

Human Reproduction system

Part-1

Learn with easy language

By Anurag Jaiswal
Asst. Prof.



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Our Body Systems

Reproductive System

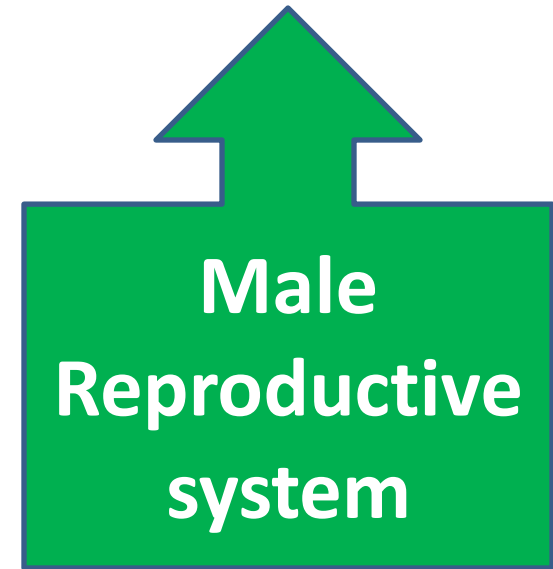
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Why do we need to reproduce?

- To ensure survival of the species
 - To produce egg and sperm cells
 - To transport and sustain these cells
 - To nurture the developing offspring
 - To produce hormones

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Reproductive System





Male Reproductive System

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The Male Reproductive System

- **Adolescence**

- Puberty
- Burst of hormones activate maturation of the gonads: testes
- Begins: 9 – 14 yrs of age
- Abnormally early = precocious puberty
- Delayed = eunuchoidism

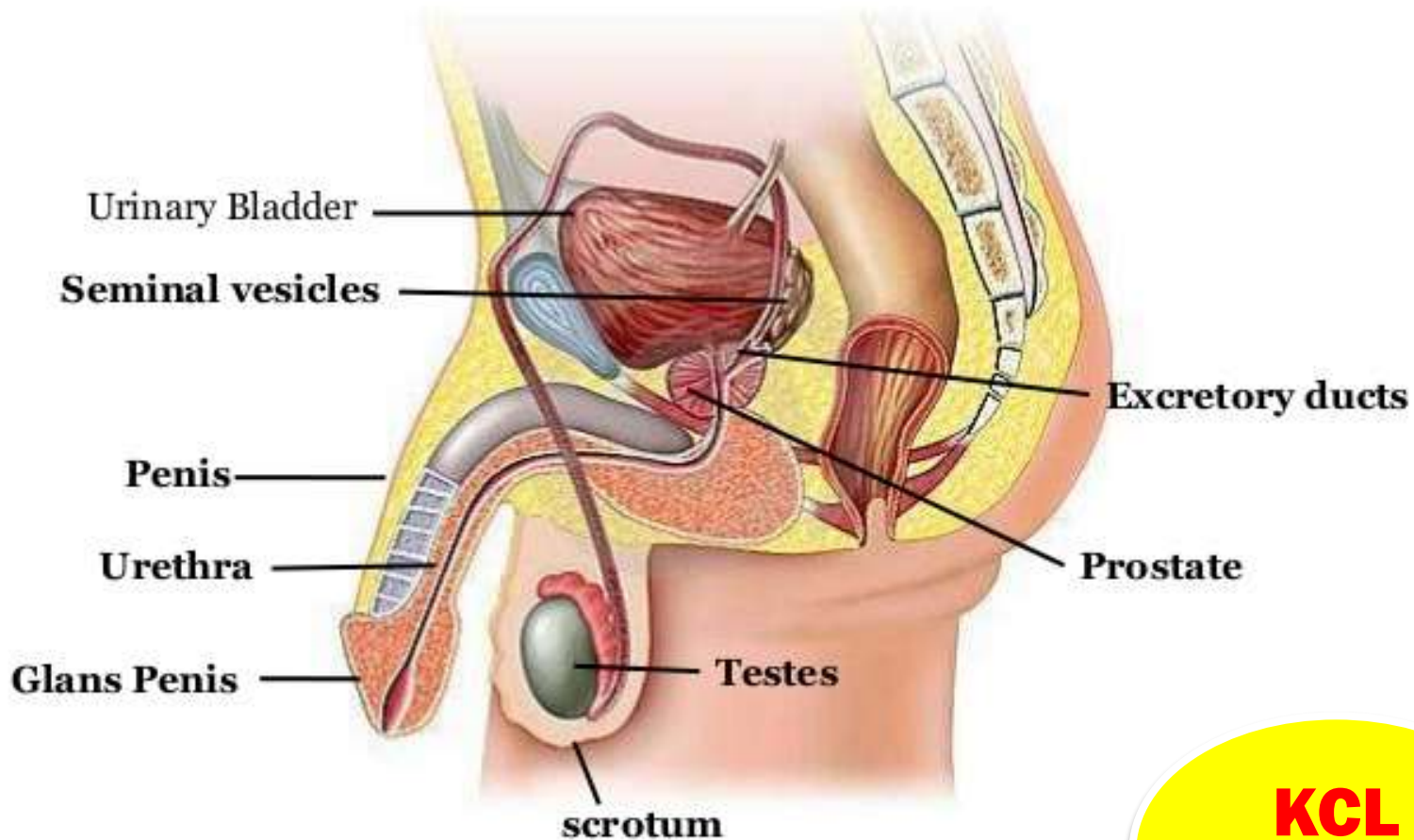
- **General Physical Changes**

- Enlargement of the external and internal genitalia
- Voice changes
- Hair growth
- Mental changes
- Changes in body conformation and skin
- Sebaceous gland secretions thicken/increase → acne

The Male Reproductive System

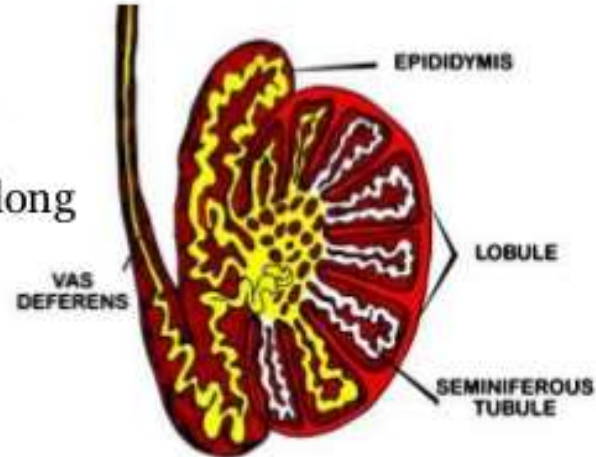
- Functions
 - To produce, maintain and transport sperm (the male reproductive cells) and protective fluid (semen) .
 - To produce and secrete male sex hormones responsible for maintaining the male reproductive system .
- **Consists of:**
 - A pair of testes
 - A network of excretory ducts
 - Epididymis
 - Vas deferens
 - Ejaculatory ducts
 - Seminal vesicles
 - Prostate
 - Urethra
 - Penis

The Male Reproductive System



• Testes / Testicles (Gonads)

- Produce sperm (Spermatogenesis)
 - Sperm production begins at puberty and continues throughout the life of a male.
- Each testis is an oval structure about 5 cm long and 3 cm in diameter.
- Covered by: tunica albuginea
- Located in the scrotum
- Short efferent ducts exit the testes.



• Duct System

- 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
 - Sperm mature in epididymis
 - Vas Deferens
 - Transports mature sperm to the urethra
 - Ejaculatory ducts
 - Empty into 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 Gland

- 33% of semen volume.
- 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.

