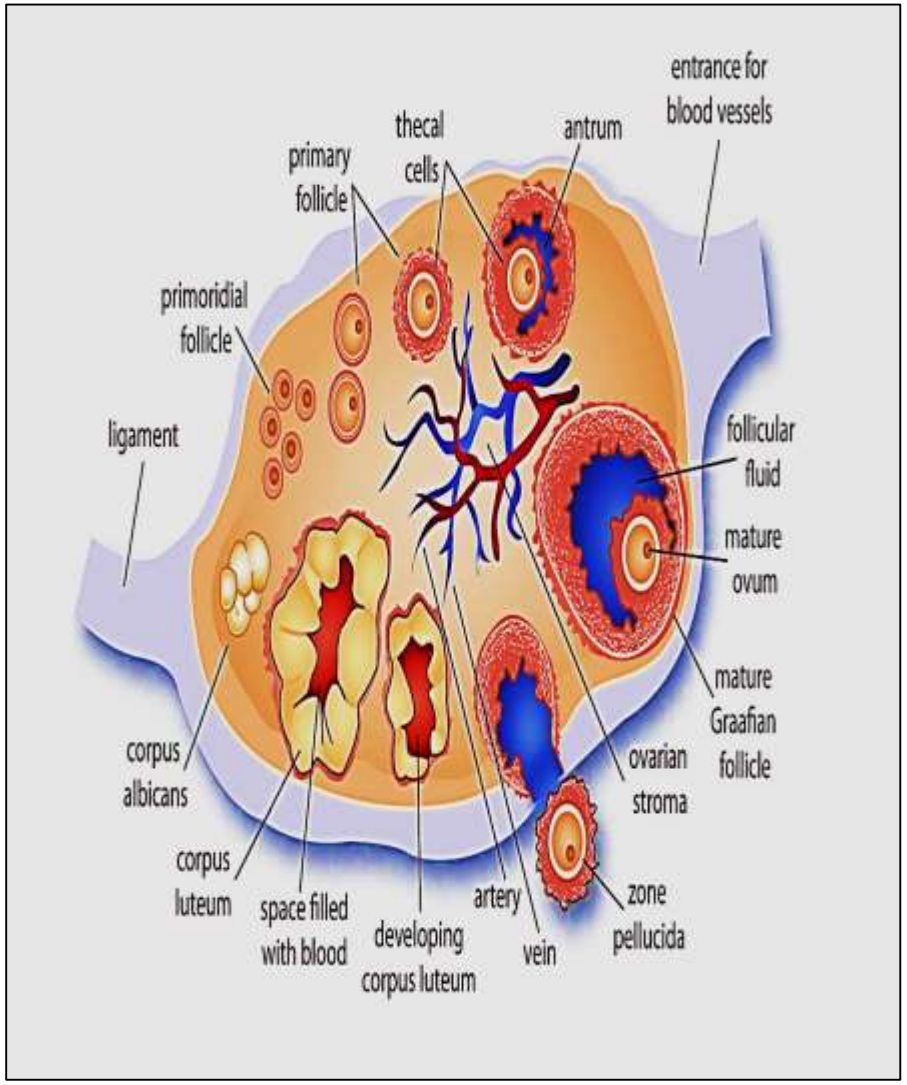


The ovary

- Is formed : **cortex** & **medulla**

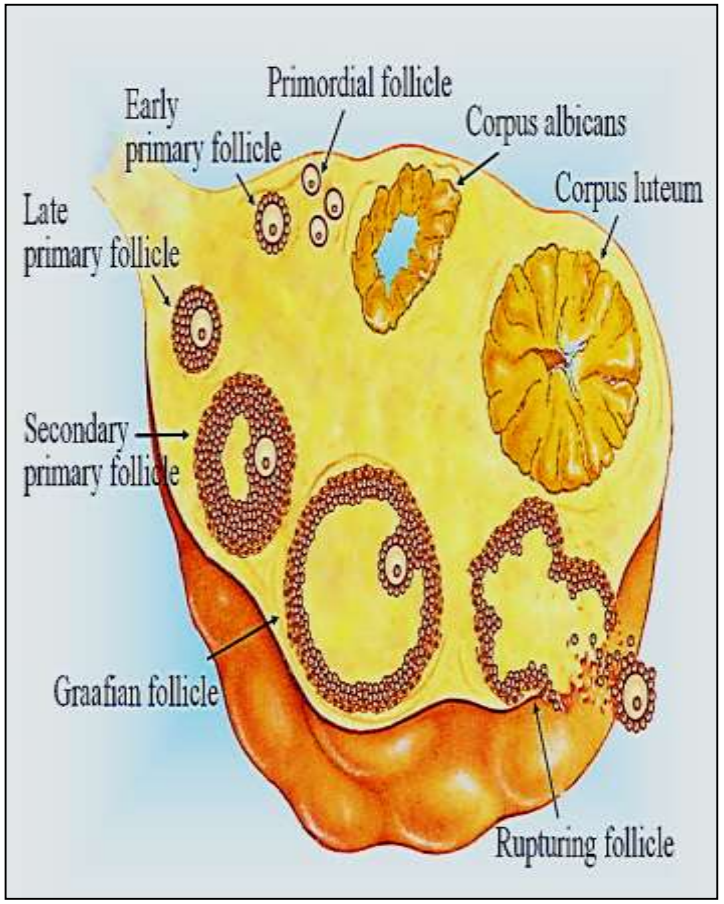
- **The cortex** : contains *ovarian follicles* at various stages of development, separated by CT contains *spindle - shape stromal cells*

- **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

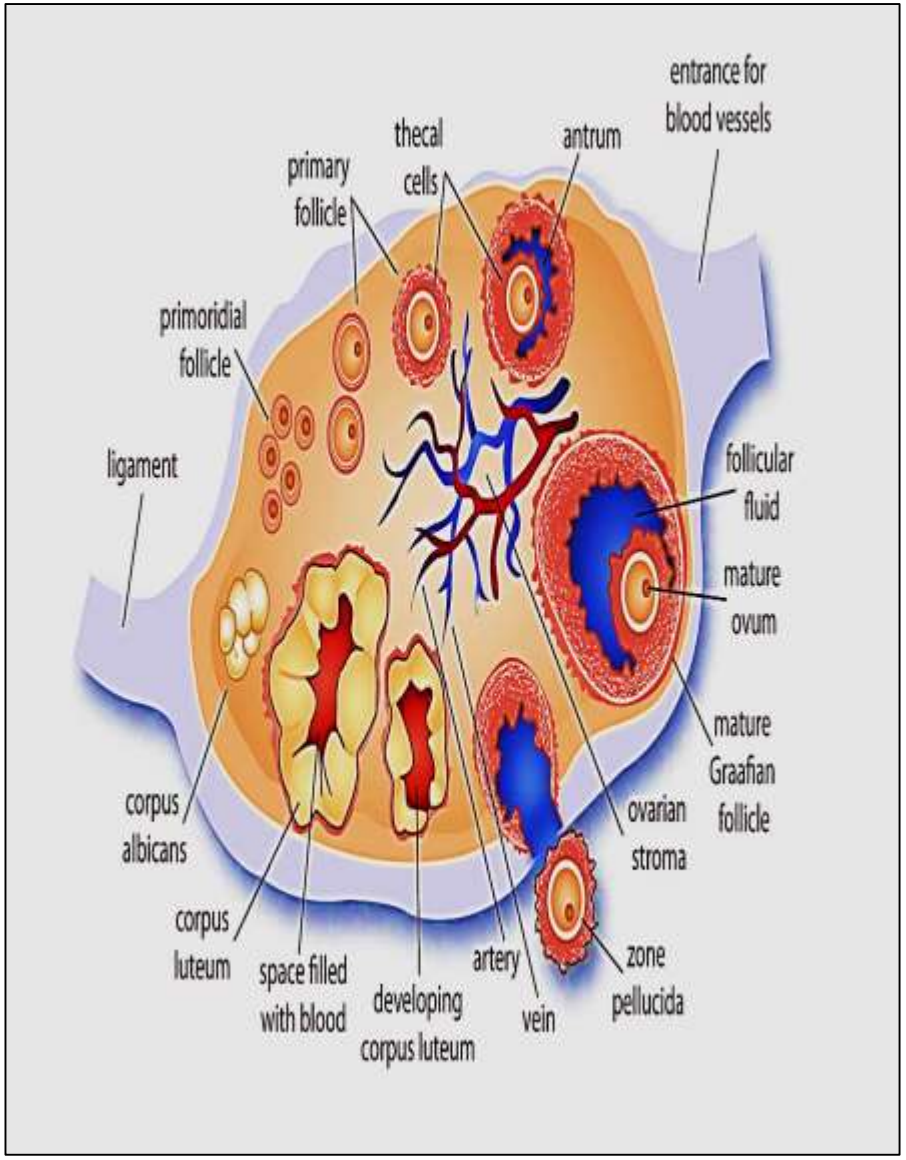
1-Primordial follicles

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 (**1st trimester**), oogonia in the fetal ovary divide by mitosis to give rise to a large # of oogonia (7 millions/ 2 ovaries)

2- Growth: (**2nd trimester**)

- mitotic division stops producing any more oogonia
- The oogonia will enter the **prophase of 1st 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 **3rd trimester**, most oogonia have completed their change into 1ry oocytes which become surrounded with follicular cells

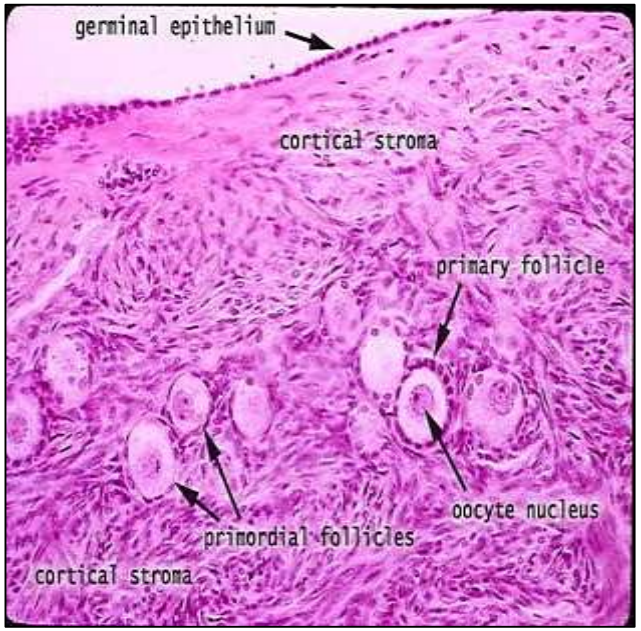
  (Ovarian follicle : oocyte surrounded by one or more layer of epithelial cells)

B- Folliculogenesis (At puberty)

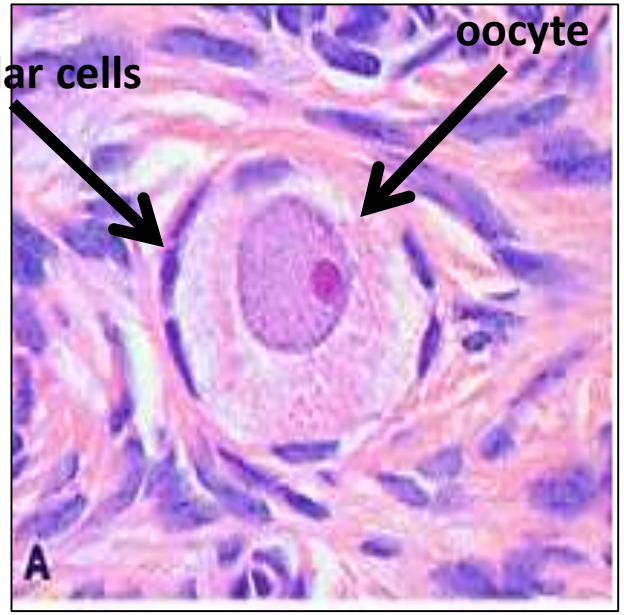
- Each month, FSH cause several **Primordial follicles** to mature.
- Throughout folliculogenesis from 1ry follicle→ mature follicle, oocyte is arrested in the prophase of 1st meiotic division
- **The primary oocytes resume meiosis I, just before ovulation.** *1ry oocyte are diploid (2n)*

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



- <u>Oocyte (1ry oocyte):</u>
- 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 µm

- Its nucleus enlarges &its mitochondria & rER ↑

- Oocyte (1ry oocyte) arrested in prophase of 1st **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**

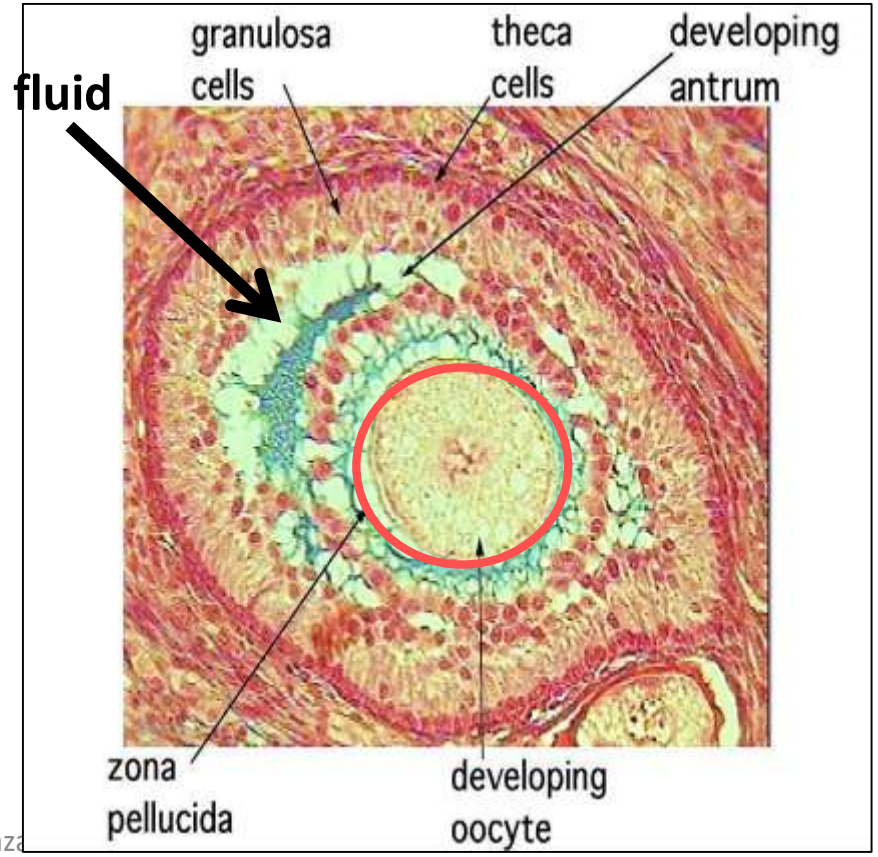
Secondary (antral) follicles

- Granulosa cells start to secret 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:

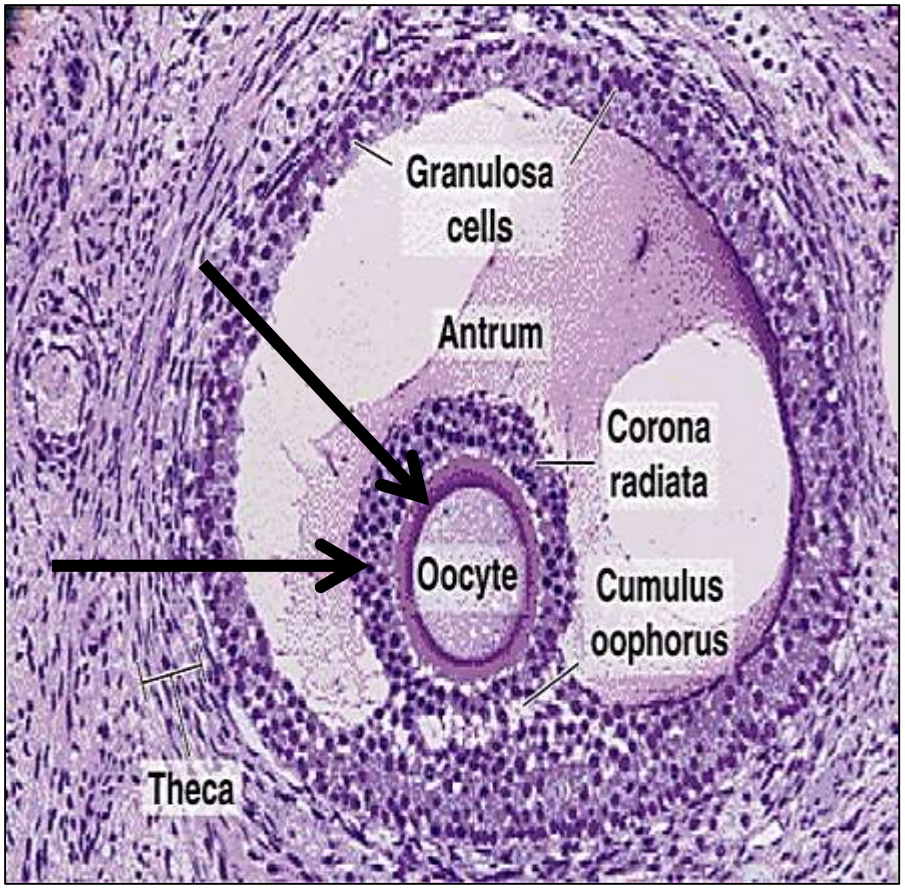
it changes to 2ry oocyte with **haploid # of chromosomes** just before ovulation

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 inning the cavity called membrana granulosa

6- Theca interna:

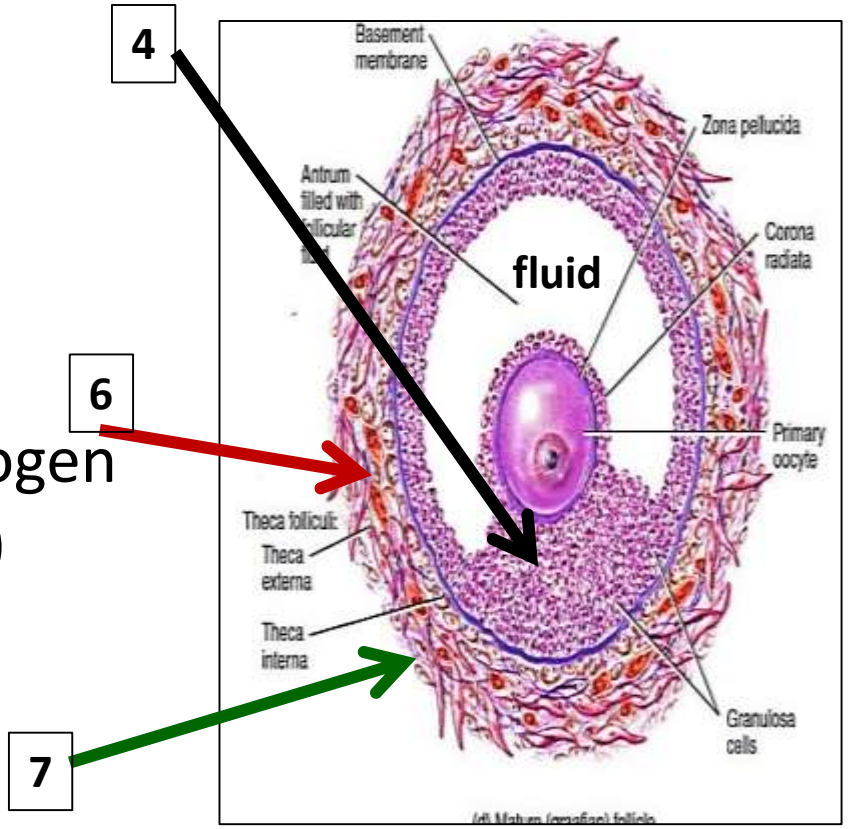
Large polyhedral cells, secrete estrogen & androgen (steroid secreting cells)

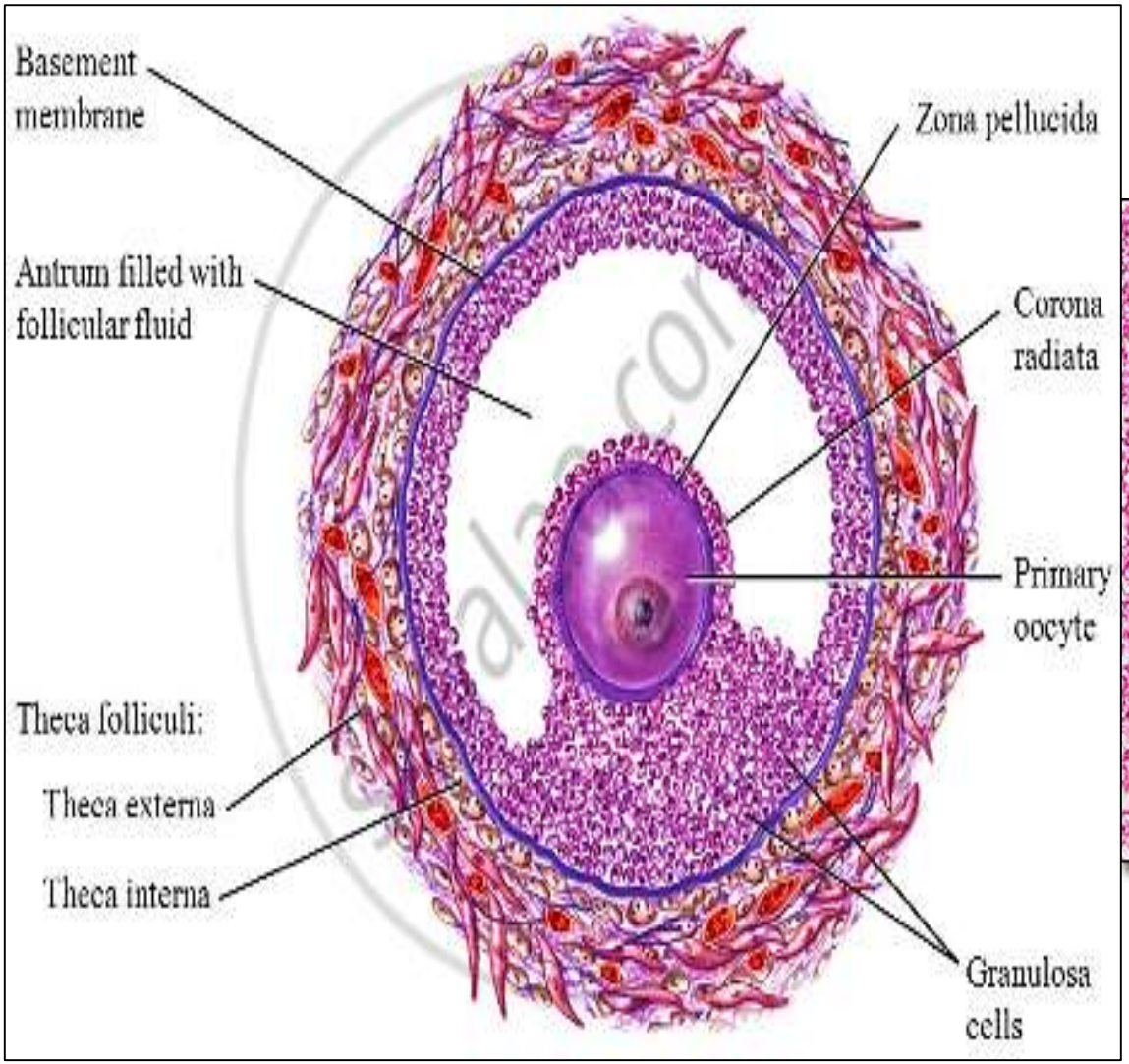
7- Theca externa:

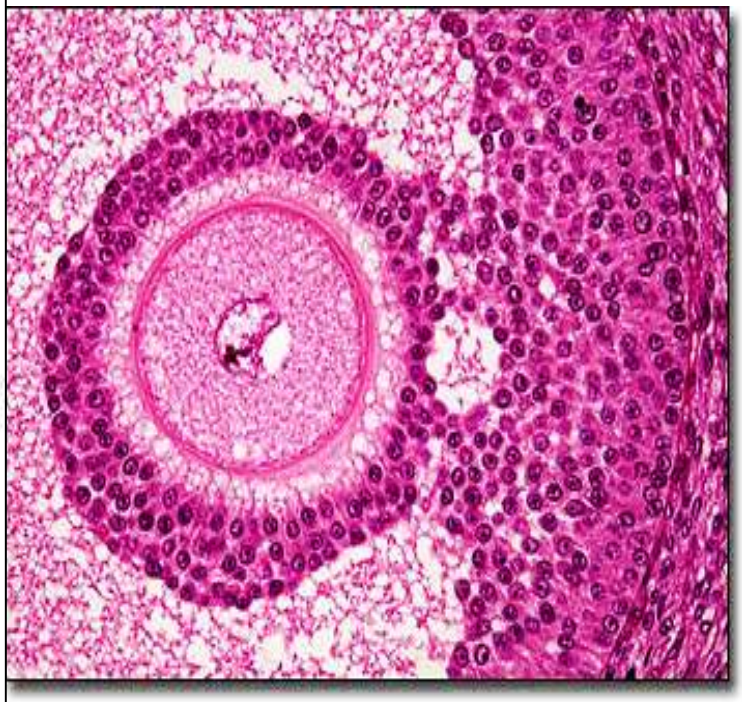
fibroblast- like layer.

