

GPAT Online Class for B Pharm students

Human Anatomy and Physiology part -1

(Reproductive system)

By

Dr. K. SOMASEKHAR REDDY, M. Pharm., Ph. D

Associate Professor and Head

Department of Pharmacology

**Raghavendra Institute of Pharmaceutical Education and
Research (RIPER) – Autonomous, Ananthapuramu**



Raghavendra Institute of Pharmaceutical Education and Research - Autonomous
K.R.Palli Cross, Chiyvedu, Anantapuramu, A. P- 515721

- The reproductive system of both males and females consists of primary (or essential) organs and secondary (or accessory) organs.
- The primary organs are referred to as “Gonads”. (The female gonads are the ovaries, the male gonads are the testes.
- The primary function /responsibility of the gonads is secretion of hormones and production of gametes (ova & sperm.)



- Secondary organs are responsible for transporting and nourishing the ova and sperm as well as preserving and protecting the fertilized eggs
- **Male reproductive system**
- The primary roles of the male reproductive system are...
Production and transportation of sperm.
- Deposit of sperm in the female reproductive tract and
Secretion of hormones



Male reproductive system

- The reproductive system in men has components in the abdomen, pelvis, and perineum.



- **MALE REPRODUCTIVE ORGANS**

External Genital Organs

1. Penis 2. Scrotum

Internal Genital Organs

1. Testis 2. Ducts (Epididymis, Duct deference, ejaculatory duct, Urethra)

4. Accessory Glands

a. Seminal Vesicles (pair) b. Prostate Gland (single)

c. Bulbourethral Glands (pair)



- **Penis**
- is a cylindrical pendant organ located anterior to the scrotum and functions to transfer sperm to the vagina.
- consists of three columns of erectile tissue that are wrapped in connective tissue and covered with skin. The two dorsal columns are the **corpora cavernosa**. The single, midline ventral column surrounds the urethra and is called **the corpus spongiosum**.
- 3 parts: a root, body (shaft), and glans penis.
- The root of the penis attaches it to the pubic arch.

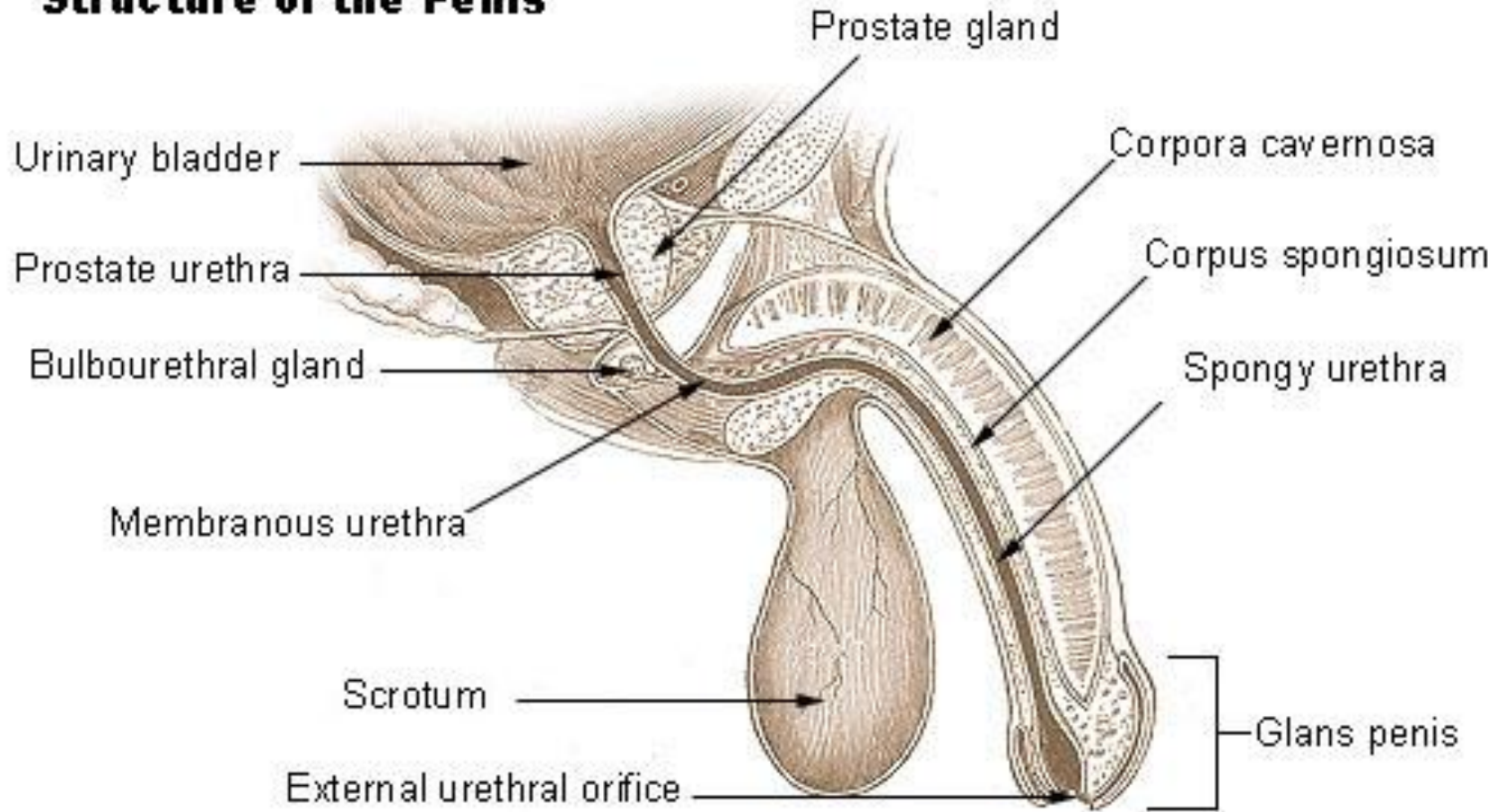


the body is the visible, pendant portion.

- The corpus spongiosum expands at the distal end to form the glans penis.
- The urethra, which extends throughout the length of the corpus spongiosum, opens through the external urethral orifice at the tip of the glans penis. A loose fold of skin, called the prepuce, or foreskin, covers the glans penis.



Structure of the Penis



- **Erection**
- Involves increase in length, width & firmness
- Changes in blood supply: arterioles dilate, veins constrict
- The spongy erectile tissue fills with blood
- Erectile Dysfunction [ED] also known as impotence