Urethra

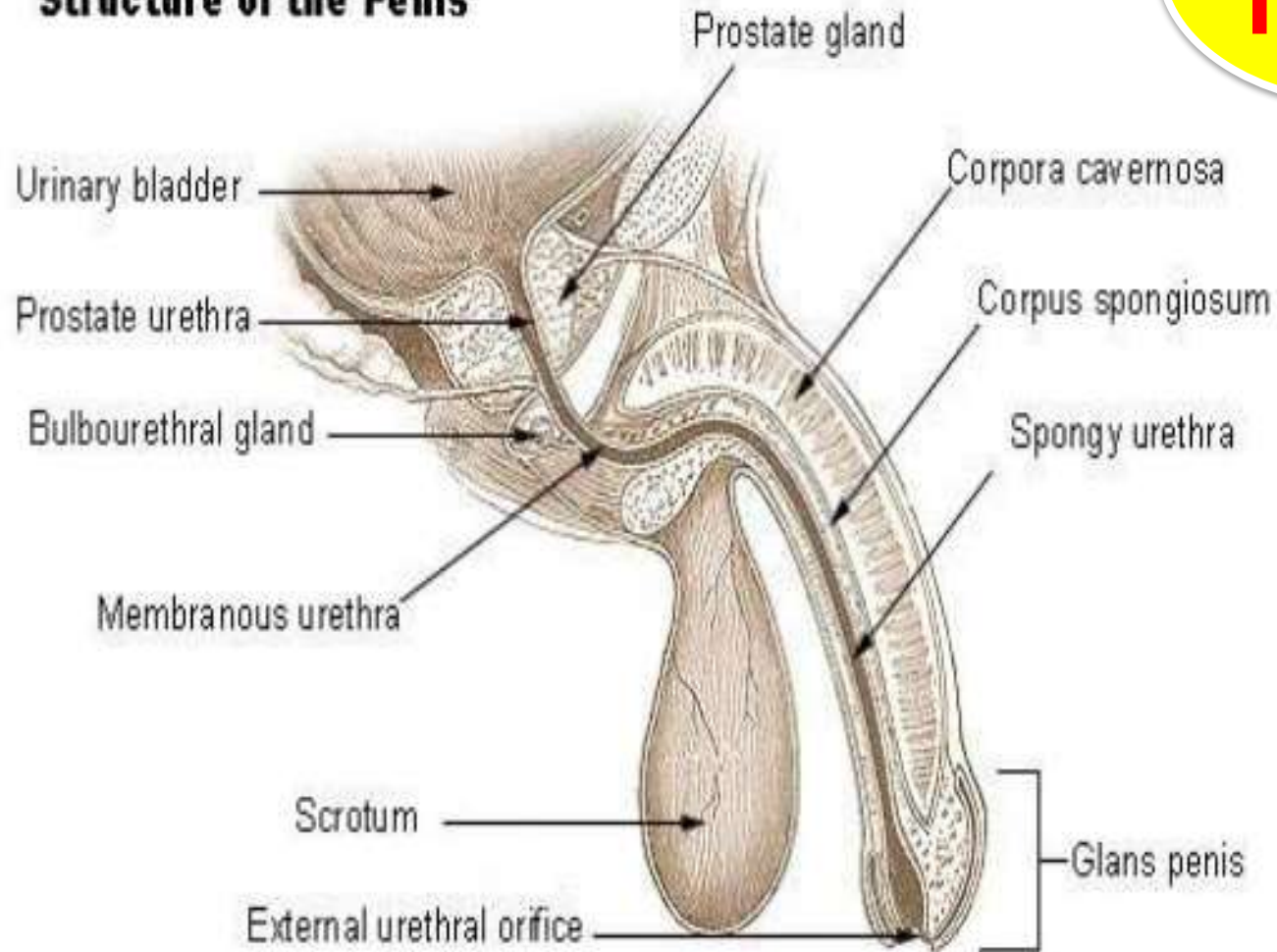
- Extends from the urinary bladder to the external urethral orifice at the tip of the penis.
- It is a passageway for sperm and fluids from the reproductive system and urine from the urinary system.
- **Divided into three regions:**
 - The prostatic urethra
 - The membranous urethra
 - The penile urethra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

Penis

- A tube-shaped organ that extends from the trunk of the body just above the testes.
- Made of spongy tissue containing many blood vessels.
- When blood flow increases it becomes enlarged and erect.
- Releases semen a thick fluid containing sperm and other secretions from the male reproductive system.
- At the height of sexual arousal a series of muscular contractions known as ejaculation may occur.

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Structure of the Penis

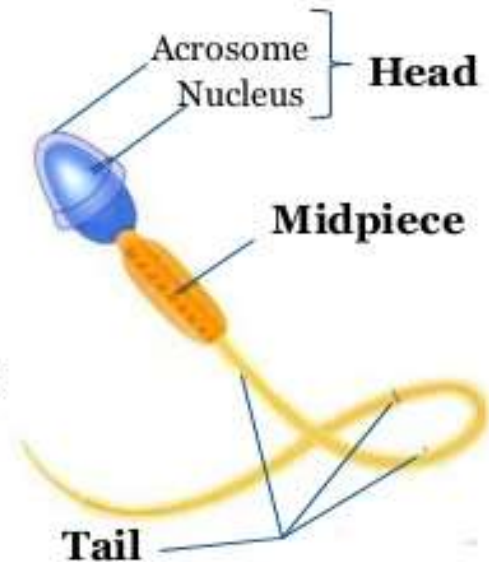


Seminal Fluid or Semen

- A slightly alkaline mixture of sperm cells and secretions from the accessory glands.
- Secretions from the seminal vesicles make up about 60% of the volume of the semen, with most of the remainder coming from the prostate gland.
- The sperm and secretions from the bulb urethral gland contribute only a small volume.
- **Semen**
 - Alkaline mixture
 - Nutrients
 - Prostaglandins
 - 1.5 to 5.0 ml per ejaculate
 - Sperm count of 40 to 250 million / ml

Sperm

- Sperm are produced within 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.
- **Sperm cells**
 - Head
 - Nucleus with 23 chromosomes
 - **Acrosome** – enzyme-filled sac
 - Helps sperm penetrate ovum
 - Midpiece
 - Mitochondria that generate cell's energy
 - Tail
 - Flagellum that propels sperm forward



Erection, Orgasm, and Ejaculation

- **Erection**

- Parasympathetic nervous system stimulates erectile tissue
- Become engorged with blood

- **Orgasm**

- Sperm cells propelled out of testes into urethra
- Secretions from accessory organs also released into urethra

- **Ejaculation**

- Semen is forced out of urethra
- Sympathetic nerves then stimulate erectile tissue to release blood
- Penis returns to flaccid state

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SPERMATOGENESIS

SPERMATOGENESIS: Process in which spermatozoa are produced from spermatogonial stem cells by way of mitosis and meiosis.

