CBCS 3RD SEM (M) PAPER 3026UNIT:5

REPRODUCTION

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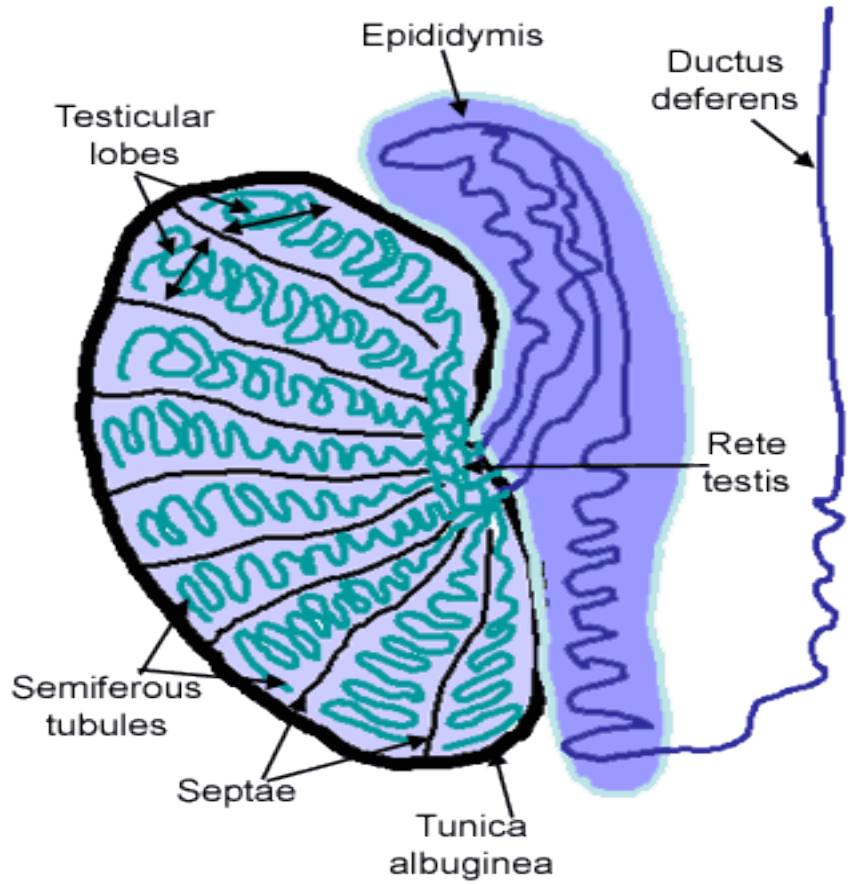
The reproductive system of an organism, also known as the genital system, is the biological system made up of all the anatomical organs involved in sexual reproduction.

Many non-living substances such as fluids, hormones, and pheromones are also important accessories to the reproductive system.

HISTOLOGY OF TESTIS

The pair of testes produces spermatozoa and androgens. Several accessory glands produce the fluid constituents of semen. Long ducts store the sperm and transport them to the penis.

The male reproductive system consists of paired testes and genital ducts, accessory sex glands and the penis.


Epididymis
Ductus deferens
Testicular lobes
Rete testis
Semiferous tubules
Septae
Tunica albuginea

Testes

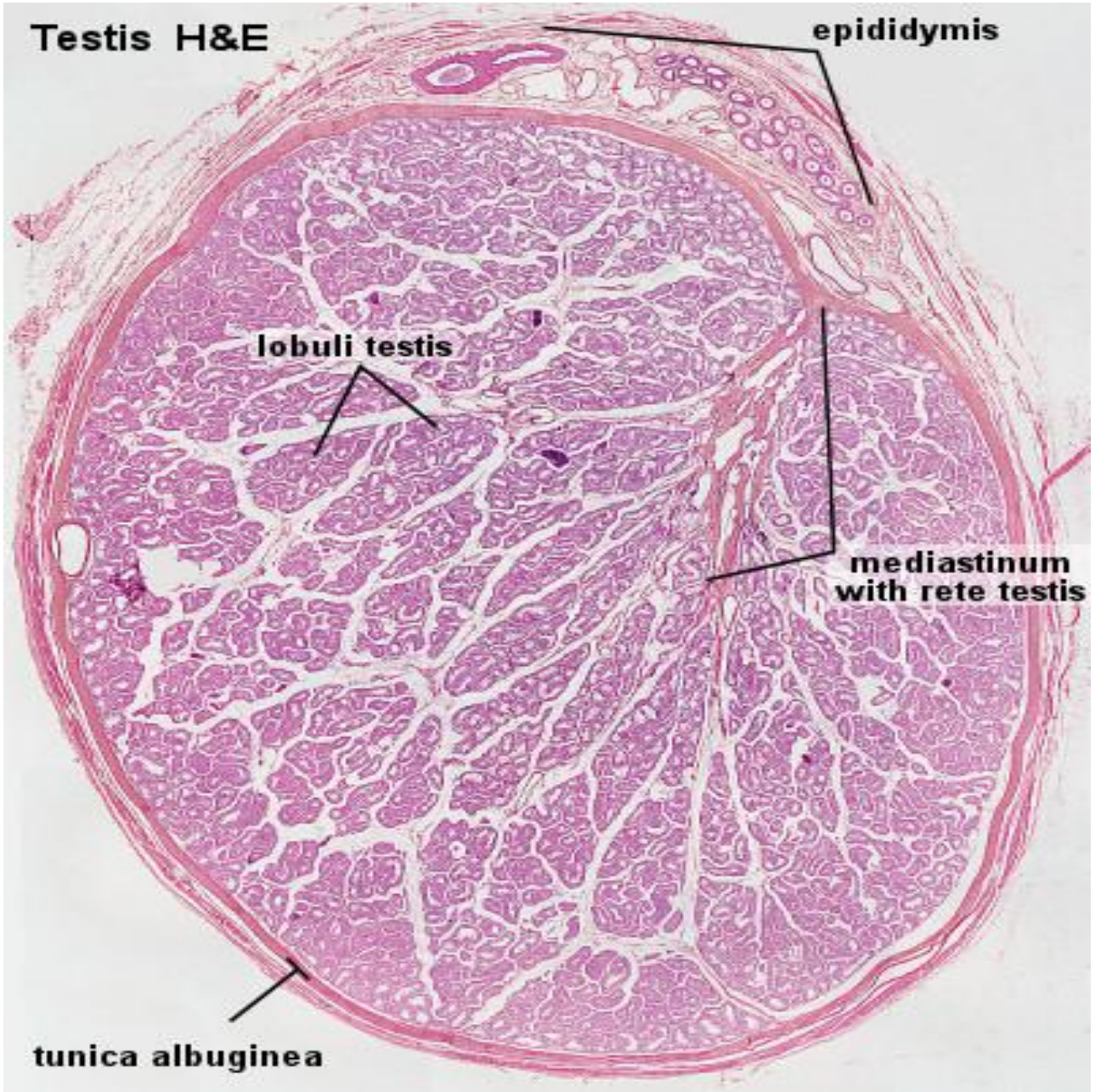
The testes have, like the ovaries, two functions: they produce the male gametes or spermatozoa, and they produce male sexual hormone, testosterone, which stimulates the accessory male sexual organs and causes the development of the masculine extragenital sex characteristics.

The testis is surrounded by a thick capsule, the tunica albuginea, from which a conical mass of connective tissue, the mediastinum testis, projects into the testis. The tunica albuginea is covered externally by a serosa.

From the mediastinum, delicate fibrous septa radiate towards the tunica albuginea and divide the parenchyma of the testis into about 300 lobuli testis, which communicate peripherally. Each lobule contains 1-4 convoluted seminiferous tubules (about 150-300 µm in diameter, 30-80 cm long).

Interstitial tissue between the convoluted tubules is continuous with a layer of loose vascular connective tissue, the tunica vasculosa testis, which is found beneath the tunica albuginea.

Each seminiferous tubule continues near the mediastinum into a straight tubule, a tubulus rectus. The straight tubules continue into the rete testis, a labyrinthine system of cavities in the mediastinum



Testis, young and mature - H&E

The Convoluted Seminiferous Tubules

These tubules are enclosed by a thick basal lamina and surrounded by 3-4 layers of smooth muscle cells (or myoid cells). The insides of the tubules are lined with seminiferous epithelium, which consists of two general types of cells: spermatogenic cells and Sertoli cells.

Spermatogenic cells: Spermatogonia

are the first cells of spermatogenesis. They originate in the 4th week of foetal development in the endodermal walls of the yolk sac and migrate to the primordium of the testis, where they differentiate into spermatogonia. Spermatogonia remain dormant until puberty. They are always in contact with the basal lamina of the tubule.

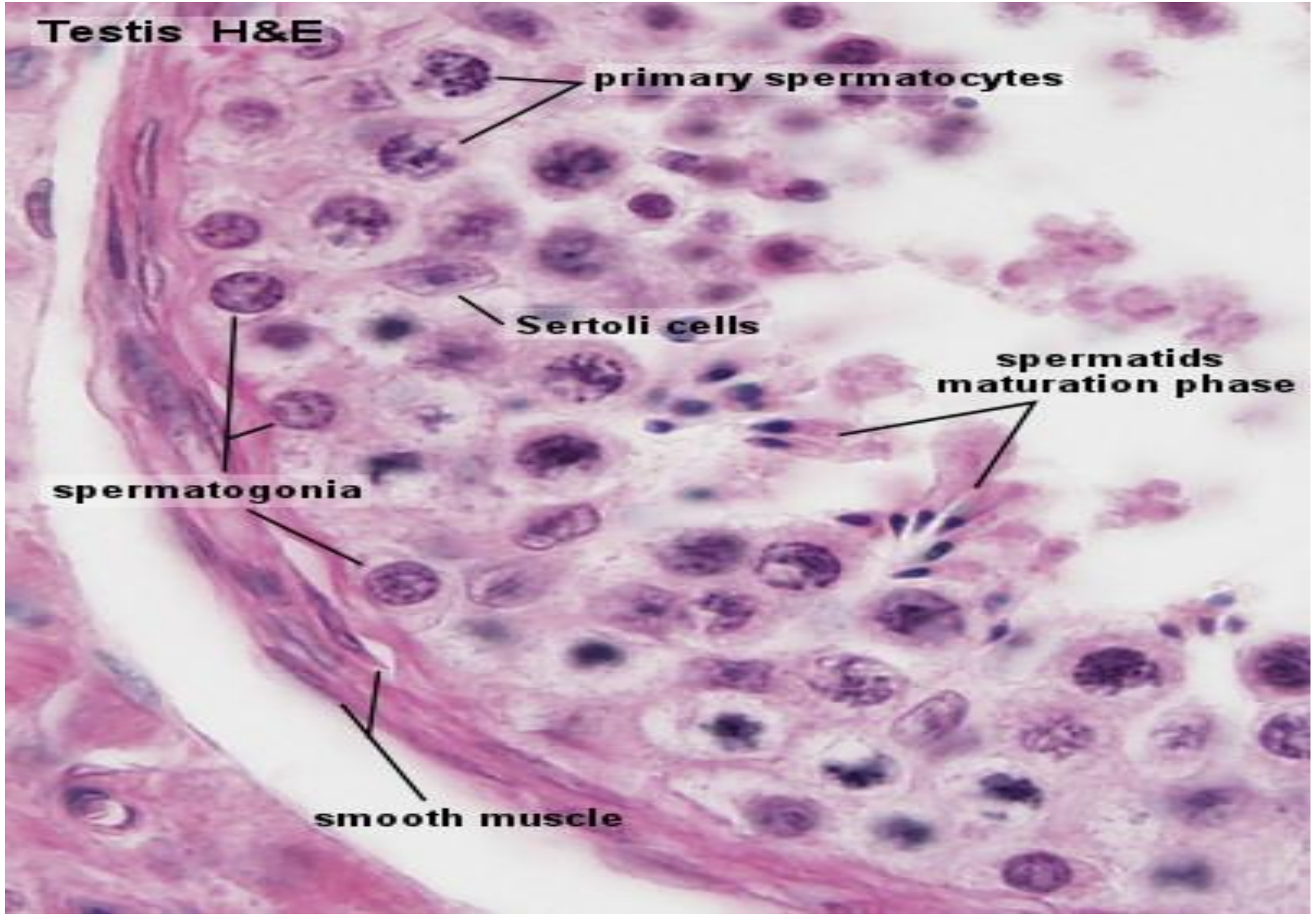
Two types of spermatogonia can be distinguished in the human seminiferous epithelium:

Type A spermatogonia have a rounded nucleus with very fine chromatin grains and one or two nucleoli. They are stem cells which divide to form new generations of both type A and type B spermatogonia.

Type B spermatogonia have rounded nuclei with chromatin granules of variable size, which often attach to the nuclear membrane, and one nucleolus. Although type B spermatogonia may divide repeatedly, they do not function as stem cells and their final mitosis always results in the formation of

Primary spermatocytes

which lie in the cell layer luminal to the spermatogonia.


Testis H&E
primary spermatocytes
Sertoli cells
spermatids
maturation phase
spermatogonia
smooth muscle

They appear larger than spermatogonia. They immediately enter the prophase of the first meiotic division, which is extremely prolonged (about 22 days!).

A large number of primary spermatocytes is always visible in cross-sections through seminiferous tubules.

Cell divisions, from the formation of primary spermatocytes and onwards, to the production of the spermatocytes, are incomplete. The cells remain connected by bridges of cytoplasm. The completion of the first meiotic division results in the formation of

Secondary spermatocytes,
which are smaller than primary spermatocytes. They rapidly enter and complete the second meiotic division and are therefore seldom seen in histological preparations. Their division results in the formation of

Spermatids,
which lie in the luminal part of the seminiferous epithelium. They are small (about 10 µm in diameter) with an initially very light (often eccentric) nucleus. The chromatin condenses during the maturation of the spermatids into spermatozoa, and the nucleus becomes smaller and stains darker.

The terminal phase of spermatogenesis is called spermiogenesis and consists of the differentiation of the newly formed spermatids into

Spermatozoa

The mature human spermatozoon is about 60 µm long and actively motile. It is divided into head, neck and tail.

The head (flattened, about 5 µm long and 3 µm wide) chiefly consists of the nucleus (greatly condensed chromatin!). The anterior 2/3 of the nucleus is covered by the acrosome, which contains enzymes important in the process of fertilisation. The posterior parts of the nuclear membrane forms the so-called basal plate.

The neck is short (about 1 µm) and attached to the basal plate. A transversely oriented centriole is located immediately behind the basal plate. The neck also contains nine segmented columns of fibrous material, which continue as the outer dense fibres into the tail.

The tail is further divided into a middle piece, a principal piece and an end piece. The axonema (the generic name for the arrangement of microtubules in all cilia) begins in the middle piece. It is surrounded by nine outer dense fibres, which are not found in other cilia.

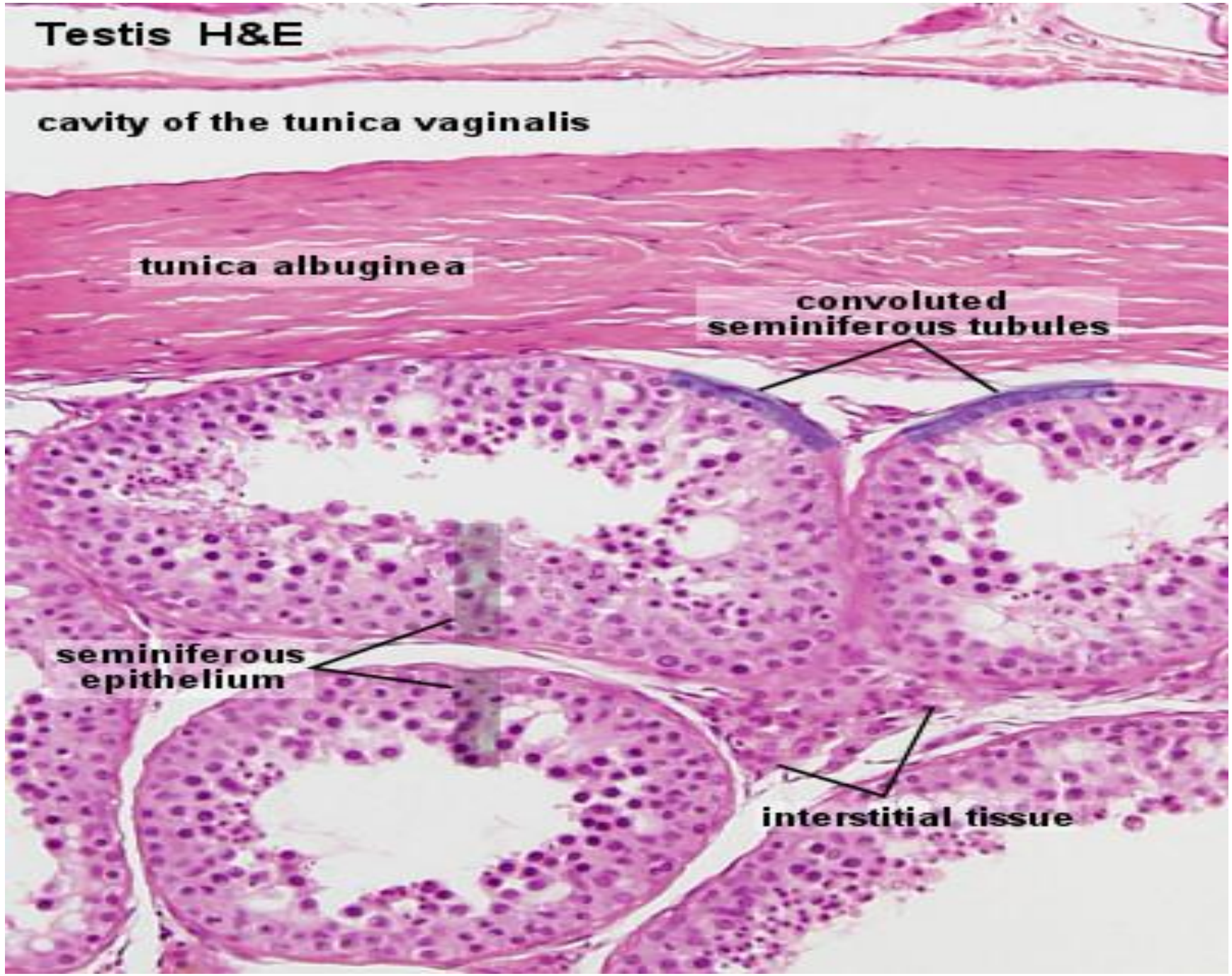
In the middle piece (about 5 µm long), the axonema and dense fibres are surrounded by a sheath of mitochondria. The middle piece is terminated by a dense ring, the annulus.

The principal piece is about 45 µm long. It contains a fibrous sheath, which consists of dorsal and ventral longitudinal columns interconnected by regularly spaced circumferential hoops.

The fibrous sheath and the dense fibres do not extend to the tip of the tail. Along the last part (5 µm) of the tail, called the end piece, the axonema is only surrounded by a small amount of cytoplasm and the plasma membrane.

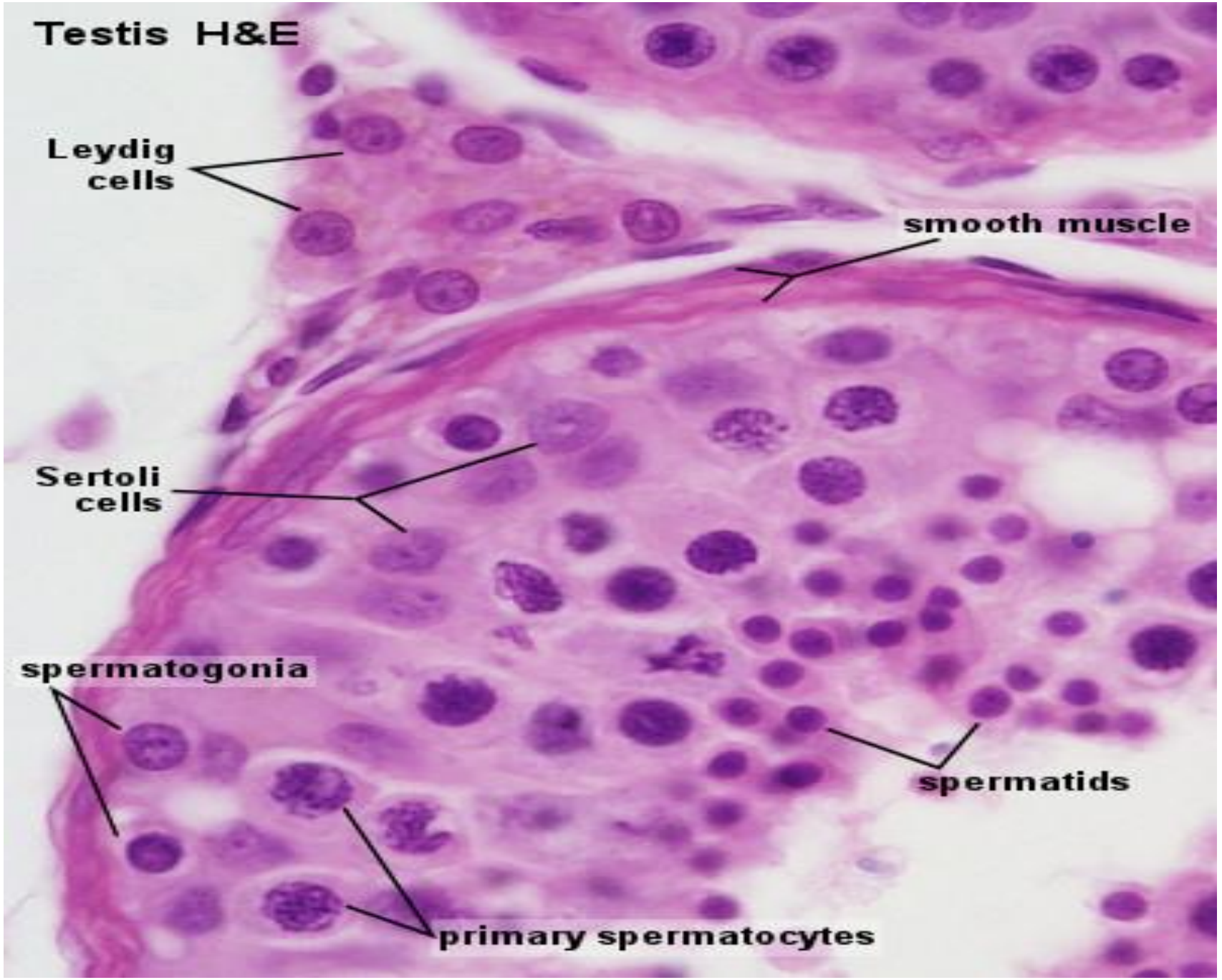
It takes about 48 days from the time cells enter meiosis until morphologically mature spermatozoa are formed. Depending on the length of reproduction of spermatogonia (which is not precisely determined) it takes approximately 64 days to complete spermatogenesis.

Spermatogenesis is regulated by follicle stimulating hormone (FSH), which in males stimulates the spermatogenic epithelium, and luteinizing-hormone (LH), which in males stimulates testosterone production by Leydig cells in the interstitial tissue.


Testis H&E
cavity of the tunica vaginalis
tunica albuginea
convoluted
seminiferous tubules
seminiferous
epithelium
interstitial tissue

Sertoli cells

are far less numerous than the spermatogenic cells and are evenly distributed between them. Their shape is highly irregular - columnar is the best approximation. Sertoli cells extend from the basement membrane to the luminal surface of the seminiferous epithelium. Processes of the Sertoli cells extend in between the spermatogenic cells (cell limits are therefore not clearly visible in the LM). The nucleus of Sertoli cells is ovoid or angular, large and lightly stained and often contains a large nucleolus. The long axis of the nucleus is oriented perpendicular to wall of the tubule. A fold in the nuclear membrane is characteristic for Sertoli cells but not always visible in the LM (well ... actually ... it's not that difficult to find, but not that easy either ....).


Testis H&E
Leydig cells
smooth muscle
Sertoli cells
spermatogonia
spermatids
primary spermatocytes

Lateral processes of Sertoli cells are interconnected by tight junctions, which are likely to be the structural basis for the blood-testis barrier. Spermatogonia and primary spermatocytes are located in the basal compartment, other cellular stages of spermatogenesis are located in the adluminal compartment. Tight junctions may temporarily open to permit the passage of spermatogenic cells from the basal into the adluminal compartment. Sertoli cells provide mechanical and nutritive support for the spermatogenic cells. Sertoli cells also secrete two hormones - inhibin and activin - which provide positive and negative feedback on FSH secretion from the pituitary.