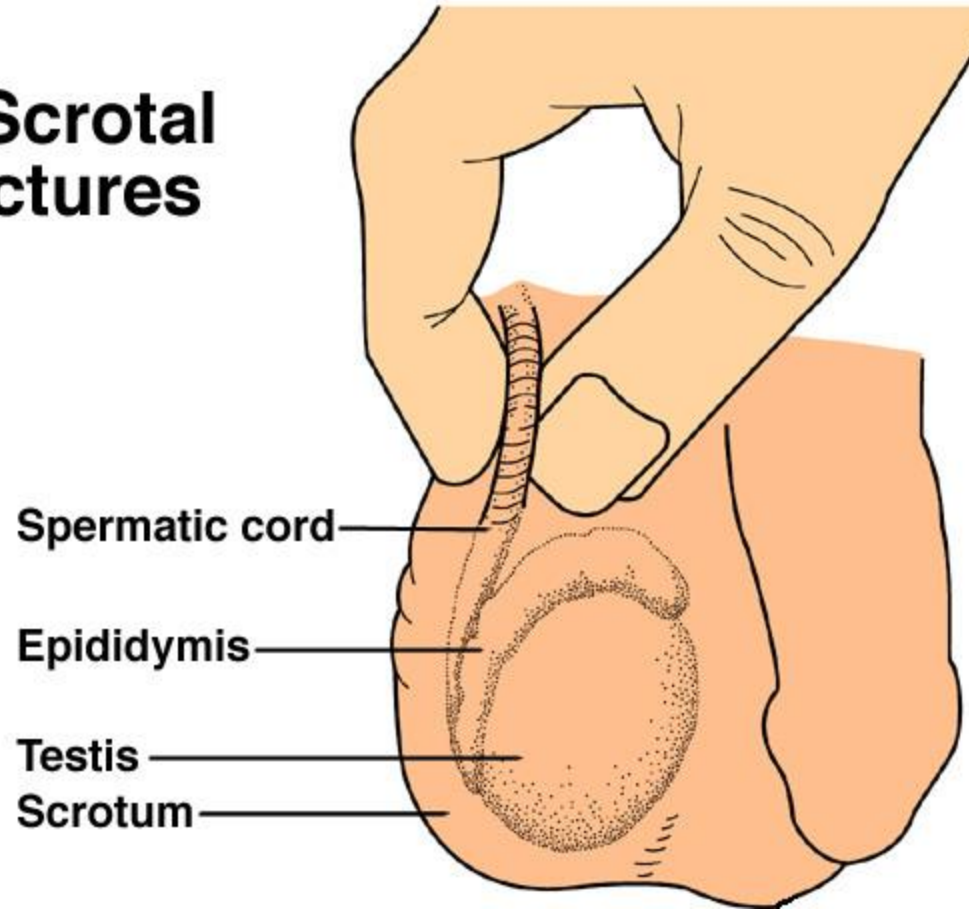


Scrotum

- consists of skin and subcutaneous tissue
- A vertical septum, of subcutaneous tissue in the center divides it into two parts, each containing one testis.
- Smooth muscle fibers, called the **dartos muscle**, in the subcutaneous tissue contract to give the scrotum its wrinkled appearance. When these fibers are relaxed, the scrotum is smooth.
- the **cremaster muscle**, consists of skeletal muscle fibers and controls the position of the scrotum and testes. When it is cold or a man is sexually aroused, this muscle contracts to pull the testes closer to the body fo warmth.



The Scrotal Structures

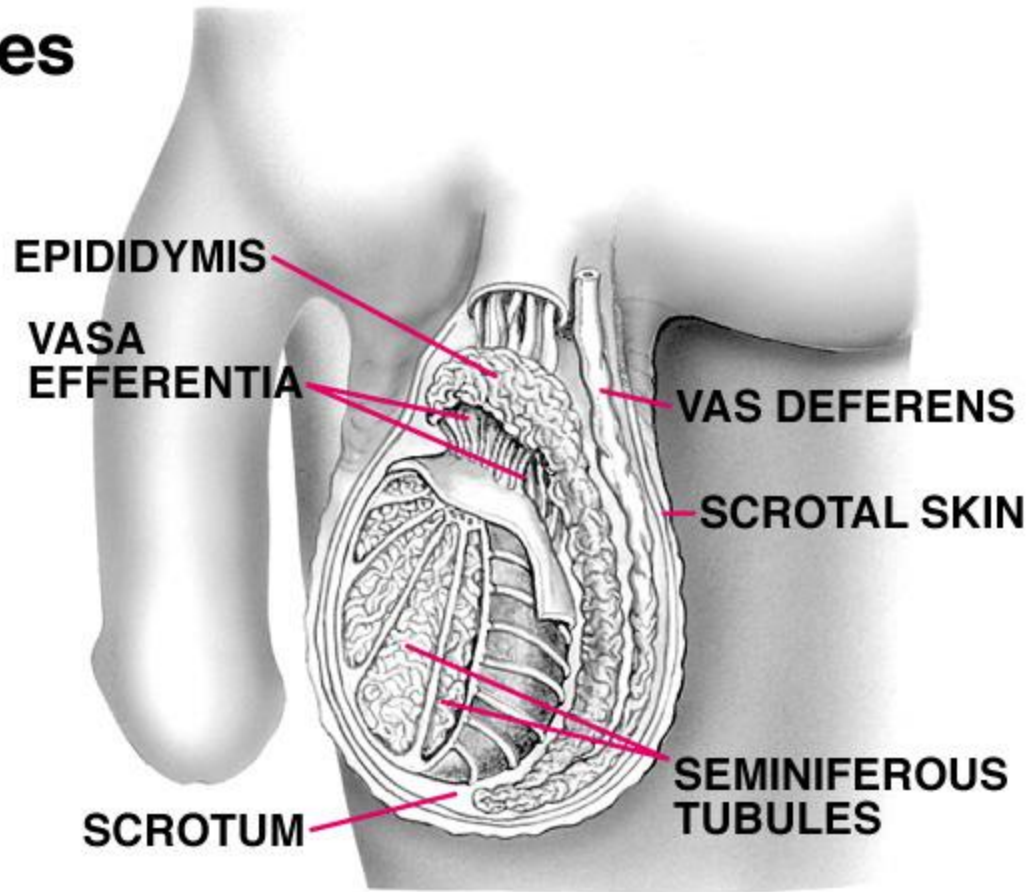


Testes

- Each testis is an oval structure about 5 cm long and 3 cm in diameter
- Covered by: tunica albuginea
- Located in the scrotum
- There are about 250 lobules in each testis. Each contains 1 to 4 -seminiferous tubules that converge to form a single straight tubule, which leads into the rete testis.
- Short efferent ducts exit the testes.
- **Interstitial cells (cells of Leydig)**, which produce male sex hormones, are located between the seminiferous tubules within a lobule.



Testes



Sperm cells pass through a series of ducts to reach the outside of the body. After they leave the testes, the sperm passes through the epididymis, ductus deferens, ejaculatory duct, and urethra.



- **Epididymis**
- a long tube (about 6 meters) located along the superior and posterior margins of the testes.
- Sperm that leave the testes are immature and incapable of fertilizing ova. They complete their maturation process and become fertile as they move through the epididymis. Mature sperm are stored in the lower portion, or tail, of the epididymis



Ductus Diferens (Vas Diferens)

A fibromuscular tube that is continuous with the epididymis.

- Enters the abdominopelvic cavity through the inguinal canal and passes along the lateral pelvic wall, behind bladder & toward the prostate gland. Just before it reaches the prostate gland, each ductus deferens enlarges to form an ampulla.
- Sperm are stored in the proximal portion of the ductus deferens, near the epididymis



- **Ejaculatory Duct**
- Each ductus deferens, at the ampulla, joins the duct from the adjacent seminal vesicle (one of the accessory glands) to form a short ejaculatory duct.
- Each ejaculatory duct passes through the prostate gland and empties into the urethra.



Urethra

- extends from the urinary bladder to the external urethral orifice at the tip of the penis.
- It is a passageway for sperm and fluids from the reproductive system and urine from the urinary system.
- divided into three regions: The prostatic urethra, the membranous urethra & the penile urethra (also called spongy urethra or cavernous urethra).



Accessory glands

are the seminal vesicles, prostate gland, and the bulbourethral glands. These glands secrete fluids that enter the urethra.

Seminal vesicles

- glands posterior to the urinary bladder.
- Each has a short duct that joins with the ductus deferens at the ampulla to form an ejaculatory duct, which then empties into the urethra.
- The fluid is viscous and contains fructose, prostaglandins and proteins

Prostate glands

- a firm, dense structure about the size of a walnut that is located just inferior to the urinary bladder.
- encircles the urethra as it leaves the urinary bladder.
- Numerous short ducts from the prostate gland empty into the prostatic urethra. The secretions of the prostate are thin, milky colored, and alkaline. They function to enhance the motility of the sperm.