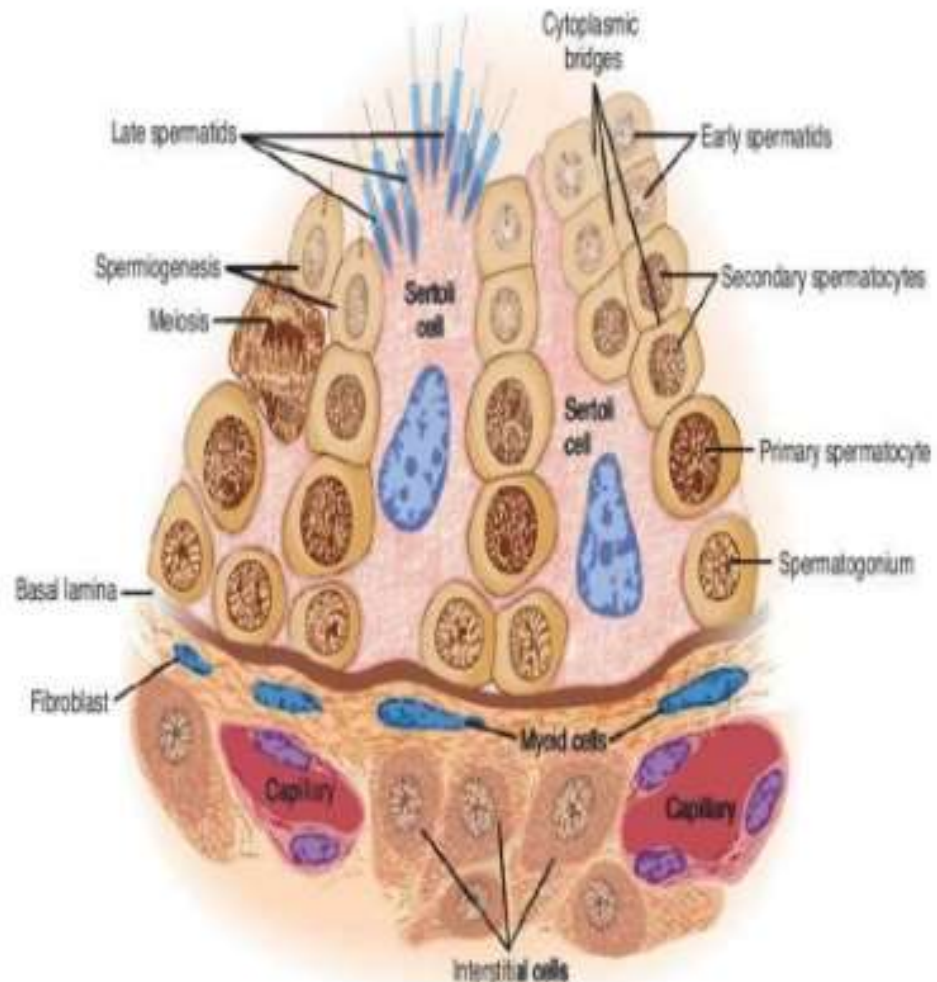
- Starts at puberty.

DURATION

- For humans → **74 days**.
- Including transport on ductal system, it takes **3 months**.

LOCATION -:

- Seminiferous tubules
- Epididymis (Maturation and storage until ejaculation.)
- **PURPOSE OF SPERMATOGENESIS**
- To preserve number of chromosomes in offspring.



STAGES OF SPERMATOGENESIS

- 2 Types of spermatogonia type A (A_d , A_p) and type B
- 512 spermatids are formed from single spermatogonium.
- During division, cells bound to each other by cytoplasmic bridges for synchronised development (**incomplete cytogenesis**)

1-spermatocytogenesis

2- spermatidogenesis

3-spermiogenesis

4- spermiation

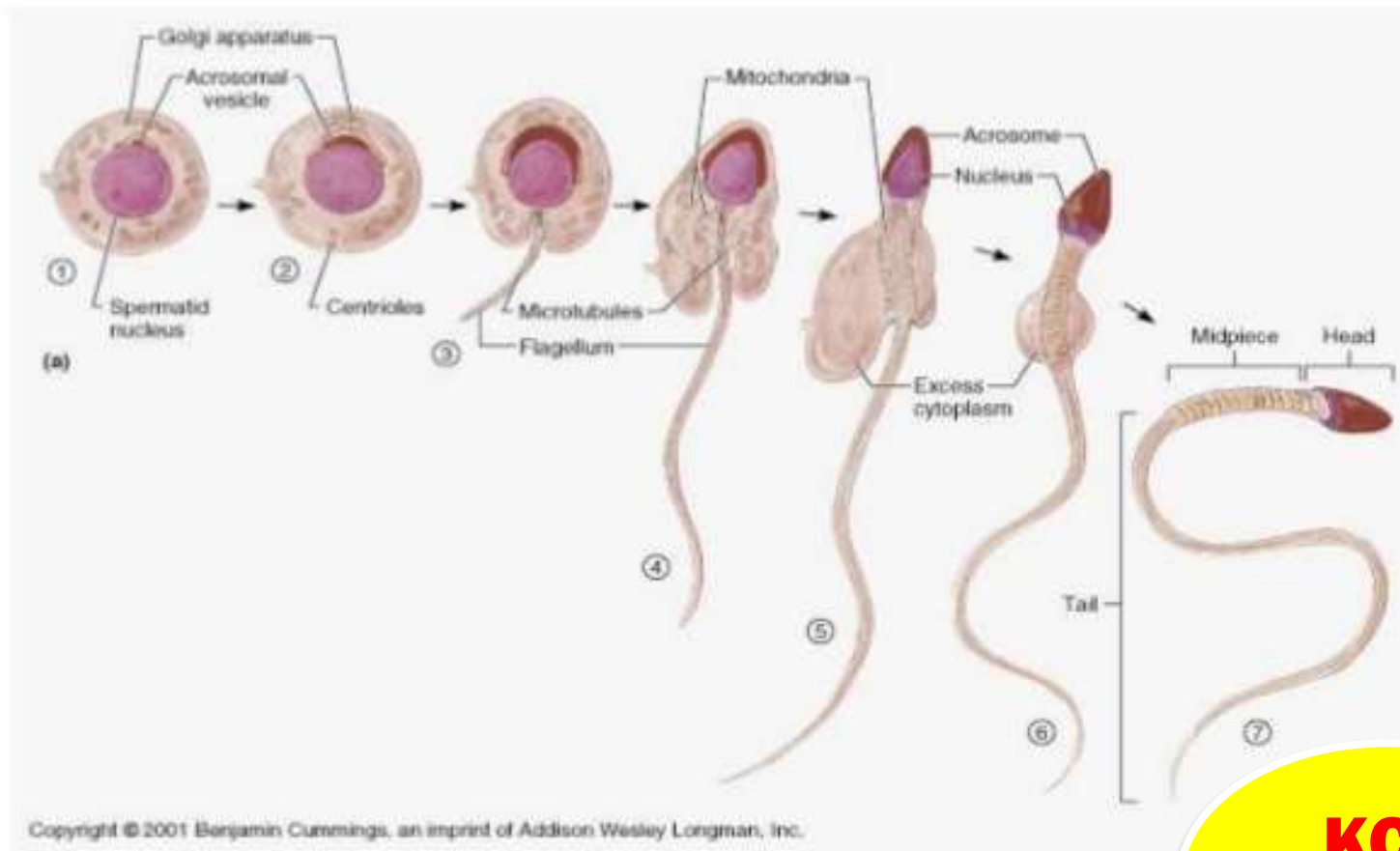
5-maturation

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SPERMIOGENESIS

- Metamorphosis of small, round spermatid cell in to spermatozoon.