Interstitial tissue

Leydig cells (15-20 µm), located in the interstitial tissue between the convoluted seminiferous tubules, constitute the endocrine component of the testis. They synthesise and secrete testosterone. Ledig cells occur in clusters , which are variable in size and richly supplied by capillaries. The cytoplasm is strongly acidophilic and finely granular. The nucleus is large, round and often located eccentric in the cell

Ducts of the Testis

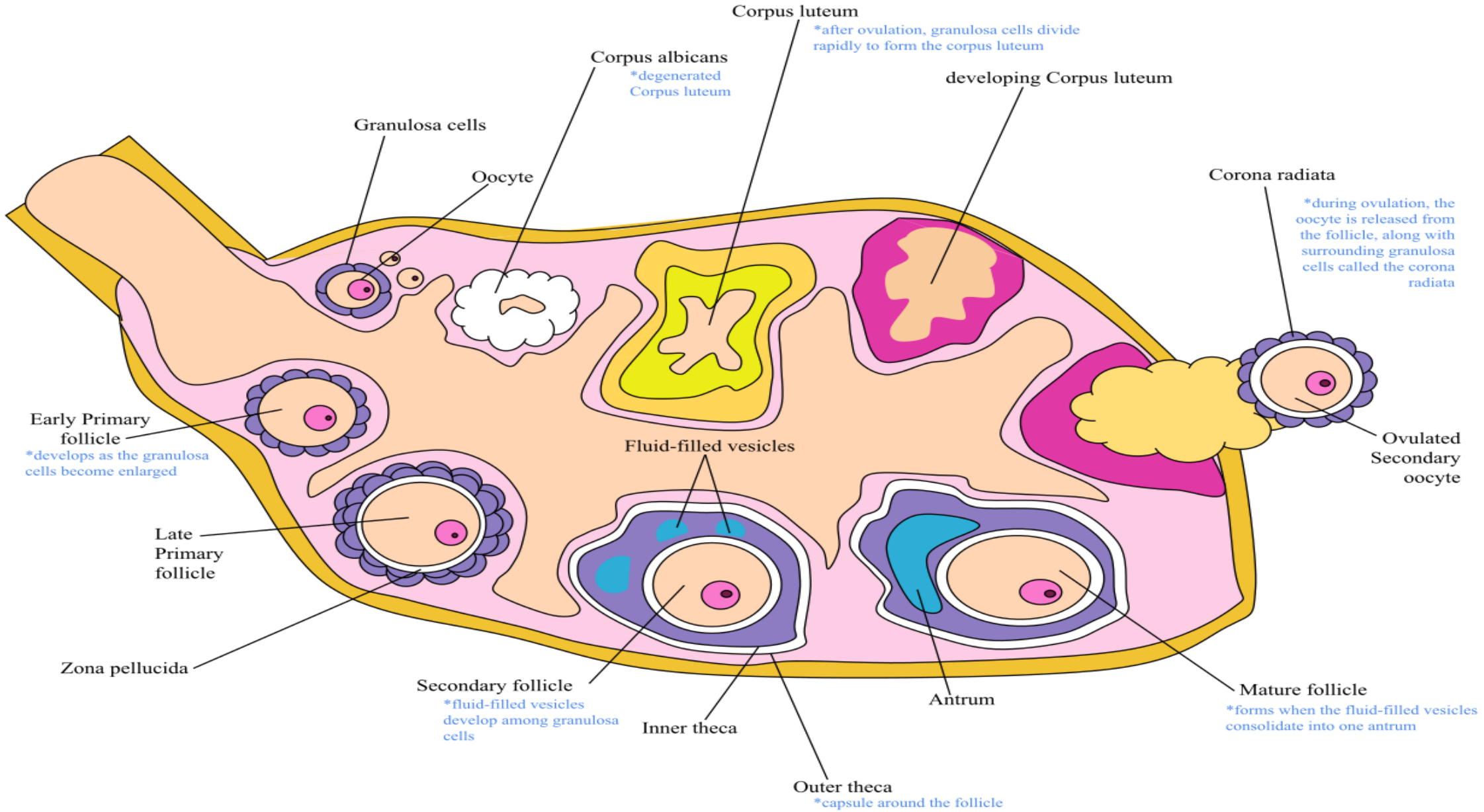
Spermatozoa pass via the tubuli recti (low columnar epithelium) and the rete testis (flattened or cuboidal epithelium) into numerous ductuli efferentes, which are lined by a columnar epithelium, which consists of both absorptive and ciliated cells. The height of the two cells types which form the epithelium of the ductuli efferentes is variable which gives the lumen a characteristic wavy outline.

The ductuli efferentes leave the testis and open into a common duct, the ductus epididymidis (about 6 m long!). It is lined by a very tall pseudostratified columnar epithelium. Most cells of the epithelium, also called principal cells, have long stereocilia. Stereocilia are non-motile structures, which in the EM resemble large microvilli. Towards the basal lamina we see a number of small nuclei, which belong to the basal cells of the ductus epididymidis. These cells regenerate the epithelium.

Peristaltic contractions of smooth muscle cells surrounding the ductus epididymidis move the spermatozoa towards the middle segment of the duct, which is the site of final functional maturation of the spermatozoa - now they are motile.

The terminal segment of the ductus epididymidis is the site of storage of the mature spermatozoa. Smooth muscle fibres of the terminal part of the ductus epididymidis do not contract spontaneously. They contract during sexual stimulation concurrently with the contraction of the musculature of the duct into which it opens, the vas deferens

HISTOOGY OF OVERY


Corpus luteum
*after ovulation, granulosa cells divide rapidly to form the corpus luteum
Corpus albicans
*degenerated Corpus luteum
developing Corpus luteum
Granulosa cells
Oocyte
Corona radiata
*during ovulation, the oocyte is released from the follicle, along with surrounding granulosa cells called the corona radiata
Early Primary follicle
*develops as the granulosa cells become enlarged
Fluid-filled vesicles
Ovulated Secondary oocyte
Late Primary follicle
Zona pellucida
Secondary follicle
*fluid-filled vesicles develop among granulosa cells
Inner theca
Antrum
Mature follicle
*forms when the fluid-filled vesicles consolidate into one antrum
Outer theca
*capsule around the follicle

Structure

The ovaries are considered the female gonads. Each ovary is whitish in color and located alongside the lateral wall of the uterus in a region called the ovarian fossa. The ovarian fossa is the region that is bounded by the external iliac artery and in front of the ureter and the internal iliac artery. This area is about 4 cm x 3 cm x 2 cm in size.

The ovaries are surrounded by a capsule, and have an outer cortex and an inner medulla. The capsule is of dense connective tissue and is known as the tunica albuginea

Usually, ovulation occurs in one of the two ovaries releasing an egg each menstrual cycle.
The side of the ovary closest to the fallopian tube is connected to it by infundibulopelvic ligament,[3] and the other side points downwards attached to the uterus via the ovarian ligament.

Other structures and tissues of the ovaries include the hilum.

Ligaments

The ovaries lie within the peritoneal cavity, on either side of the uterus, to which they are attached via a fibrous cord called the ovarian ligament. The ovaries are uncovered in the peritoneal cavity but are tethered to the body wall via the suspensory ligament of the ovary which is a posterior extension of the broad ligament of the uterus. The part of the broad ligament of the uterus that covers the ovary is known as the mesovarium.

Microanatomy

The surface of the ovaries is covered with membrane consisting of a lining of simple cuboidal-to-columnar shaped mesothelium, called the germinal epithelium.

Micrograph of the ovarian cortex from a rhesus monkey showing several round follicles embedded in a matrix of stromal cells. A secondary follicle sectioned through the nucleus of an oocyte is at the upper left, and earlier stage follicles are at the lower right. The tissue was stained with the dyes hematoxylin and eosin.

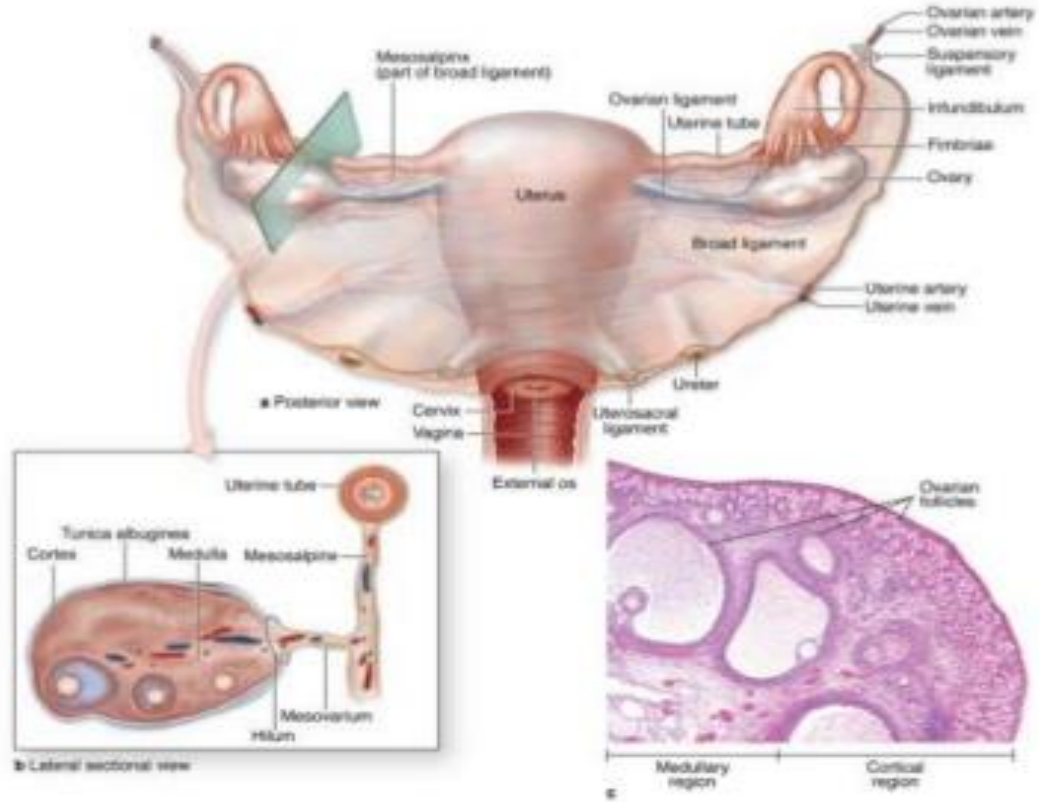
The outer layer is the ovarian cortex, consisting of ovarian follicles and stroma in between them. Included in the follicles are the cumulus oophorus, membrana granulosa (and the granulosa cells inside it), corona radiata, zona pellucida, and primary oocyte

Theca of follicle, antrum and liquor folliculi are also contained in the follicle. Also in the cortex is the corpus luteum derived from the follicles. The innermost layer is the ovarian medulla. It can be hard to distinguish between the cortex and medulla, but follicles are usually not found in the medulla.

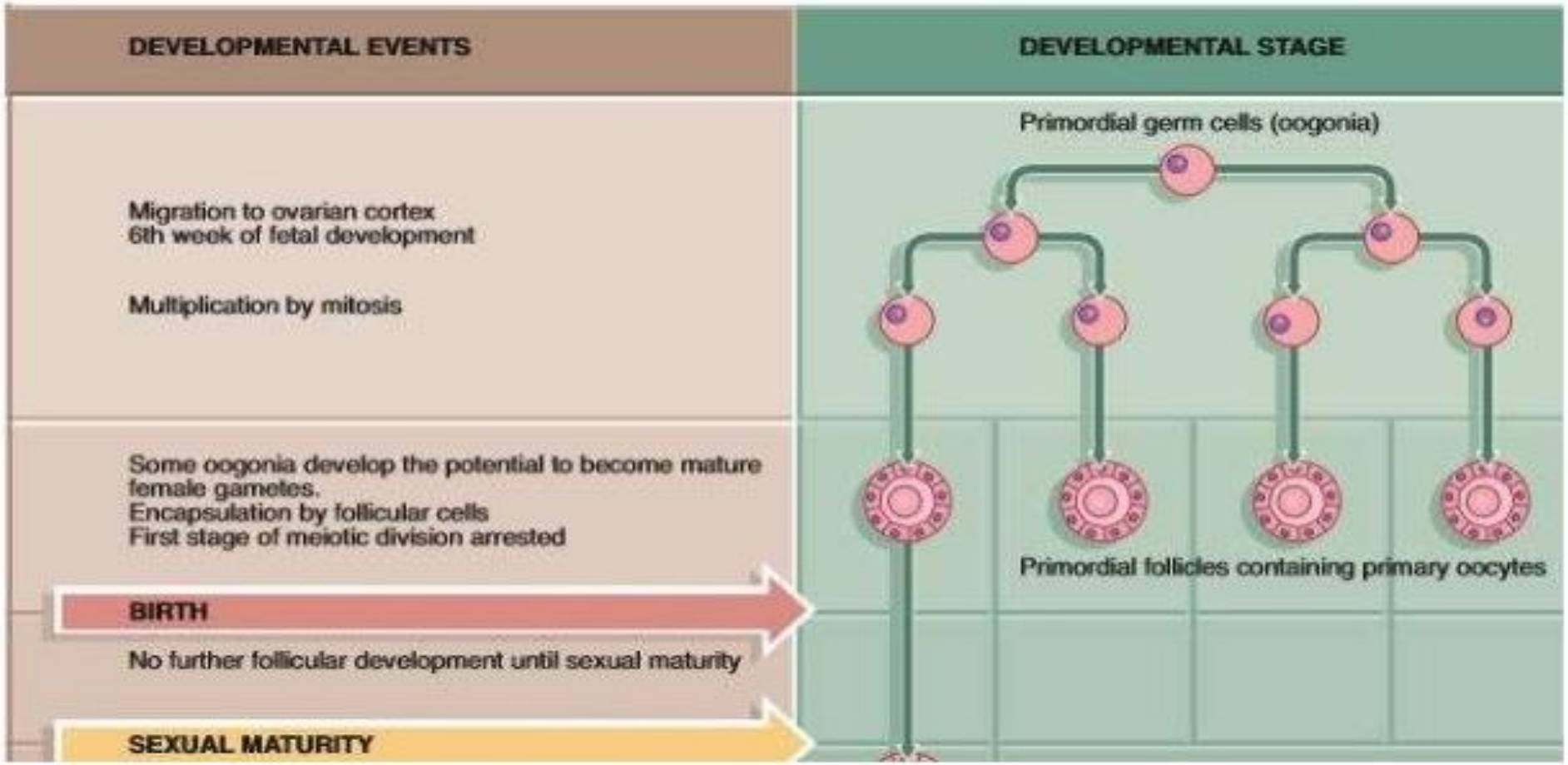
Follicular cells are flat epithelial cells that originate from surface epithelium covering the ovary, are surrounded by Granulosa cells - that have changed from flat to cuboidal and proliferated to produce a stratified epithelium

Ovary

- Size: 3x1.5x1 cm
- Location: Lateral pelvic wall
- Coverings:Extension of mesovarium forming germinal epithelium, overlying tunica albuginea
- Parts:Cortex & Medulla

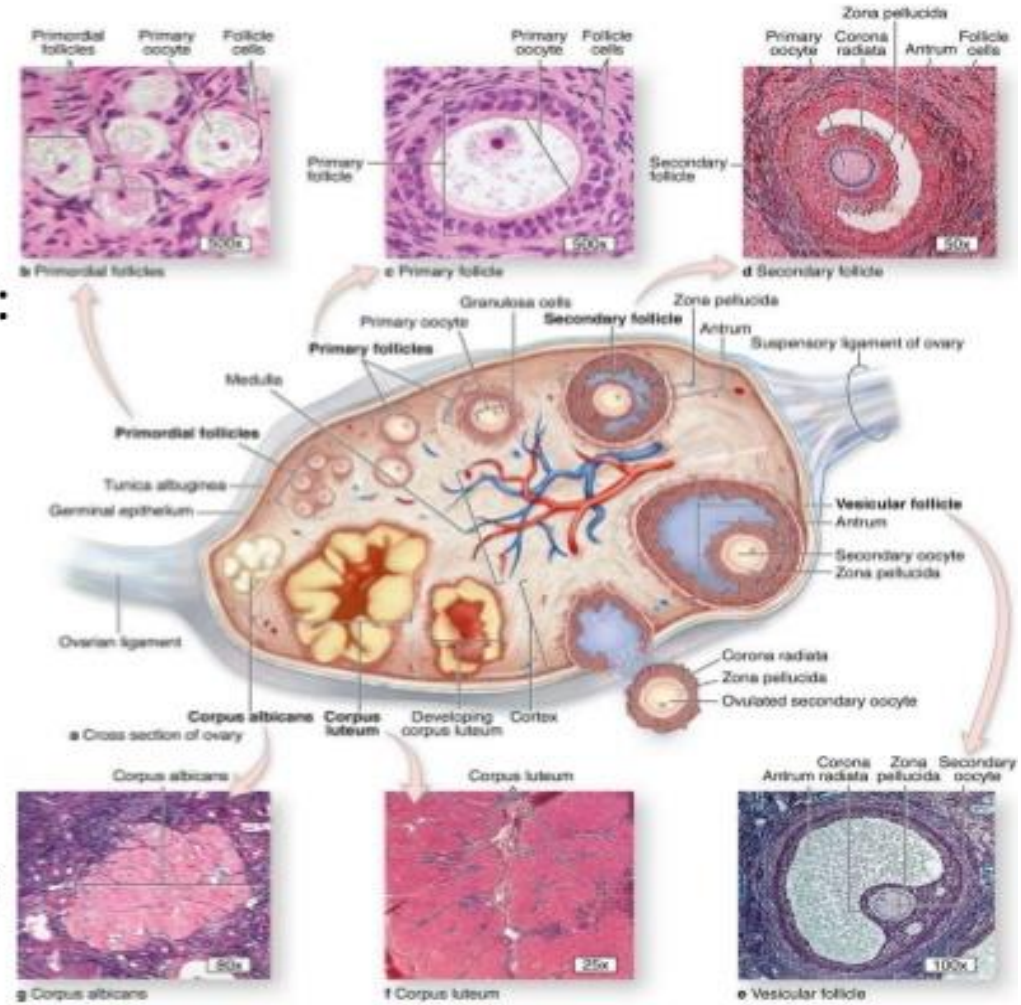


Development of Ovary



Ovary

- Cortex: outer part consists of:
- Stroma: connective tissue & stromal cells
- Paranchyma: different phases of ovarian follicles



CORTEX:

The outermost layer of the ovary composed of stroma and developing follicle.

STROMA :

comprises the bulk of ovarian tissue contains lutinized stromal cells, decidual cells, smooth muscle, fat, neuroendocrine cells and endometrial stroma like cells.

MEDULLA:

The middle parts of the ovary composed of stroma, blood vessels and nerves.

Hilium: Where the blood vessels and nerve enter the Parenchyma.

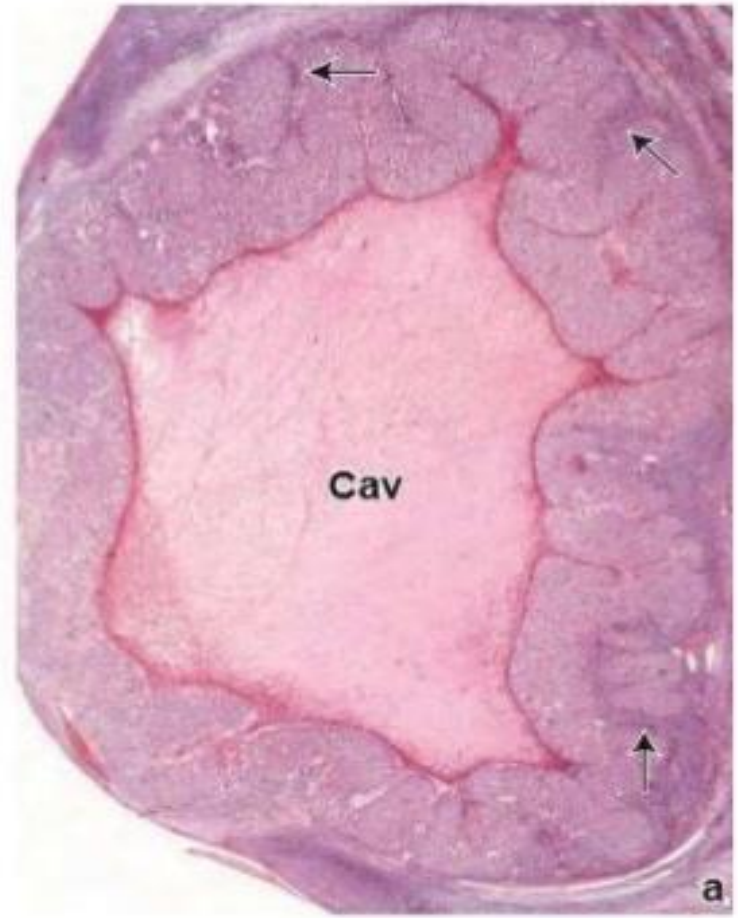
The ovaries are covered by surface epithelium.(OSE)
OSE is a modified epithelium which is composed of a delicate single layer of cuboidal to columnar cells.

STROMA of the Medulla are composed of fibroblasts, collagen and elastic fibers. Which contains clusters of blood vessels transgressing from the hilium . Hilium contains hiller cells presumed to be vestigial remnants of the gonad from its ambisexual phase.

CORPUS LUTEUM: It is formed by thecal and granulosa cells after ovulation has occurred.The follicle collapsed into a folded structure.The thecal cells and granulosa cells triple in size and start accumulating luteum .

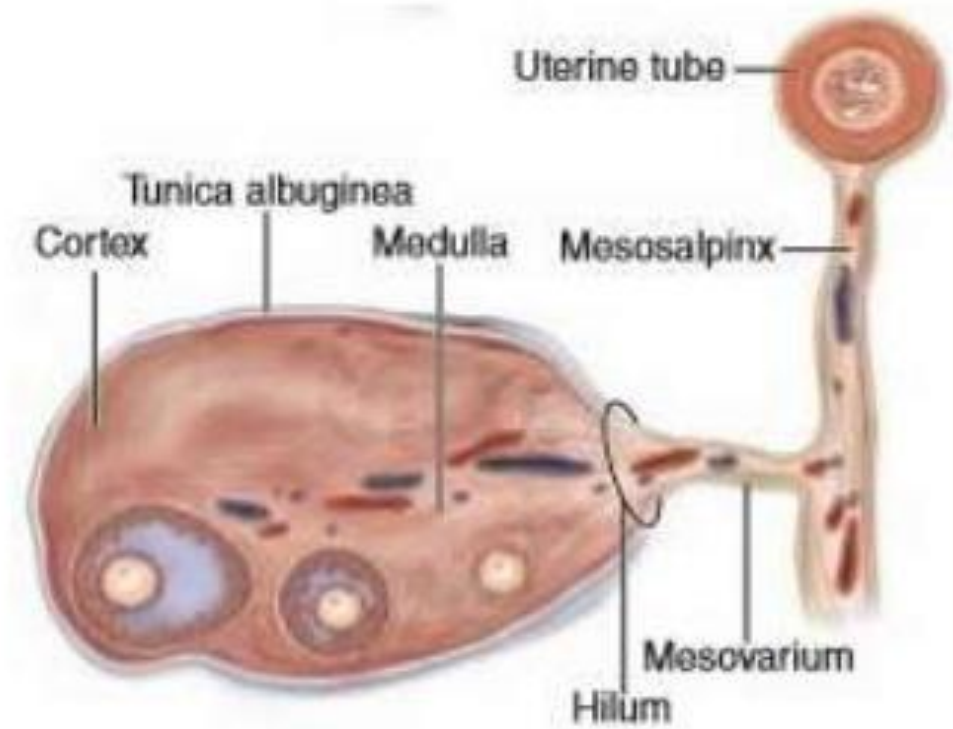
Corpus Luteum

- After ovulation reorganization of collapsed follicular wall
- Formation of the corpus hemorrhagicum
- Invasion of connective tissue
- Differentiation of granulosa & theca interna cells into luteal cells – luteinization
- Leuteal cells have structure of steroid secreting cells.



Ovary

- Medulla: Most internal part of the ovary, consists of loose con. Ts. and blood vessels entering through hilum from mesenteries.



OVERIAN FOLLICLE:

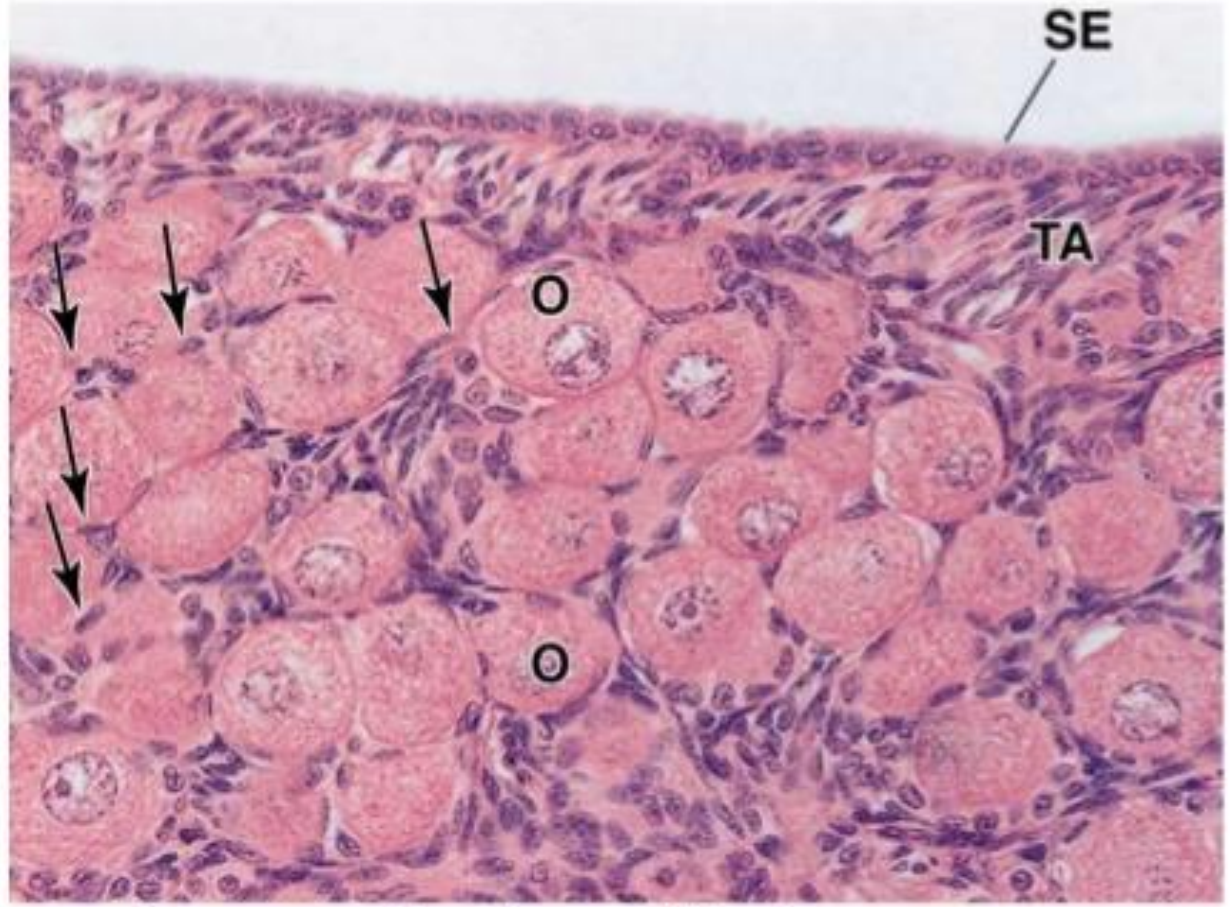
Overian follicle embedded in the stroma of the cortex. It consists of one oocyte and surrounding follicular cells.
Stages of follicular development .