Bulbourethral glands (Cowper's)

- small, about the size of a pea, and located near the base of the penis. A short duct from each enters the proximal end of the penile urethra.
- In response to sexual stimulation, the bulbourethral glands secrete an alkaline mucus-like fluid



Seminal fluid or semen

- a slightly alkaline mixture of sperm cells and secretions from the accessory glands.
- Secretions from the seminal vesicles make up about 60 percent of the volume of the semen, with most of the remainder coming from the prostate gland. The sperm and secretions from the bulbourethral gland contribute only a small volume.
- The volume of semen in a single ejaculation may vary from 1.5 to 6.0 ml. There are between 50 to 150 million spermatoocytes per milliliter of semen. Sperm counts below 10 to 20 million per milliliter usually present fertility problems.



Hormones

- Follicle-stimulating hormone (FSH) stimulates spermatogenesis
- Interstitial Cell Stimulating Hormone (ICSH) stimulates the production of [testosterone](#)
- testosterone stimulates the development of male secondary sex characteristics & spermatogenesis.



Sperm

Function:

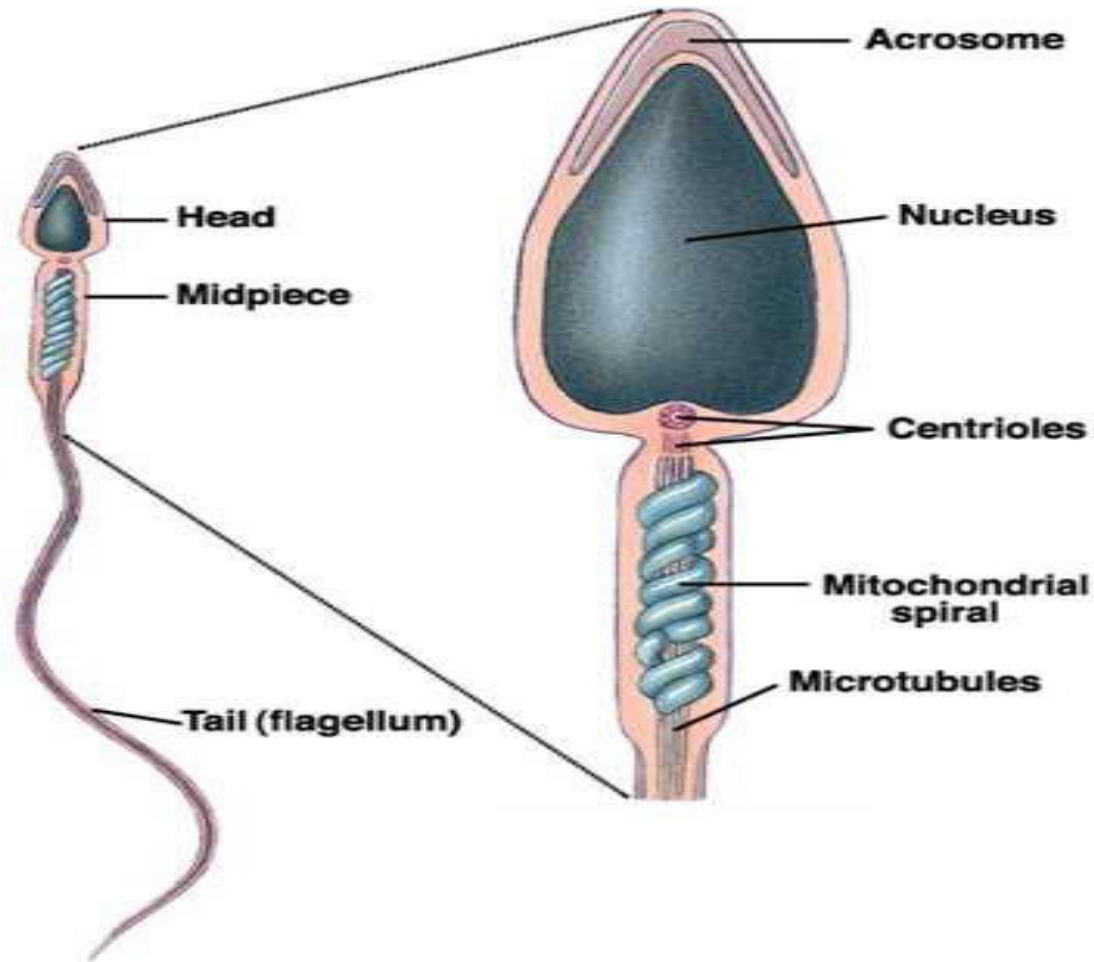
- To move and carry genetic information to the egg.

Structure

Head: The large head, region of the sperm that contains DNA. The tip of the head is covered by an acrosome, which contains enzymes that help the sperm penetrate the female gamete

Midpiece: The narrow middle part of the cell that contains mitochondria.

Tail: The wavelike motion of the flagellum propels the sperm forward.



Spermatogenesis

Spermatogenesis is the formation of sperm cells.

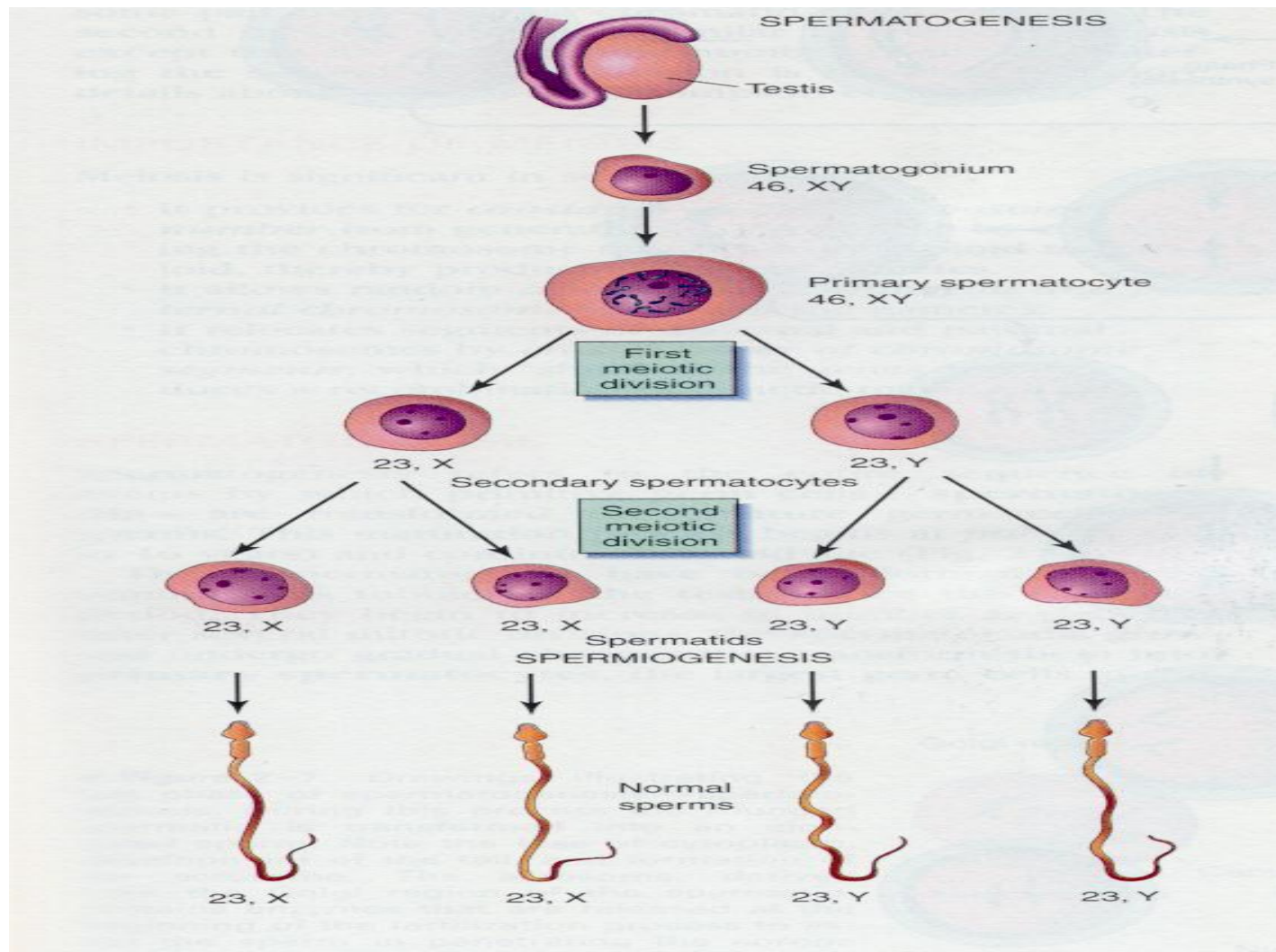
It takes place in the seminiferous tubules.