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ROLE OF HORMONES IN SPERMATOGENESIS

TESTOSTERONE

- Growth & division of germ cells

LUTEINIZING HORMONE

- Stimulate leydig cells to secrete testosterone

FOLLICLE STIMULATING HORMONE

- Stimulate sertoli cells

ESTROGENS

- probably essential for spermiogenesis

GROWTH HORMONE

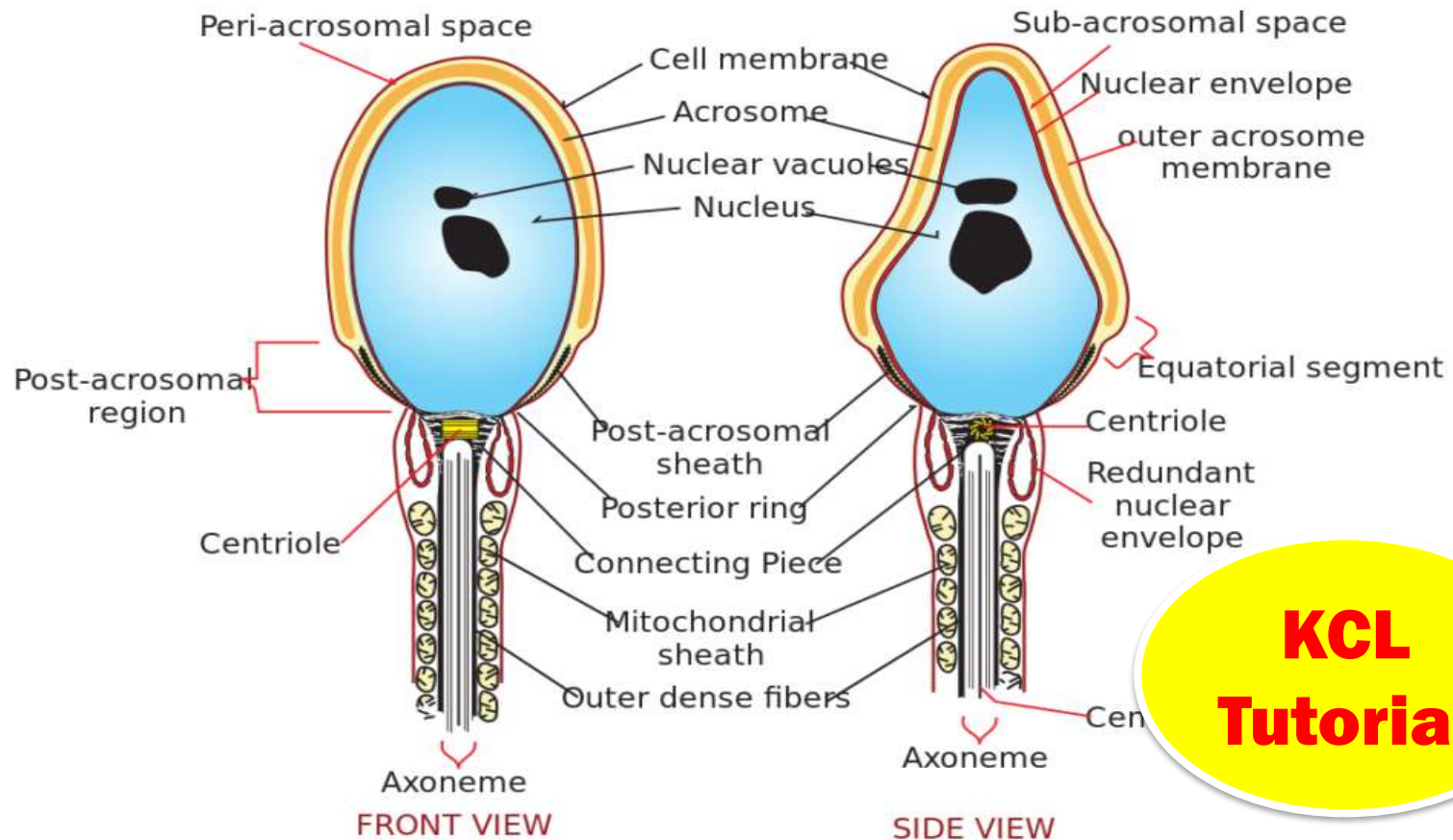
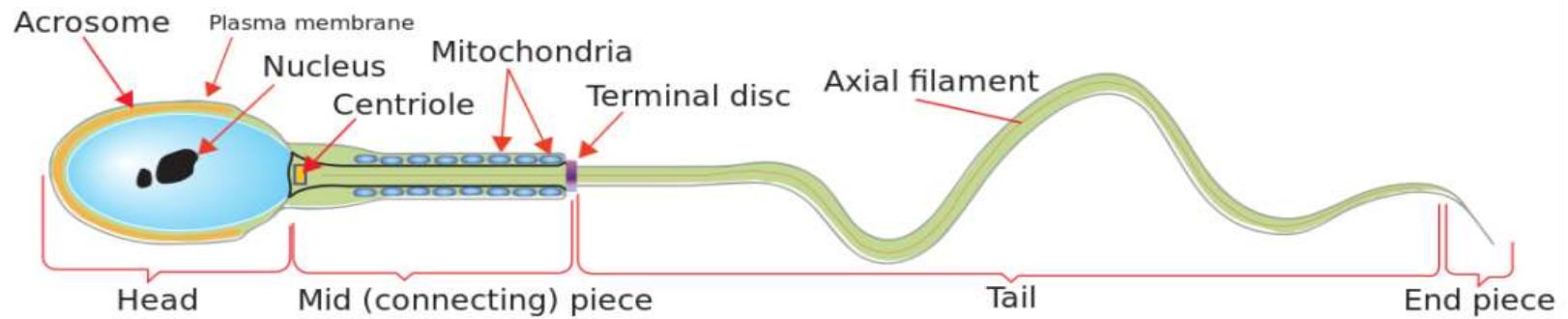
- Controls metabolic functions of testes
- Promote early division of spermatogonia
Pituitary dwarfs (spermatogenesis deficient or absent)

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Sperm Physiology and Function

- ❖ In animals, most of the energy (ATP) for sperm motility is derived from the metabolism of fructose carried in the seminal fluid
- ❖. This takes place in the mitochondria located in the sperm's midpiece. This energy is used for the journey through the female cervix, uterus, and uterine tubes.
- ❖ Motile sperm cells typically move via flagella and require a water medium in order to swim toward the egg for fertilization.
- ❖ These cells cannot swim backwards due to the nature of their propulsion. The uniflagellated sperm cells (with one flagellum) of animals are referred to as spermatozoa.

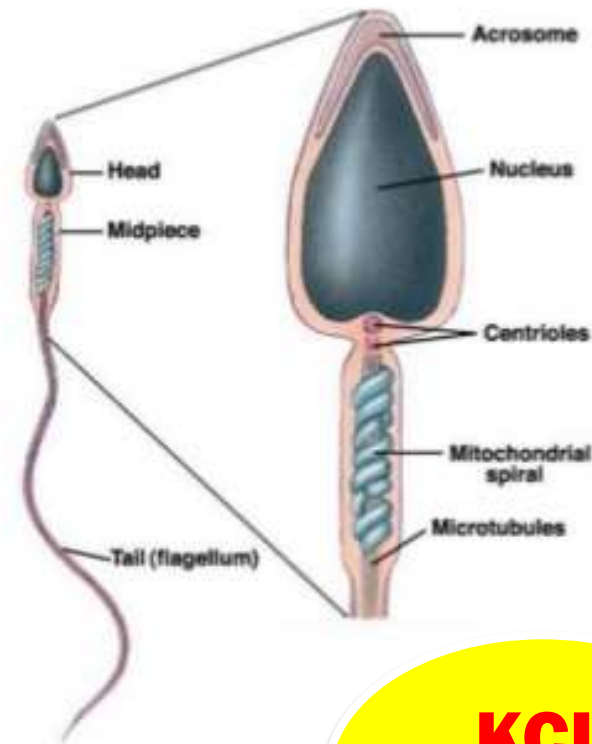
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SPERM

- **Function:**
 - To move and carry genetic information to the egg.
- **Structure:**
 - **Head:** The large head region of the sperm that contains DNA.
 - **Midpiece:** The narrow middle part of the cell that contains mitochondria.
 - **Tail:** The wavelike motion of the flagellum propels the sperm forward.