Have no secretory function

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

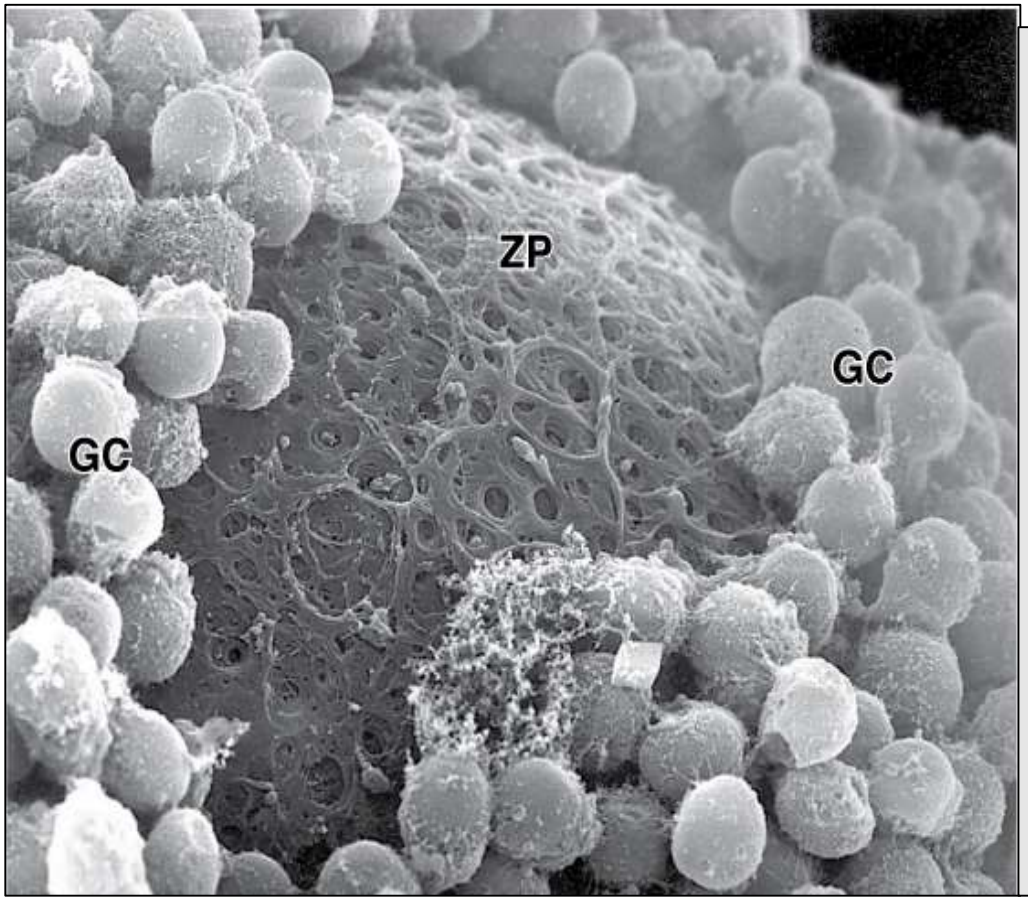


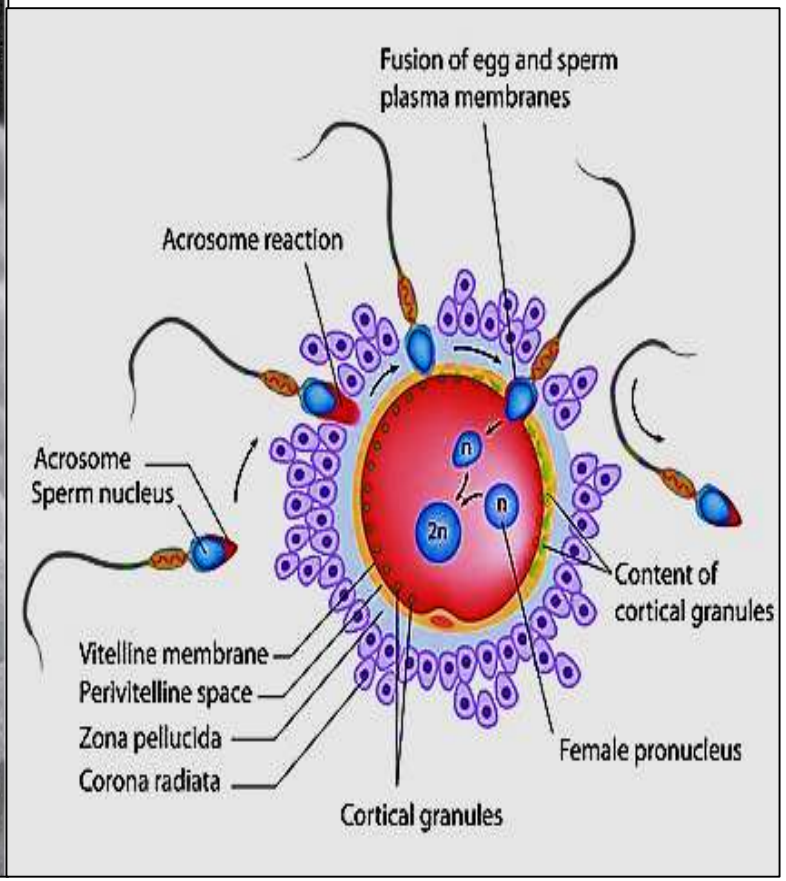




Mature Graffian Follicle

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



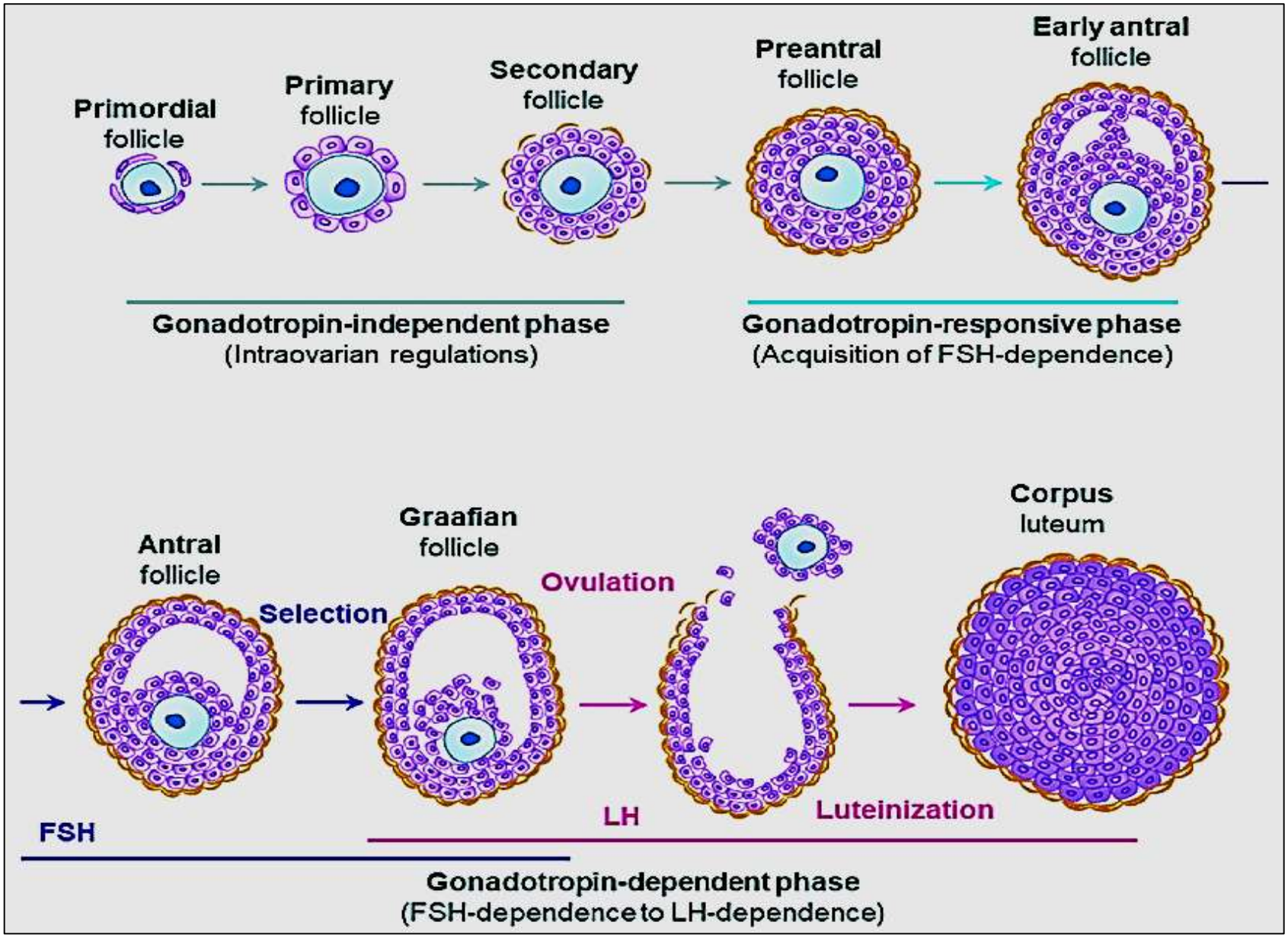


EM picture of zona pellucida

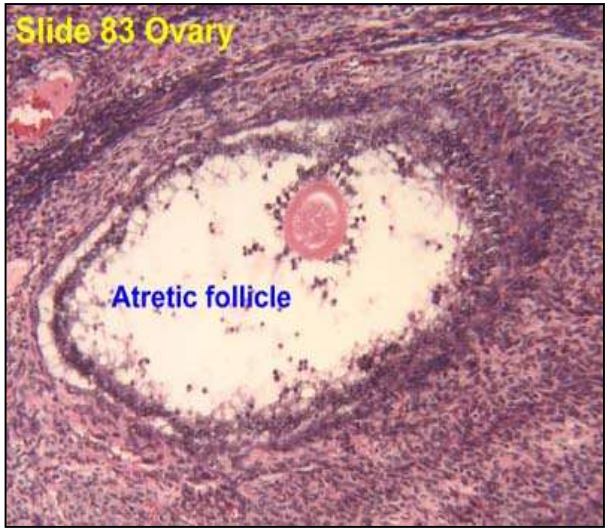
- Mature Graafian Follicle secretes inhibin hormone that shuts off FSH release

- Oocyte completes meiosis 1 just before ovulation
- 2^{ry} oocyte: is the stage at which ovulation occurs
- After ovulation , 2ry oocyte enter **2^{nd} 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**


Primordial follicle
Primary follicle
Secondary follicle
Preantral follicle
Early antral follicle
Gonadotropin-independent phase
(Intraovarian regulations)
Gonadotropin-responsive phase
(Acquisition of FSH-dependence)
Antral follicle
Selection
Graafian follicle
Ovulation
Corpus luteum
FSH
LH
Luteinization
Gonadotropin-dependent phase
(FSH-dependence to LH-dependence)

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)

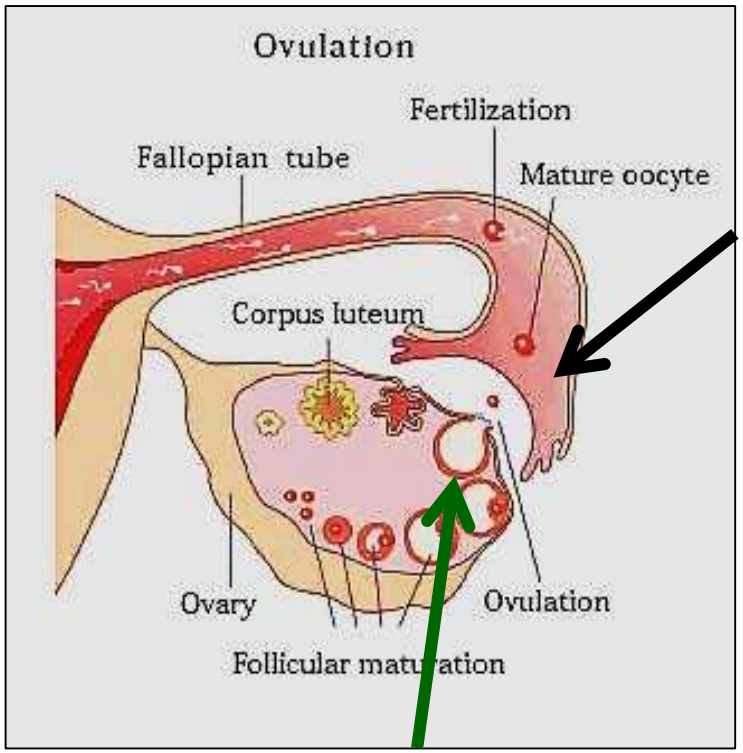
- High estrogen levels → + ant. pituitary → secretes a surge of LH

- 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 rupture → 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



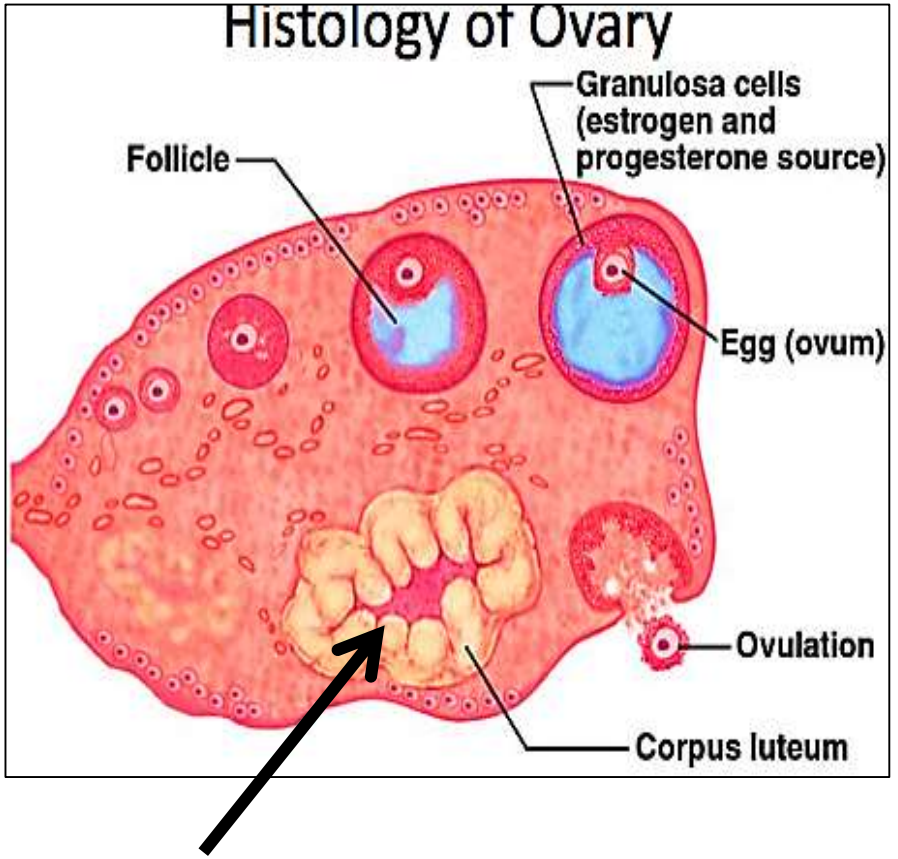
- The remaining **granulosa** + **theca interna cells**
  → **corpus luteum**