Interspersed within the tubules are large cells which are the sustentacular cells (Sertoli's cells), which support and nourish the other cells.



- Early in embryonic development, primordial germ cells enter the testes and differentiate into spermatogonia
- Spermatogonia are diploid cells, each with 46 chromosomes (23 pairs) located around the periphery of the seminiferous tubules.
- At puberty, hormones stimulate these cells to begin dividing by mitosis. Some remain at the periphery as spermatogonia.
- Others become primary spermatocytes. Because they are produced by mitosis, primary spermatocytes, like spermatogonia, are diploid and have 46 chromosomes.





RIPER
AUTONOMOUS
NAAC &
NBA (UG)
SIRO- DSIR

FEMALE REPRODUCTIVE SYSTEM



Raghavendra Institute of Pharmaceutical Education and Research - Autonomous
K.R.Palli Cross, Chiyyedu, Anantapuramu, A. P- 515721

- **The female reproductive system is designed to carry out several functions.**
- 4 is the normal pH of the vagina.
- 40 weeks is the normal gestation period.
- 400 oocytes released between menarche and menopause.
- 400,000 oocytes present at puberty.
- 28 days in a normal menstrual cycle.



OOGENESIS- The development of the egg (ovum) in the ovary.

OOGONIA: during fetal growth the oogonia ($2n$) divide to form primary oocytes ($2n$), at puberty these will form secondary oocytes (n) and later eggs (n) each month.

GRANULOSA CELLS: nourish the developing egg cells

Functions

- Produce sex hormones
Estrogen, Progesterone
- Produce egg (ova)
- Reception of spermatozoa
- Support & protect developing embryo
- Give birth to new baby
- Lactation, the production of breast milk, which provides complete nourishment for the baby in its early life.



Female external genitalia

- ***Vulva is the term given to*** the female external genitalia

The vulva includes: Mons pubis, Labia majora, Labia minora, Clitoris, Urethral opening, Vaginal opening, Perineum

- **MONS PUBIS**

- The triangular mound of fatty tissue that covers the pubic bone
- It protects the pubic symphysis
- During adolescence sex hormones trigger the growth of pubic hair on the mons pubis



- **Labia majora or "greater lips"** are the part around the vagina
- containing two glands (**Bartholin's glands**) which helps lubrication during intercourse.
- **Labia minora or "lesser lips"** are the thin hairless ridges at the entrance of the vagina, which joins behind and in front. In front they split to enclose the clitoris.
- **The clitoris is a small pea shaped** structure. It plays an important part in sexual excitement in females

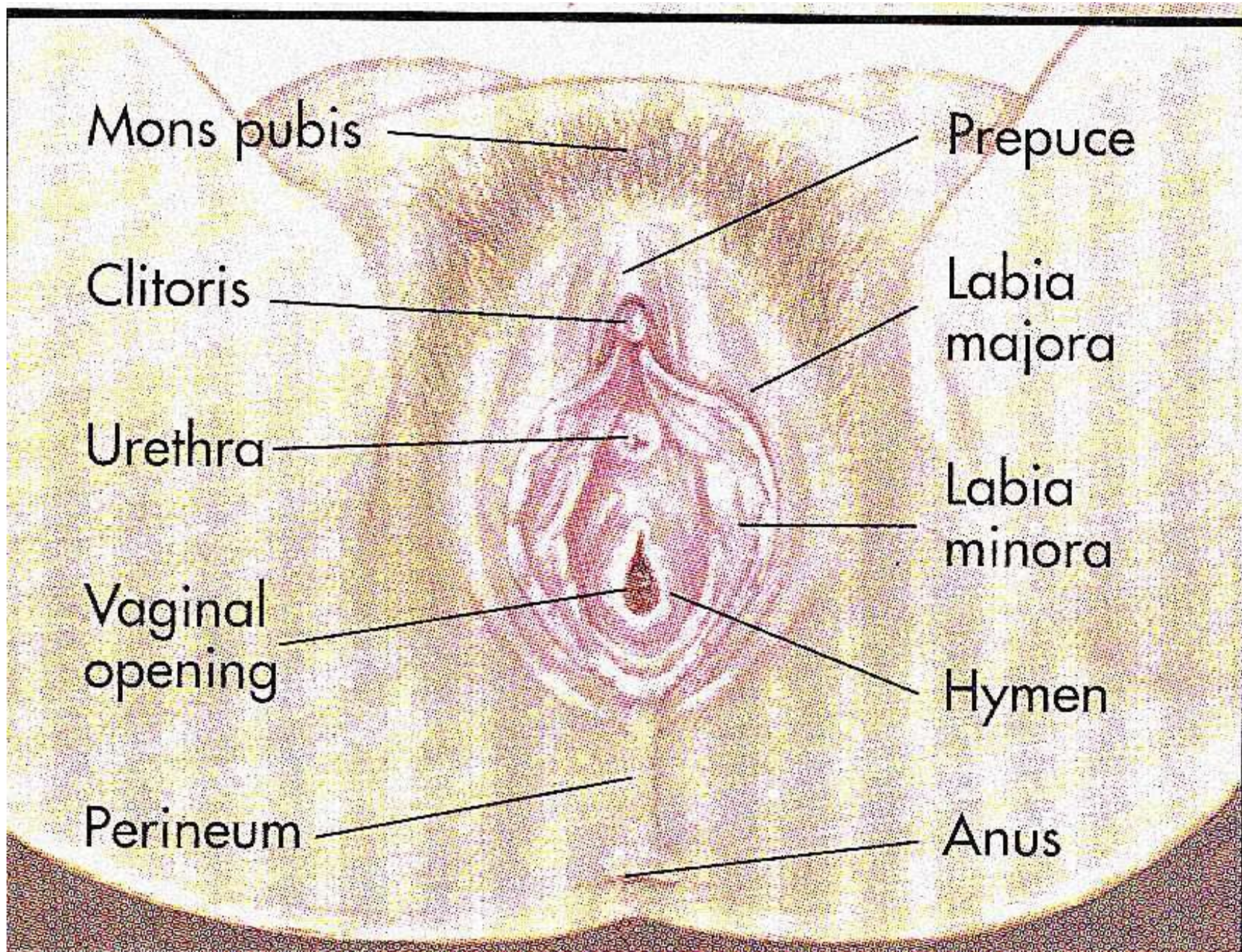


- The small penis-like structure.
- Highly sensitive organ composed of nerves, blood vessels, and erectile tissue.
- It is made up of a shaft and a glans.
- **The urethral orifice or external urinary opening** is below the clitoris on the upper wall of the vagina and is the passage for urine.
- Opening of the vagina is separate from the urinary opening and located below it.