Primordial cells

Primary follicle

Secondery follicle or Growing follicle

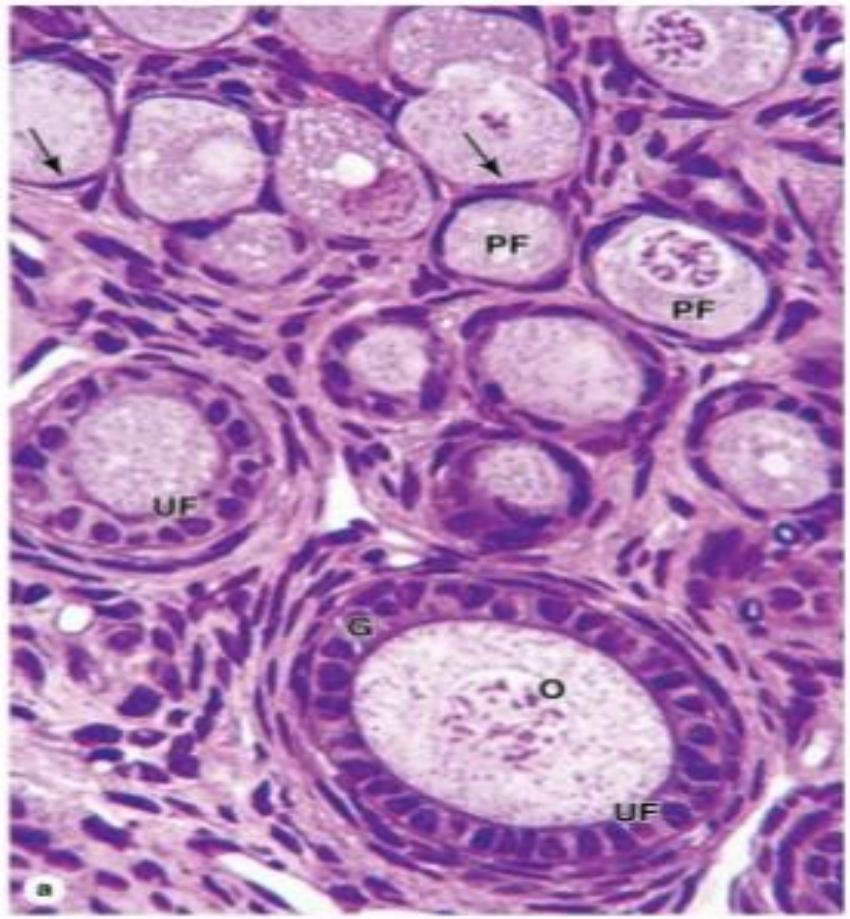
Mature follicle:Antral and Graffian follicle.



Primordial Follicle

Prim. Oocyte 25 µm in diameter with pale staining large nucleus in 1st Meiotic prophase, surrounded by a single layer of follicular cells resting on B/M

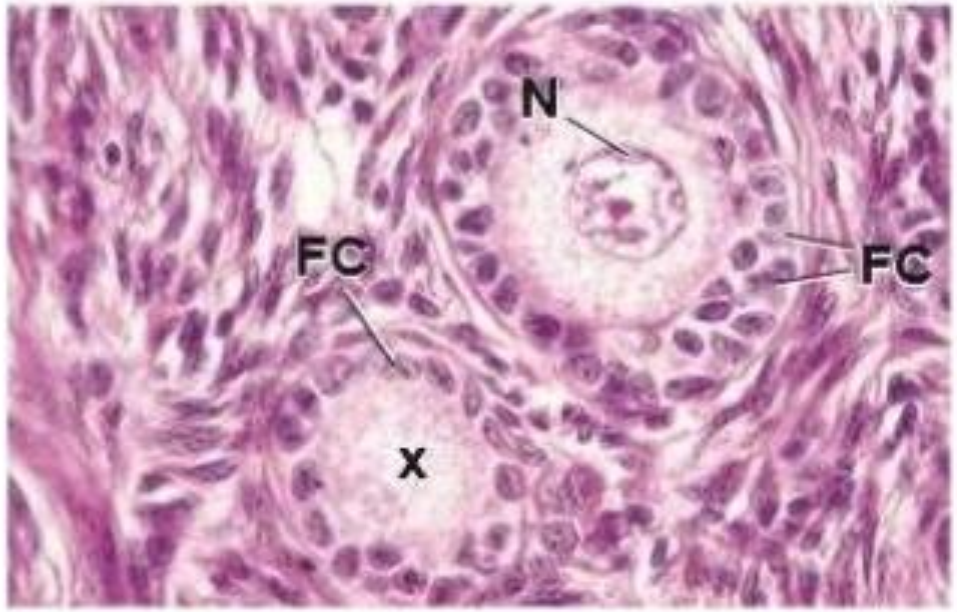
Primary Follicle



- Growing follicles include:
- Uni-laminar primary follicle
- Multi-laminar primary follicle
- Antral follicle
- As follicles started growth three things change:
- Oocyte
- Follicular cells
- Surrounding stroma

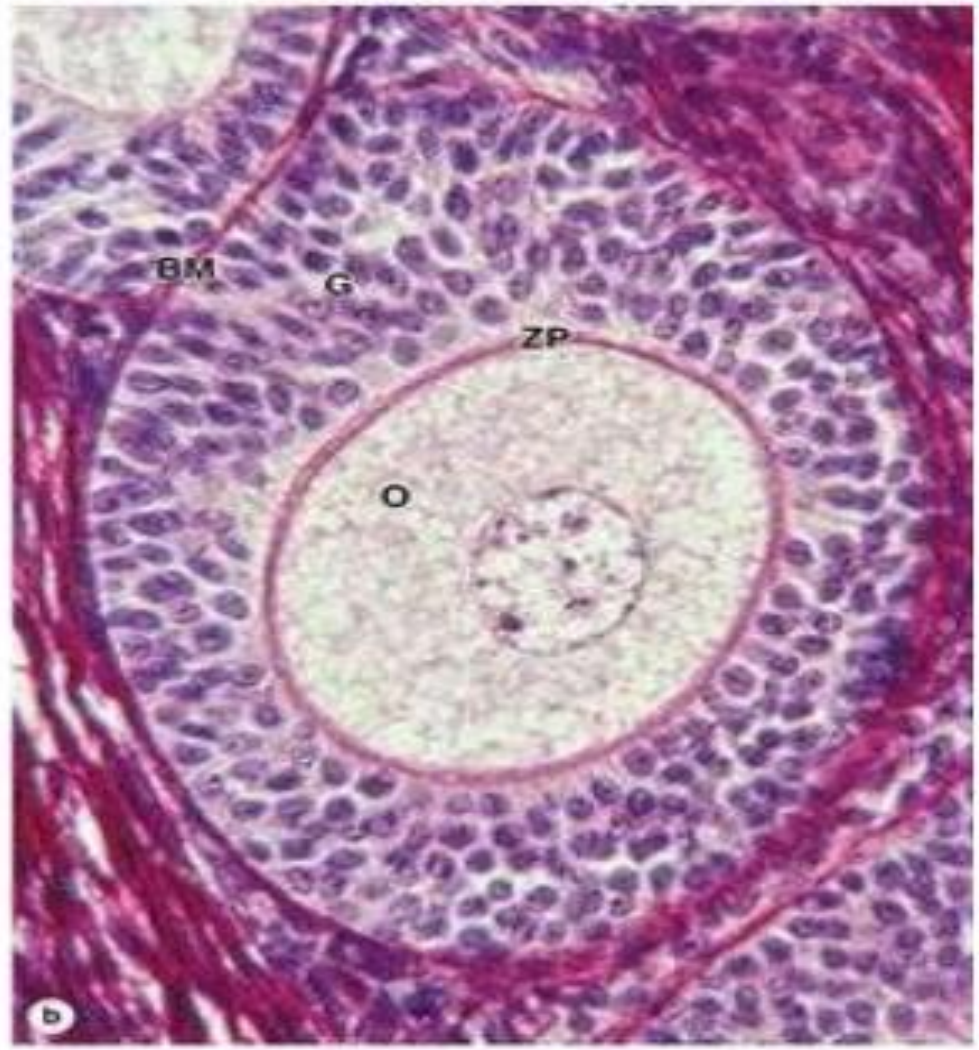
Primary Follicle

- Formation of primary follicle – marked by
- Growth of oocyte size from 25-30µm to 50 then 80µm
- Flattened follicular cells start mitosis and become cuboidal then single layer of columnar cells forming unilaminar primary follicle



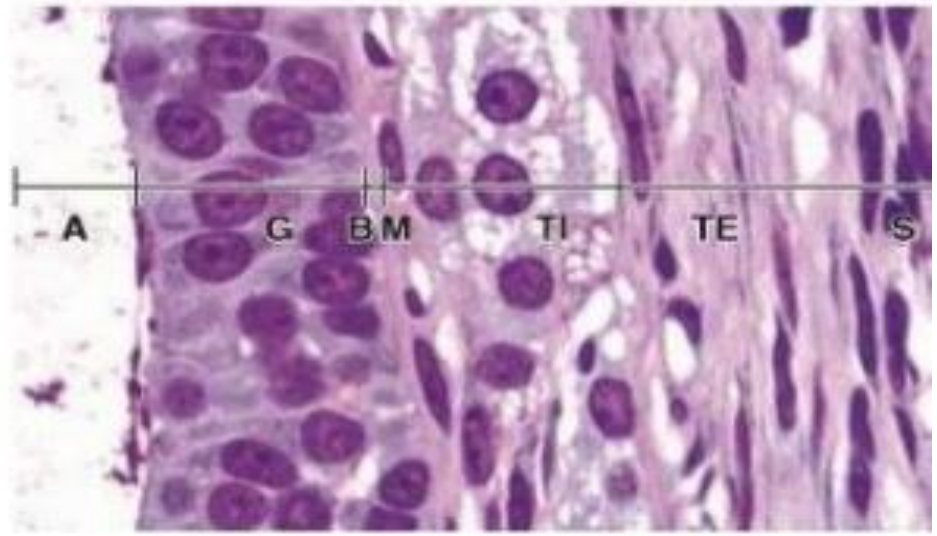
Primary Follicle

- Further proliferation of follicular cells forming multilaminar primary follicle- stratum granulosum
- With growth of oocyte it started secreting zona pellucida – gel like material rich in glycopr. & glycosaminoglycans



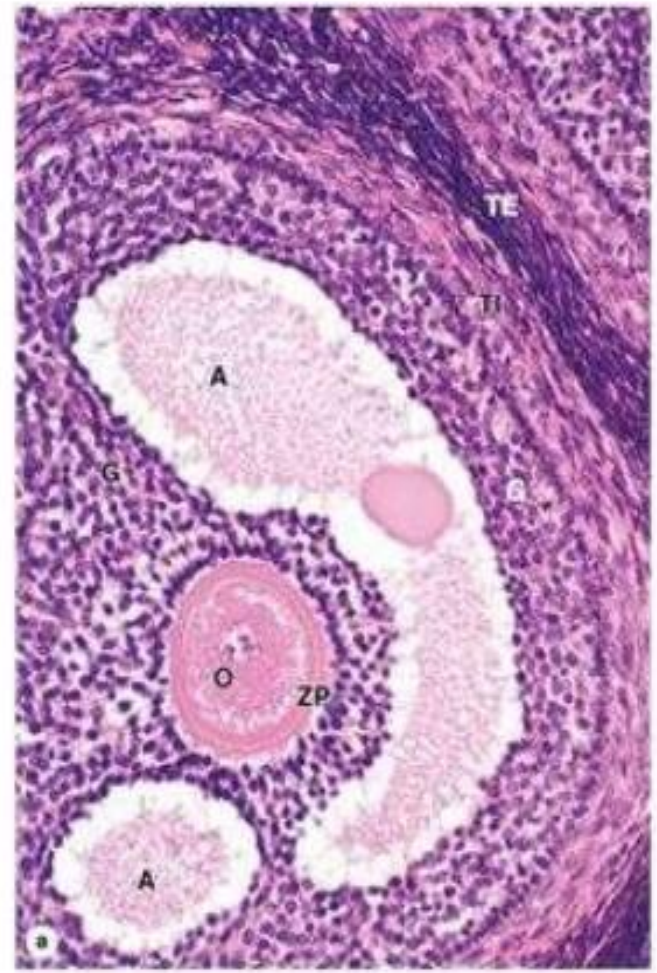
Growing Follicle

- With further growth surrounding connective tissue stroal cells specialize forming a sheath "**Theca folliculi**"
- **Fibroblasts** outside the growing follicles have developed as a steroid-secreting theca interna (TI)
- A covering theca externa where some stromal cells become smooth muscle cells



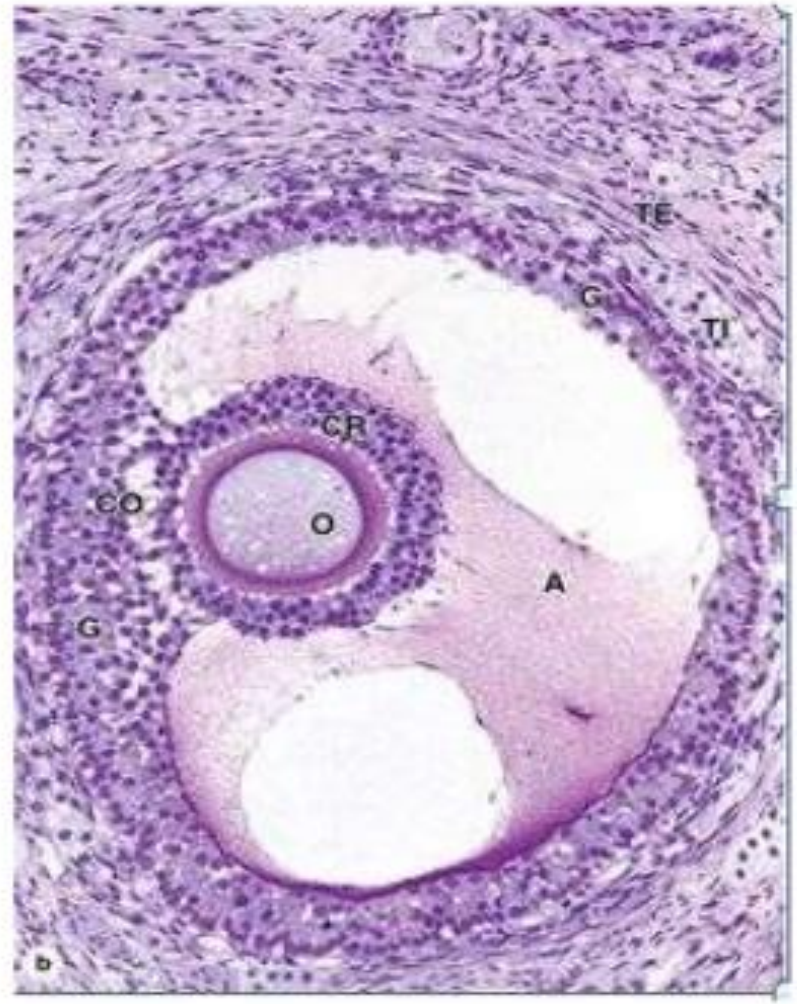
Antral Follicle

- An antral follicle with large, fluid-filled antral cavities or vesicles (A) forming within granulosa layer by the follicular cells.
- The oocyte (O) is surrounded by the zona pellucida (ZP) and granulosa cells (G).



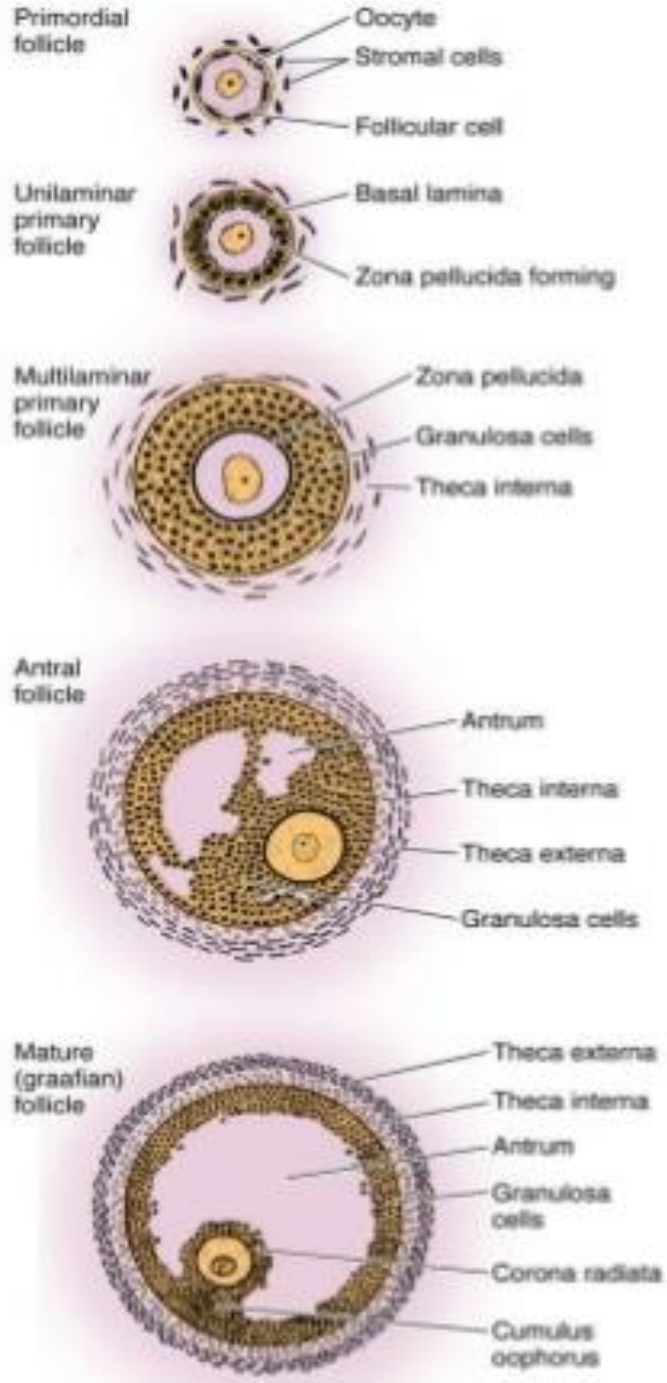
Antral Follicle

- Granulosa cells also line wall of follicle.
- Granulosa cells make up the **corona radiata**.
- The corona radiata and oocyte are attached to the side of the follicle within a larger mass of granulosa cells called the **cumulus oophorus**



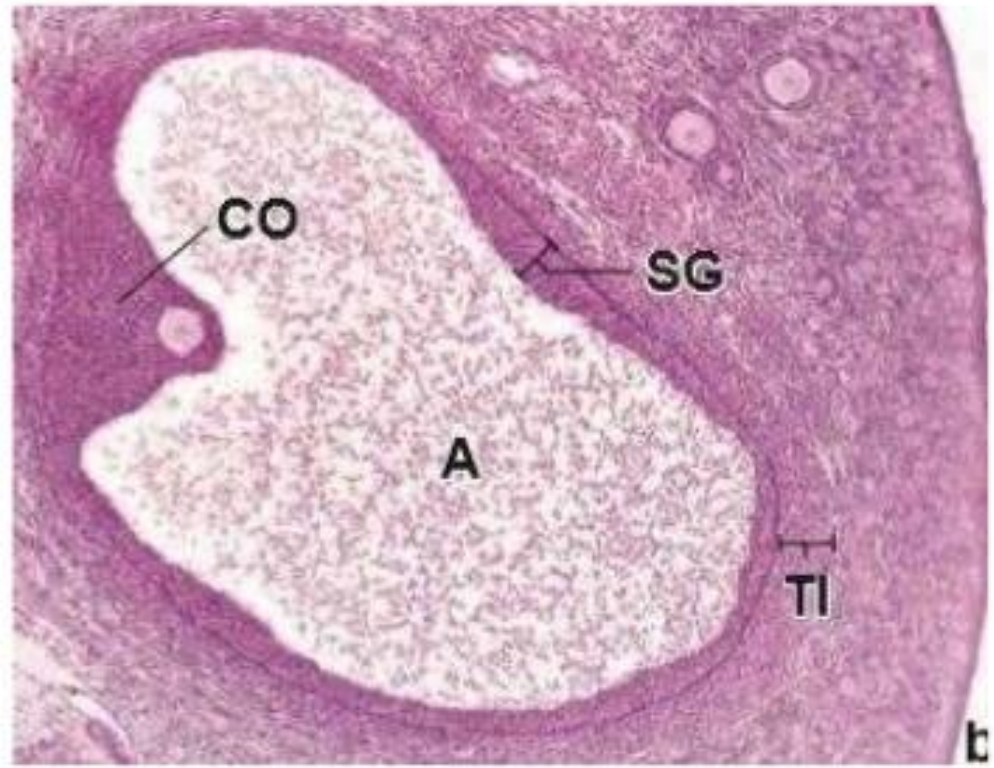
Graafian follicle

- When size of growing follicle reaches 10mm called Graafian follicle
- Oocyte development:
- ➢ Formation of cortical granules
- ➢ Formation of microvilli
- Follicular development:
- Single layer of corona cells
- Accumulation of fluid with increase in size upto 10mm.



Graafian follicle

- A buldge on suface of ovary
- Development of theca cells
- Accumulation of lipid drolets in theca interna cells



Ovulation & Atresia

- Release of secondary oocyte from mature graafian follicle, during LH surge.
- Factors responsible are
  - Increase in volume & pressure of follicular fliud
  - Lysis of follicular by activated plasminogen
  - Contraction of smooth muscles in theca externa
- Only one follicle reaches this fate others undergo atretic changes. Atresia involves apoptosis and detachment of the granulosa cells, autolysis of the oocyte, and collapse of the zona pellucida. Macrophages invade the degenerating follicle and phagocytose the debris

PHYSIOLOGY OF MALE AND FEMALE REPRODUCTION OR REPRODUCTIVE PHYSIOLOGY

Function of the reproductive system

Sexual reproduction requires a male a**nd a female of the same species to copulate and combine their genes in order to produce a new individual who is genetically different from his parents .**

sexual reproduction relies on meiosis to shuffle the genes , so that new combinations of genes occur in each generation ,allowing some of the offspring of survive in the constantly – changing environment .

The male reproductive system produces , sustains , and delivers sperm cells (spermatozoa) to the female reproductive tract .

The female reproductive system produces , sustains , and allows egg cells (oocytes) to be fertilized by sperm . it also supports the development of an offspring (gestation) and gives birth to a new individual (parturition) .

Male Reproductive System

Testis : Sex organ that produces sperm in a process called spermatogenesis , and male sex hormones (testosterone).

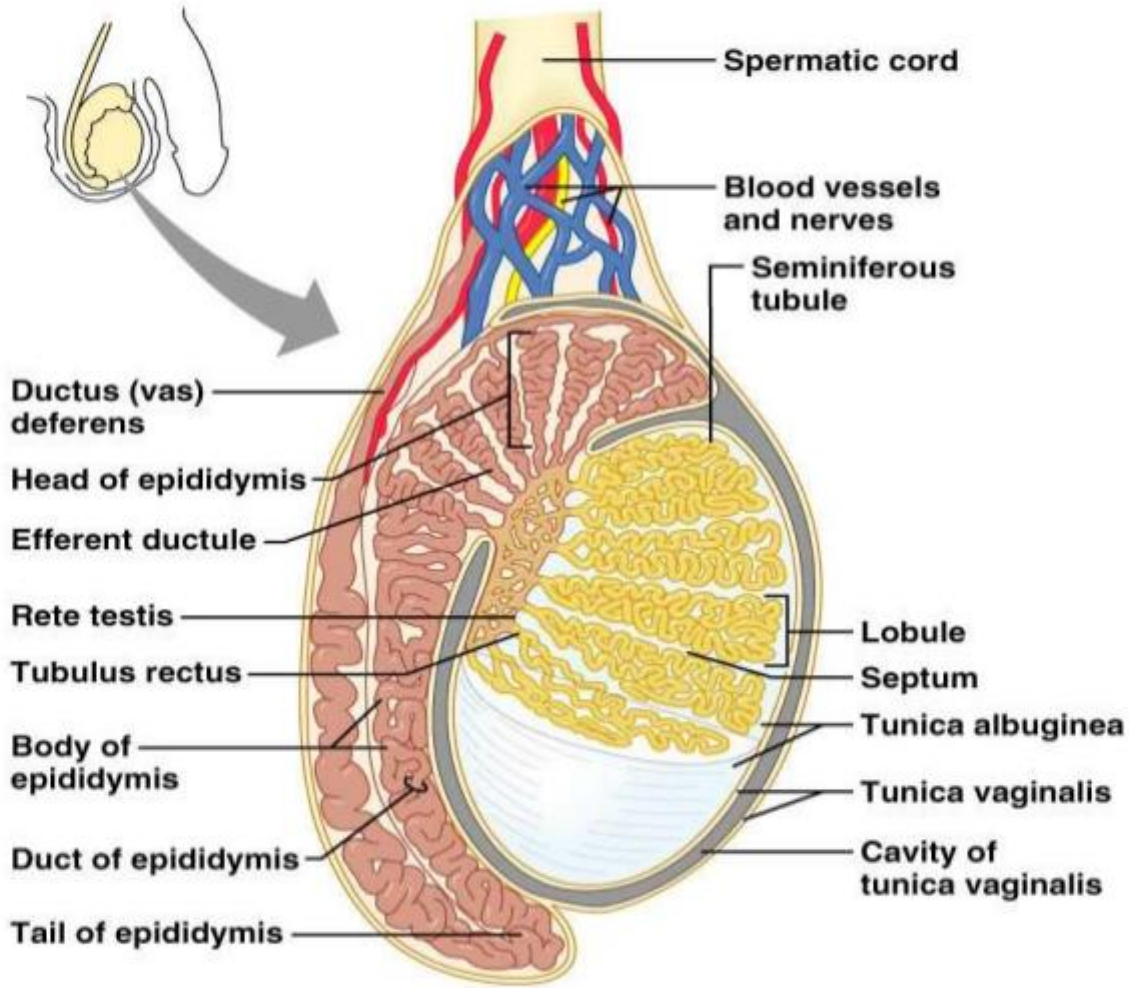
Developed in a male fetus near the kidneys , and descend to the scrotum about 2 months before birth.

Each testis is enclosed by a layer of fibrous connective tissue called tunica alumina .

Each testis contains about 250 functional units called lobules ; each lobule contains about 4 seminiferous tubules where spermatogenesis occurs .

All somniferous tubules in a testis converge and form a channel called rate testis .