The corpus luteum

- Temporary endocrine gland

- present in the ovarian cortex after rupture of the mature Graafian follicle

- The CL produces ↑levels of **progesterone & moderate levels of estrogen**



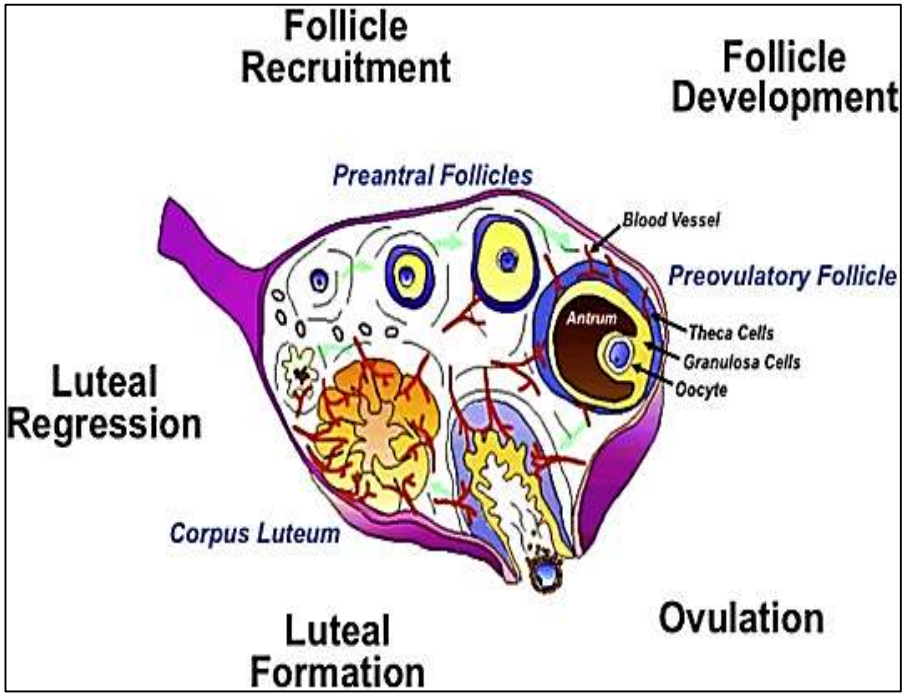
➢ **Formation & structure of CL:**

After ovulation & under the effect of LH,

the granulosa & theca interna cells from the corpus luteum

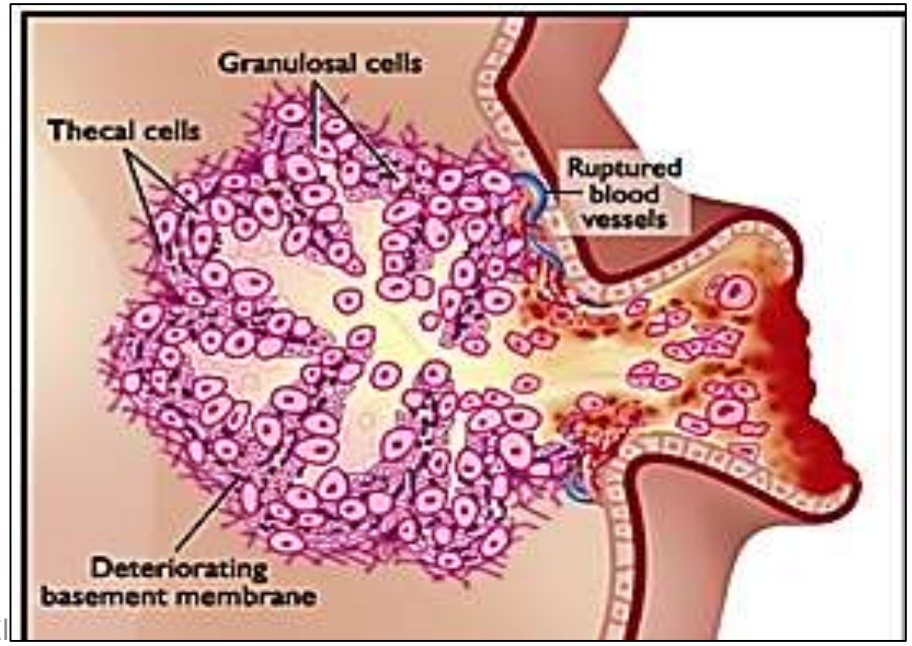
- **The granulosa cells** ↑ in size, & becomes more vascularized → **granulosa-lutein cells**

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



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

➢ These cells will secret **estrogen** hormone (↑SER)



Fate of corpus luteum

- Depends on the possibility of pregnancy

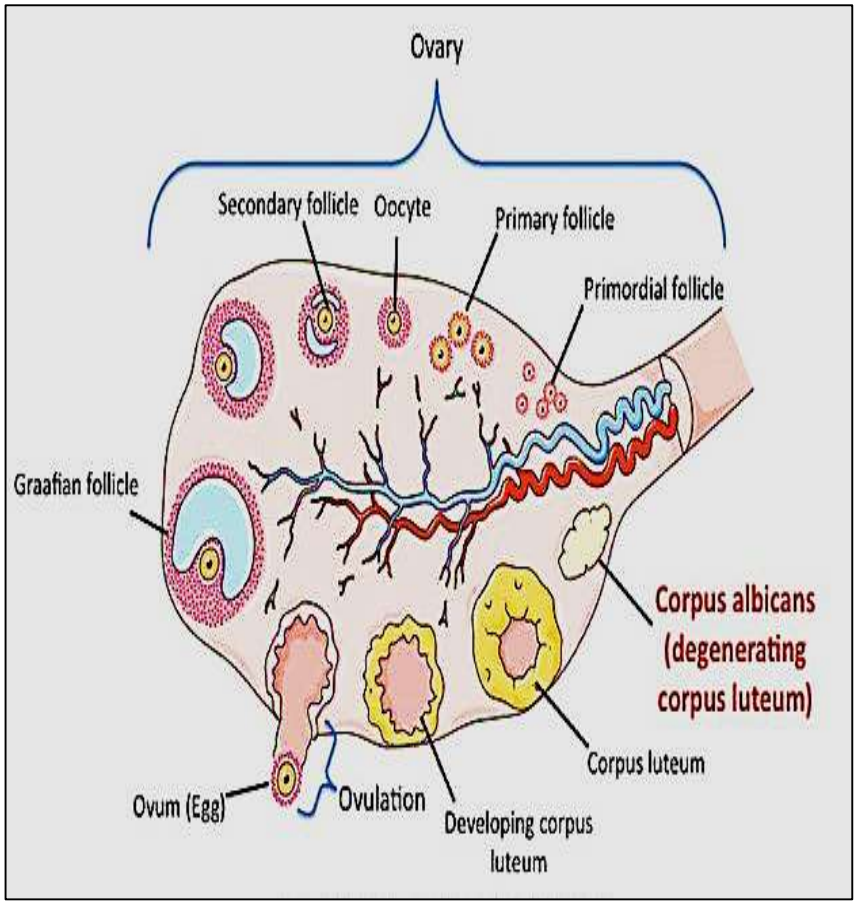
- High levels of LH stimulate the corpus luteum to secrete **progesterone** for 10 -12 days

- **In the absence of pregnancy** →

corpus luteum undergo apoptosis

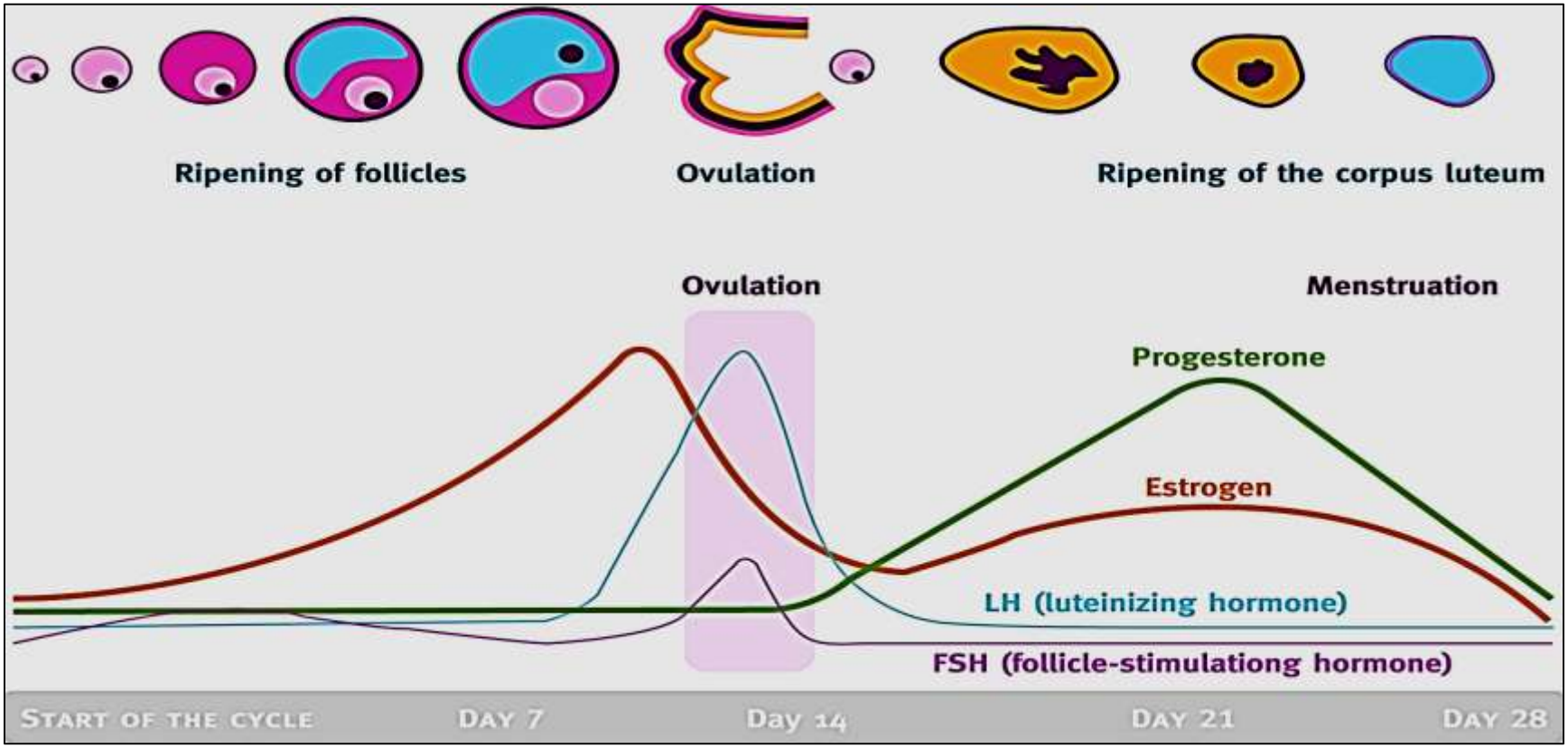
→ progesterone levels ↓

→ leads to menstruation & CL under go degeneraton then called **corpus albicans**



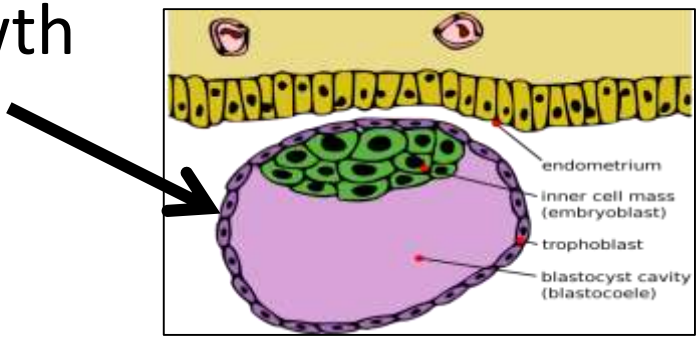
- When the corpus luteum degenerates → ↓ estrogen & progesterone in blood → ↑ FSH secretion

- This stimulate 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

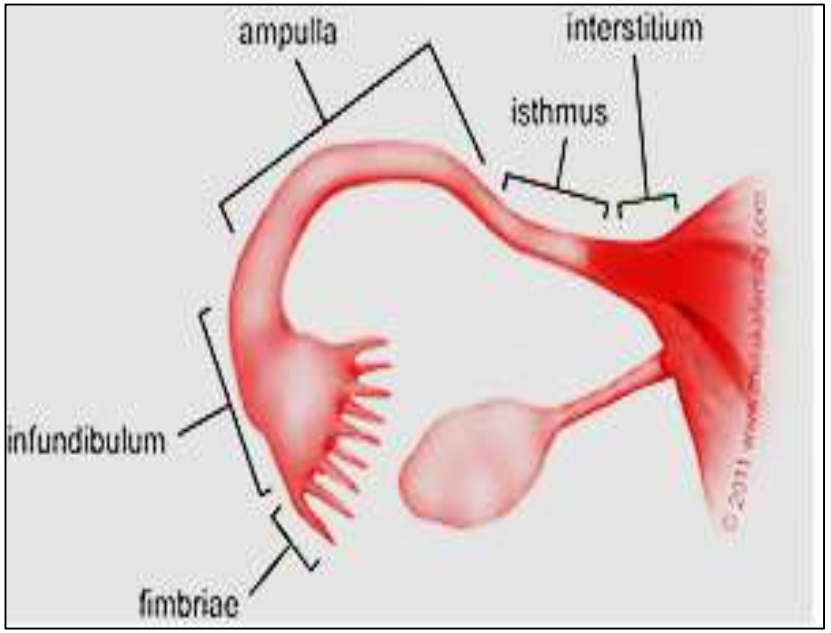


- CL will secrete **progesterone** & estrogen to maintain the **uterine mucosa** until the placenta become fully functioning.