- The hymen is a thin crescentic fold of tissue which partially covers the opening of the vagina
- **PERINEUM**
- The muscle and tissue located between the vaginal opening and anal canal.
- It supports and surrounds the lower parts of the urinary and digestive tracts.
- The perinium contains an abundance of nerve endings that make it sensitive to touch.





Female internal genitalia

The internal genitalia consists of the:

Vagina

Uterus

Fallopian Tubes

Ovaries



- Vagina = “birth canal”

A tube like, muscular but elastic organ

About 4 to 5 inches long in an adult woman.

PH- 4 acidic

It is the passageway for sperm to the egg and for menstrual bleeding



Uterus

- The uterus is a thick-walled, muscular, pear-shaped organ
- Located in the middle of the pelvis, behind the bladder, and in front of the rectum. The uterus is anchored in position by several ligaments.
- The uterus consists of the **cervix** and the main body (corpus).



- The cervix is the lower part of the uterus, which protrudes into the upper part of the vagina. It can be seen during a pelvic examination. Like the vagina, the cervix is lined with a mucous membrane, but the mucous membrane of the cervix is smooth.
- Sperm can enter and menstrual blood can exit the uterus through a channel in the cervix (cervical canal).
- There is dramatic growth of the uterus during pregnancy,
- occurring by a process of both muscle cell hyperplasia and production of new muscle cells from the resident stem cells.

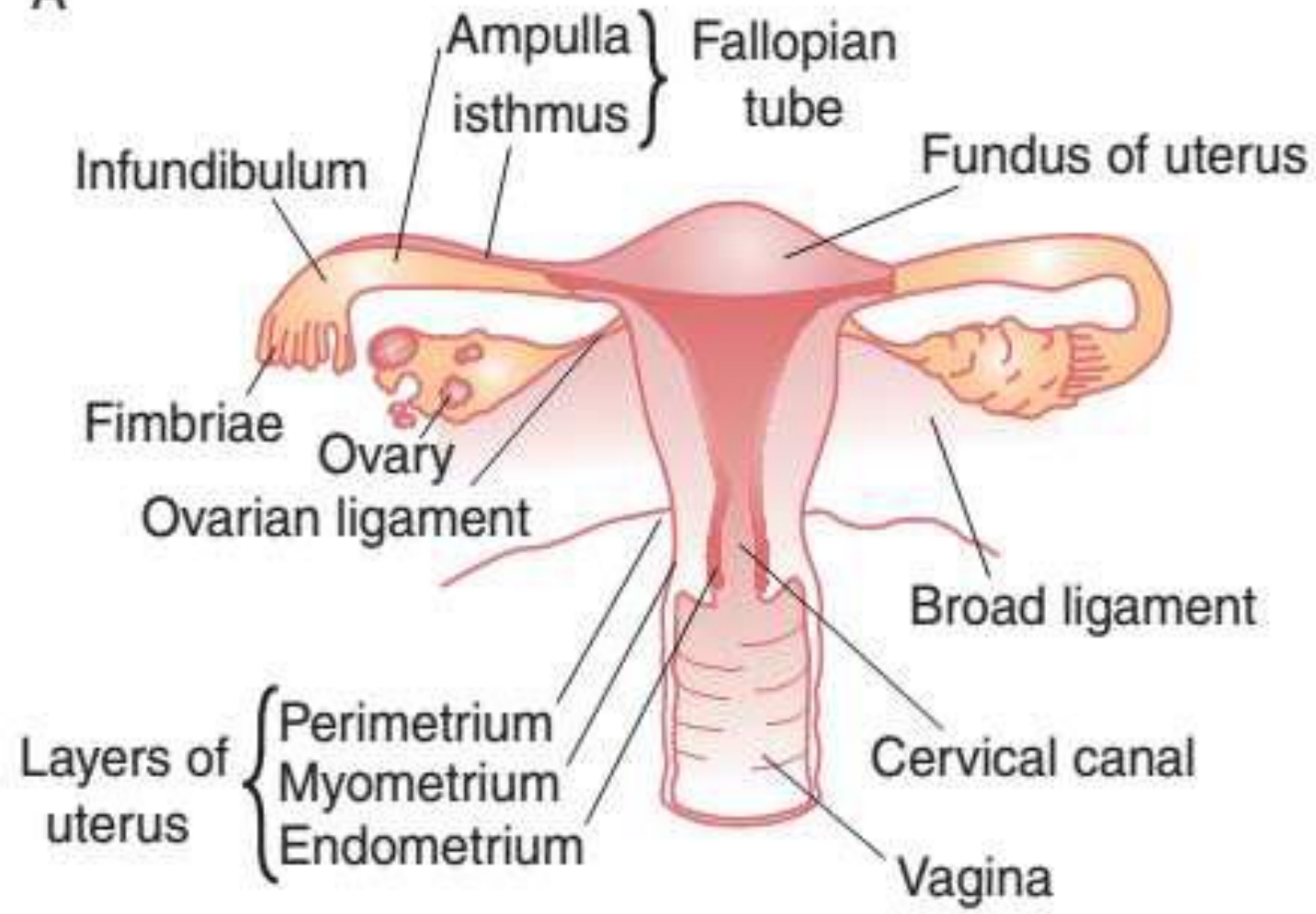


- The cervical canal is usually narrow, but during labor, the canal widens to let the baby through.
- The cervix is usually a good barrier against bacteria, except around the time an egg is released by the ovaries (ovulation), during the menstrual period, or during labor.

Functions

- The main function of the uterus is to sustain a developing fetus.
- It prepare for this possibility for each month.
- At termination of pregnancy it expels the uterine contents.

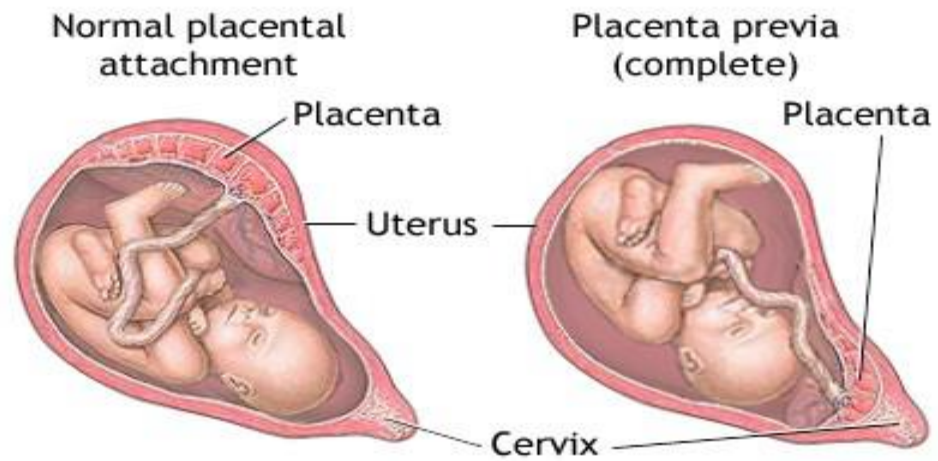
A



Layers

- **ENDOMETRIUM:** inner lining of uterus, nourishes developing embryo, built up each month for pregnancy, if not, shed during menstruation
- **MYOMETRIUM:** muscular, supports fetus, contracts at birth and to shed the endometrium during menstruation
- **PERIMETRIUM:** The perimetrium is a serous membrane that lines the outside of the uterus.