Testis



(a)

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Scrotum: A pouch – like cutaneous extension that contains the two testes . Located outside of pelvic cavity to prevent overheating of testes [internal temperature of scrotum is always about 3 ˚F below body temperature] .

Epididymis: An expanded tubule from the rate testis where sperm is stored (for about 3 days) , matured and become fully functional.Contains cilia on its columnar epithelium that help move sperm toward vas deferens during ejaculation. .

Vas deferens: A tubule (about 10 inches long) that connects epididymis to the urethra for transporting sperm during ejaculation. Contains smooth muscle that undergoes rapid peristalsis during ejaculation .

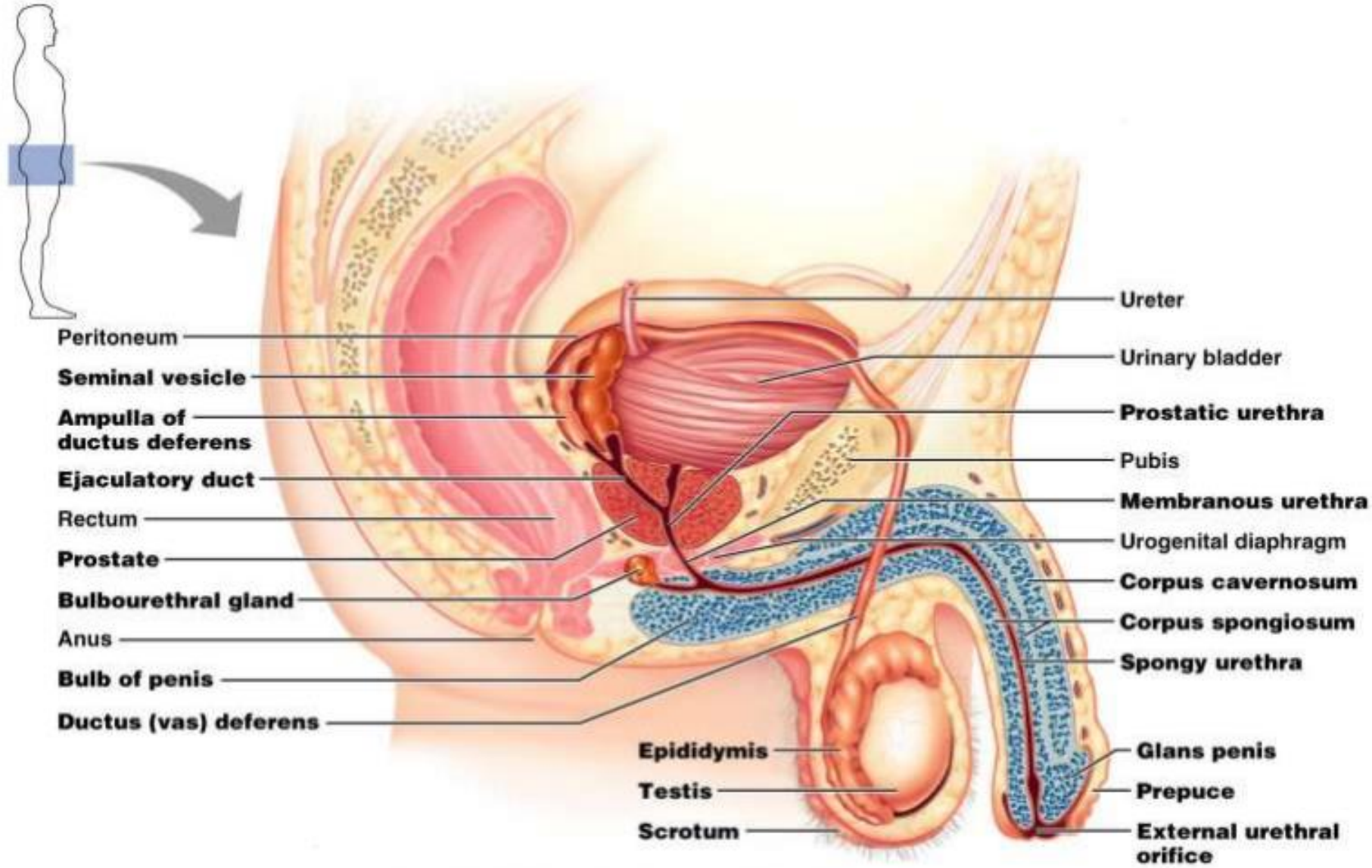
Accessory sex glands

Seminal vesicles: secrete an alkaline solution that makes up 60% of the semen volume ; this seminal fluid contains fructose (nutrient for the sperm) and prostaglandins (substances that stimulate uterine contraction during sexual excitation).

Prostate gland: secretes a slightly acidic , milky white fluid that makes up about 30% of semen volume ; this fluid helps neutralize the pH of semen and vaginal secretion.

Bulb urethral gland: secretes a clear lubricating fluid that aids in sexual intercourse.

Reproductive organs of the male



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Urethra: A tubule located inside the penis for urine excretion and semen ejaculation .Contains smooth muscle that performs rapid peristalsis during ejaculation .

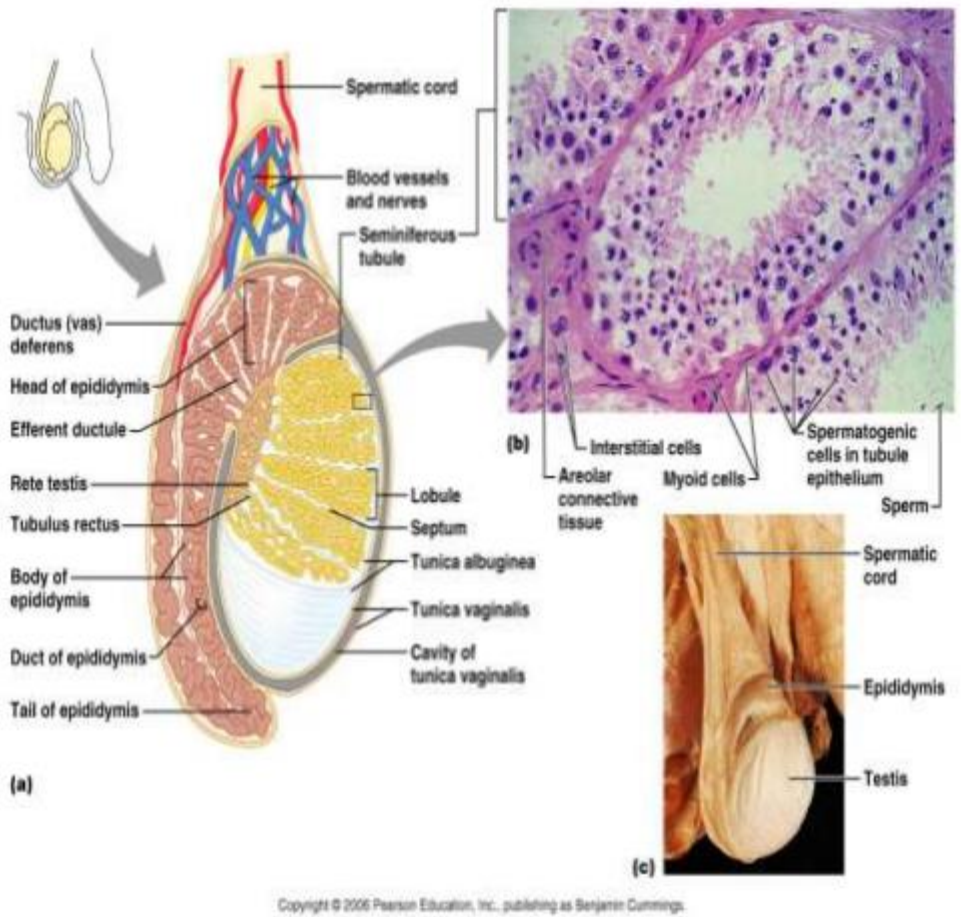
Penis: A copulatory organ that is responsible for delivering the sperm to the female reproductive tract. Contains 2 erectile tissues called corpus cavernosa and corpus spongiosum , where the latter one enlarges and forms the glans penis due to increased blood flow during sexual excitation .

During sexual excitement , parasympathetic nerves cause vasodilatation in the penis , allowing erectile tissues to swell
and erect the penis .

During ejaculation , sympathetic nerves cause vas deferens , urethra and erectile tissues to contract, forcefully expelling
semen (a mixture of sex gland fluids and about 300 million sperm) outward

Seminiferous Tubules

- About 1,000 **seminiferous tubules** in each testis conduct **spermatogenesis**.
- Between the tubules are specialized glandular cells called **interstitial cells** (or leydig's cells) which produce **testosterone.**
- Inside the tubules are specialized cells called **sertoli's cells** which support and nourish the sperm.



Spermatogenesis

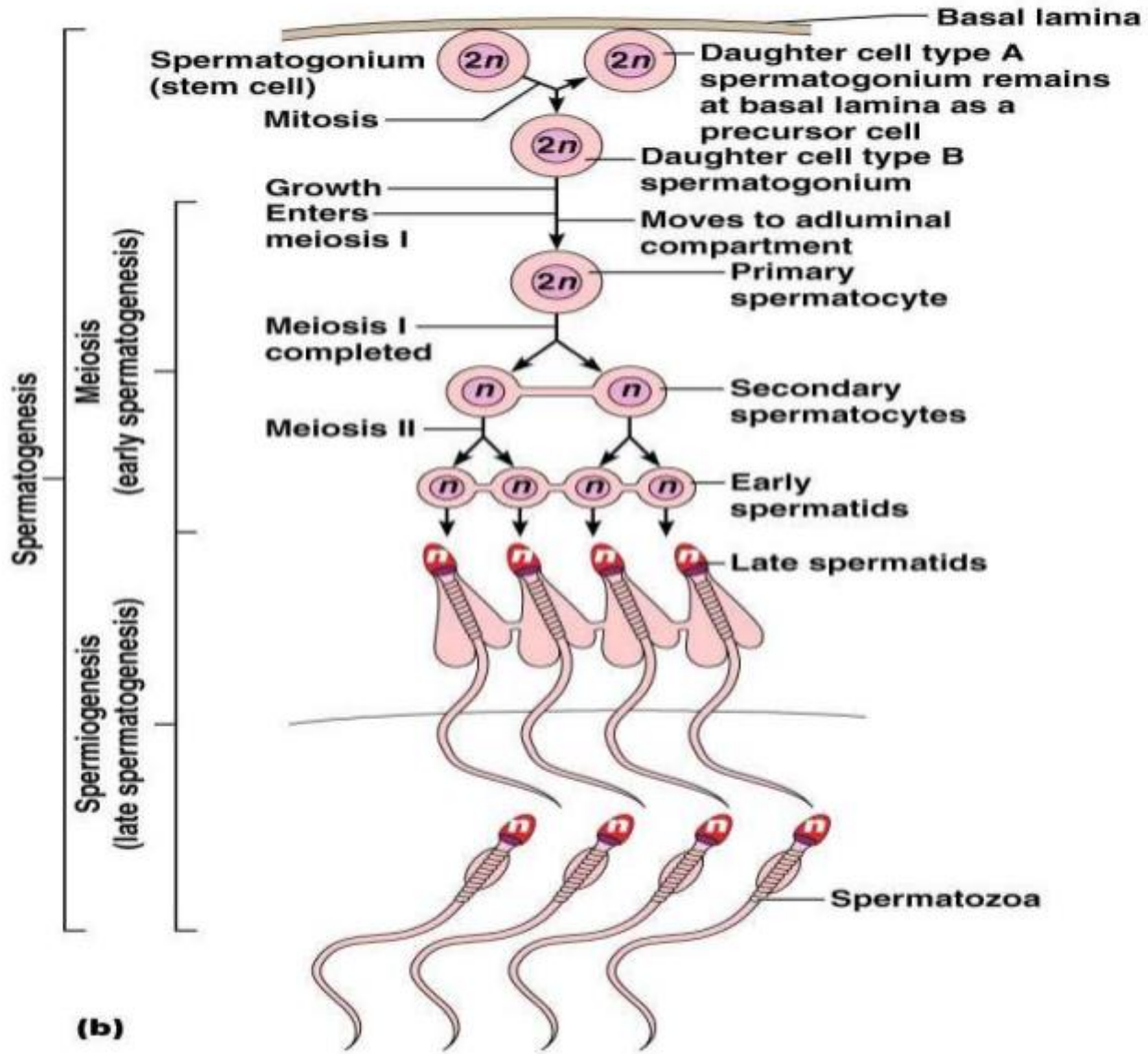
Spermatogonia (containing 46 chromosomes) undergo DNA replication and produce primary spermatocytes (with 46 pairs of chromosomes) .[some spermatozoid undergo mitosis to maintain a large population , so that spermatogenesis can be continuous for many decades].

Primary spermatocytes undergo "crossing - over" to shuffle their genes ,and undergo meiosis I which results in secondary spermatocytes (each containing 46 unique chromosomes) .

Secondary spermatocytes undergo meiosis II which produces spermatids (with 23 unique chromosomes) .

Spermatids now transform themselves into spermatozoa (also containing 23 unique chromosomes) in a final event called spermatogenesis .

Spermatogenesis



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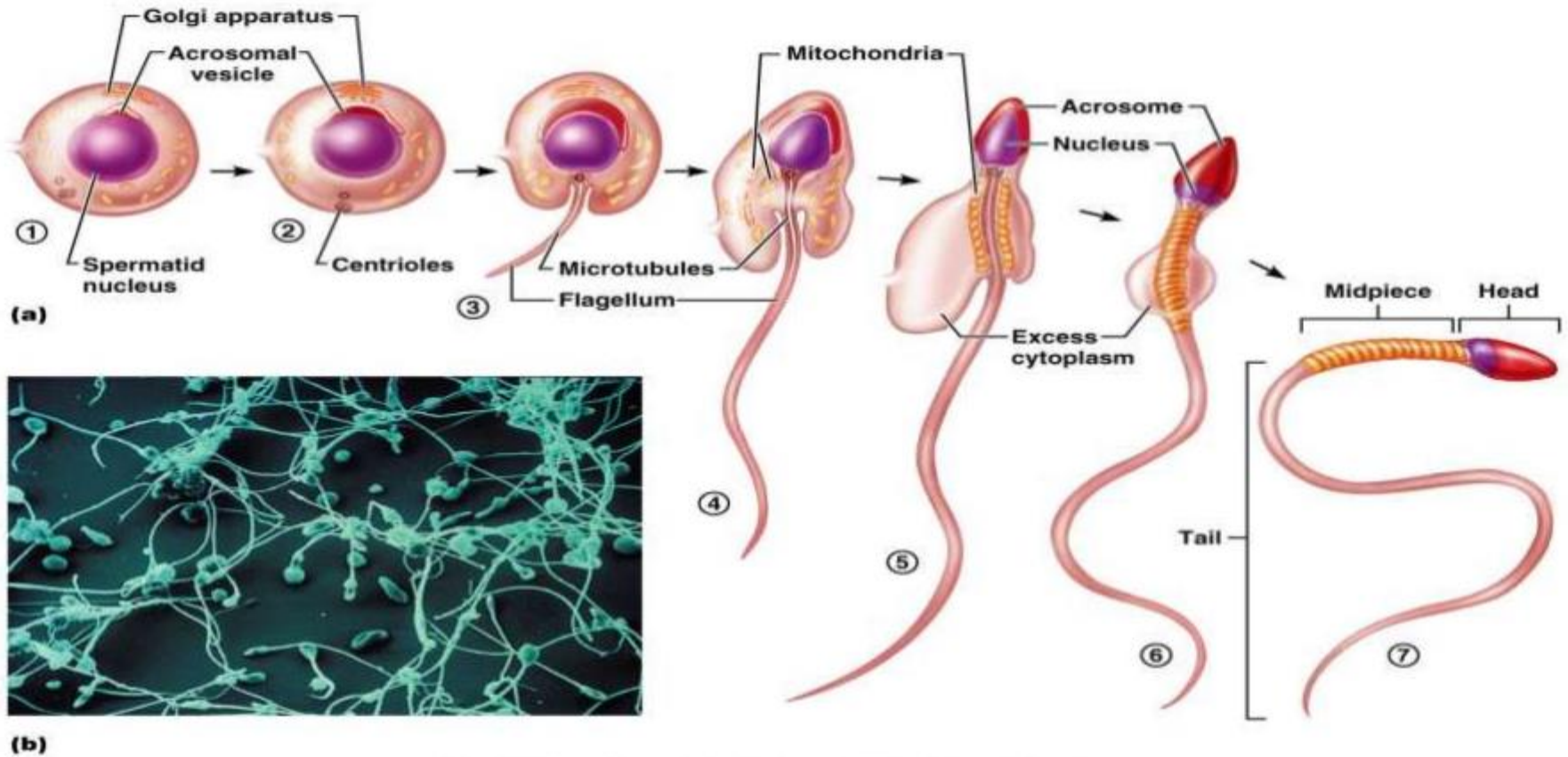
- Each spermatozoa consists of a head (which contains the 23 chromosomes), a mid piece (which stores mitochondria for energy production) , and a tail. The head is enclosed by a structure called **acrosome** which stores lays enzymes called **acrosin** for breaking down the coatings surrounding the egg.



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Journey of a Sperm

at the end of spermatogenesis , spermatozoa are propelled by cilia inthe inner walls of rete testis toward the epididymes (the tails of these sperm are not movable at this point) .

inside the epididymis, certain enzymatic reactions occur that allow spermatozoa to be fully matured and functional , but not yet have the ability to fertilize the egg .

if no ejaculation occurs during the 3- day storage time in the epididymis , phagocytes will destroy millions of older sperm in storage.

during ejaculation , rapid peristalsis in the epididymis and vas deferens propel the millions of sperm , passing the accessory sex glands ,and be expelled through the urethra into the vagina of the female .

after several minutes in the vagina (about 25% of sperm is destroyed by the acidic secretion of vagina), the tail becomes functional , propelling the sperm through the cervix and into the uterus.

Half of the sperm will swim into the left uterine tube , while the other half swim towards the right uterine tube . only one of theuterine tubes carries the egg cell.

sperm continue swimming toward the deeper end of uterine tube , against the expulsion force of the cilia lining the inner wall of uterine tube .

During this movement in the uterine tube, the acrosome is slowly activated to prepare for the release of acrostin enzyme.

By the time sperm has arrived at the ampoule region of uterine tube ,only about 50 sperm are viable enough to try to fertilize the egg. And usually only 1 sperm will penetrate through the coatings surrounding the egg.

Each ejaculation emits about 2-6 ml of semen which contains about 300-400 million sperm .

It takes the sperm about 2-12 hours to reach the fertilization site in the uterine tube , but many sperm can survive .some where in the female reproductive tract for up to 2-3 days .

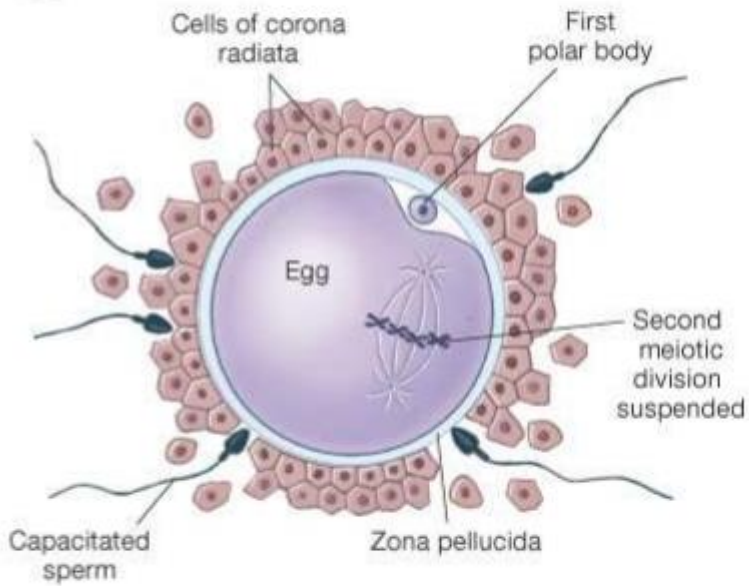
One of the sperm will eventually penetrate through zone pellucida ,and allow its cell membrane to fuse with the cell membrane of ovum .

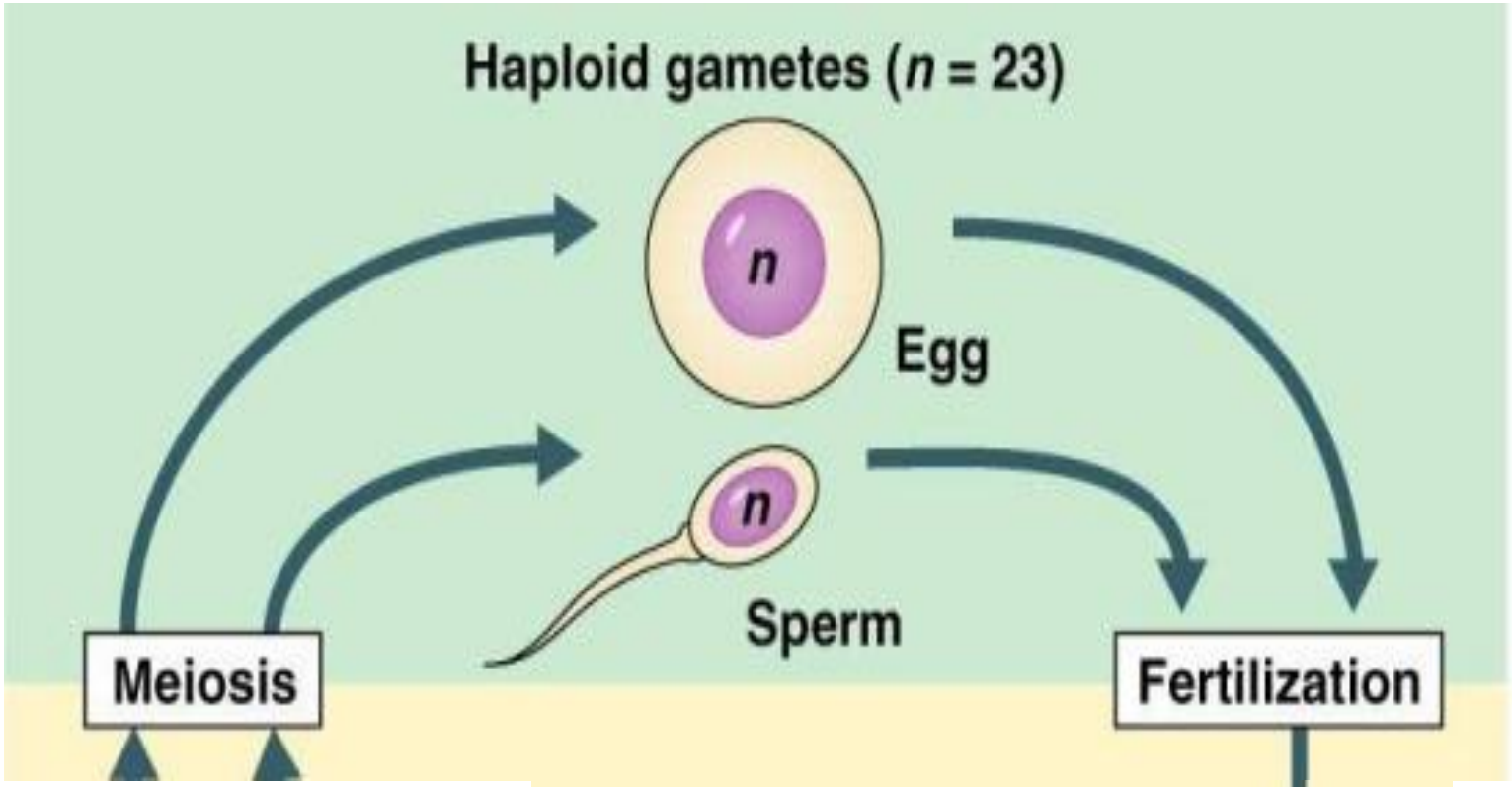
This causes a rapid electrical depolarization at the cell membrane of ovum, preventing other sperm entering the ovum (a phenomenon called polysperm) .

Fertilization

(a)

(b) Capacitated sperm release enzymes from their acrosomes in order to penetrate the cells and zona pellucida surrounding the egg.





MALE AND FEMALE

Mechanism of penile erection

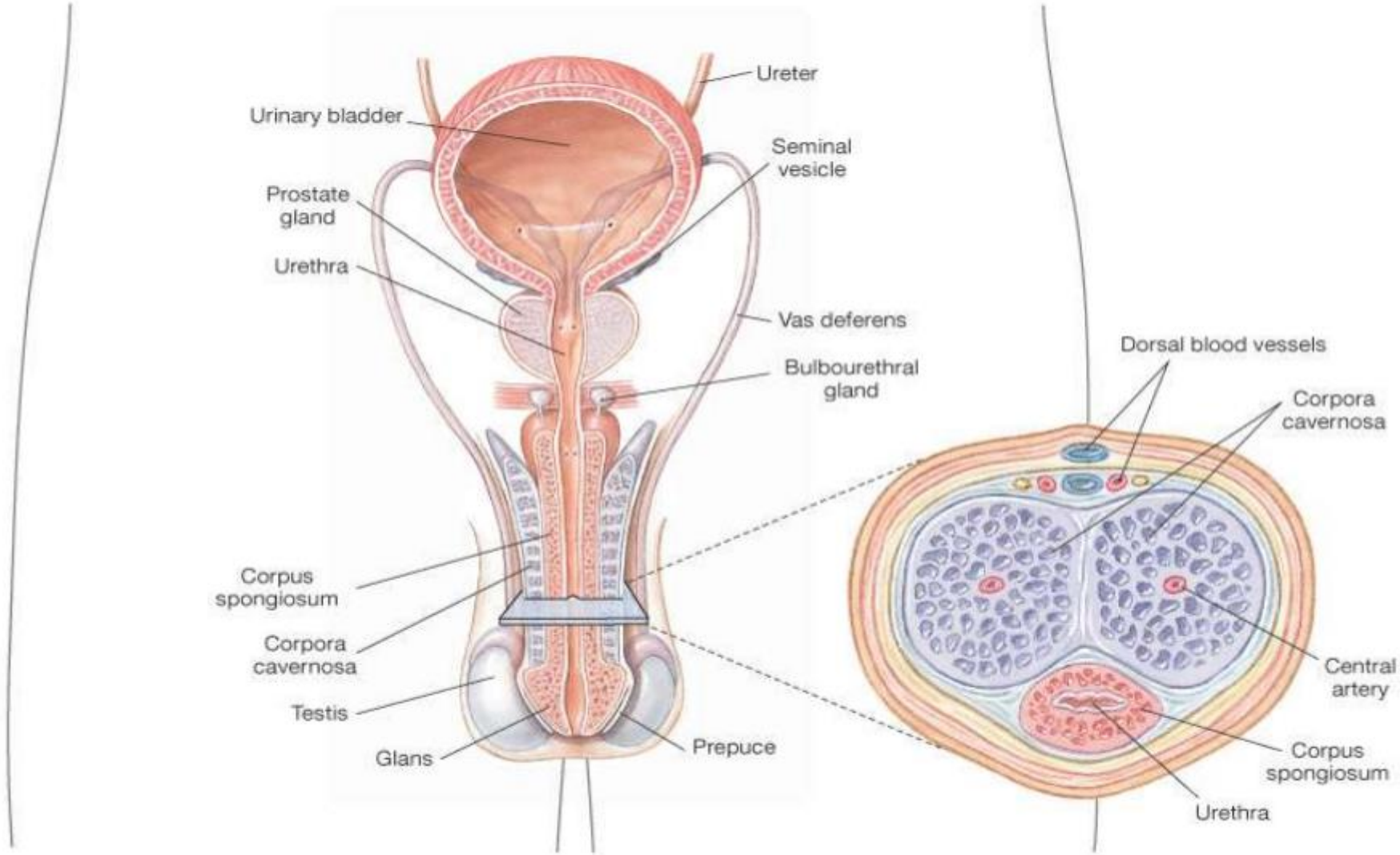
1. Sexual stimulation

2. Parasympathetic neurons release nitric oxide, causing dilation of small arterioles of penis (meanwhile veins are compressed reducing blood flow away from penis).