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Human Reproduction system

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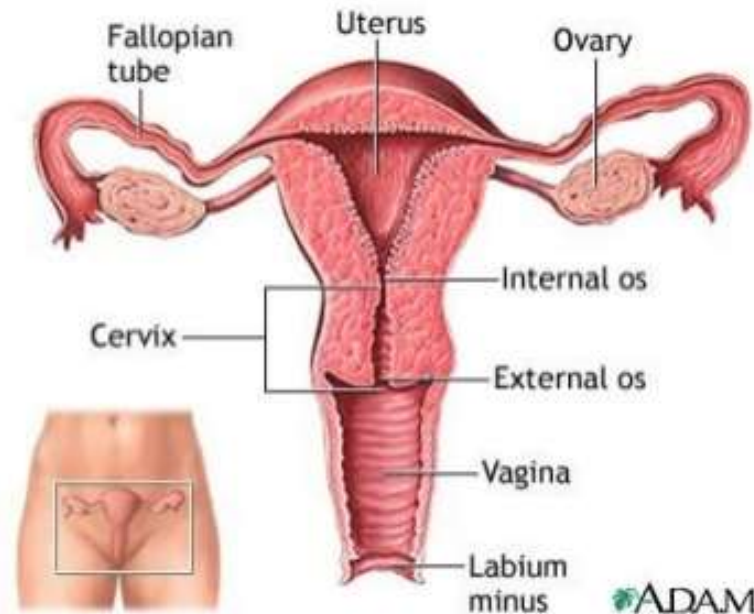
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Female Reproductive System



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Female Reproductive System

- Produce sex hormones
 - Estrogen, Progesterone
- Produce egg (ova)
- Support & protect developing embryo
- Give birth to new baby

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Major Organs

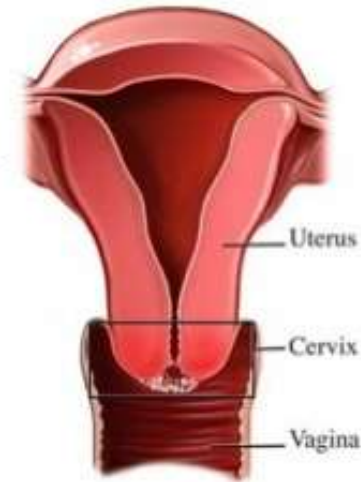
- ❑ Cervix
- ❑ Vagina
- ❑ Ovaries [gonads]
- ❑ Uterine tubes [fallopian tubes]
- ❑ Uterus



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The Cervix

- ❑ The lower portion or neck of the uterus.
- ❑ The cervix is lined with mucus, known as cervical mucus
 - Cervical mucus provides lubrication & sperm transport during sexual intercourse
 - During ovulation secretion of cervical mucus increases in response to estrogen
 - But when an egg is ready for fertilization, the mucus then becomes thin and slippery, offering a “friendly environment” to sperm



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The Cervix

At the end of pregnancy

The cervix acts as the passage through which the baby exits the uterus into the vagina.

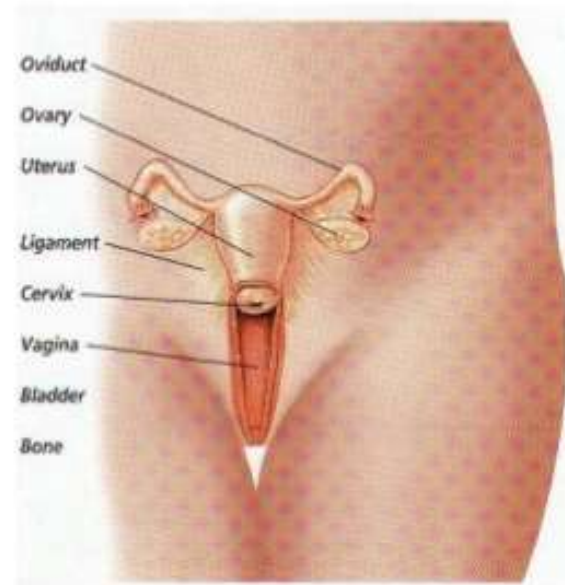
The cervical canal expands to roughly 50 times its normal width for the passage of the baby during birth



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The Vagina

- ❑ A muscular, ridged sheath connecting the external genitals to the uterus.
- ❑ Functions as a two-way street, accepting the penis and sperm during intercourse
- ❑ Serving as the avenue of birth through which the new baby enters the world

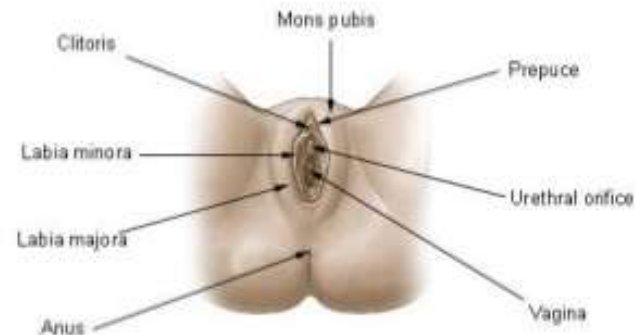


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External genitalia

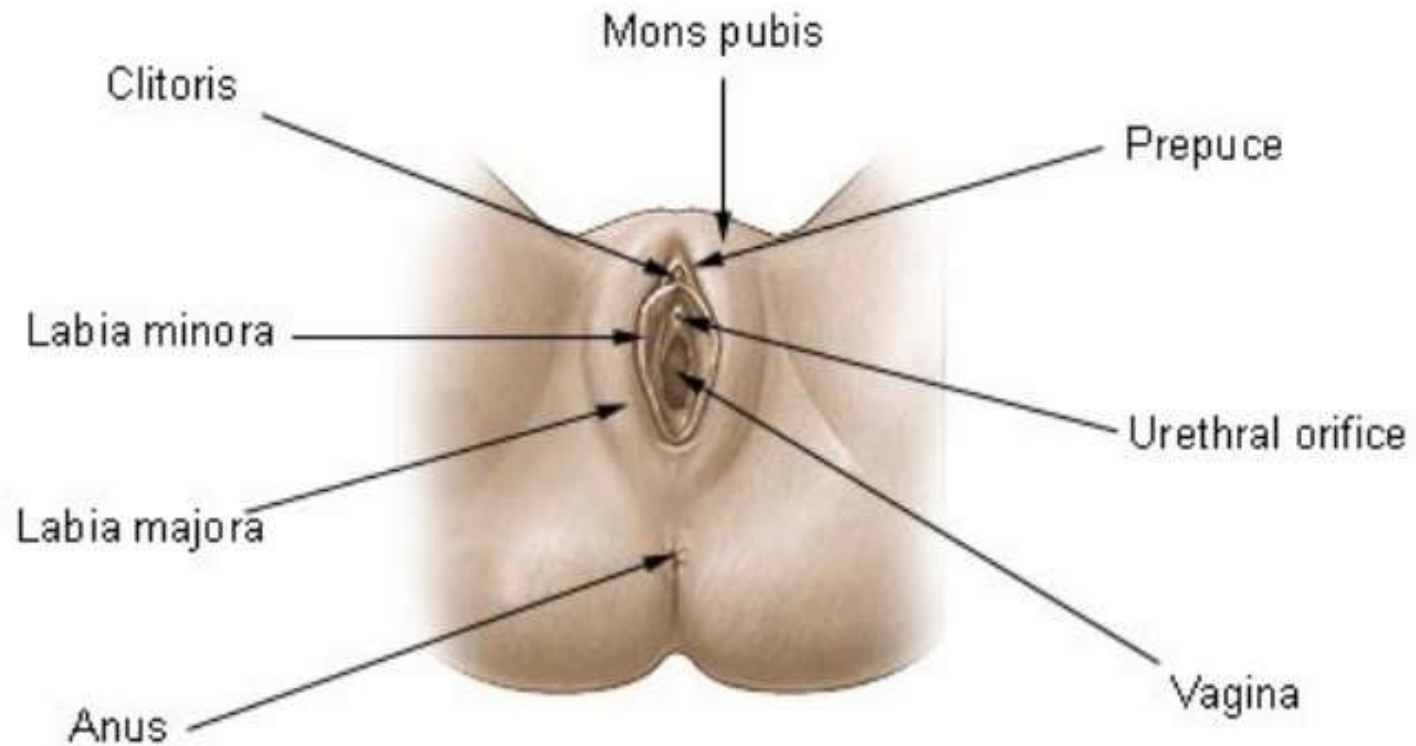
- **Vulva**—which runs from the pubic area downward to the rectum.
- **Labia majora** or "greater lips" are the part around the vagina containing two glands (Bartholin's glands) which helps lubrication during intercourse.
- **Labia minora** or "lesser lips" are the thin hairless ridges at the entrance 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.