- 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

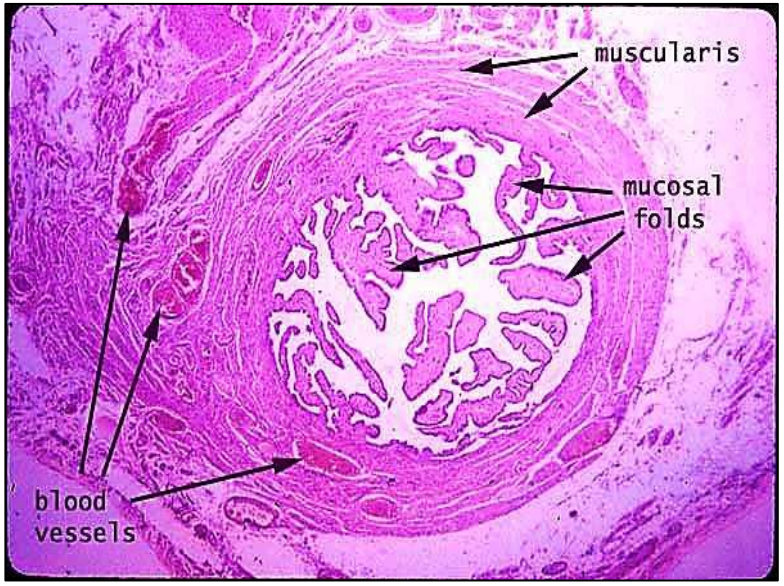
1- mucosa:

- Highly folded
- Simple columnar consists of :

  ciliated & secretory (**Peg cells**)

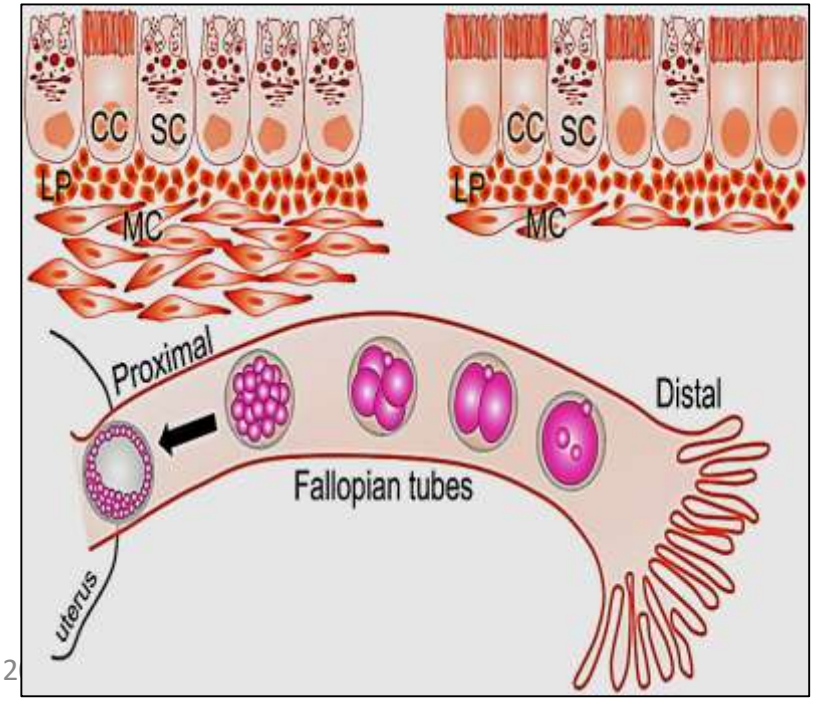
  Cilia beat toward the uterus

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



2- musculosa :

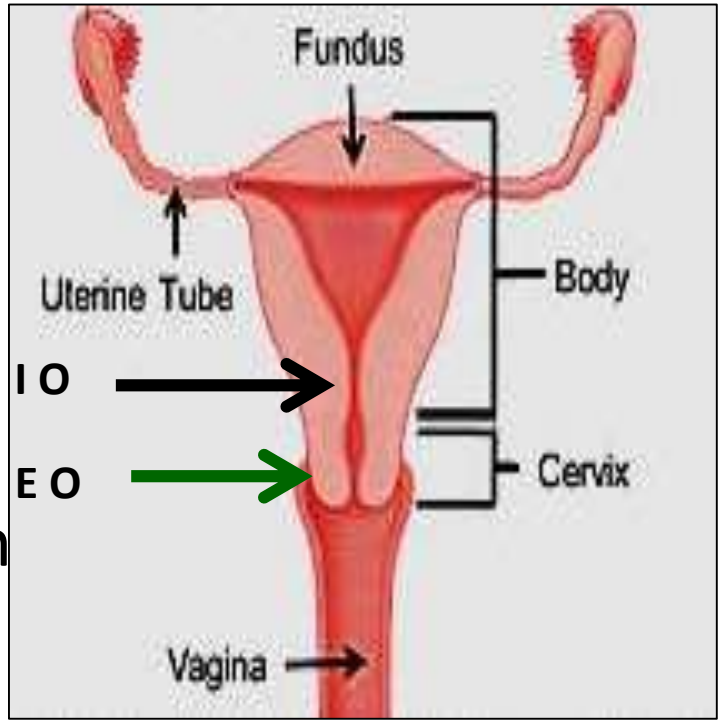
- IC & OL layers
- Their peristalsis play major role in pushing the ovum



3- Serosa:

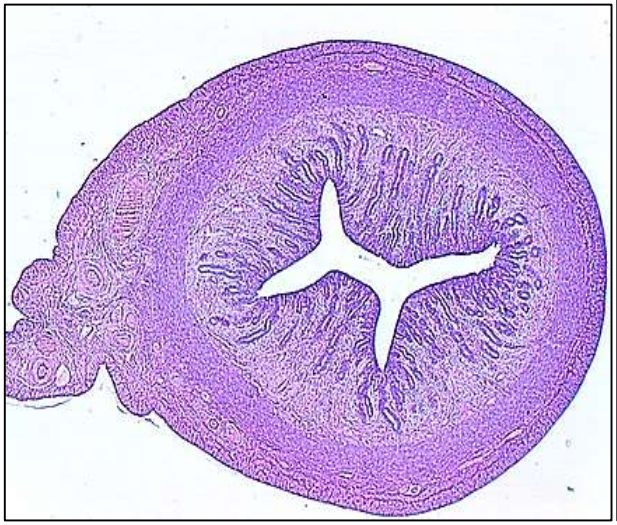
The uterus

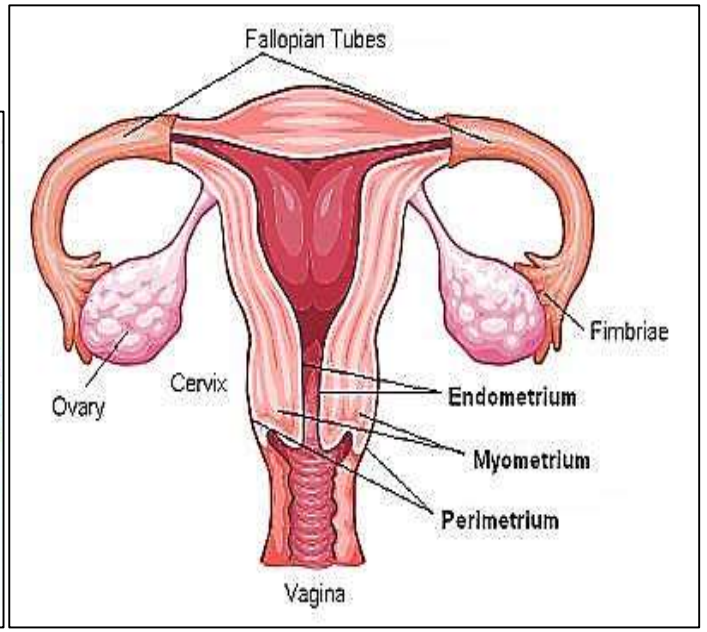
- Pear shaped organ
- Fundus: dome shaped region
- Body: Major portion of the uterus
- Cervix: cylindrical part extends from the internal os & ends at external os



The uterine wall consists of 3 layers:

- Endometrium
- Myometrium
- Perimetrium

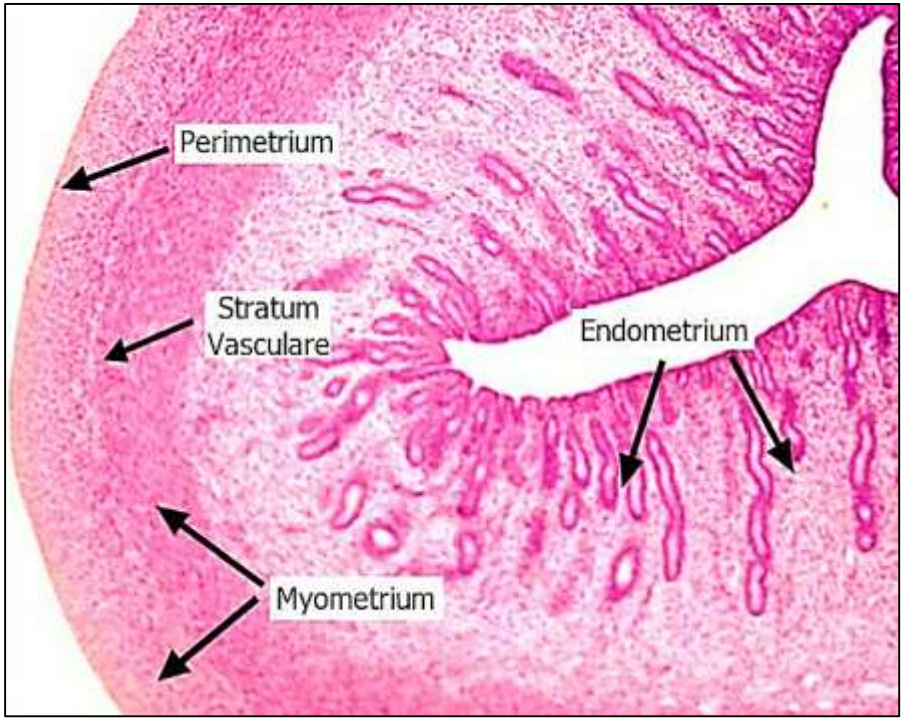




➢ Endometrium (mucosa)

Lined with simple columnar epithelium partially ciliated & contain simple tubular glands

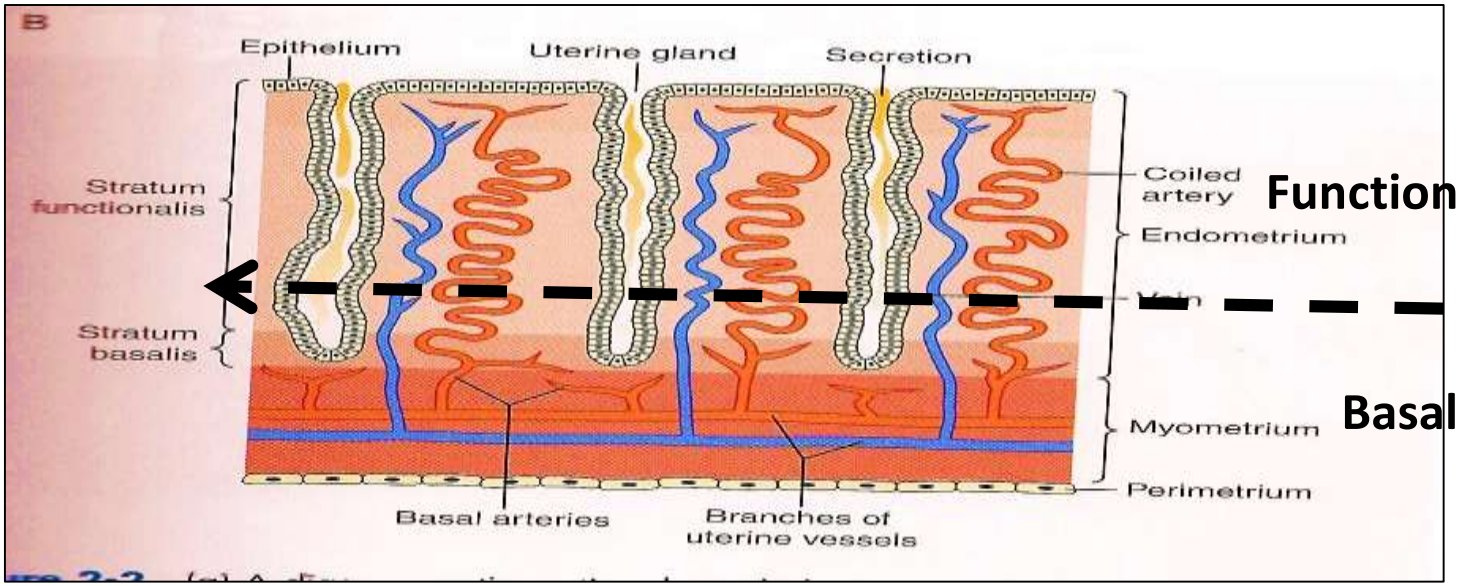
(endometrial glands)