3. Blood accumulates within the vascular spaces in erectile tissue of penis .

4. Penis swells & become erect .

Reproductive structure in the male



Mechanism of emission & Ejaculation ♂

1. Intense sexual stimulation .

2. Sympathetic impulses contract smooth muscles causing:

- Peristaltic contractions in testicular ducts, Epididymis, vas deference and ejaculatory ducts .
- Rhythmic contraction in bulbourethral, prostate, and seminal vesicles .
- Rhythmic contractions in erectile columns of penis .

3. Emission-semen moves into urethra

4. Ejaculation- semen is forcefully expelled from urethra .

Hormonal control of ♂ reproductive function

1. Hypothalamic and pituitary hormones:

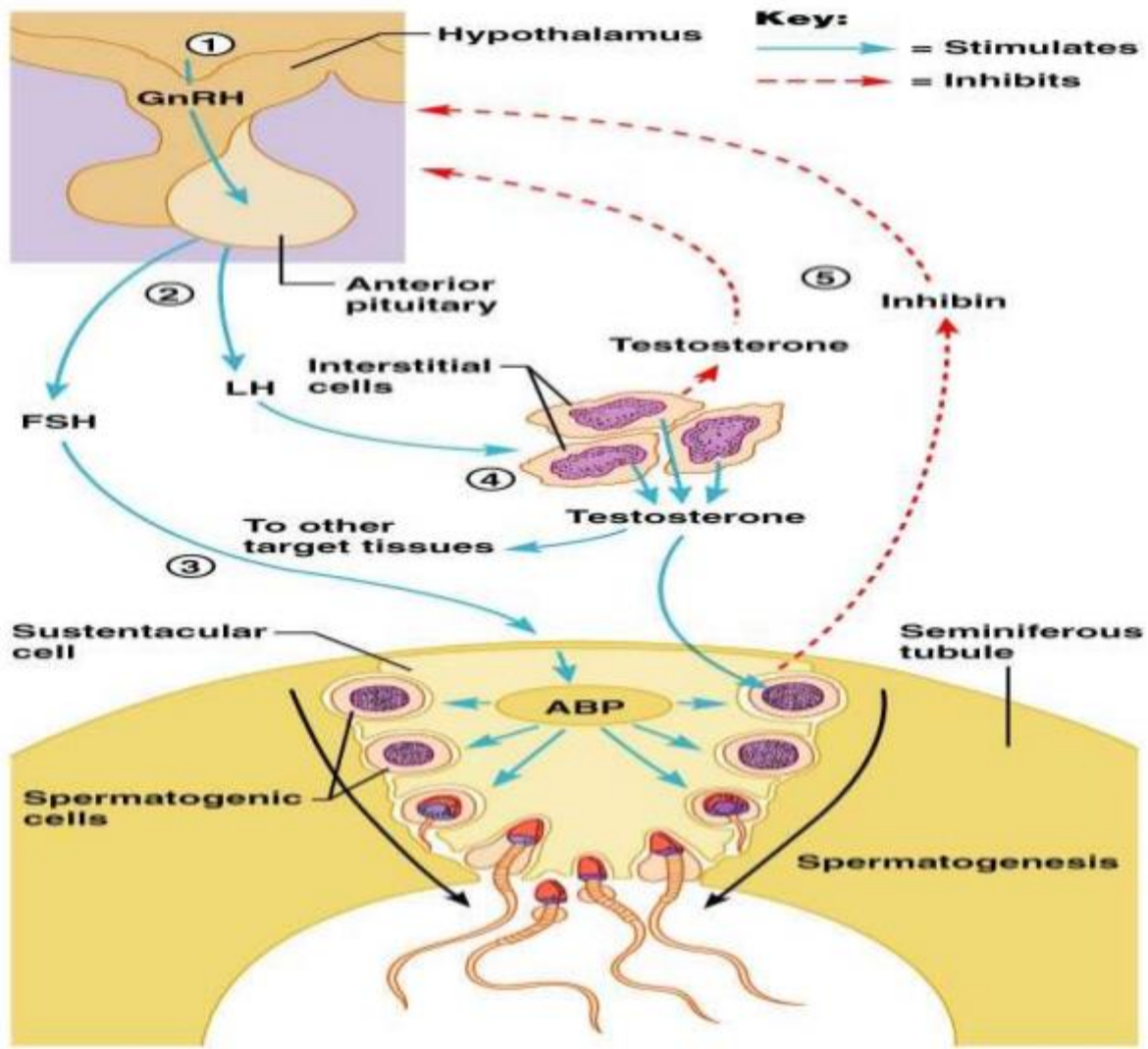
The male body remains reproductively immature until the hypothalamus releases GnRH (Ganadotropin – releasing hormone), which stimulates the anterior pituitary gland to release gonadotropins (FSH, LH) .

FSH- stimulates spermatogenesis .

LH (ICSH) – stimulates the interstitial cells to produce male sex hormone (testosteronne) .

Inhibin prevents over secretion of FSH . (Inhibin – from substentacular cells of seminiferous tubules).

The brain – testicular axis



Male sex hormones

2. Male sex hormones are called androgens . Testosterone is converted into dihydrotestestrone in some organs (stimulates cells of these organs) .

Androgens that fail to become fixed in tissues are metabolized in the liver and excreted . Androgens production increases rapidly at puberty

3. Action of testosterone :

stimulates the development of the male reproductive organs and causes the testes to descend . it is responsible for the development and maintenance of male secondary sex characteristics (facial hair , deeper voice , muscular development).

Regulation of male sex hormone

a. Negative feedback mechanism regulates testosterone conc.

As the conc. of testosterone rises , the hypothalamus is inhibited , and the Ant. pituitary secretion of gonadotropins is reduced .

As the conc. of testosterone falls , the hypothalamus signals the ant. Pituitary to secrete gonadotropins .

b. The conc. of testosterone remains relatively stable from day to day.

Female reproductive system

ovary :

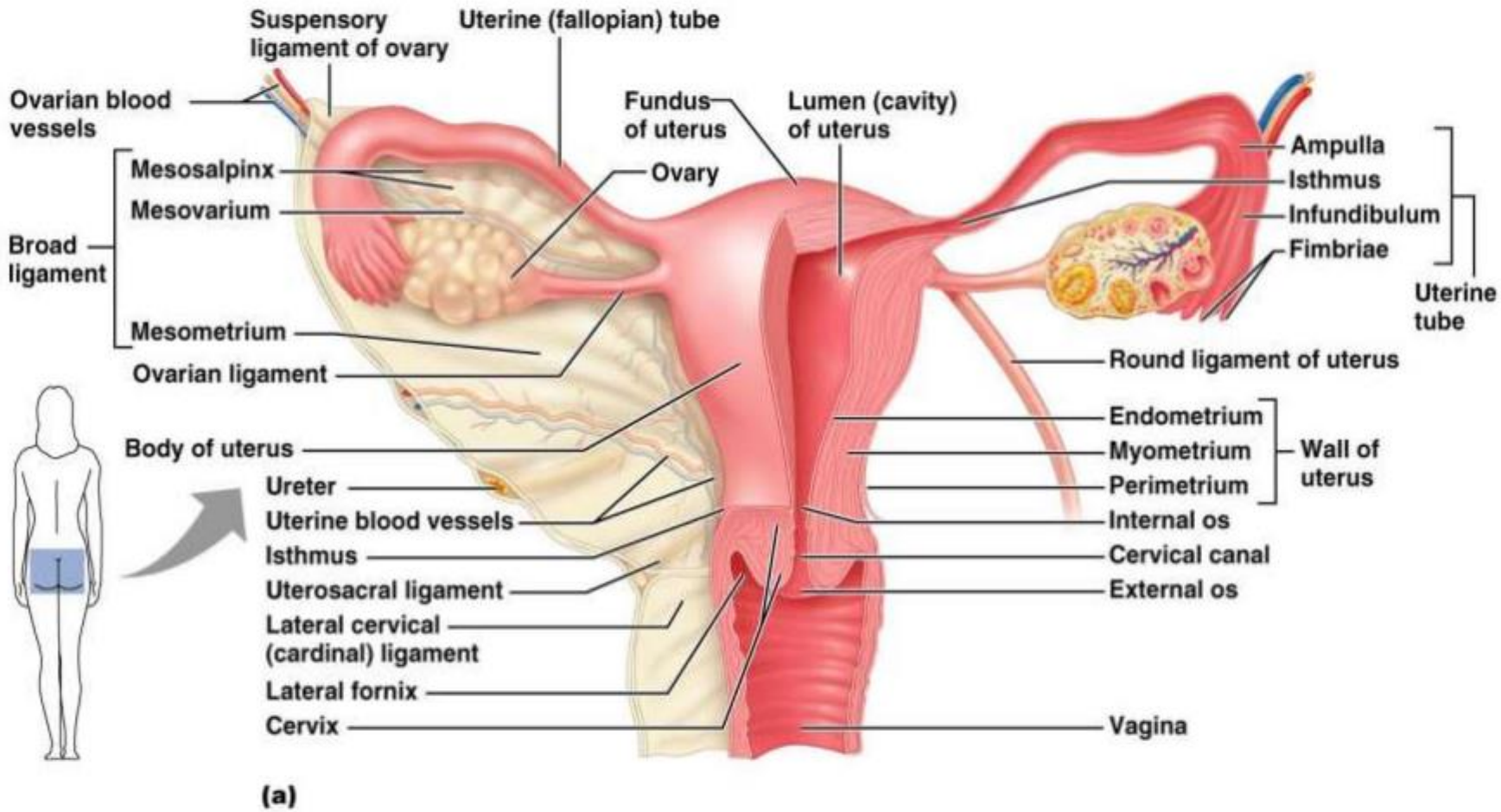
primary sex organ that produces egg cells in a process called oogenesis , and also produces female sex hormones such as estrogens and progesterone.

Developed near the kidneys during fetal development ,and toward the end of pregnancy descend into the pelvic cavity .

Consists of ovarian cortex where the ovarian cycle occurs , and ovarian medulla where scar tissues and connective tissue are located .

Enclosed by a layer of cubical cells called germinal epithelium. bound to the uterine tubes and uterus by ovarian ligaments .

Internal reproductive organs of a female



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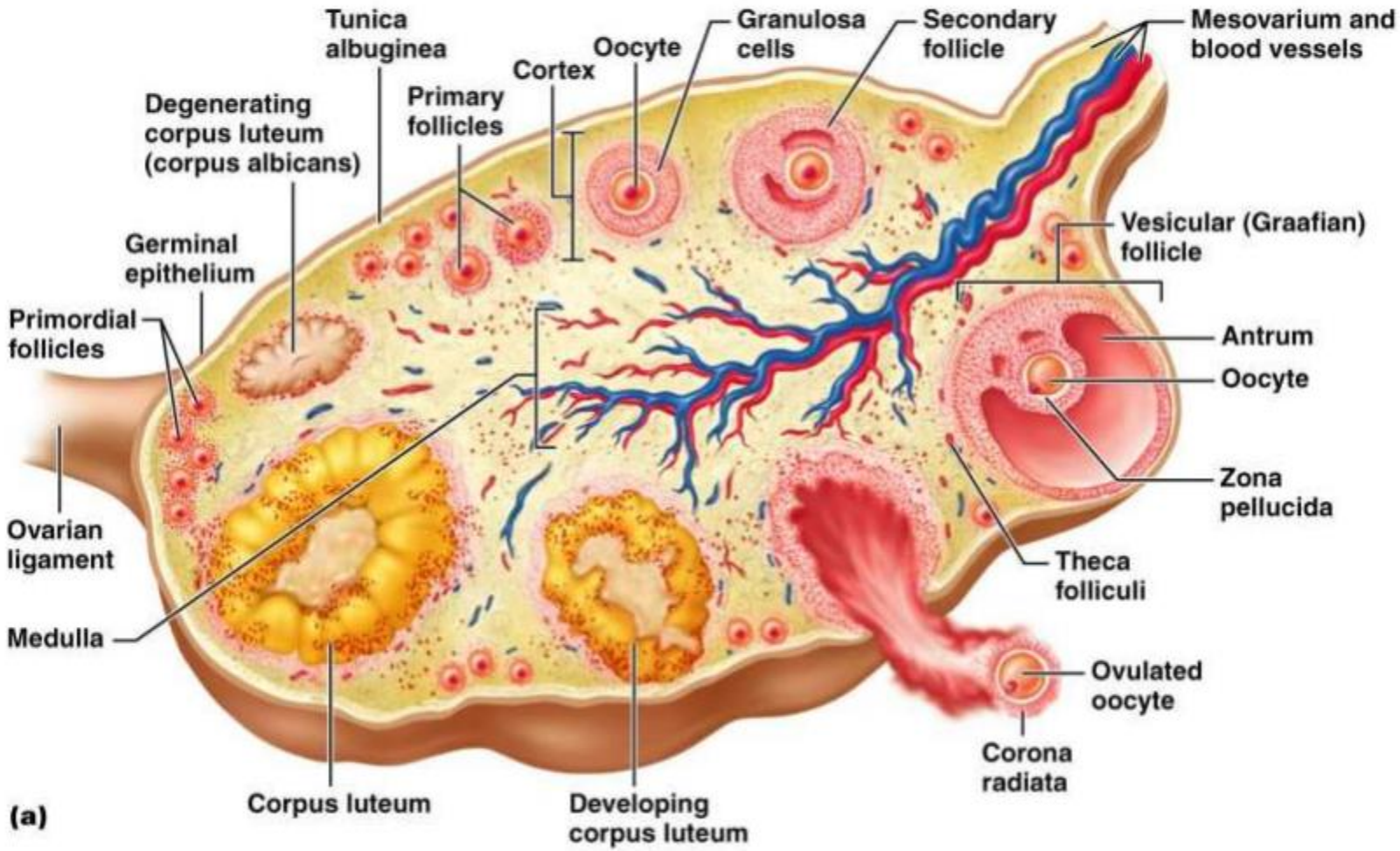
Structure of an ovary



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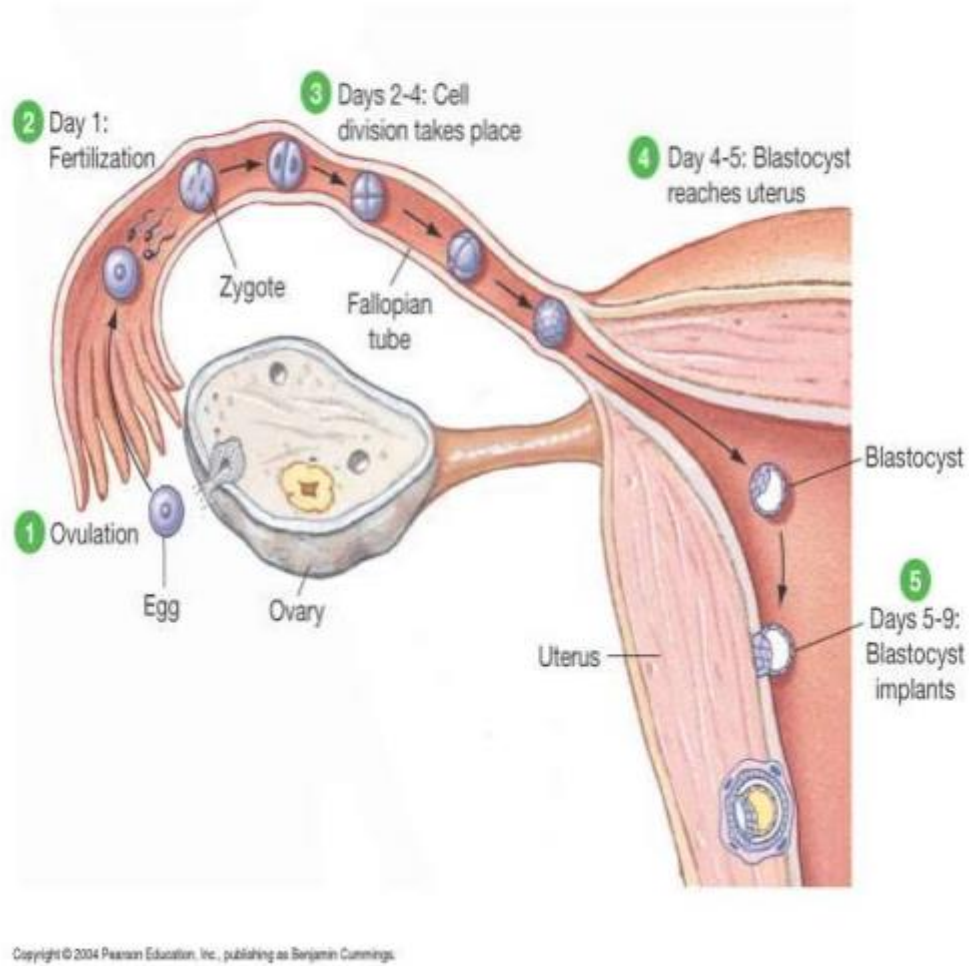
- **Uterine tube** (or fallopian tube): consists of **firmbriae** , finger – like appendages that collect the ovum from the ovary during ovulation.
- **Infundibulum** channels the ovum from the firmbriae into the uterine tube .
- **Ampulla** is the curvature of the uterine tube where most fertilization occurs .
- inner wall of uterine tube is made of ciliated mucosa , where the cilia propel the ovum toward the uterus .



Uterus

A pear – shaped cavity formed by the union of the two uterine tubes .

Composed of 3 layers of tissue – perimetrium (fibrous connective tissue) , myometrium (smooth muscle), and endometrium (epithelial and connective tissues) .

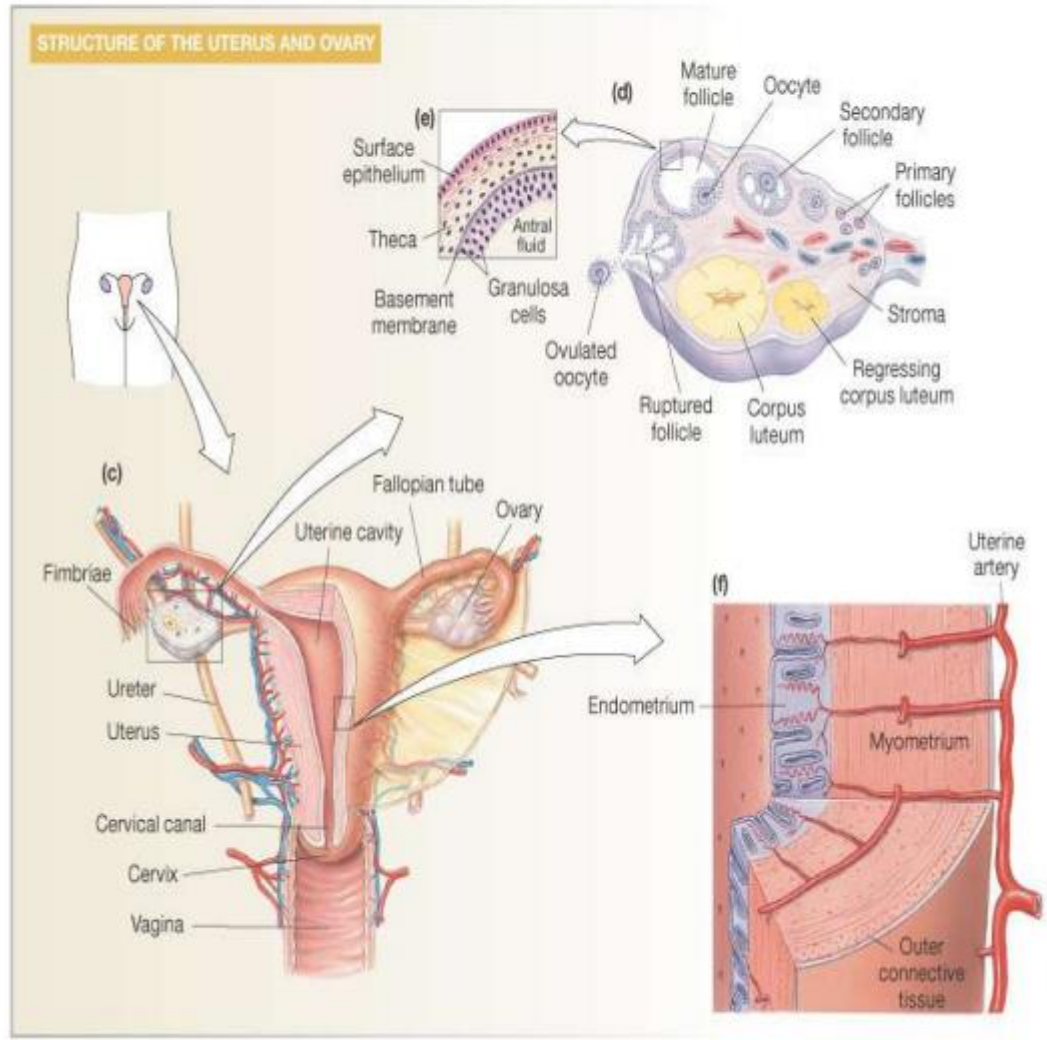
After fertilization , embryo adheres to the endometrial layer for further development – an event called implantation .

To prepare for implantation and development , endometrium is stimulated by estrogens to thicken and becomes vascularzed – a process called the menstrual cycle .

Myometrium ,under the stimulation of oxytocin, contracts during labor to expel the fetus into the vagina .

The base of uterus is closed by a narrow passageway called cervix to prevent the entry of foregin substances

- **Vagina:** an elastic channel inferior to the cervix that serves as the "birth canal" during parturition.
- Also serves as the copulatory receptacle , where it receives the penis during sexual intercourse.
- In addition to the acids secretion from cervix , it also coveys uterine secretions (i.e. menstrual flow).



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Oogenesis

In the ovarian cortex ,a process called oogenesis (formation of egg) occurs to develop a mature ovum . Before birth , several million cells called primordial oocytes exist in the ovaries – most of them spontaneously degenerate .

At birth , only 1 million primordial oocytes are left ; and by puberty (age 10-11) ,only 400,000 remain in the ovaries .

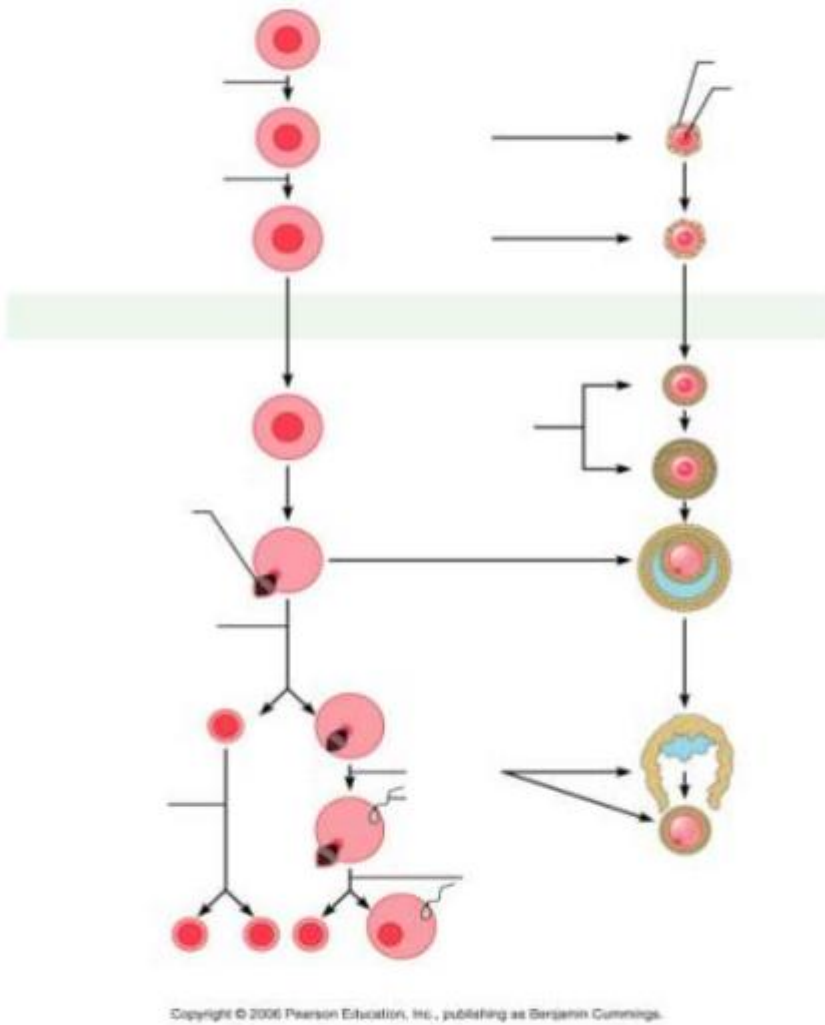
From puberty to menopause , some of these primordial oocytes (containing 46 chromosomes) undergo DNA replication and become primary oocytes (with 46 pairs of chromosomes)

.