Female External Genitalia



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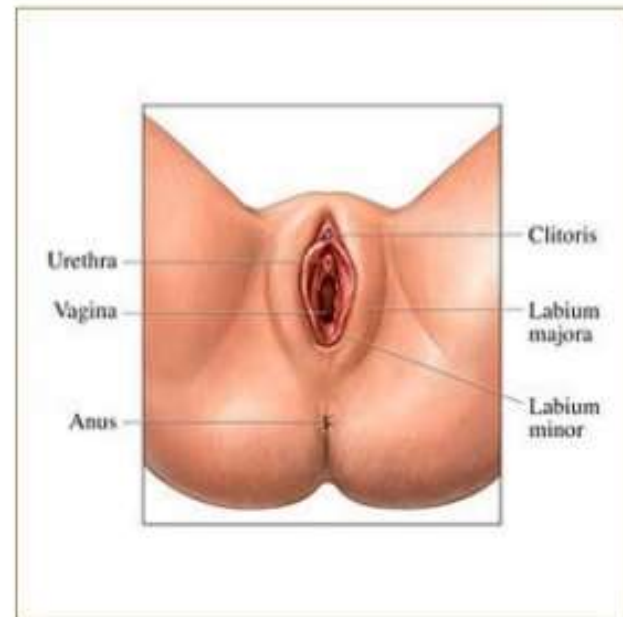
Female External Genitalia



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External genetalia

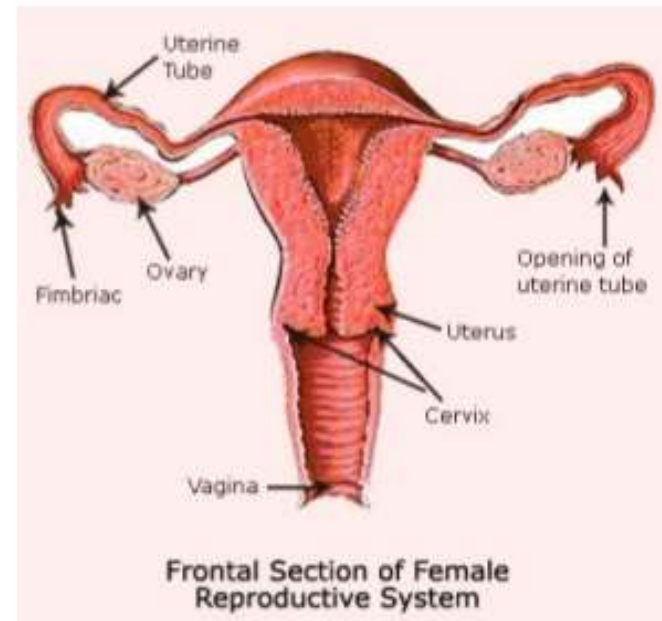
- ❑ The urethral orifice or external urinary opening is below the clitoris on the upper wall of the vagina and is the passage for urine
- ❑ Opening of the vagina is separate from the urinary opening and located below it.
- ❑ The hymen is a thin crescentic fold of tissue which partially covers the opening of the vagina. medically it is no longer considered to be a 100% proof of female virginity.



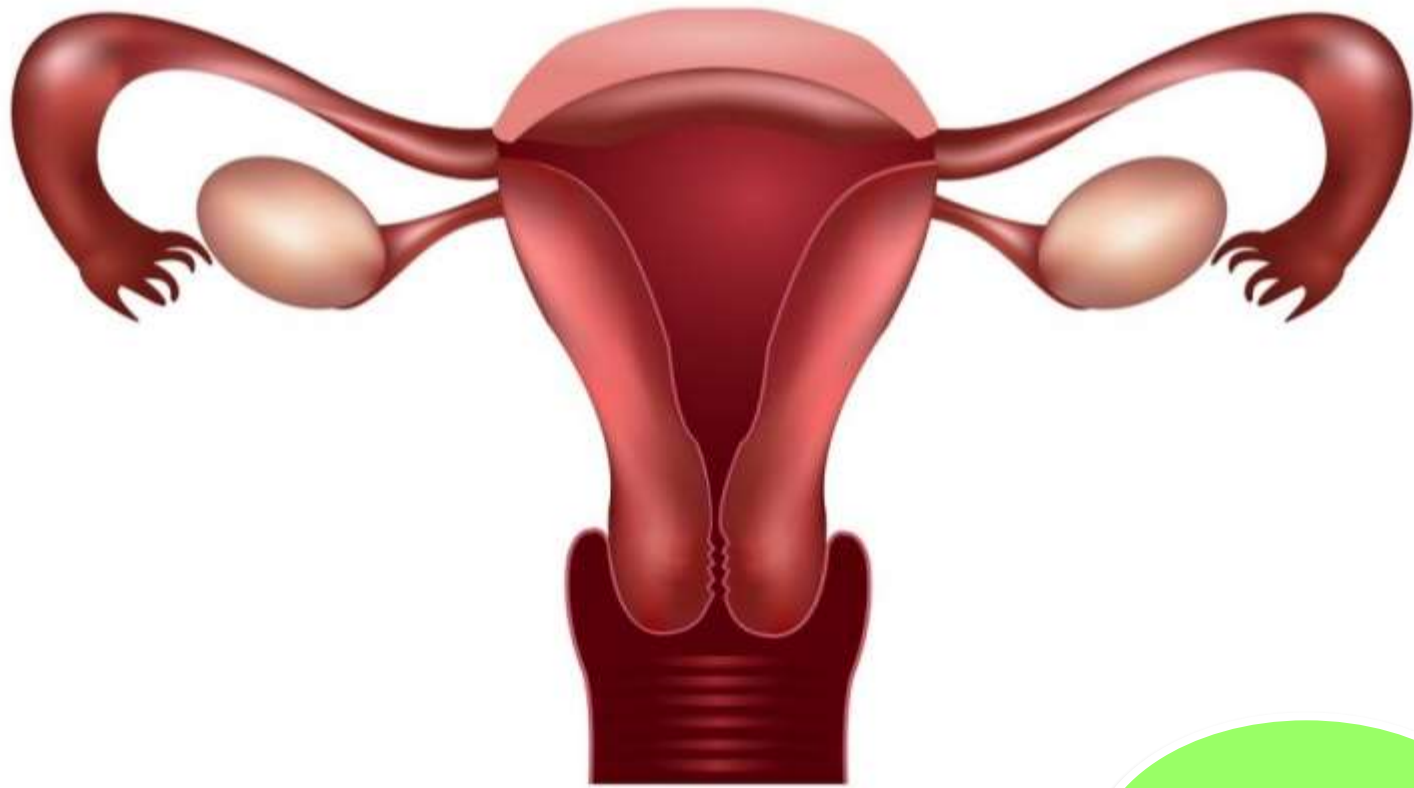
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Ovaries