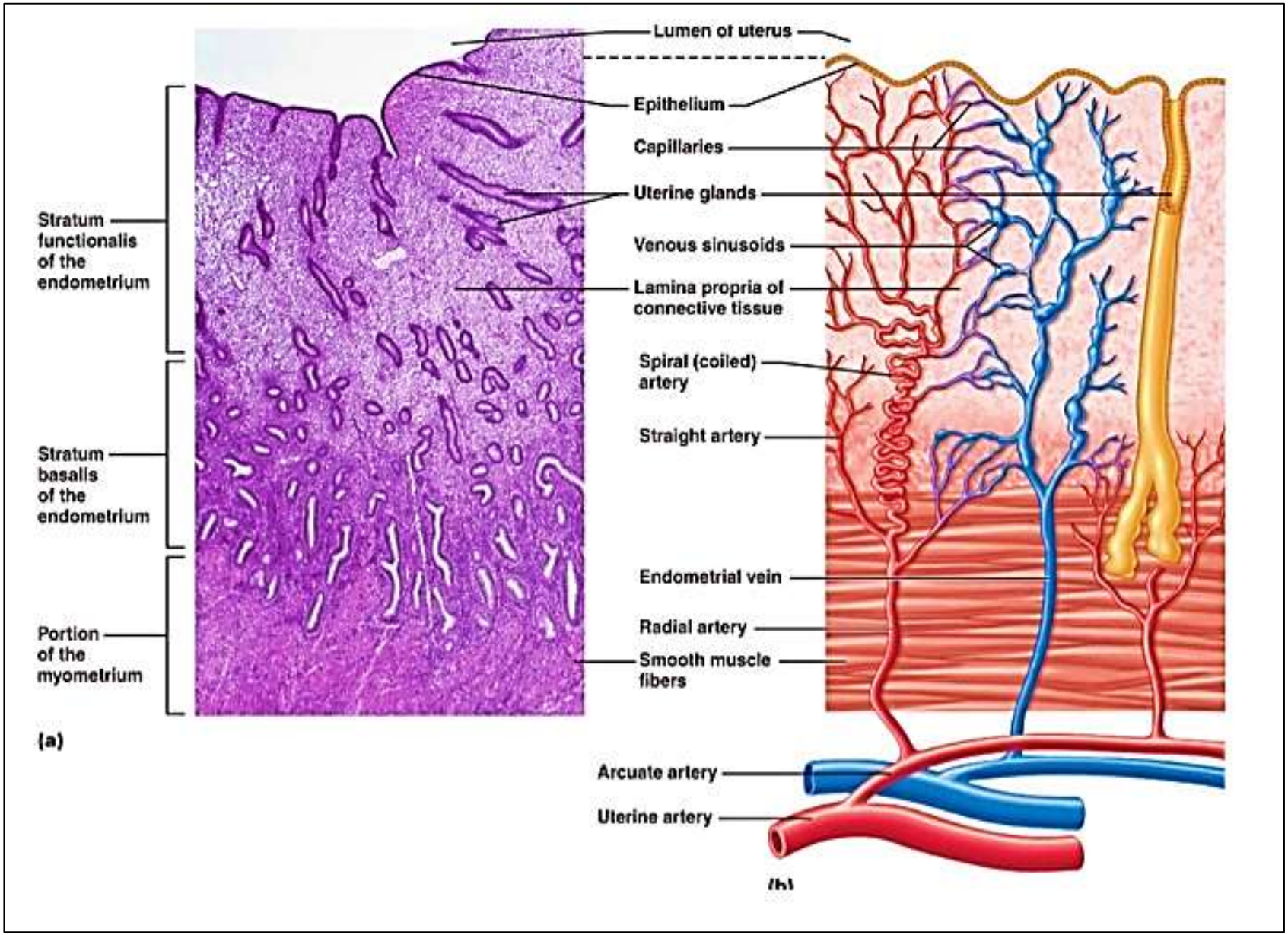


Endometrium composed of 2 layers:

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

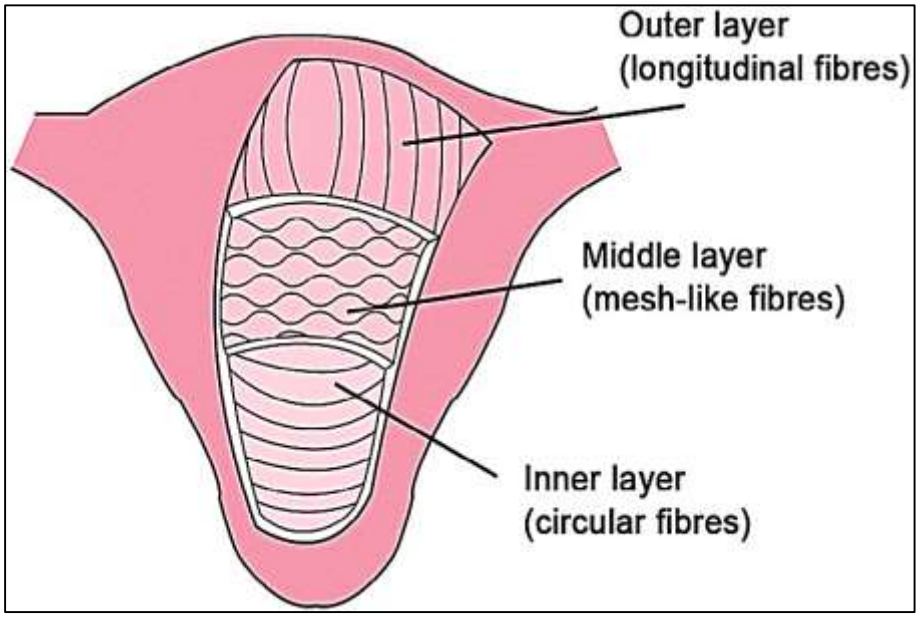
➢ Myometrium:

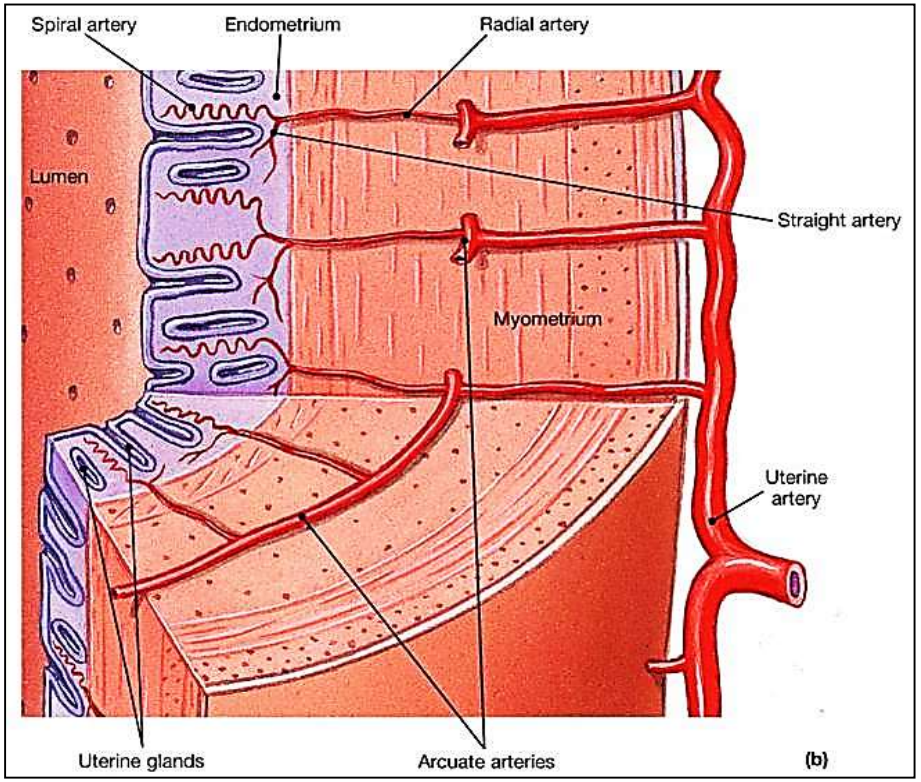
Is the thickest layer,

Composed 3 layers of smooth muscles:

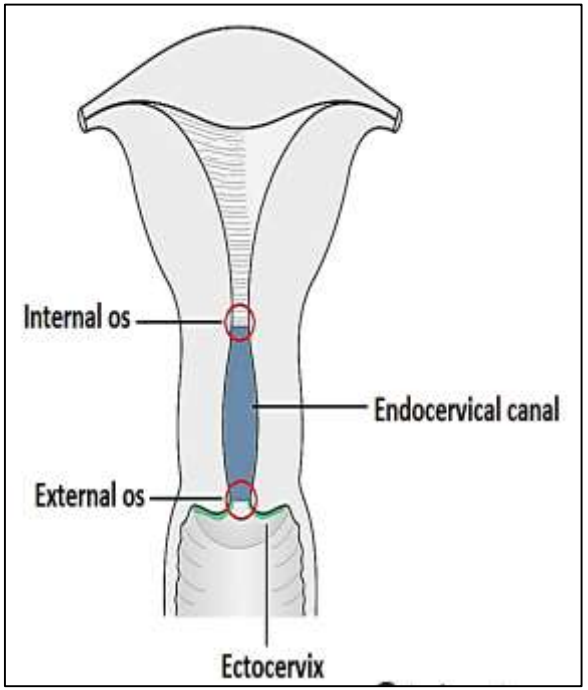
- outer longitudinal
- Middle thick, mesh like fibers, richly vascularized
- Inner circular
- Uterine muscles during pregnancy undergoes hyperplasia & hypertrophy

➢ 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

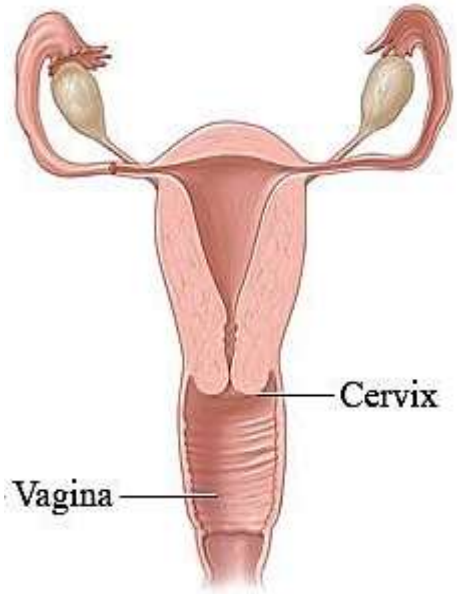
2- Not significantly affected by Menstruation

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

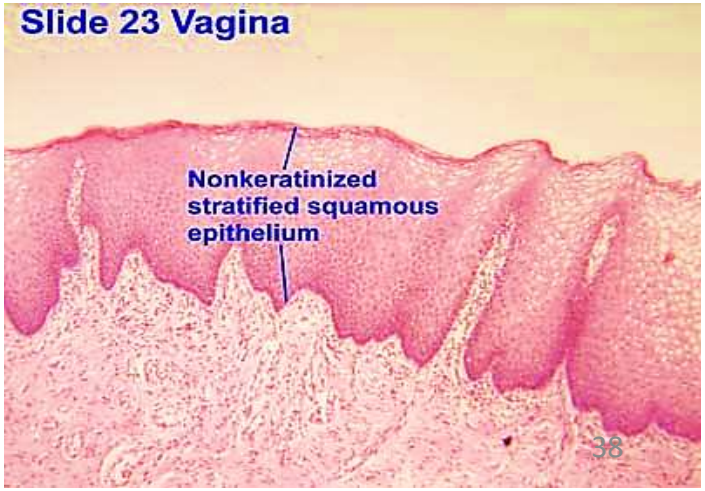


It is a fibro-muscular canal

Wall consists of 3 layers: Mucosa, musculosa, adventitia

Epithelium : stratified squamous epith.

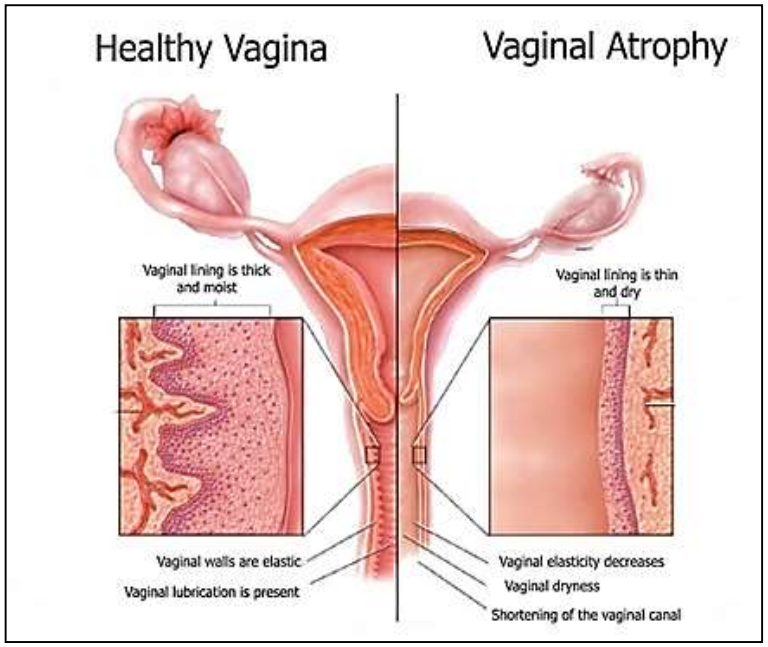
- The epith synthesize & accumulate ↑ glycogen (estrogen effect)
- Normal bacteria in vaginal lumen → glycogen → lactic acid → acidic pH of vagina (protective barrier)