Primary oocytes will then undergo "crossing - over" to shuffle their genes, and meiosis I will occur to divide the cells into secondary oocytes (containing 46 unique chromosomes) and the first polar bodies (also containing 46 unique chromosomes ; but will be degenerated) .

Events of oogenesis

- oogenesis now is arrested where the ovary discharges a mature secondary oocyte into the uterine tube (in a process called **ovulation**) .
- **Meiosis II** is reactivated when this secondary oocyte is fertilized by a sperm (if no fertilization occurs , secondary oocyte is discarded along with the menstrual flow), instantly dividing the 46 chromosomes into 23 (inside the **second polar body**) and another 23 will be united with the 23 chromosomes released from the sperm.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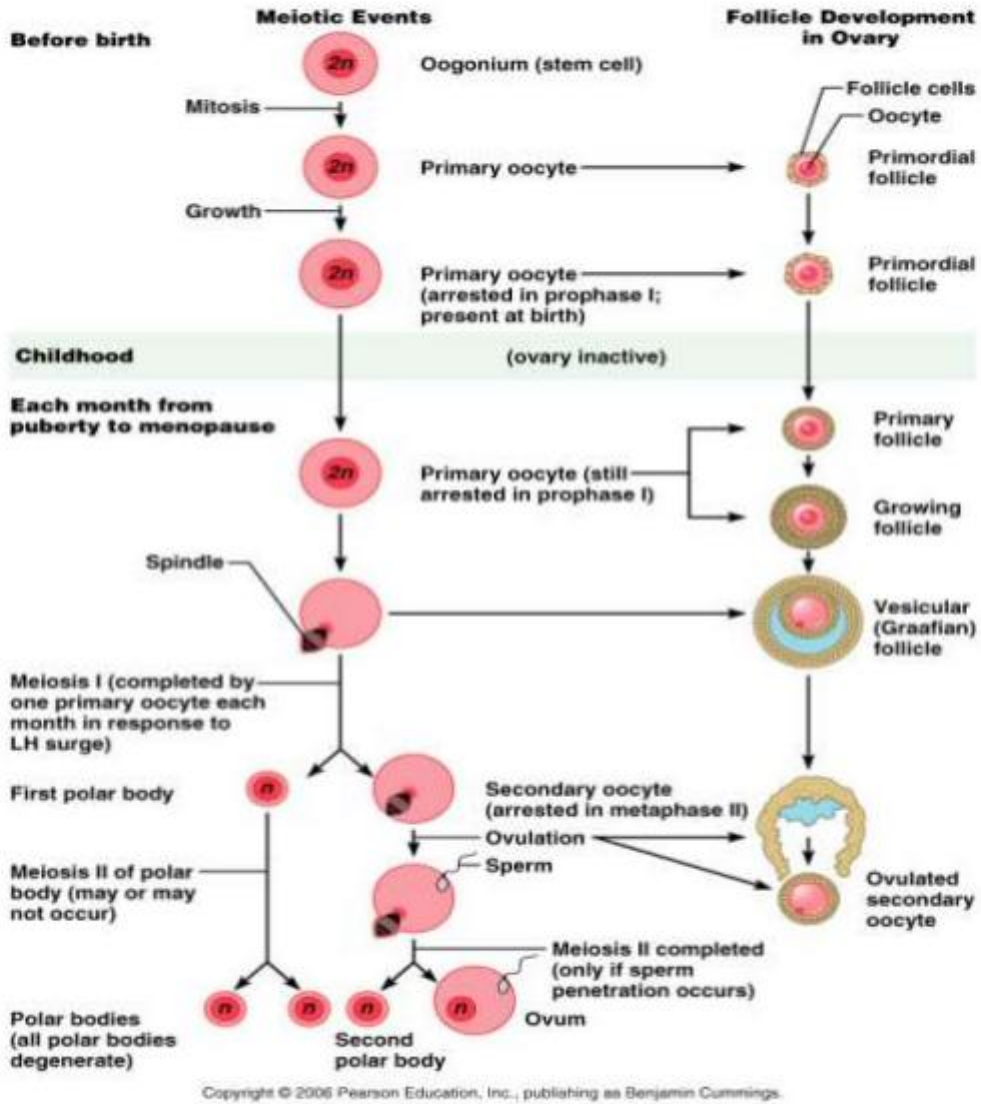
Events of oogenesis



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Mechanism of erection, lubrication, and orgasm in human female

1. sexual stimulation .
2. Arteries in the erectilc tissue dilate, vagina expands and elongates
3. Engorged and swollen vagina increases friction from movement of penis .
4. parasympathetic nerves impulses from sacral portion of the spinal nerve is enhanced .
5. sexual stimulation intensifies .
6. vestibule glands secrete mucus to lubricate .
7. orgasm: rhythmic contraction of muscles of the perineum, muscular walls of uterus, and uterine tube .

Hormonal control of ♀ reproductive function

Hormones from the hypothalamus , Ant. Pituitary gland and ovaries, play important roles in the control of sex cell maturation , and development and maintenance of female secondary sex characteristics .

Female sex hormones :

A female body remains reproductively immature until about 10 years of age when gonadotropin secretion increases .

The most important female sex hormones are estrogen and progesterone.

Estrogen is responsible for the development and maintenance of most female secondary sex characteristics .

Progesterone causes change in the uterus .

Hormonal control of ♀ secondary sex characteristic

- The hypothalamus releases GnRH , which stimulates the Ant.
- Pituitary gland.
- The Ant. pituitary gland secretes FSH and LH .
- FSH stimulates the maturation of a follicle .
- Granulose cells of the follicle produce and secrete estrogen; LH
- stimulated certain cells to secrete estrogen precursor molecules .
- Estrogen is responsible for the development and maintenance of
- most female secondary sex characteristics .
- Concentrtion of Androgens affect other secondary sex
- characteristics, including skeletal growth and growth of hair .
- Progesterone, secreted by the ovaries , affect cyclical changes in
- the uterus and mammary glands .

Ovarian cycle

A series of event in the ovarian cortex in order to produce a mature ovum and sex hormones .

Lasts for about 28 days , where from day 1 to 13 the mature ovum is developed and estrogens are released ,on day 14 ovulation occurs to discharge the ovum , and from day 15 to 28 scar tissues are formed and progesterone is released .

On day 1 , hypothalamus secretes Latinizing hormone releasing hormone (LHRH) to the anterior pituitary gland , which in turn secretes follicle – stimulating hormone (FSH) to the ovaries . Upon receiving FSH , about 20-25 primary follicles develop into

secondary follicles . [primary oocytes located inside primary follicles undergo meiosis I and become secondary oocoytes , contained in secondary follicles] .

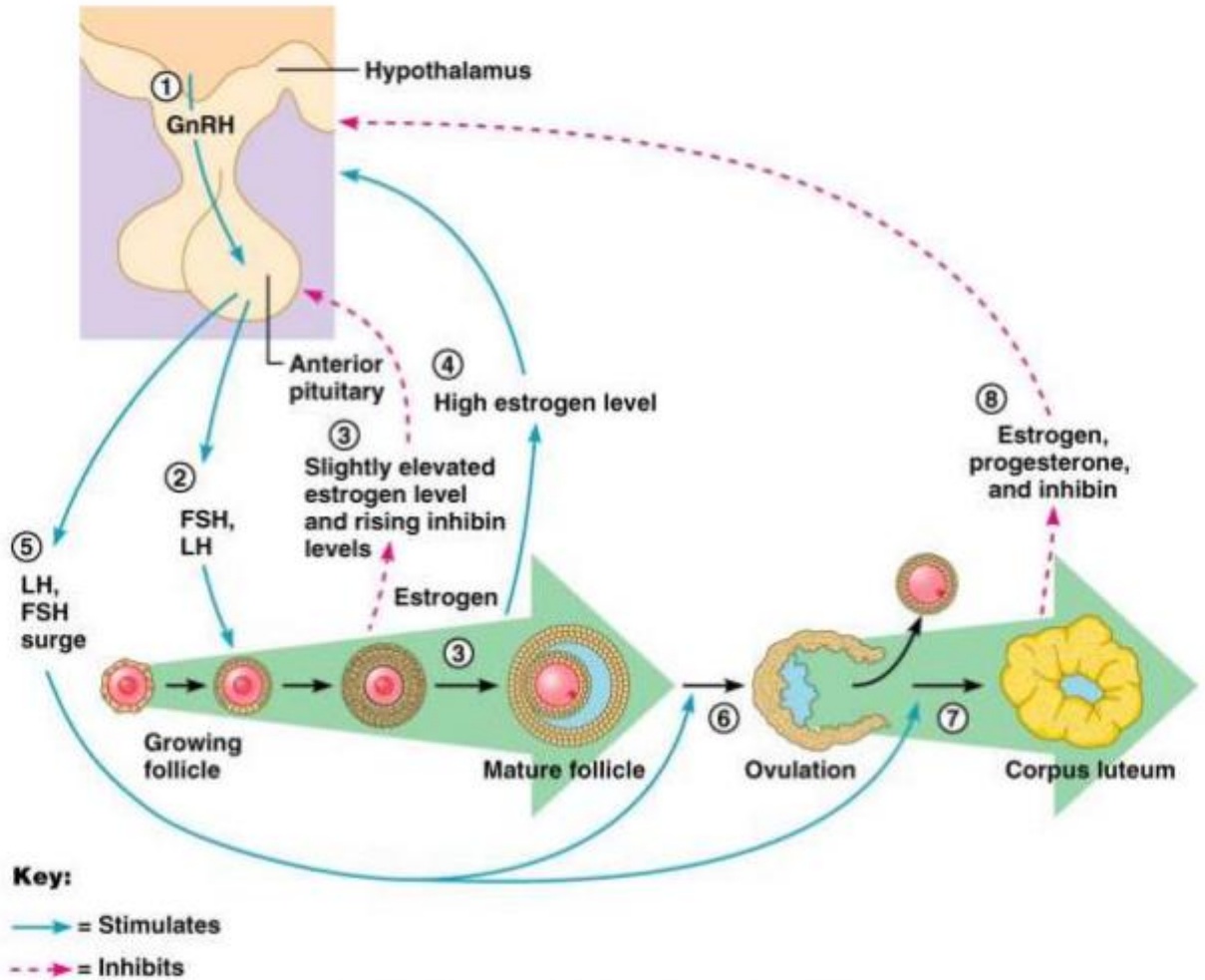
Follicular cells in secondary follicles begin to secrete estrogens (for communicating with hypothalamus and anterior pituitary and for developing the endometrium) .

With continuous stimulation of FSH and some Latinizing hormone (LH) ,secondary follicles continue to grow larger and develop multiple layers of follicular cells (while the secondary oocytes within are unchanged).

By day 13 , only 1 secondary follicle will fully mature and become the graafian follicle (or mature follicle) which secretes a large amount of estrogens to the hypothalamus – anterior pituitary system for signaling ovulation (using a positive feedback mechanism).

On day 14 , large amounts of LH ("LH surge") will be secreted by anterior pituitary , inducing ovulation where the graafian follicle ruptures and releases the secondary oocyte into uterine tube .

Regulation of ovarian function



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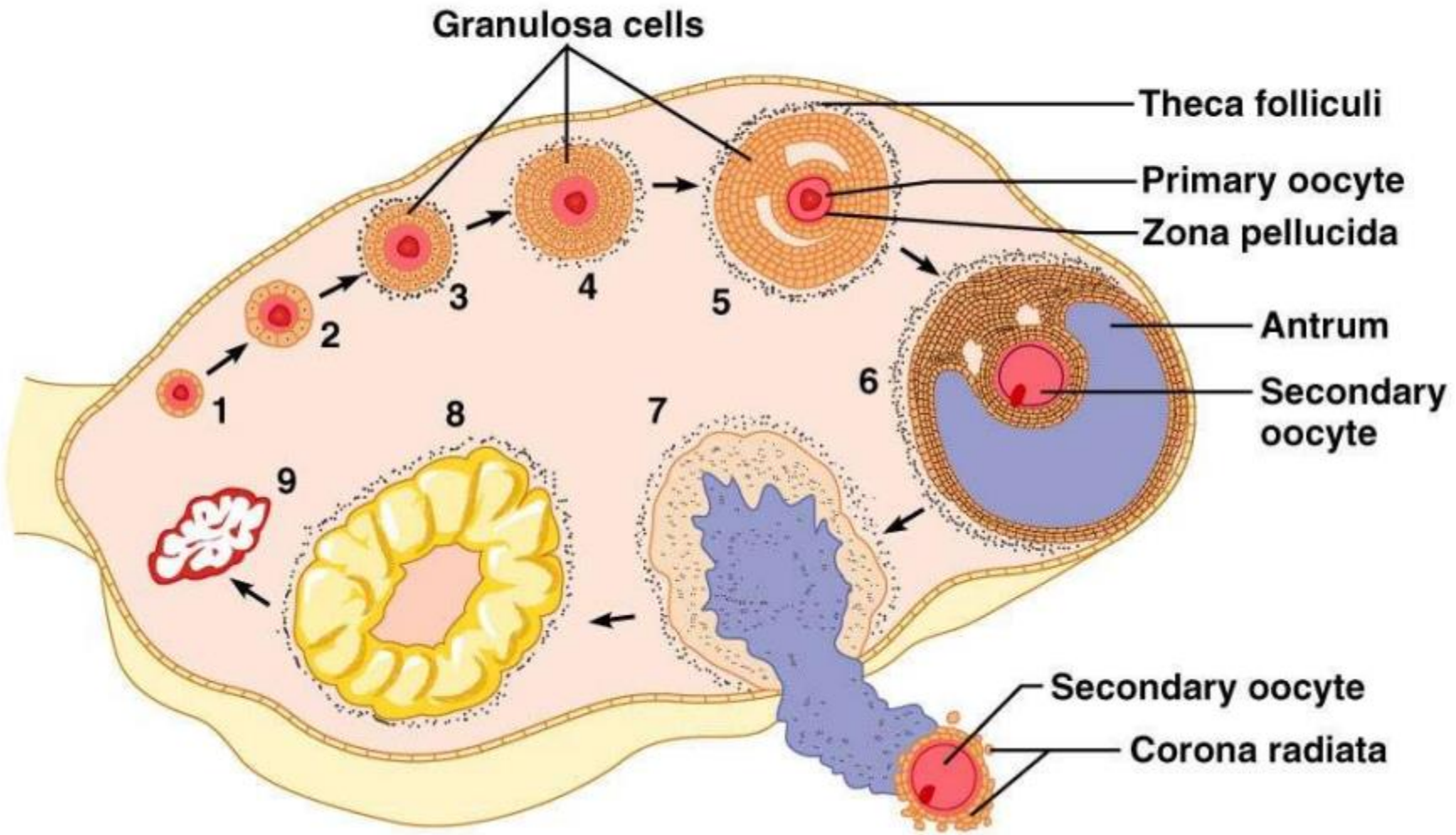
From days 15 to 25 , graafian follicle degenerates and becomes corpus hemorrhagicum ("a bleeding body") then corpus luteum ("a yellow body"; containing lutein cells that secrete progesterone and some estrogens to continuum stimulating the development of endometrium).

By day 26 , if no fertilization occurs to the secondary oocyte, resulting in a lack of human chorionic Gonadotropin hormone (HCG) from the embryo , corpus luteum degenerates into corpus albicans . [if fertilization did occur , HCG will continuously simulate corpus luteum for 2-3 months , allowing high levels of estrogens and progesterone to maintain pregnancy in the first trimester] .

When corpus luteum degenerates , the declining levels of estrogens and progesterone will signal the hypothalamus – anterior pituitary system to initiate another ovarian cycle.


Granulosa cells
Theca folliculi
Primary oocyte
Zona pellucida
Antrum
Secondary oocyte
Secondary oocyte
Corona radiata
1
2
3
4
5
6
7
8
9

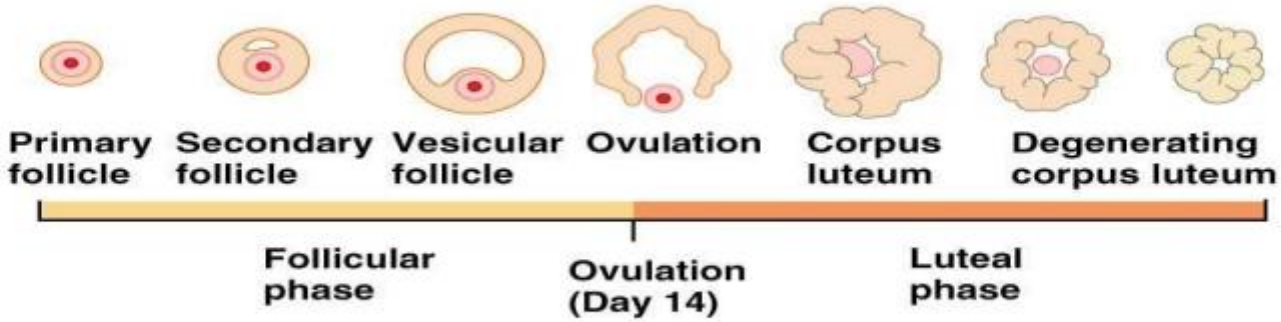
Menstrual cycle

A series of events that occurs in the uterus in order to prepare the endometrial layer for implantation and fetal development .

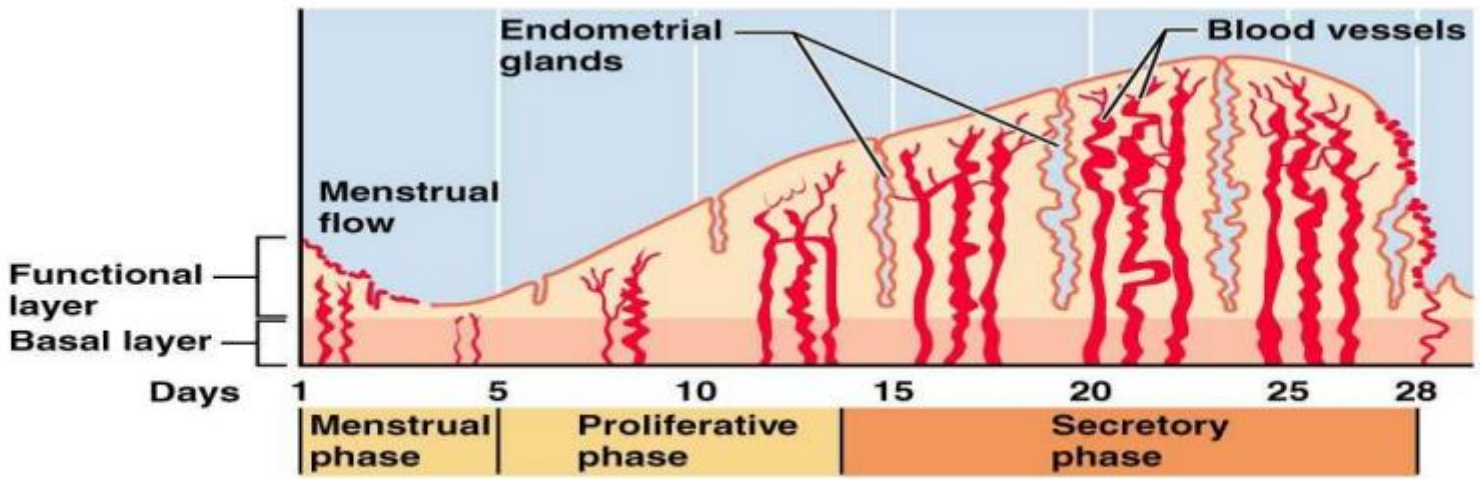
Occurs simultaneously with the ovarian cycle , but is about 1 week behind ; and also lasts about 28 days .

From days 1 to 6 , the menstruation phase occurs where the top portion of a thickened endometrial called stratum functionalis is shed off from the previous cycle . tissue repair occurs to prepare for a new menstrual cycle . Along with the stratum functionalist tissue , mucus , blood , and the secondary oocytes are discarded as "menses".

From days 7 to 13 , increasing levels of estrogens from secondary and mature follicles stimulate the endometrial to thicken and visualize – in a stage called the preovulatory phase



(c) Ovarian cycle



(d) Uterine cycle

From days 15 to 28 , continuous secretion of estrogens and progesterone from corpus luteum causes the endometrium to continue thickening and vascularizing – the postovulatory phase.

Toward the end of this phase , if no fertilization occurs , resulting in a lack of HCG stimulation to corpus luteum , the declining levels of estrogens and progesterone will cause the endometrium to degenerate – ultimately shedding off the stratum functionalis layer .

If fertilization did occur , high levels of estrogens and progesterone from the corpus luteum (in the first trimester) and from the placenta (in the second and third trimesters) will sustain the thickness and vascularization of endometrium until the end of pregnancy.

Major events in menstrual cycle - Summary

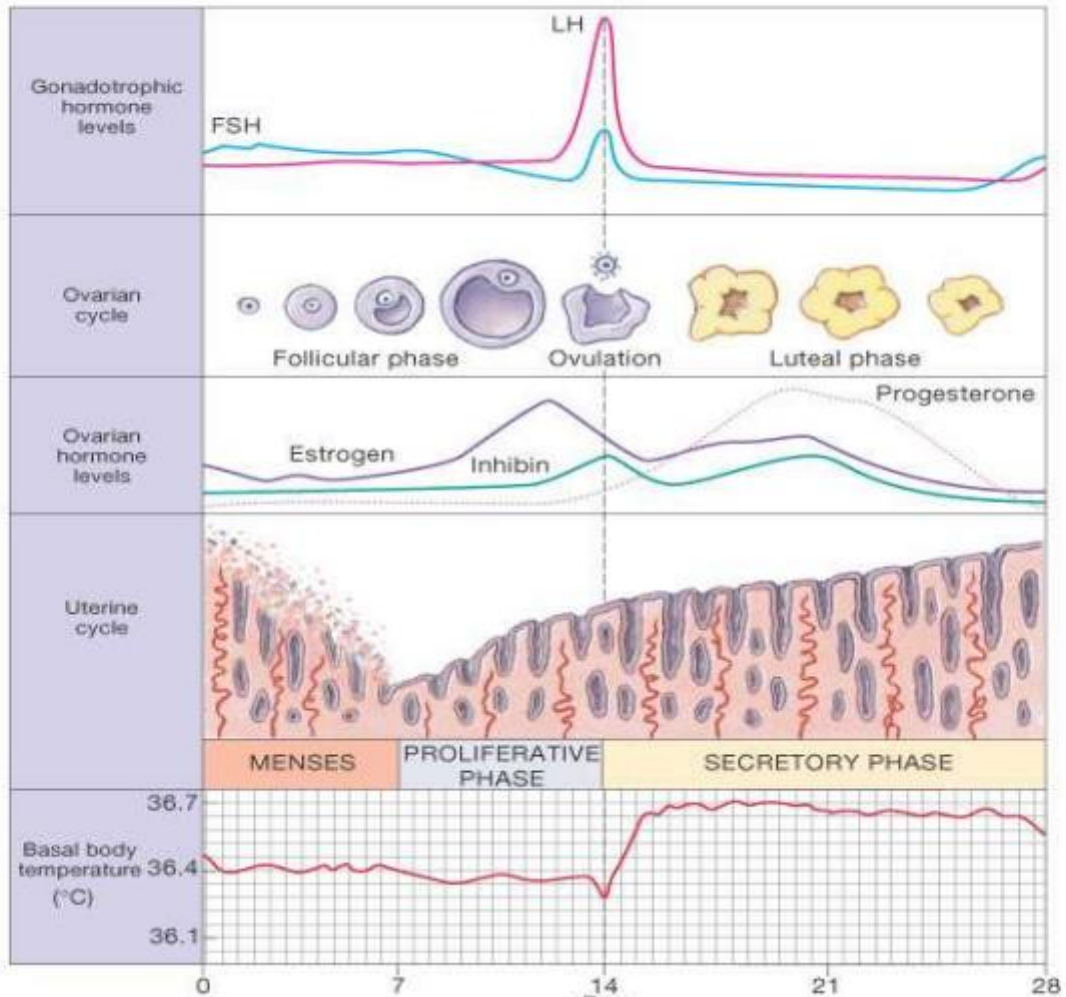
1. The Ant. pituitary gland secretes FSH and LH .
2. 2. FSH stimulates maturation of a follicle .Granulose cells of thefollicle produce and secrete estrogen . Estrogen maintains 2ndry sextraits & causes the uterine lining to thicken .
3. The Ant. pituitary gland releases a surge of LH, which stimulates ovulation . Follicular and thecal cells become corpus luteum cells which secrete estrogen and progesterone.

a. Estrogen continues to stimulate uterine wall development .

b. Progesterone stimulates the uterine lining to become more glandular and vascular .

c. Estrogen and progesterone inhibit secretion of FSH and LH fromthe Ant. pituitary gland .

The Menstrual Cycle



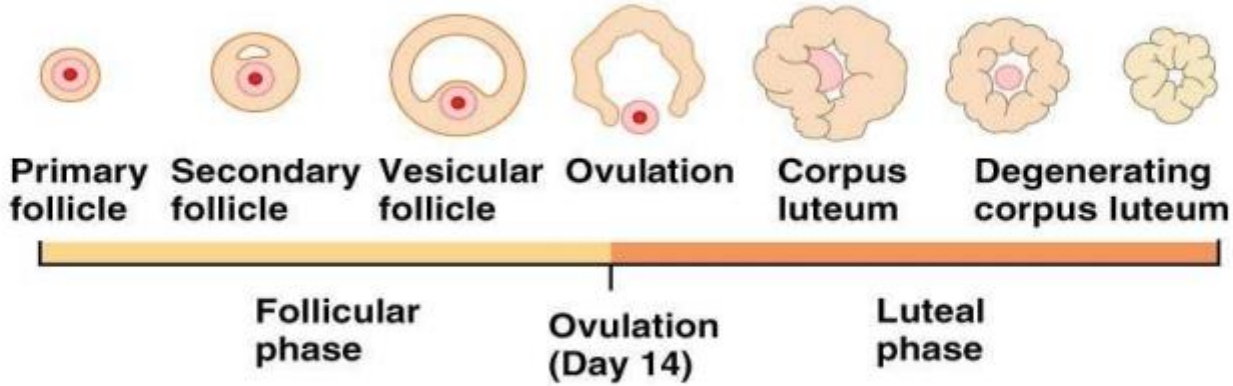
4. If the egg is not fertilized , the corpus luteum degenerates and no longer secretes estrogen and progesterone (24th day of the cycle).