- ❑ Also known as female gonads
- ❑ They produce eggs (also called ova) every female is born with a lifetime supply of eggs
- ❑ They also produce hormones:
Estrogen & Progesterone



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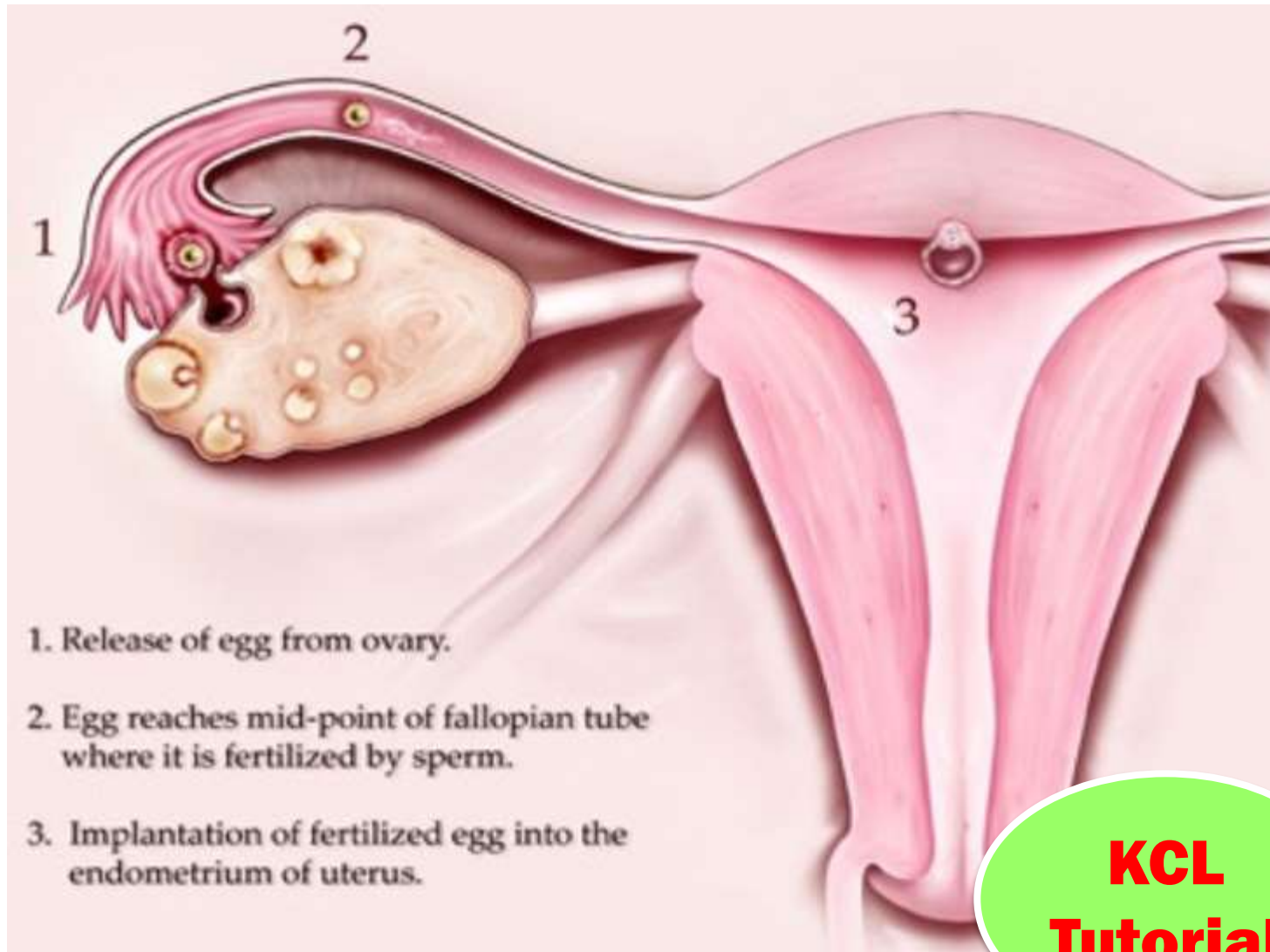


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Fallopian tubes [uterine tubes]

- ❑ Stretch from the uterus to the ovaries and measure 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

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Uterus

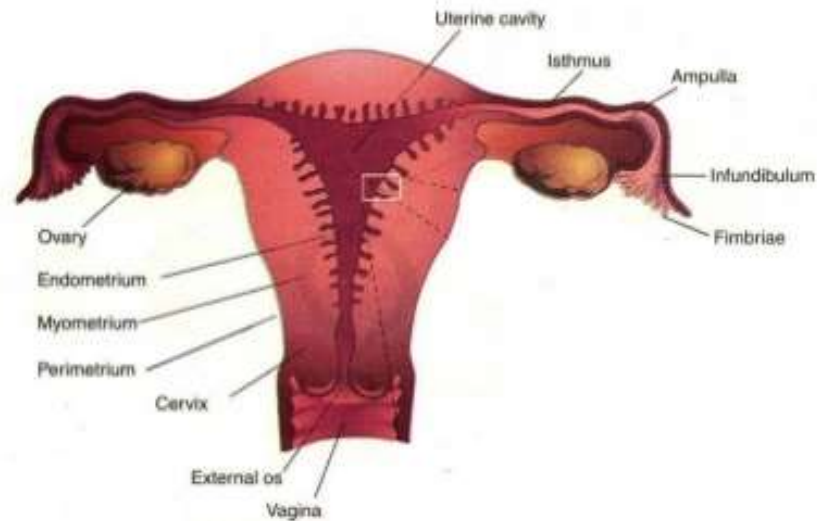


- ❑ Pear-shaped muscular organ in the female reproductive tract.
- ❑ The fundus is the upper portion of the uterus where pregnancy occurs.
- ❑ The cervix is the lower portion of the uterus that connects with the vagina and serves as a sphincter to keep the uterus closed during pregnancy until it is time to deliver a baby.
- ❑ The uterus expands considerably during the reproductive process.
- ❑ The organ grows to from 10 to 20 times its normal size during pregnancy.

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Uterus

- ❑ The main body consists of a firm outer coat of muscle (myometrium) and an inner lining of vascular, glandular material (endometrium).



- ❑ The endometrium thickens during the menstrual cycle to allow implantation of a fertilized egg.
- ❑ Pregnancy occurs when the fertilized egg implants successfully into the endometrial lining.

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Endometrium

- ❑ The endometrium is the innermost layer as a lining for the uterus
- ❑ During the menstrual cycle, the endometrium grows to a thick, blood vessel-rich, glandular tissue layer.
- ❑ This represents an optimal environment for the implantation of a blastocyst upon its arrival in the uterus.

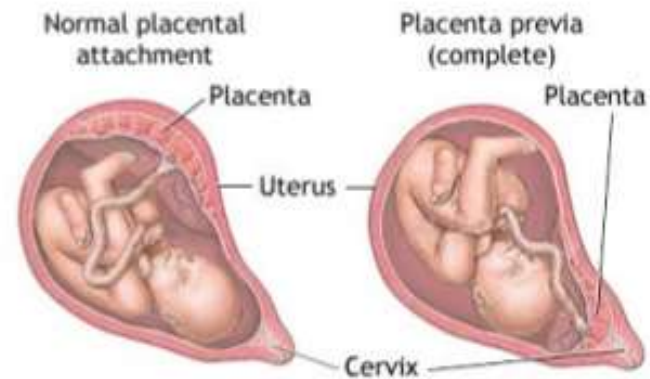
Normal endometrium



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Endometrium

- The endometrium is central, echogenic (detectable using ultrasound scanners), and has an average thickness of 6.7 mm.
- During pregnancy, the blood vessels in the endometrium further increase in size and number, forming the **placenta**,
- Placenta supplies oxygen and nutrition to the embryo & fetus.