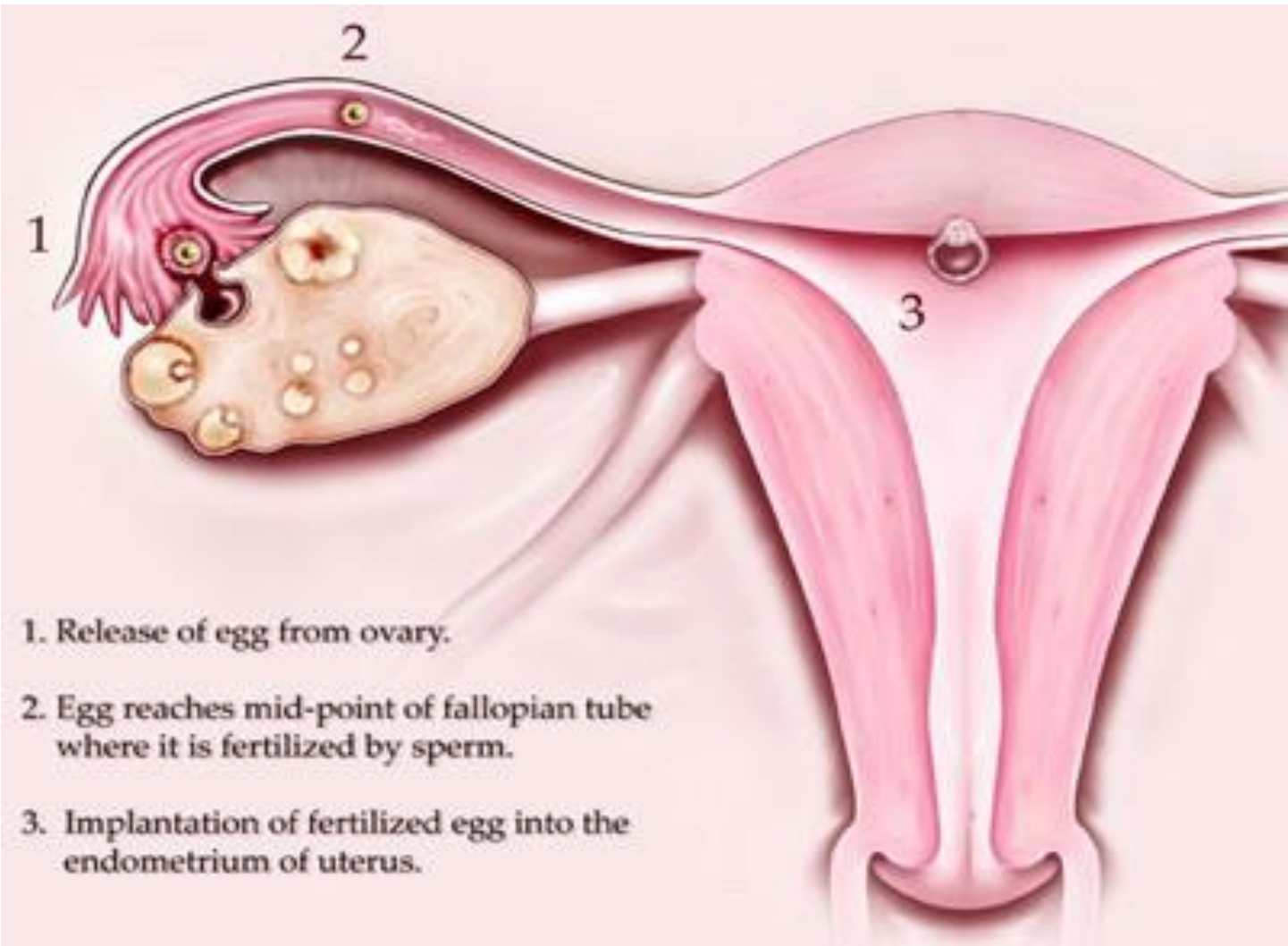


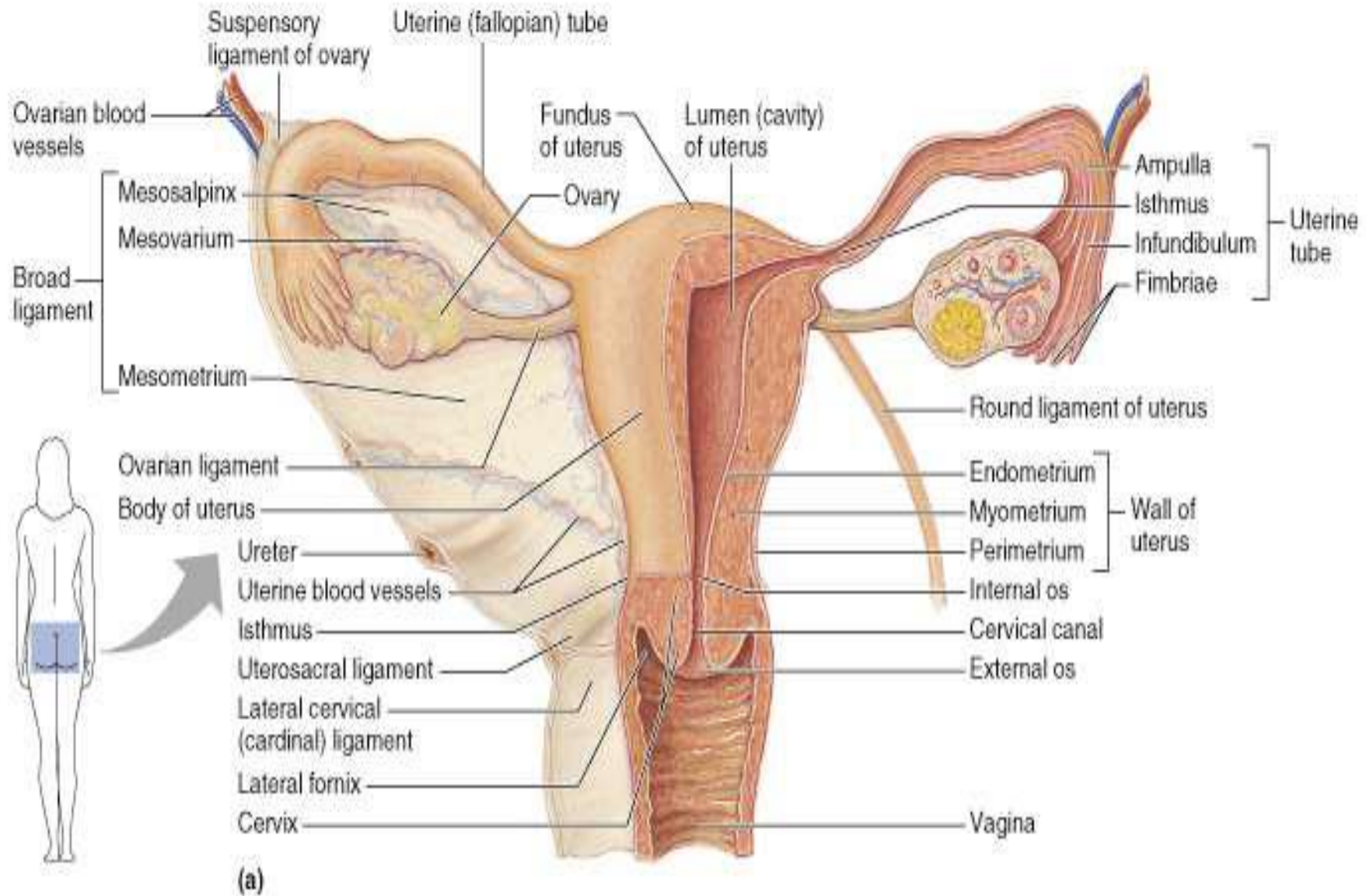


Fallopian tubes (or) Oviducts

- Stretch from the uterus to the ovaries and about 8 to 13 cm in length.
- The ends of the fallopian tubes lying next to the ovaries feather into ends called fimbria.
- Millions of tiny hair-like cilia line the fimbria and interior of the fallopian tubes.
- The cilia beat in waves hundreds of times a second catching the egg at ovulation and moving it through the tube to the uterine cavity.
- Fertilization typically occurs in the fallopian tube.