5.As the conc. of luteal hormones decline , blood vessels in the uterine lining constrict .

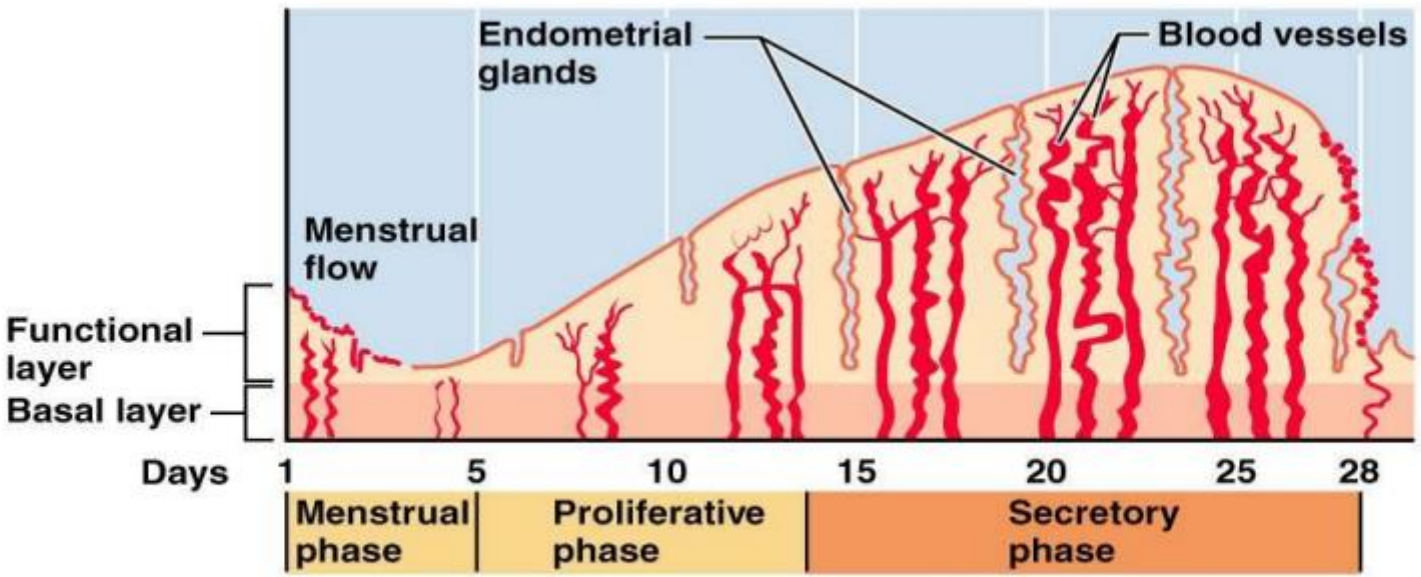
6. The uterine lining disintegrates and sloughs off, producing a menstrual flow (28th day of the cycle).

7.The Ant. pituitary gland , no longer inhibited, again secretes FSH and LH .

9. The menstrual cycle repeats .



(c) Ovarian cycle



(d) Uterine cycle

Fertilization

Within an hour after sexual intercourse , sperm would have traveled from the vagina , through the cervix , into the uterus and uterine tube .

During this journey , the acrosome on the head of spermatozoa would be worn off , releasing acrosin enzyme by the time sperm are attached to the outer coatings of the ovum .

About 50 spermatozoa are attached to the outermost coating called corona radiate . using hydrolysis reaction aided by acrosin , some of these sperm reach the inner coating called zone pellucida .

One of the sperm will eventually penetrate through zone pellucida, and allow its cell membrane to fuse with the cell membrane of ovum . This causes a rapid electrical depolarization at the cell membrane of ovum , preventing other sperm entering the ovum

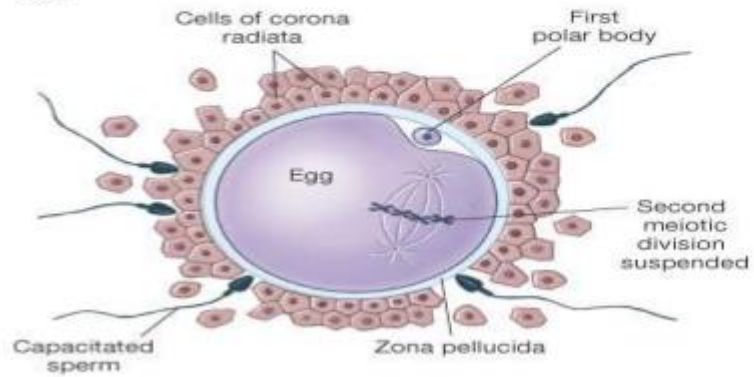
Now meiosis II is reactivated in the cytoplasm of ovum , dividing the 46 chromosomes in the nucleus into 23 chromosomes for fertilization (uniting with another 23 chromosomes from the sperm) , and 23 chromosomes to be eliminated along with the second polar body .

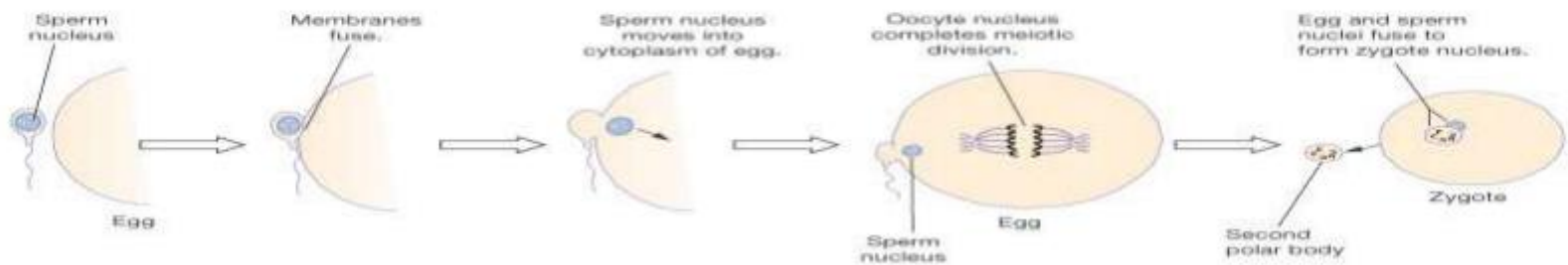
The head of the penetrated sperm is now detached from its mid piece and tail . It will then rupture , releasing 23 chromosomes in the form of long strands of DNA molecules .

The chromosomes from the sperm and ovum now unite to form a complete set of genetic makeup for the offspring – 2 haploid cells (sperm and ovum) are now joined to become a single diploid celled zygote . Fertilization is now complete .

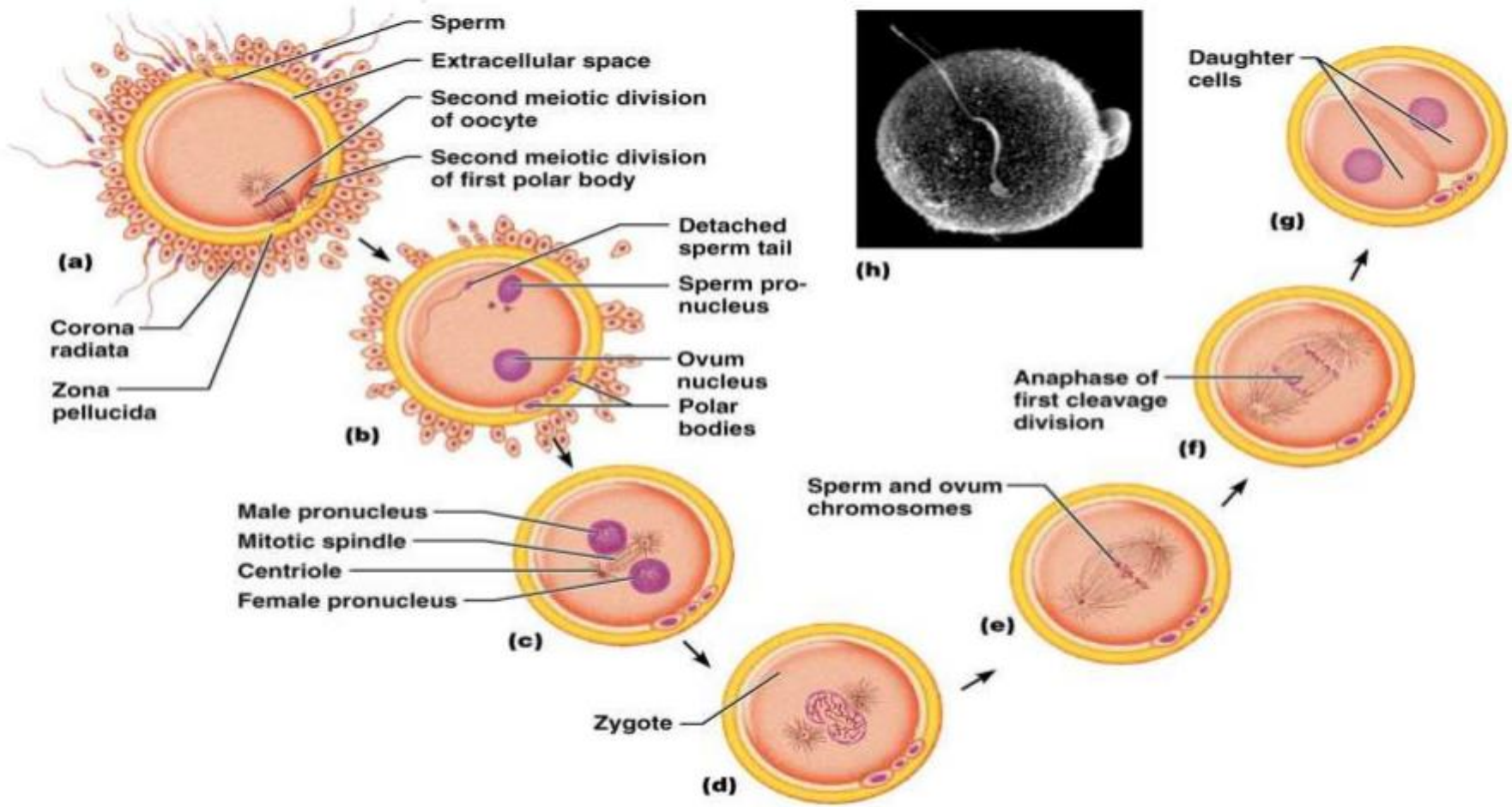
(a)

(b) Capacitated sperm release enzymes from their acrosomes in order to penetrate the cells and zona pellucida surrounding the egg.





Fertilization



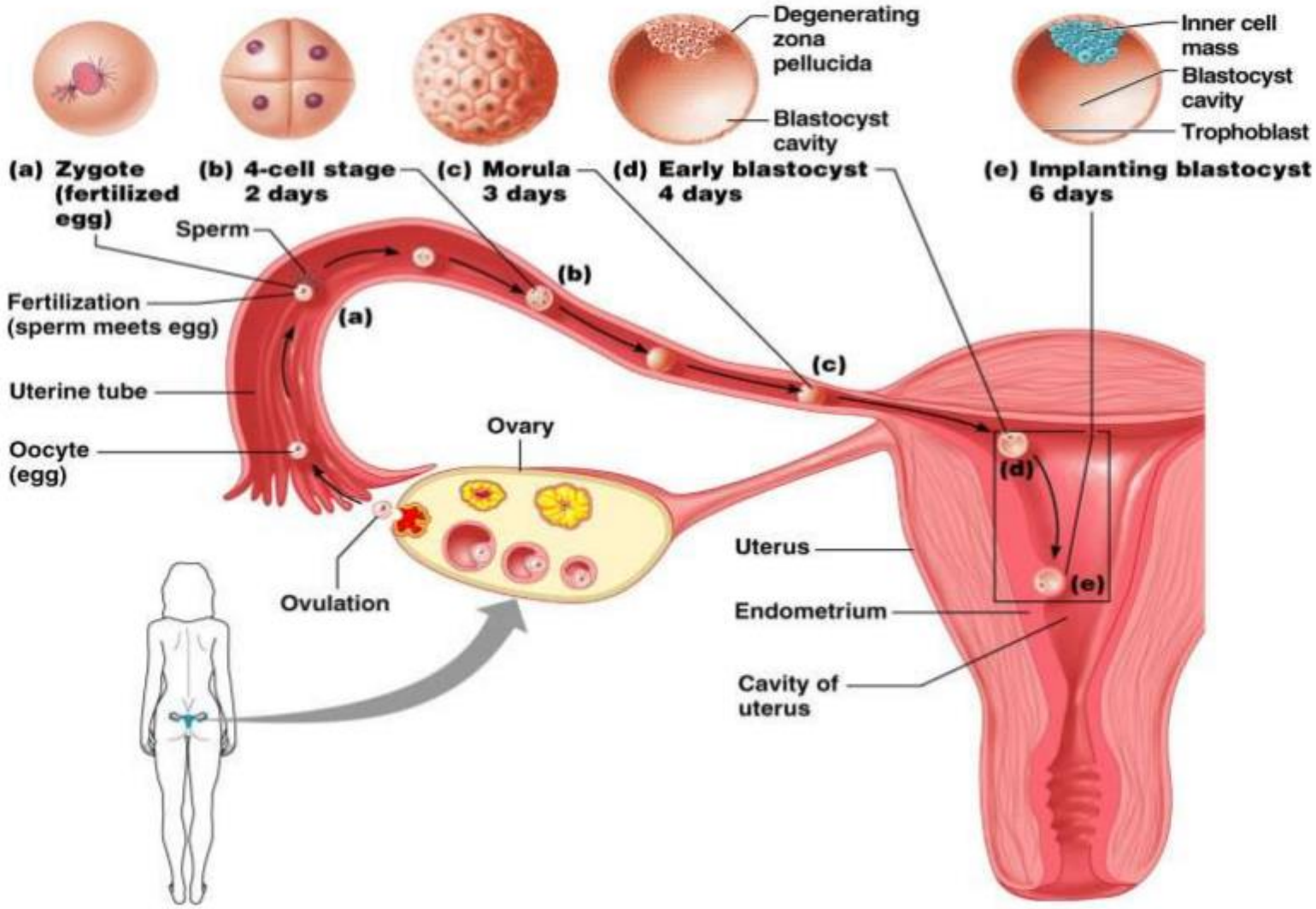
Pregnancy

1. A zygote is formed about 12-24 hours after ovulation .
2. This single cell , still the same size as the original ovum , continues to travel through the uterine tube toward the uterus by the action of cilia along the inner lining of uterine tube .

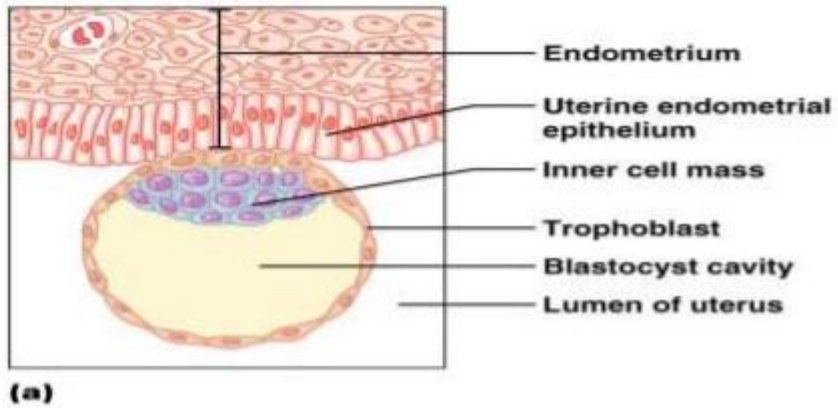
3. About an hour after fertilization is complete, mitotic cell divisioncalled cleavage occurs , dividing the zygote into a cluster of smaller cells .

4. By the time cleavage has produced 16 identical cells , it is called a morula (which occurs about 2-3 days after fertilization).
5. Cleavage continues along the journey through the uterine tube , by the time this cluster of cells has arrived at the uterus (abut 5-6 days after fertilization) , it is called a blastocyst which contains hundreds of small cells called blastomeres surrounding a hollow cavity called blastocoel.

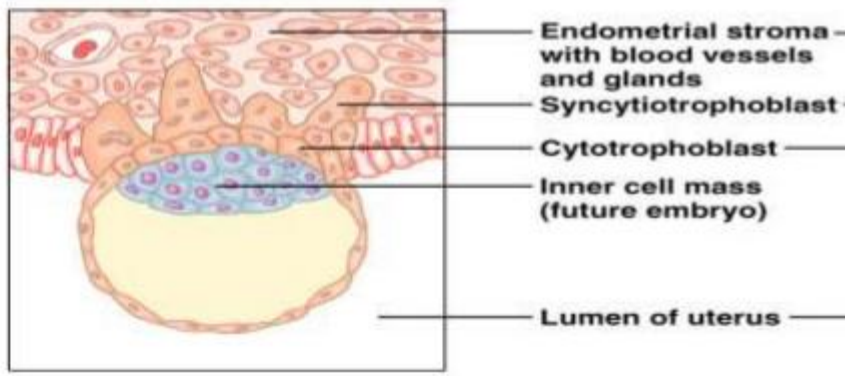
Cleavage from zygote to blastocyst



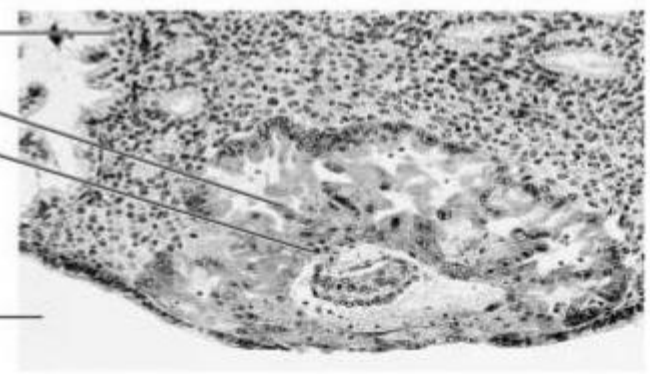
- 6. The blastocyst releases digestive enzymes and embedds itself onto the thickened and vascularized **endometrium** layer – a process called **implantation** which occurs about 7 days after fertilization . The blastocyst is now called an **embryo**, which continues to develop for the next 2 months until a **fetus** is formed .



(a)



(b)


(c)

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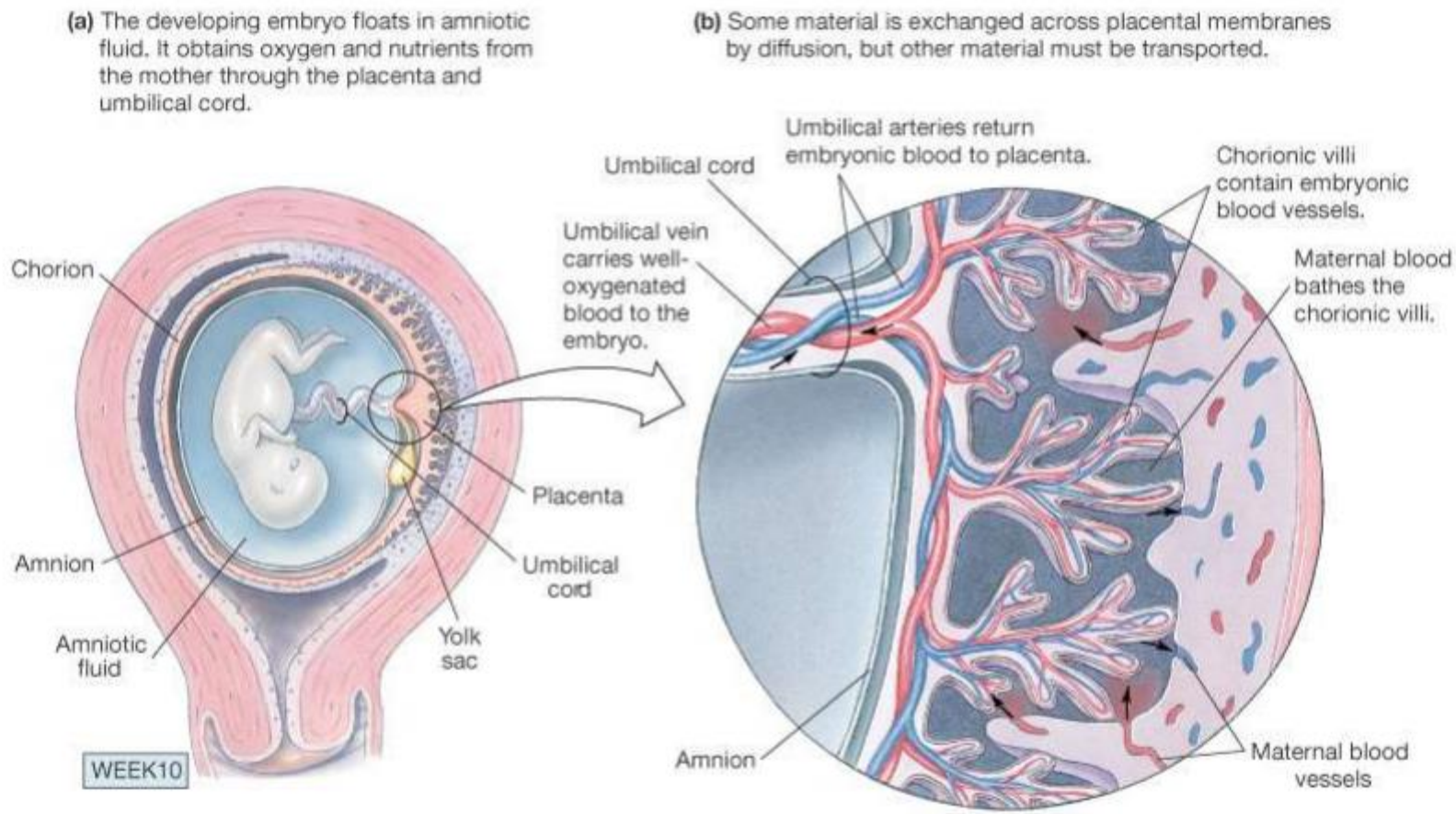
7. Soon after implantation , layers of membrane begin to form outside the embryo –

a. Chorion – the innermost membrane which secretes a hormone called the Human Chorionic Gonadotropin (HCG) which stimulates the corpus luteum in the ovary for the secretion of estrogens and progesterone , until the placenta is fully developed and can secrete estrogens and progesterone.

b. Amnion – the middle membrane that secretes amniotic fluid for nourishing the embryo.

c. Placenta – the outermost membrane that protects the embryo and fetus, allows exchange of nutrients and wastes between fetal and maternal blood, and secretes estrogens and progesterone to maintain pregnancy .

The placenta



8. In the first 3 months of pregnancy (or "first trimester") , HCG level is the highest and it declines in the last two trimesters. This is to ensure that corpus luteum is sustained and not degenerated into corpus albicans .

[HCG is secreted by renal tubules into urine , allowing pregnancy to be tested positive in a typical pregnancy test . the high HCG level may be responsible for "morning sickness " and other discomfort felt by pregnant women].

9. In the last two trimesters , placental estrogens and progesterone cause the uterus and breasts to enlarge , and during labor, cause the vagina to stretch. The sharp decline of estrogens after birth will signal new ovarian and menstrual cycles to begin.

The sudden reduction of progesterone before birth removes the suppression of oxytocin (from posterior pituitary gland), resulting in uterine contractions during the birth process.

10. pregnancy lasts for about 40 weeks (280 days after the last menstruation or 266 days after fertilization) and ends with partuition.

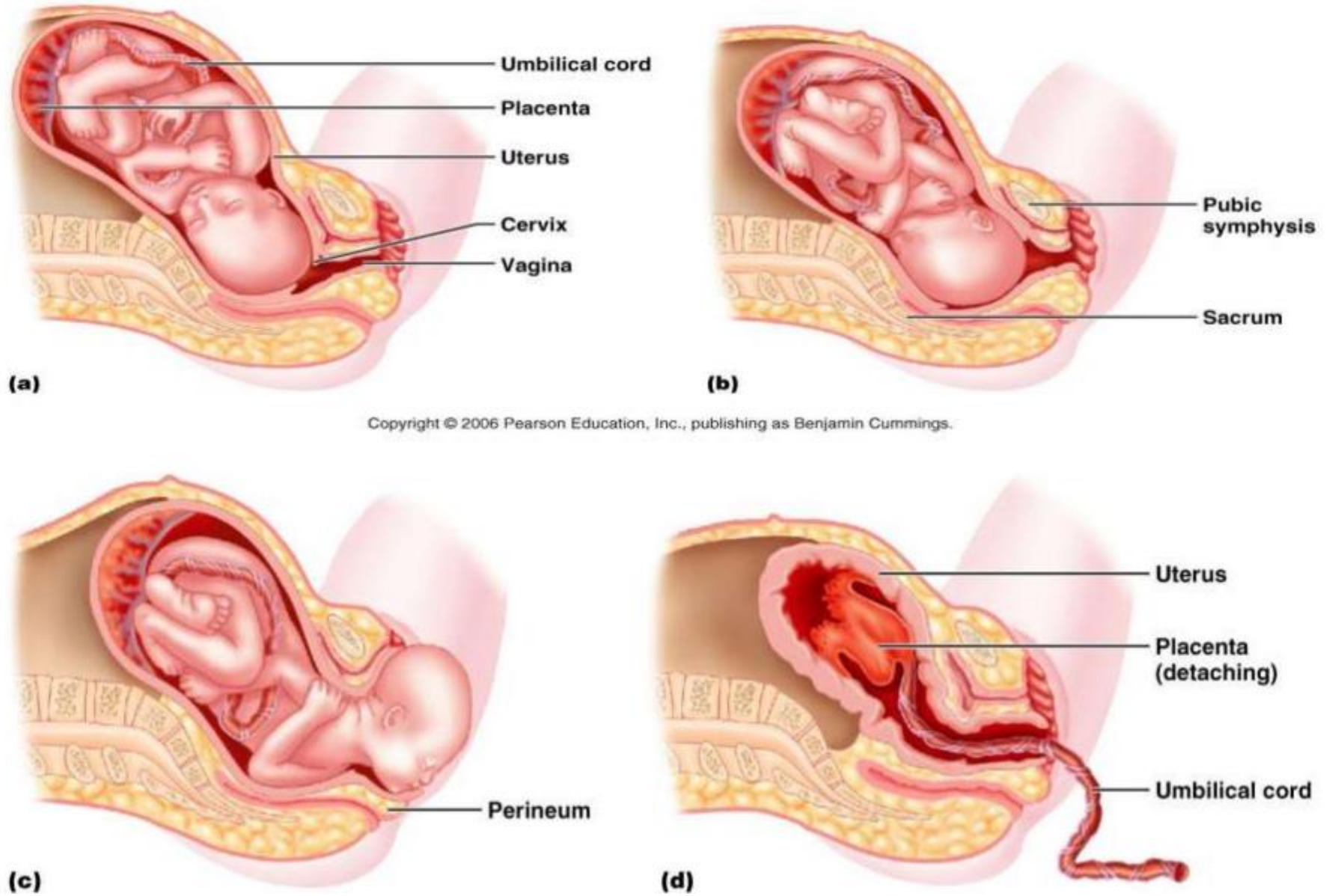
a. During the last 6 weeks of fetal development , the fetus assumes the vertex position where the head faces the cervix .

b. At the end of pregnancy , the fetus moves downward and its head causes pressure onto the dilating cervix , [the hormone Relaxin from the ovaries stimulates the dilation of cervix and pubic symphysis].

c. The pressure onto the cervix signals the hypothalamus which in turn stimulates the posterior pituitary gland for the release of oxytocin.

d. Oxytocin causes the myometrium layer (made of smooth muscle) to contract involuntarily , pushing the fetus downward .

e. The downward movement of fetus exerts more pressure onto the cervix , a phenomenon called positive feedback – until the fetus is expelled from the uterus, through the cervix and vagina , to the outside.