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



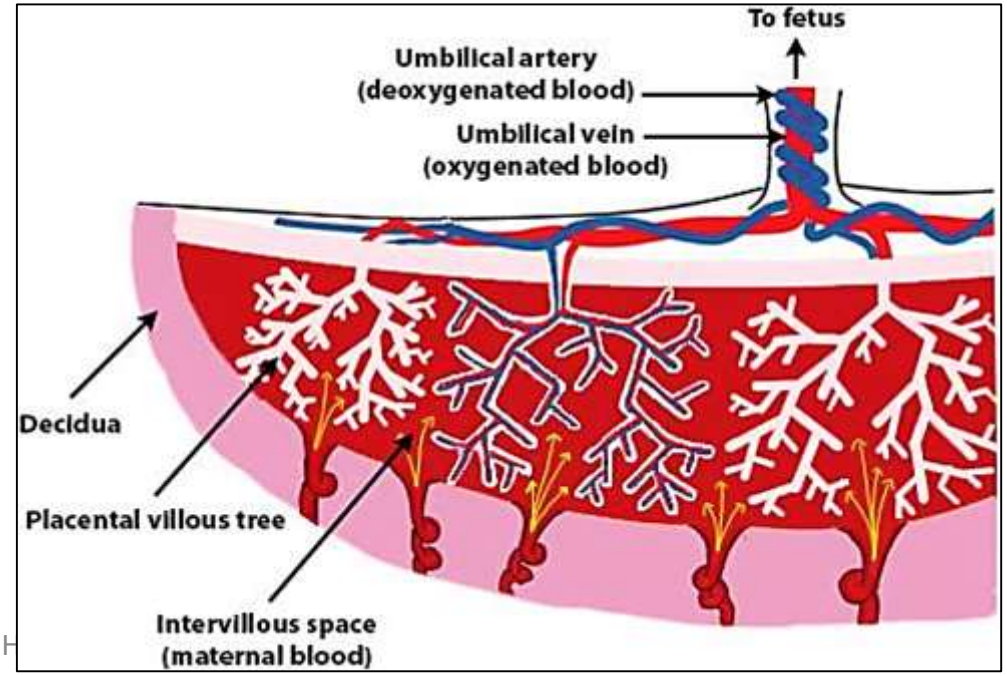
- The mucus in vagina comes from cervical glands . The vagina contains **No glands**

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):

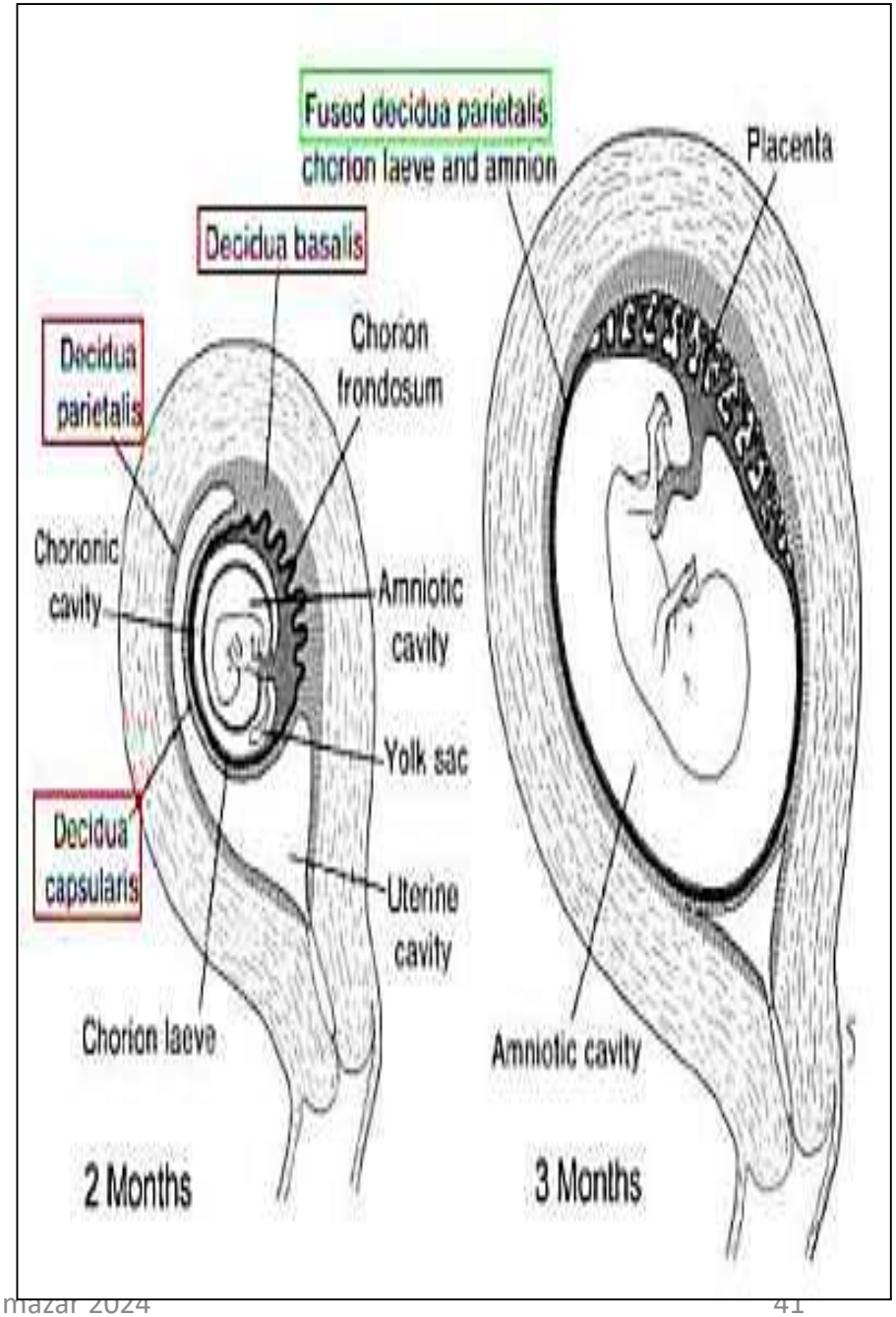
The decidua (**endometrium**) is divided into:

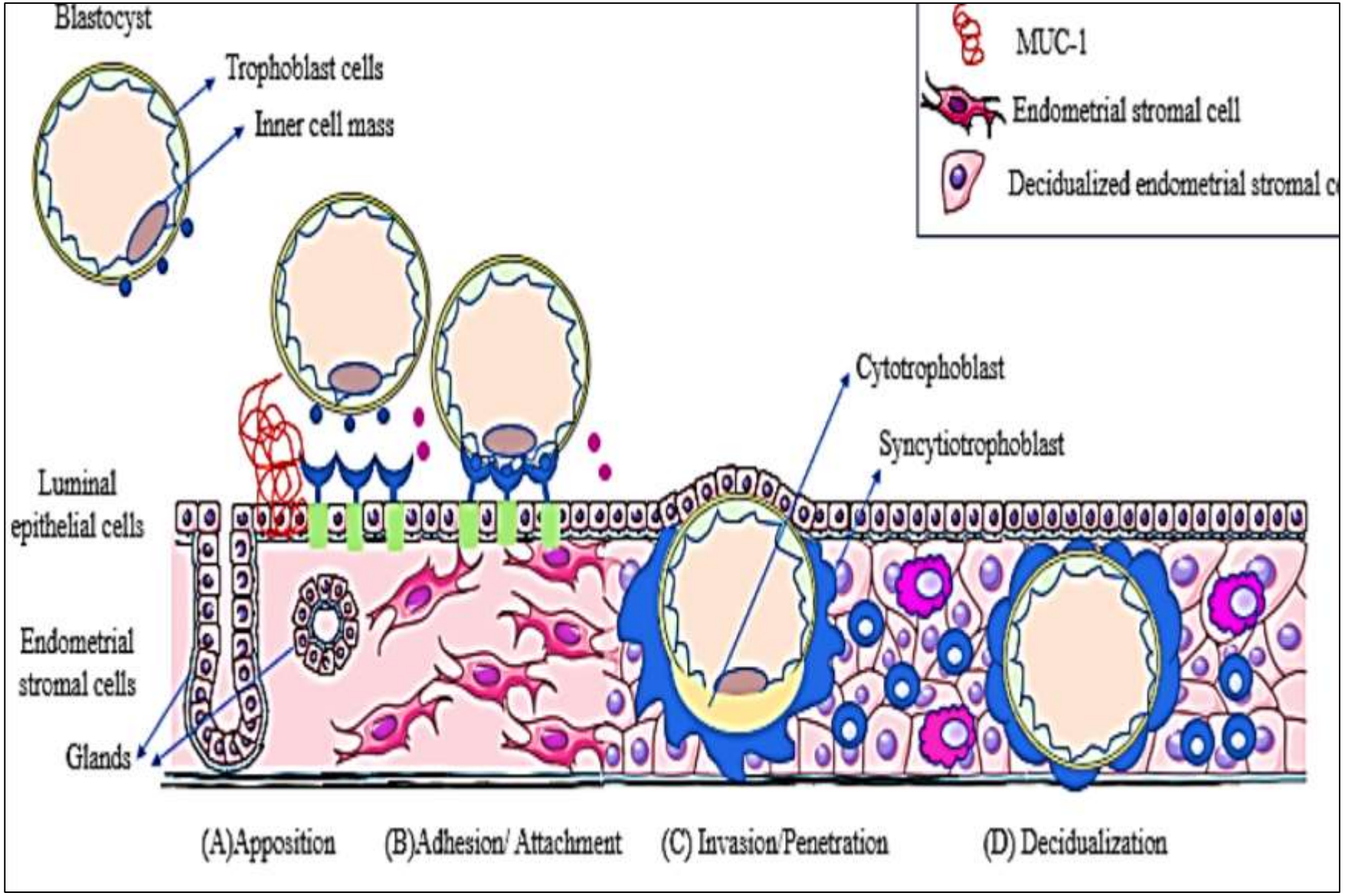
- **Decidua basalis**: between embryo
  & myometrium (most imp)

- **Decidua capsularis**: between embryo & lumen of uterus

- **Decidua parietalis** : endometrium

lining the rest of uterine cavity

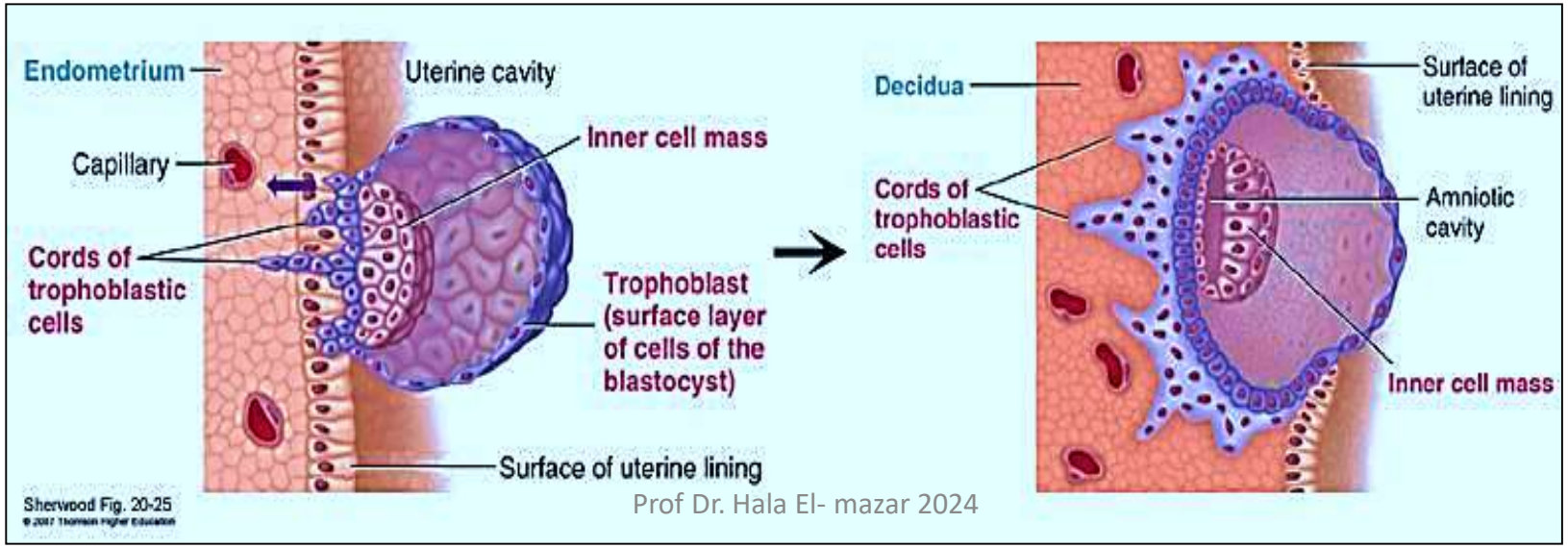




Implantation of blastocyst

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



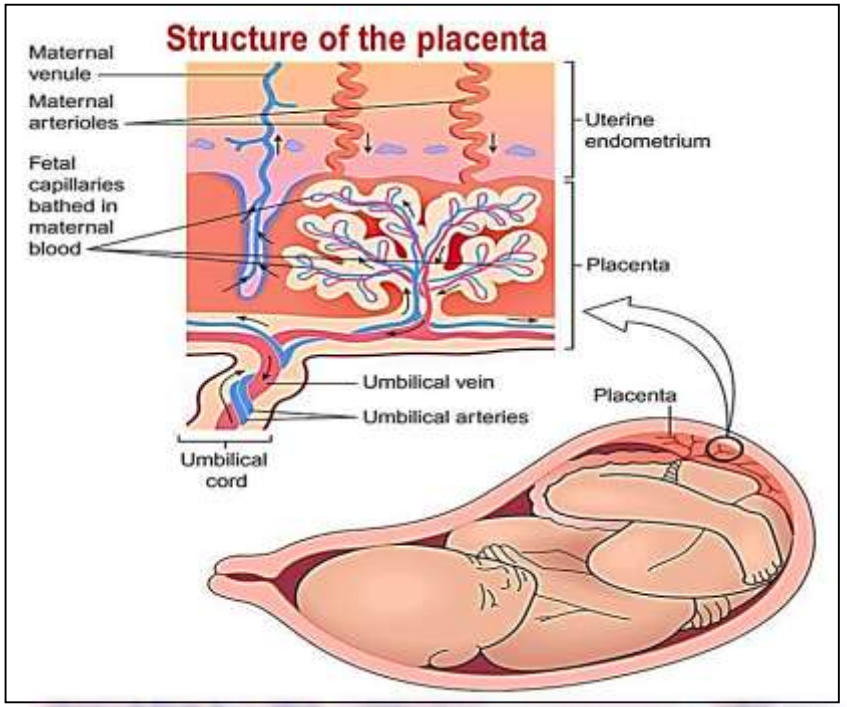
Each chorionic villus consists of:

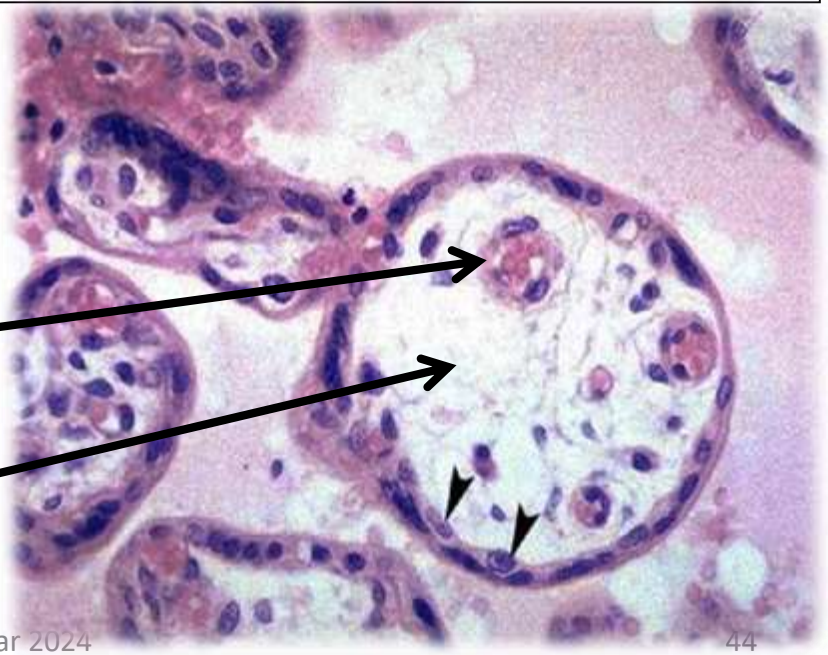
1- Central core: contain fetal BV

2- Trophoblast: epithelial

Covering formed of 2 layers:

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



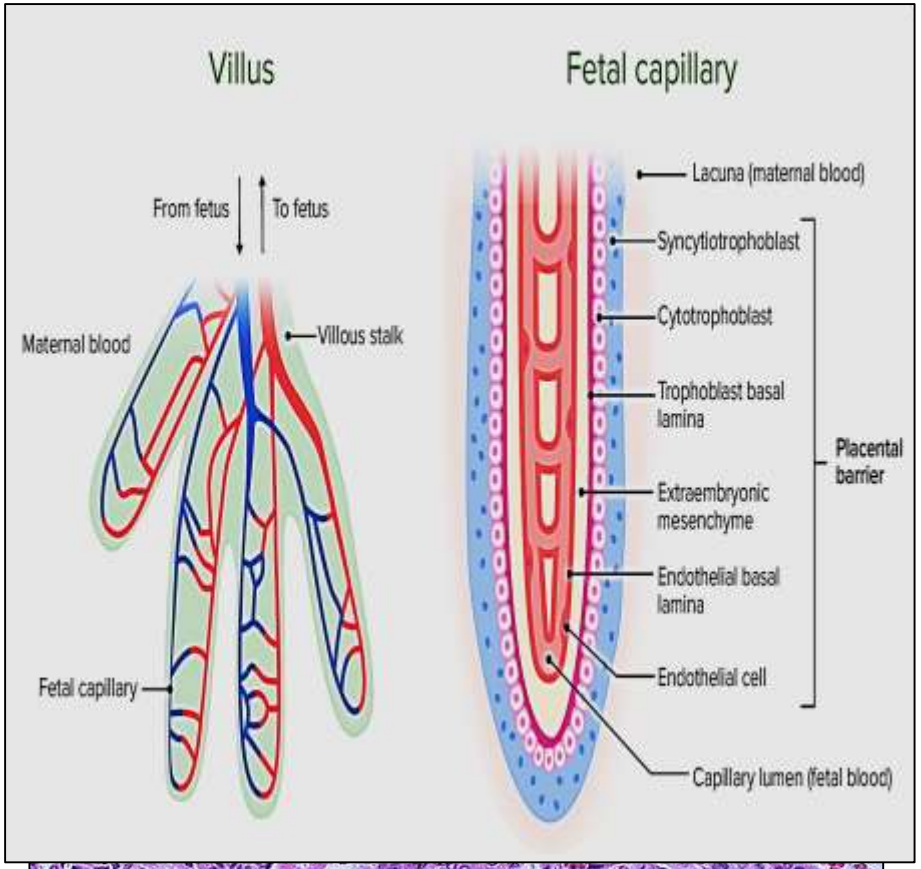


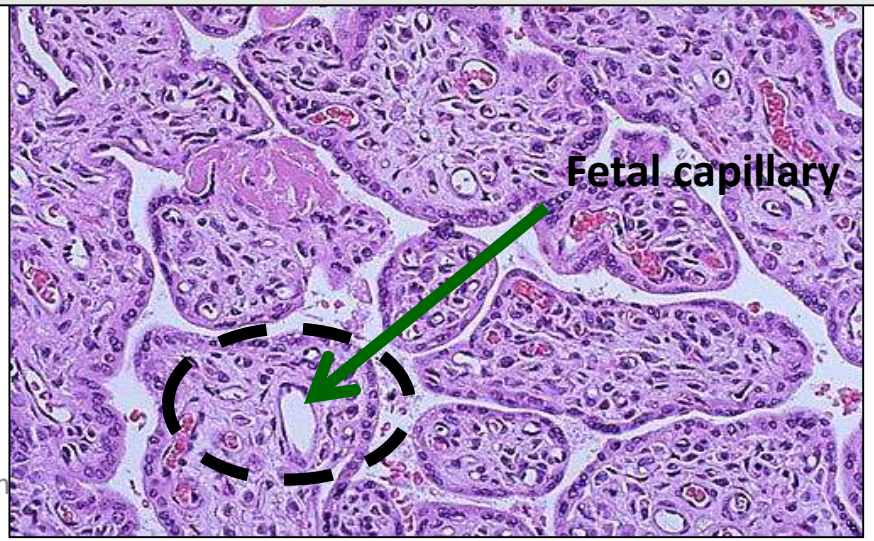
The placental barrier:

- Barrier that separate blood in the fetal circulation from blood in maternal circulation

- Is composed of:

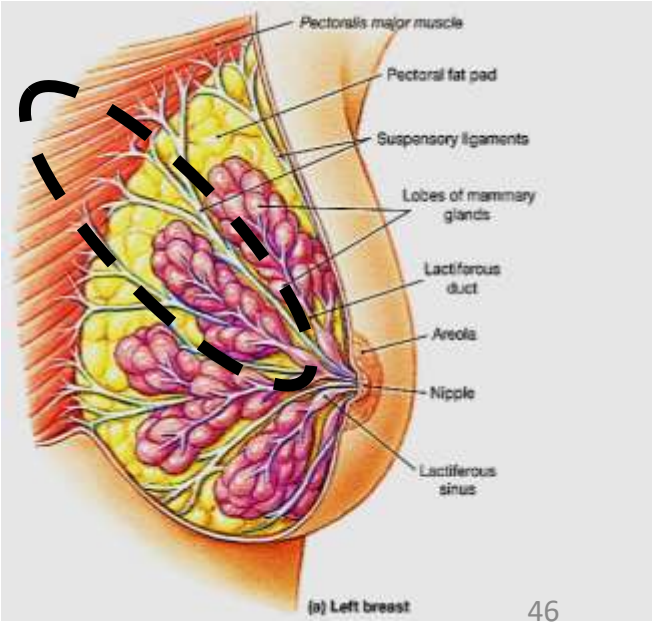
1. Endothelium of fetal capillaries
2. Basal lamina of fetal capillary endothelium
3. Basal lamina of cytotrophoblast
4. Cells of Cytotrophoblast
5. Cells of Syncytiotrophoblast

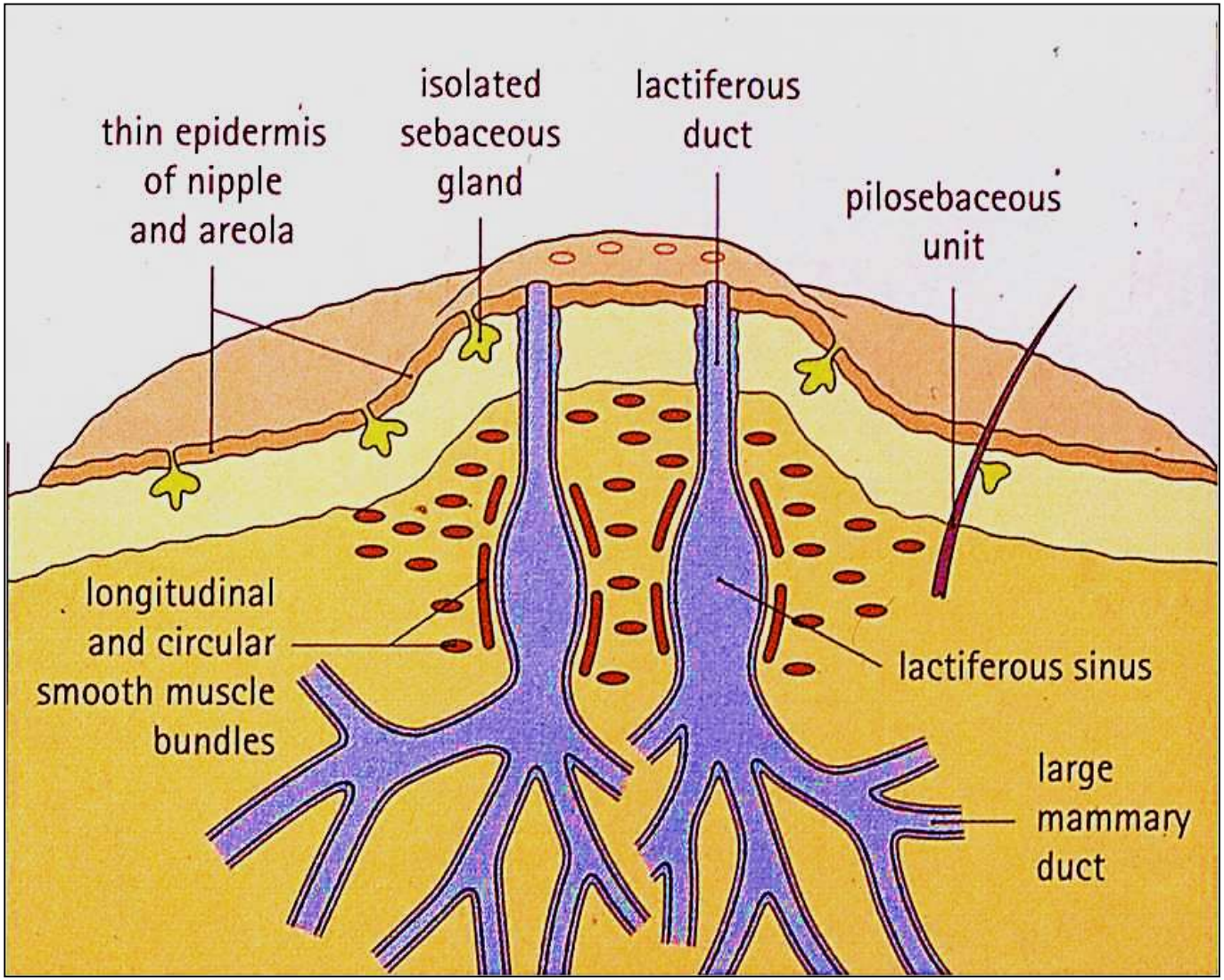




The mammary gland

- 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



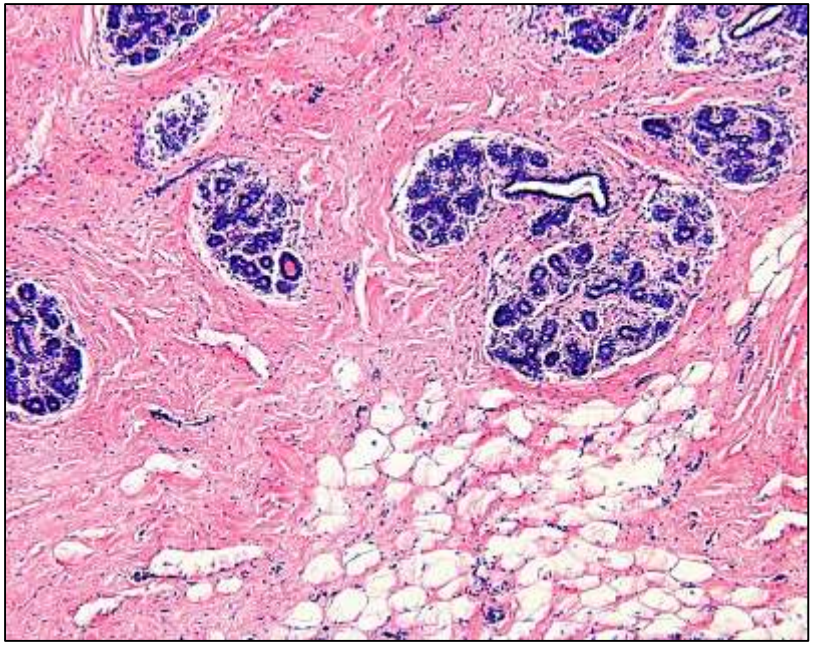


Lactiferous ducts

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 myoepithelia cells