Ovaries

- The ovaries are usually pearl-colored, oblong, and about the size of a walnut.
- They are attached to the uterus by ligaments. In addition to producing female sex hormones (estrogen and progesterone) and male sex hormones, the ovaries produce and release eggs.
- The developing egg cells (oocytes) are contained in fluid-filled cavities (follicles) in the wall of the ovaries. Each follicle contains one oocyte.



Structure

Medulla

Cortex

MEDULLA

- supporting frame work
- Made of fibrous tissue
- Has ovarian blood vessels
- Lymphatics and nerve travels through it

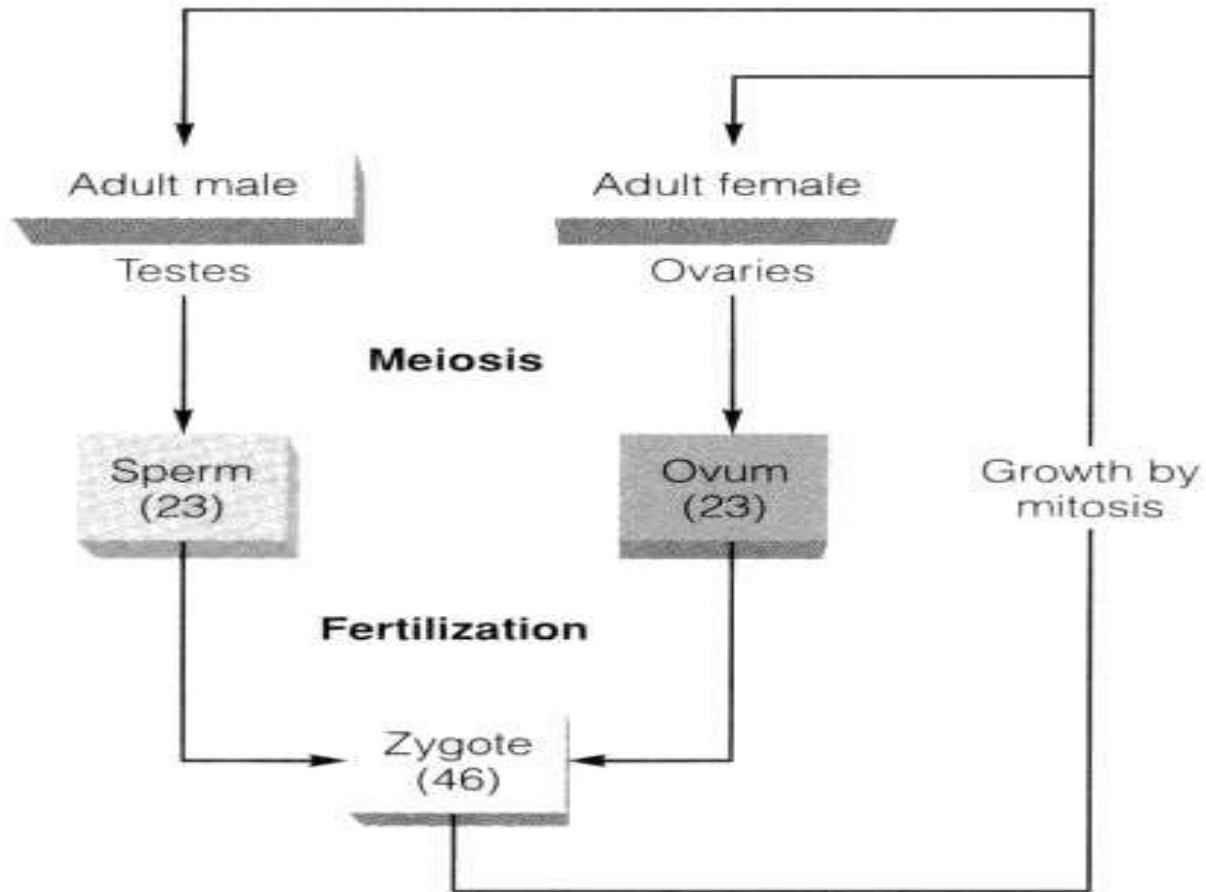


- **CORTEX**
- Functioning part of the ovum
- Contains ovarian follicles in different stage
- **Ovulation**
- Process of releasing one mature ovum each month into that ovary's fallopian tube
- Hormones from pituitary cause ovaries to begin producing female sex hormones
- Ova begin to mature
- Ovum can live about 2 days in fallopian tube
- One sperm will enter ovum =fertilization/conception



- If the ovum is not fertilized it doesn't attach to the uterine lining/endometrium. Muscles of the uterus contract, lining breaks down ("cramps"), Lining passes through the cervix into the vagina and out of the vaginal opening





- The **mammary glands** are sweat glands specialized for the production of milk.
- The milk-producing secretory cells form walls of bulb-shaped chambers called alveoli that join together with ducts, in grapelike fashion, to form clusters called lobules.
- Numerous lobules assemble to form a lobe. Each breast contains a single mammary gland consisting of 15 to 20 of these lobes.



- Lactiferous ducts leading away from the lobes widen into
- lactiferous sinuses that serve as temporary reservoirs for milk.



- If the ovum is not fertilized it doesn't attach to the uterine lining/endometrium. Muscles of the uterus contract, lining breaks down ("cramps"), Lining passes through the cervix into the vagina and out of the vaginal opening



- If the ovum is not fertilized it doesn't attach to the uterine lining/endometrium. Muscles of the uterus contract, lining breaks down ("cramps"), Lining passes through the cervix into the vagina and out of the vaginal opening



NORMAL MENSTRUAL CYCLE

mean duration of the MC

Mean 28 days (only 15% of)

Range 21-35

average duration of menses 3-8 days

normal estimated blood loss Approximately 30 ml

ovulation occur

Usually day 14

36 hrs after the onset of mid-cycle LH surge

NORMAL MENSTRUAL CYCLE

the phases of the MC & ovulation regulates by:

Interaction between hypothalamus, pituitary & ovaries

mean age of menarche & menopause are: Menarche

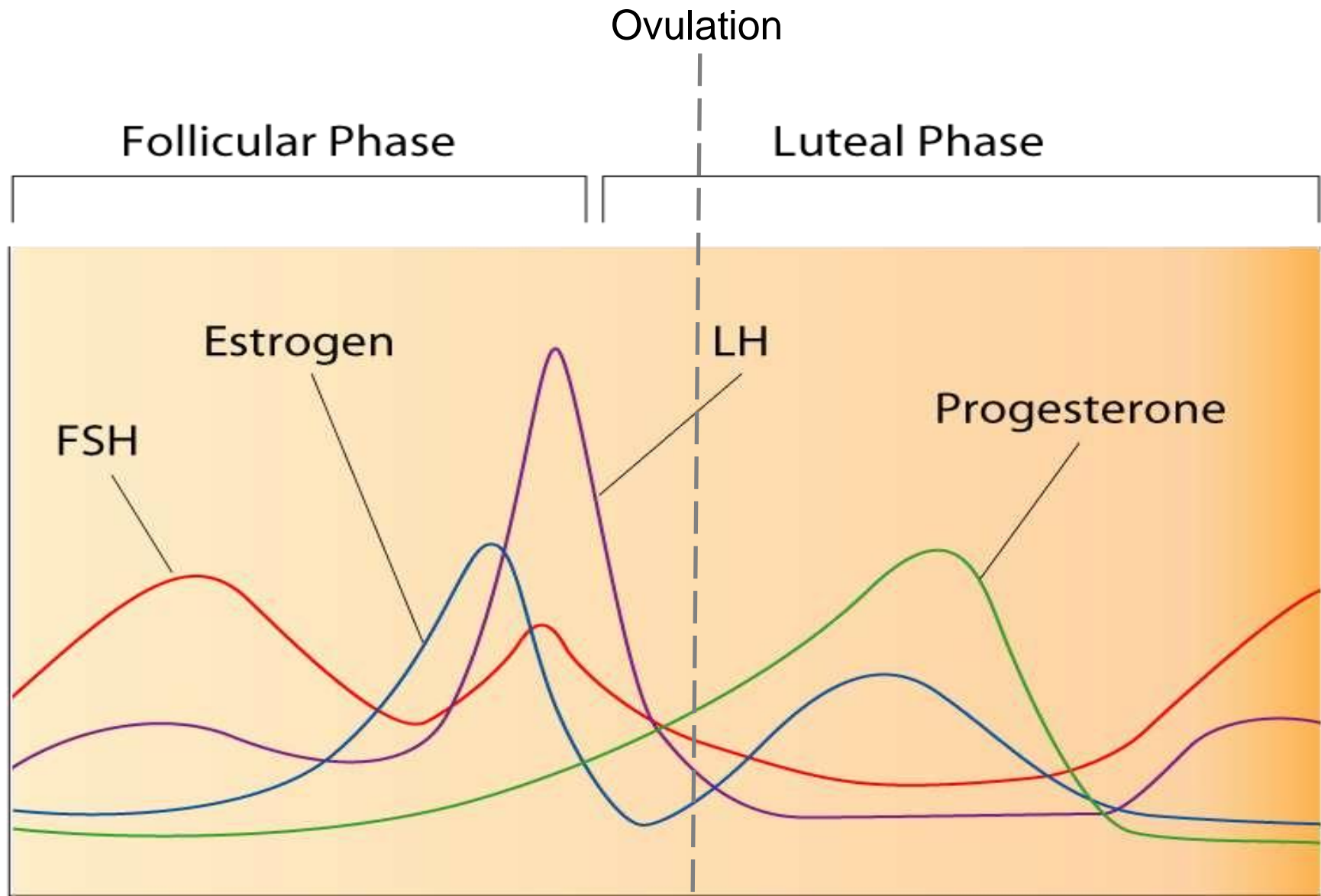
12.7

Menopause 51.4

The Cycle

- Strongly linked to the endocrine system (hormone based and paracrine based)
- Typically takes 28 days to cycle through 4 phases
 - Follicular
 - Ovulation
 - Luteal
 - Menstruation
- Hormones raise and fall

Hormone Levels
in the Blood



Follicular Phase

Ovulation

Luteal Phase

FSH

Estrogen

LH

Progesterone

Follicular

- Begins when estrogen levels are low
- Anterior pituitary secretes FSH and LH, stimulation follicle to develop
- Cells around egg enlarge, releasing estrogen
- This causes this uterine lining to thicken

Ovulation

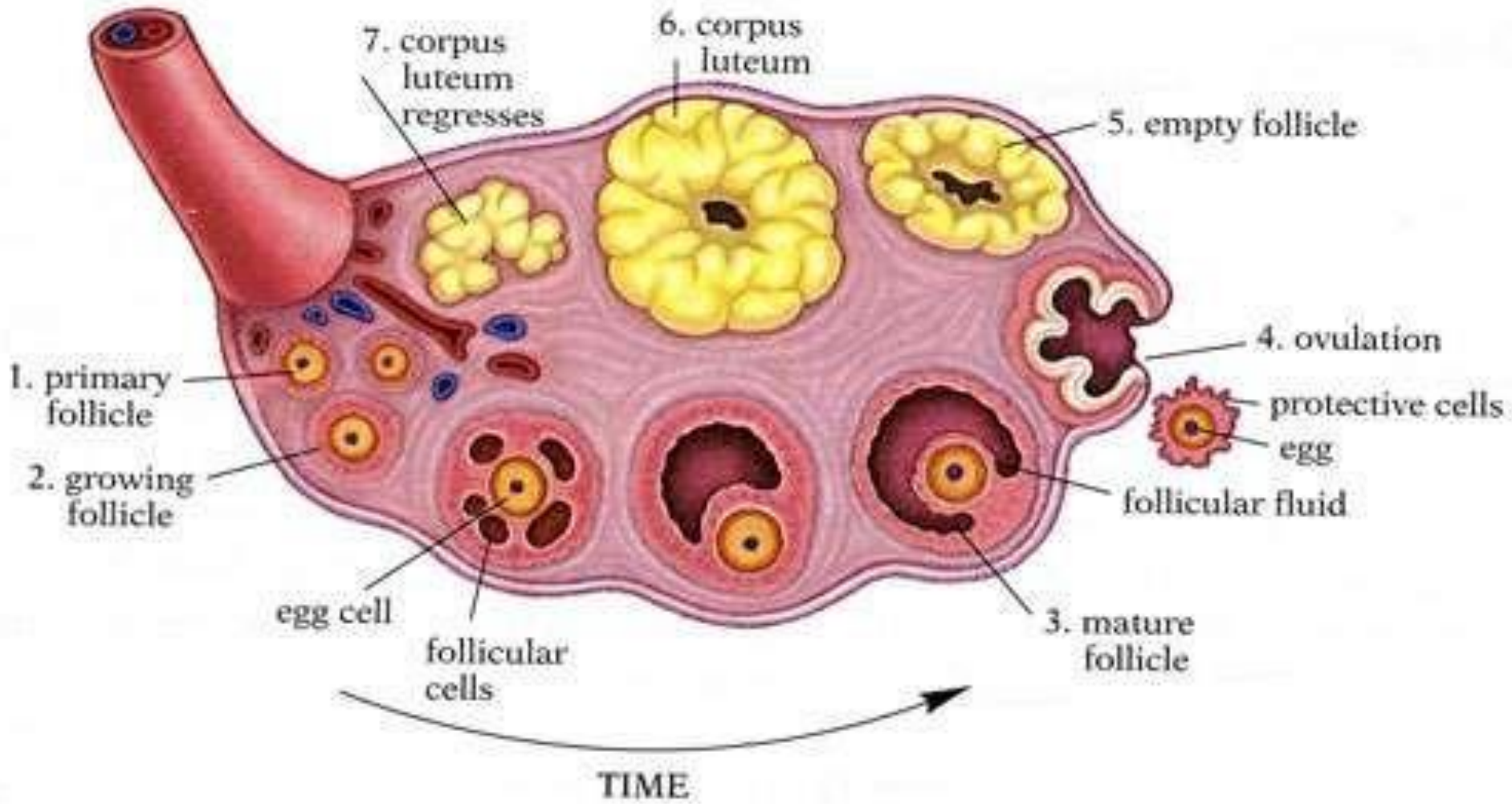
- LH and FSH still being released, for another 3-4 days
- Follicle ruptures, releasing ova into the Fallopian tubes

Luteal

- Now empty follicle changes to a yellow colour, becomes **corpus luteum**
- Continues to secrete estrogen, but now begins to release progesterone
- Progesterone further develops uterine lining
- If pregnant, embryo will release hormones to preserve corpus luteum

Menstruation

- Menstruation
- If no embryo, the corpus luteum begins to disintegrate
- Progesterone levels drop, uterine lining detaches, menstruation can begin
- Tissue, blood, unfertilized egg all discharged
- Can take from 3-7 days



RIPER
AUTONOMOUS
NAAC &
NBA (UG)
SIRO- DSIR

THANK YOU ONE AND ALL



Raghavendra Institute of Pharmaceutical Education and Research - Autonomous
K.R.Palli Cross, Chiyyedu, Anantapuramu, A. P- 515721