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Hormonal changes during pregnancy - summary

1. Following implantation , cells of the trophoblast (embryonic cells that helps from the placenta). begins to secrete HCG (human chorionic gonadotropin) .
2. HCG maintains the corpus luteum, which continues secreting estrogen & progesterone .
3. As the placenta develops, it secrets large quantities of estrogen and progesterone. placental estrogen and progesterone :
   a. stimulate the uterine lining to continue development .
   b. maintain the uterine lining .
   c. Inhibit secretion of FSH and LH from the Ant. pituitary gland .
   d. stimulates development of the mammary gland.

e. Inhibit uterine contractions (progesterone) .

f. enlarge the reproductive organs (estrogen) .

4. Relaxin from the corpus luteum also inhibits uterine contractions and relaxes the pelvic ligaments .

5. The placenta secretes placental lactogen that stimulates breast development .

6. Aldosterone from adrenal cortex promotes reabsorption of sodium (leading to fluid retention).

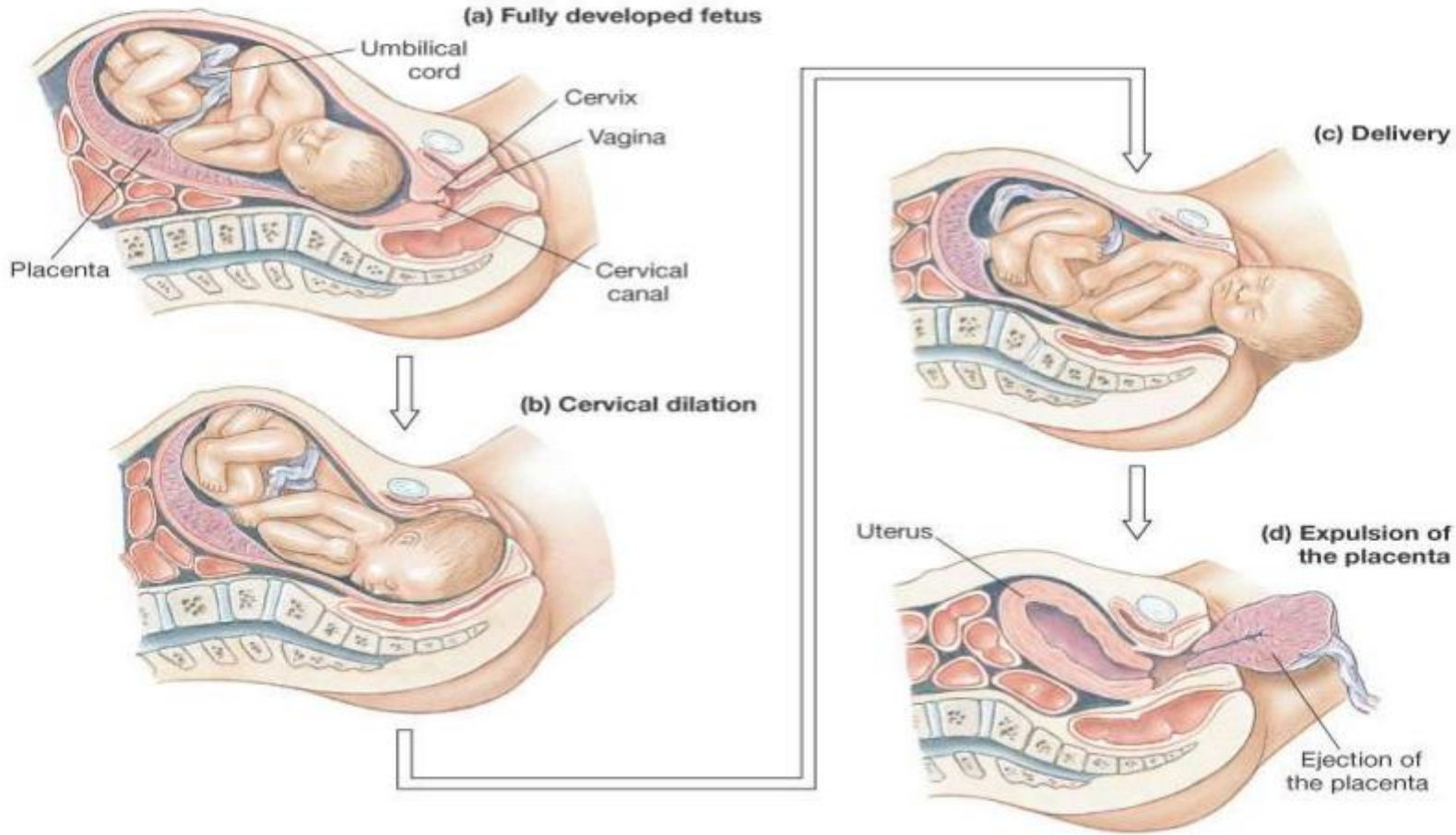
7. Parathyroid hormone from the parathyroid glands helps maintain a high conc. of maternal blood Ca++ (due to high fetal demand for calcium).

Note : Detecting HCG in a woman’s urine or blood is used to confirm pregnancy .

Factors contributing to labor process

1. As the time of birth approaches, secretion of progesterone declines, and its inhibiting effect on uterine contractions may lessen .
2. Decreasing progesterone conc. may stimulate synthesis of prostaglandins, which may initiate labor .
3. Stretching uterine tissues stimulates release of oxytocin from the post. Pituitary gland .
4. Oxytocin may stimulate uterine contractions and aid labor in its later stages .
5. As the fetal head stretches the cervix, a positive feedback mechanism results in stronger and stronger uterine contractions and a greater release of oxytocin .

- 6. positive feedback stimulates abdominal wall muscles to contract with greater and greater force .
- 7. The fetus is forced out through the birth canal to the outside.



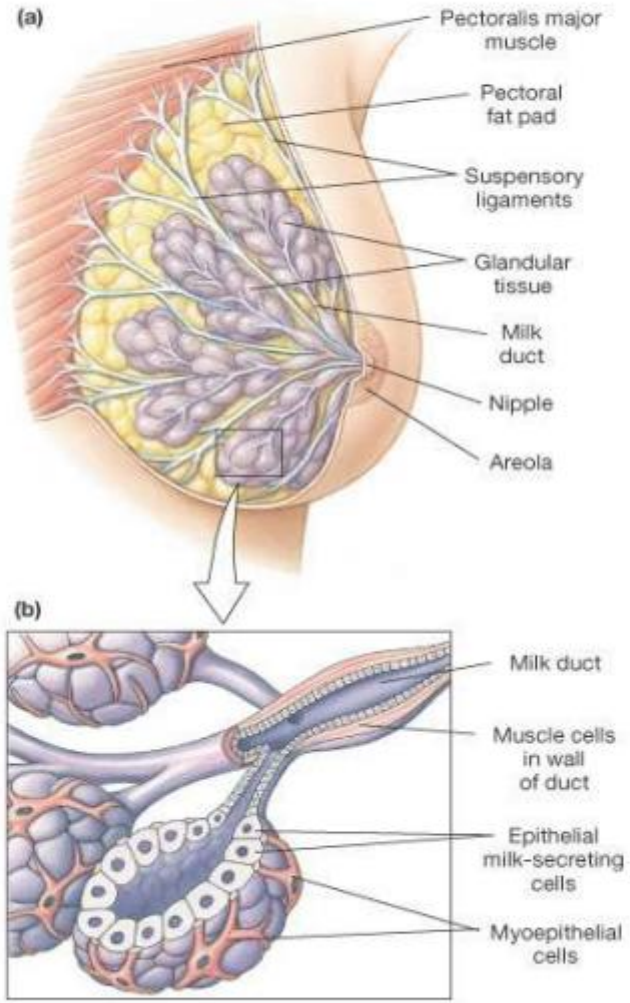
Hormonal control of mammary glands

I. Before pregnancy (Beginning of puberty) : Ovarian hormones secreted during menstrual cycles stimulate alveolar glands and ducts of mammary glands to develop.

II. During pregnancy :

- **Estrogen causes the ductile system to grow and branch.**
- **Progesterone stimulates development of alveolar glands**
- **Placental Lactogen promotes development of the breasts .**
- **Prolactin (from Ant. pituitary) is secreted throughout pregnancy but placental progesterone inhibits milk production (until after birth).**

Structure of lactating mammary glands



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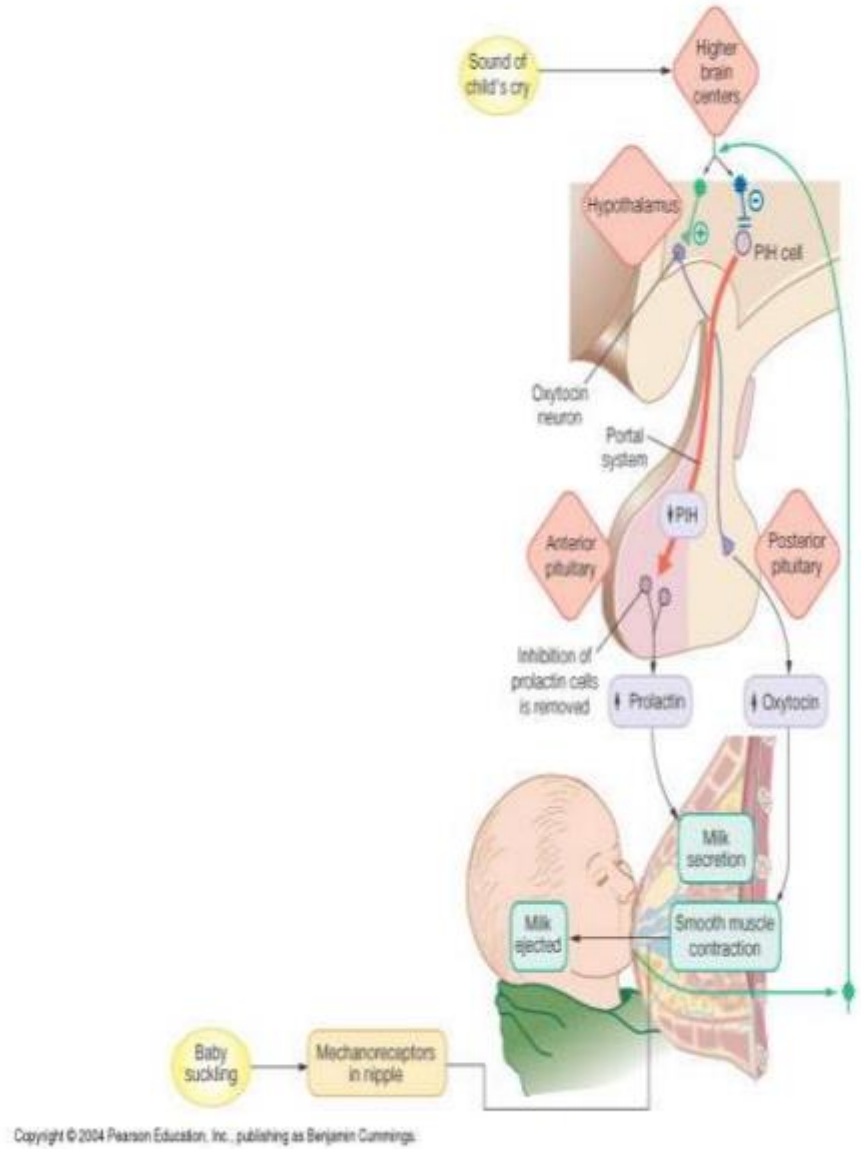
- III. **Following childbirth** :
- Placental hormonal concentrations decline , so that the action of prolatin is no longer inhibited andthe breasts begin producing milk.
- Mechanical stimulation of the breasts releases oxytocin from Ant. pituitary gland.
- Oxytocin stimulates ejection of milk from ducts.
- As long as milk is removed , more prolactin is released ; if milk is not removed , milk production ceases.



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Birth Control

1.Birth control is a voluntary regulation of conception.

2. Contraception is any method used in birth control to prevent fertilization of the ovum.

3. The most common contraceptive methods and their success rate –

a. Abstinence (100%) done by male and female where sexual intercourse is avoided.

b)Vasectomy (99%) done by male where the vas deferens tubes are cut to prevent sperm transport.

c) Tubule ligation (99%) done by female where the uterine tubes are tied or cut to prevent ovum transport and passage of sperm.

d) Birth control pills (98%) taken by female in which daily moderate level of estrogens suppress the ovarian and menstrual cycles.

e) intrauterine devices (IUDS) (95%) inserted under the cervix in female activates leukocytes and antibodies to be formed in the female reproductive tract , preventing sperm from entering the uterine tubes .

f) condom (90%) used by male or female is impermeable to sperm during ejaculation . [condoms also could prevent the transmission of sexually transmitted diseases] .

g) diaphragm and / or foam (80%) used by female block the entrance of sperm into the cervix .

h) withdrawal method (or coitus interrupts) (75%) done by male in which the penis is withdrawn from the vagina before ejaculation occurs.

i) Rhythm method (75%) done by female where sexual intercourse is performed only before ovulation and about a week after ovulation occurs , there are three ways to time ovulation.

Sexually transmitted diseases (STDs)

1. formerly called venereal diseases (VDs).
2. bacterial or viral infections that are spread through sexual contact .
3. Gonorrhea

Caused by bacterium named Neisseria gonorrhoeae. Bacteria invade the mucosal layer of reproductive and urinary tracts.

Most common symptoms in male is urethritis (infection of urethra), resulting in painful urination .

Symptoms in female include abdominal discomfort , vaginal discharge ,and uterine bleeding .

Penicillin and tetracycline antibiotic drugs are effective ,but sometimes bacteria might be resistant to these drugs.

4. Syphilis

a) caused by a bacterium named Treponema pallidum . It can be transmitted from mother to fetus where the fetus usually will be stillborn or die after birth .

b) bacteria penetrate mucosal layer and skin easily ,and enter into blood and lymph .

c) incubation period is about 12 weeks, after which a red , painless lesion appears on external genitalia .

d) if untreated , pink skin rash will appear all over the body. Fever , joint pain , anemia , hair loss will occur if still untreated .e)final stage of development occurs after a 10-years latent period –bacteria invade central nervous system , blood vessels , bones , skin , and other organs – which might lead to death . penicillin is the only known treatment , but only effective during early stages of symptoms .

5. Chlamydia

Caused by a bacterium named Chlamydia trachomatis.

The most common STD in U.S.

Infects 3-4 million new victims each year .

Responsible for 25-50% of all pelvic inflammation .

Each year about 150,000 infants are born with the disease (in these cases , Chlamydia becomes a "congenital disease " where the fetus acquires the bacteria from mother's vagina during the birth process).

Symptoms are often unrecognized – urethritis , vaginal discharge , abdominal pain , painful urination and intercourse ,and irregular menstruation .

Infants tend to develop pneumonia .

Treatment is tetracycline .

6. Genital herpes

a. caused by a virus named Epstein – Barr Virus (EBV) .

b. the most difficult STD to control or treat .

c. most common type of genital herpes is herpes simplex virus type II (which affects mainly the lower body) .

d.symptom is usually painful lesions on reproductive organs .

e. can cause severe malformation of a fetus .

f. can remain latent for years in the body with no signs orsymptoms .

g. about 25-50% of all Americans might carry this virus .

PEBURTY

Puberty is the process of physical changes through which a child's body matures into an adult body capable of sexual reproduction. It is initiated by hormonal signals from the brain to the gonads: the ovaries in a girl, the testes in a boy.

Puberty is the process of physical changes through which a child's body matures into an adult body capable of sexual reproduction. It is initiated by hormonal signals from the brain to the gonads: the ovaries in a girl, the testes in a boy. In response to the signals, the gonads produce hormones that stimulate libido and the growth, function, and transformation of the brain, bones, muscle, blood, skin, hair, breasts, and sex organs.

Physical growth—height and weight—accelerates in the first half of puberty and is completed when an adult body has been developed. Before puberty, the external sex organs, known as primary sexual characteristics, are sex characteristics that distinguish boys and girls. Puberty leads to sexual dimorphism through the development of the secondary sex characteristics, which further distinguish the sexes

On average, girls begin puberty at ages 10–11 and complete puberty at ages 15–17; boys generally begin puberty at ages 11–12 and complete puberty at ages 16–17.

The major landmark of puberty for females is menarche, the onset of menstruation, which occurs on average between ages 12 and 13. For males, first ejaculation occurs on average at age 13.

In the 21st century, the average age at which children, especially girls, reach puberty is lower compared to the 19th century, when it was 15 for girls and 16 for boys.

This can be due to any number of factors, including improved nutrition resulting in rapid body growth, increased weight and fat deposition, or exposure to endocrine disruptors such as xenoestrogens, which can at times be due to food consumption or other environmental factors.

Puberty which starts earlier than usual is known as precocious puberty, and puberty which starts later than usual is known as delayed puberty.

Notable among the morphologic changes in size, shape, composition, and functioning of the pubertal body, is the development of secondary sex characteristics, the "filling in" of the child's body; from girl to woman, from boy to man. Derived from the Latin puberatum (age of maturity), the word puberty describes the physical changes to sexual maturation, not the psychosocial and cultural maturation denoted by the term adolescent development in Western culture, wherein adolescence is the period of mental transition from childhood to adulthood, which overlaps much of the body's period of puberty

Differences between male and female puberty

Two of the most significant differences between puberty in girls and puberty in boys are the age at which it begins, and the major sex steroids involved, the androgens and the estrogens.

Although there is a wide range of normal ages, girls typically begin puberty around ages 10–11 and end puberty around 15–17; boys begin around ages 11–12 and end around 16–17.

Girls attain reproductive maturity about four years after the first physical changes of puberty appear.

In contrast, boys accelerate more slowly but continue to grow for about six years after the first visible pubertal changes. Any increase in height beyond the post-pubertal age is uncommon.

For boys, the androgen testosterone is the principal sex hormone; while testosterone is produced, all boys' changes are characterized as virilization. A substantial product of testosterone metabolism in males is estradiol.

The conversion of testosterone to estradiol depends on the amount of body fat and estradiol levels in boys are typically much lower than in girls.

The male "growth spurt" also begins later, accelerates more slowly, and lasts longer before the epiphyses fuse.

Although boys are on average 2 centimetres (0.8 in) shorter than girls before puberty begins, adult men are on average about 13 centimetres (5.1 in) taller than women.

Most of this sex difference in adult heights is attributable to a later onset of the growth spurt and a slower progression to completion, a direct result of the later rise and lower adult male levels of estradiol.

The hormone that dominates female development is an estrogen called estradiol. While estradiol promotes growth of the breasts and uterus, it is also the principal hormone driving the pubertal growth spurt and epiphyseal maturation and closure.

Estradiol levels rise earlier and reach higher levels in women than in men.

The hormonal maturation of females is considerably more complicated than in boys.

The main steroid hormones, testosterone, estradiol, and progesterone as well as prolactin play important physiological functions in puberty. Gonadal steroidgenesis in girls starts with production of testosterone which is typically quickly converted to estradiol inside the ovaries.

However the rate of conversion from testosterone to estradiol (driven by FSH/LH balance) during early puberty is highly individual, resulting in very diverse development patterns of secondary sexual characteristics.

Production of progesterone in the ovaries begins with the development of ovulatory cycles in girls (during the lutheal phase of the cycle), before puberty low levels of progesterone are produced in the adrenal glands of both boys and girls.

METHOD OF CONTRACEPTION IN MALE AND FEMALE

Male contraceptives, also known as male birth control, are methods of preventing pregnancy that solely involve the male physiology. The most common kinds of male contraception include condoms, outercourse,and vasectomy. In domestic animals, castration is commonly used for contraception. Other forms of male contraception are in various stages of research and development. These include methods like RISUG/VasalGel (which has completed a small phase II clinical trial in humans in India) and ultrasound (with results so far obtained in experimental animals).

Surgery

Vasectomy is a surgical procedure for male sterilization or permanent birth control. During the procedure, the vasa deferentia of a man are severed, and then tied or sealed to prevent sperm from entering into the seminal stream (ejaculate). Vasectomies are usually performed in a physician's office or medical clinic. CDC research has estimated there is a probability of 11 failures per 1,000 procedures over 2 years; half of the failures occurred in the first three months after the vasectomy, and no failures occurred after 72 weeks. Due to the presence of sperm retained beyond the blocked vasa deferentia, vasectomies only become effective about three months following the operation

Condoms

A condom is a sheath-shaped barrier device that may be used during sexual intercourse to reduce the probability of pregnancy. It is rolled onto an erect penis before intercourse and blocks ejaculated semen from entering the sexual partner's reproductive system. With perfect use, the pregnancy rate of condoms is 2%. Condoms may be combined with other forms of contraception (such as spermicide) for greater protection. The typical use pregnancy rate among condom users varies depending on the population being studied, ranging from 10 to 18%.

Withdrawal

The withdrawal method is a behavior that involves halting penile-vaginal intercourse to remove the penis out and away from the vagina prior to ejaculation. Pulling out is a popular contraceptive behavior that many couples use because of convenience, dissatisfaction with other methods, it's free of expense, and has constant availability. Failure rate varies with population studied, but withdrawal is overall not considered to be efficacious enough to be the sole method of pregnancy prevention being utilized. The accepted rate of failure is about 4% with perfect use at every act of intercourse but the failure rate with typical use ranges in between 18% and 27%[

Retrograde ejaculation

Intentional retrograde ejaculation (coitus saxonicus) is a primitive form of male birth control. It involves squeezing the urethra at the base or applying pressure to the perineum during orgasm. However, the practice is not considered a reliable method compared to most modern types of birth control.

Medications

Two delivery methods are currently under active study: male hormonal contraceptives that can be taken in pill form by mouth, similar to the existing birth control pill for women and male hormonal injections.

Gossypol, an extract of cotton, has been studied as a male contraceptive pill. It decreased sperm production; however this is permanent in 20% of people. Inhibition of chromatin remodeling by binding to a pocket on BRDT has been shown to produce reversible sterility in male mice. JQ1, a selective BRDT inhibitor which acts in this manner, is currently under development as a non-hormonal male contraceptive drug. It effectively blocks the production of sperm by the testes, and lacks the adverse effects of previously researched hormonal contraceptives for men.

Immunocontraception targeting sperm antigens has been found to be effective in male primates.
Calcium channel blockers such as nifedipine may cause reversible infertility by altering the lipid metabolism of sperm so that they are not able to fertilize an egg.
Recent Research at Israel's Bar-Ilan University show that as of June 2010, such a pill may be five years away.
Testing it on mice has been found to be effective, with no side effects.

A compound that interferes with the vitamin A pathway has been shown to render male mice sterile for the course of the treatment without affecting libido. Once taken off the compound, the mice continued to make sperm. The mechanism of action includes blocking the conversion of vitamin A into its active form retinoic acid which binds to retinoic receptors which is needed to initiate sperm production.This can be done, for instance, by blocking an aldehyde dehydrogenase called RALDH3 (ALDH1A2), which converts retinaldehyde into retionic acid in testes. Past attempts to do this failed because the blocking compounds were not sufficiently specific and also blocked other aldehyde dehydrogenases, such as those responsible for the alcohol metabolism, causing serious side effects. Another way is blocking retionic receptors themselves, although it can also have serious side effects.

Different Types of Birth Control Options for Men and Women

Birth control can be broadly divided into two main categories.

1. Contraception

Contraception is considered one of the most popular methods of birth control due to its relative availability and low risk of side effects, the contraception method ensures that the ovum is not fertilized by a sperm.

2. Contragestion

This is better known as the emergency contraception. The morning-after pill is taken to prevent a fertilized egg from attaching itself to the uterine wall, thus preventing pregnancy.

FEMALE BIRTH CONTROL

Table 1: Effectiveness of Contraceptive Methods

Contraceptive method	Pregnancies per 100 women in first 12 months of use	
	As commonly used	Perfect use
Oral contraceptives		
Combined hormonal contraceptives	9	0.3
Progestin-only pills	9	0.3
Transdermal contraceptives		
Combined hormonal contraceptives	9	0.3
Vaginal ring		
Combined hormonal contraceptives	9	0.3
Injectable contraceptives		
Depot medroxyprogesterone acetate	6	0.2
Progestin-only subdermal implant	0.05	0.05
Intrauterine devices		
levonorgestrel IUD	0.2	0.2
copper IUD	0.8	0.6
Barrier contraceptives		
Diaphragm with spermicide	12	6
Cervical cap Nulliparous women Parous women	 12 24	 9 20
Female condoms	21	5
Spermicides	28	18
Contraceptive sponge Nulliparous women Parous women	 12 24	 9 20
Male condoms	18	2
Sterilization		
Female sterilization	0.5	0.5
Male sterilization	0.15	0.1
Fertility awareness-based methods		
Lactation amenorrhea method	2	0.5
coitus interruptus	22	4

THANK YOU