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MENSTRUAL CYCLE

- Menstruation is the periodic discharge of blood and sloughed endometrium (collectively called menses or menstrual flow) through the vagina.
- Menstruation occurs throughout a woman's reproductive life in the absence of pregnancy.
- The average Menstrual Cycle length is 28 days (usual range, about 25 to 36 days).
- Average duration of menses is 5 (\pm 2) days.
- Blood loss per cycle averages 30 mL (normal range, 13 to 80 mL) and is usually greatest on the 2nd day.

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MENSTRUAL CYCLE

- **Menarche** is the first menstrual cycle, or first menstrual bleeding, in female human beings.
- The average age of menarche is 11.75 years.
- **Menopause** is the permanent cessation of menses.
- Menopause typically (but not always) occurs in women during their late 40s or early 50s, and signals the end of the fertile phase of a woman's life.

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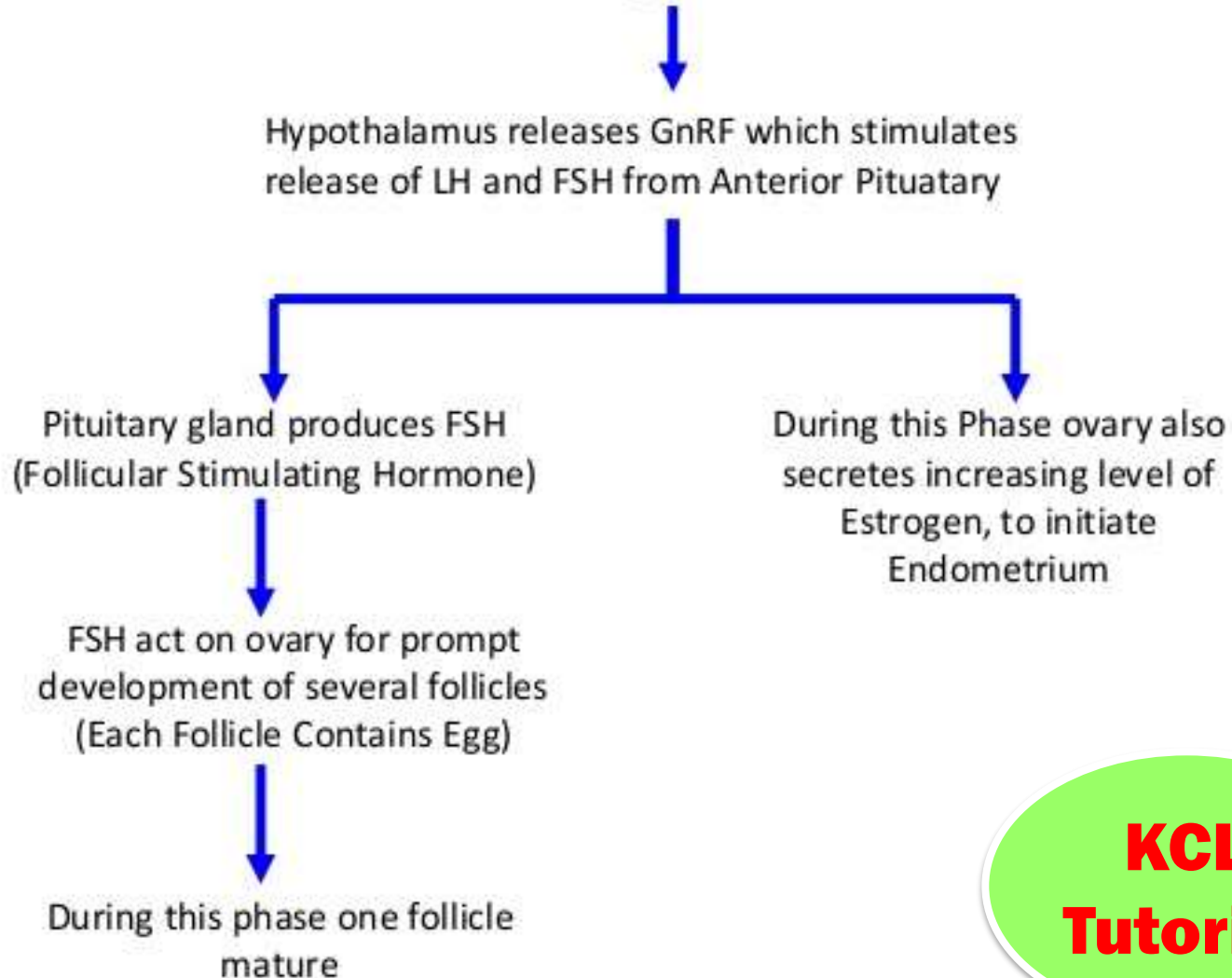
MENSTRUAL CYCLE

- The Menstrual Cycle can be divided into 3 Phases.
 - Follicular (Preovulatory) Phase
 - Ovulatory Phase
 - Luteal (Postovulatory) Phase

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Follicular Phase

Day 1-13



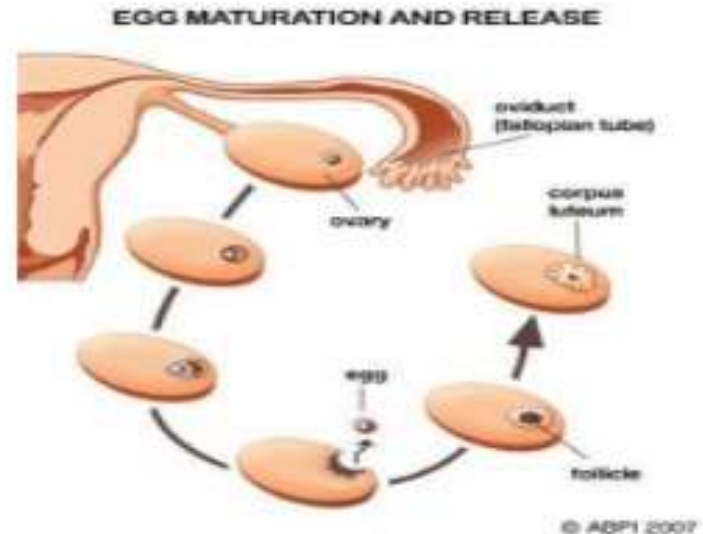
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Ovulatory Phase Lasts for 16 to 32 hours

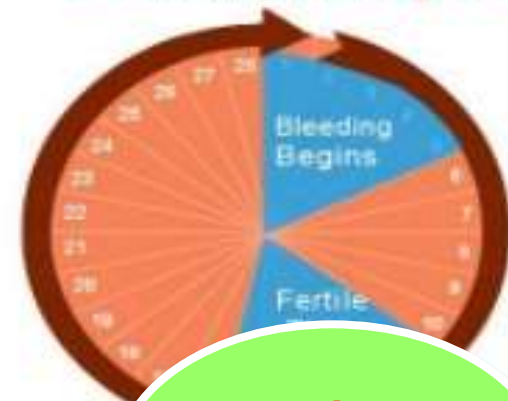
Phase begins when the level of LH surges.

LH stimulates dominant follicle to bulge from the surface of ovary and finally rupture, releasing the Egg.

Egg travel to Fallopian Tube. This is the time when the women is most likely to become Pregnant. The Egg can be fertilized for only up to about 12 hours after its release.



The Menstrual Cycle



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Luteal Phase, Day 15-28

After releasing Egg this empty Follicle develops the structure called Corpus Luteum (CL)

CL secretes increasing amount of Progesterone. CL prepares Uterus in case fertilization occurs.

Progesterone causes the Endometrium to thicken

If Egg is Fertilized

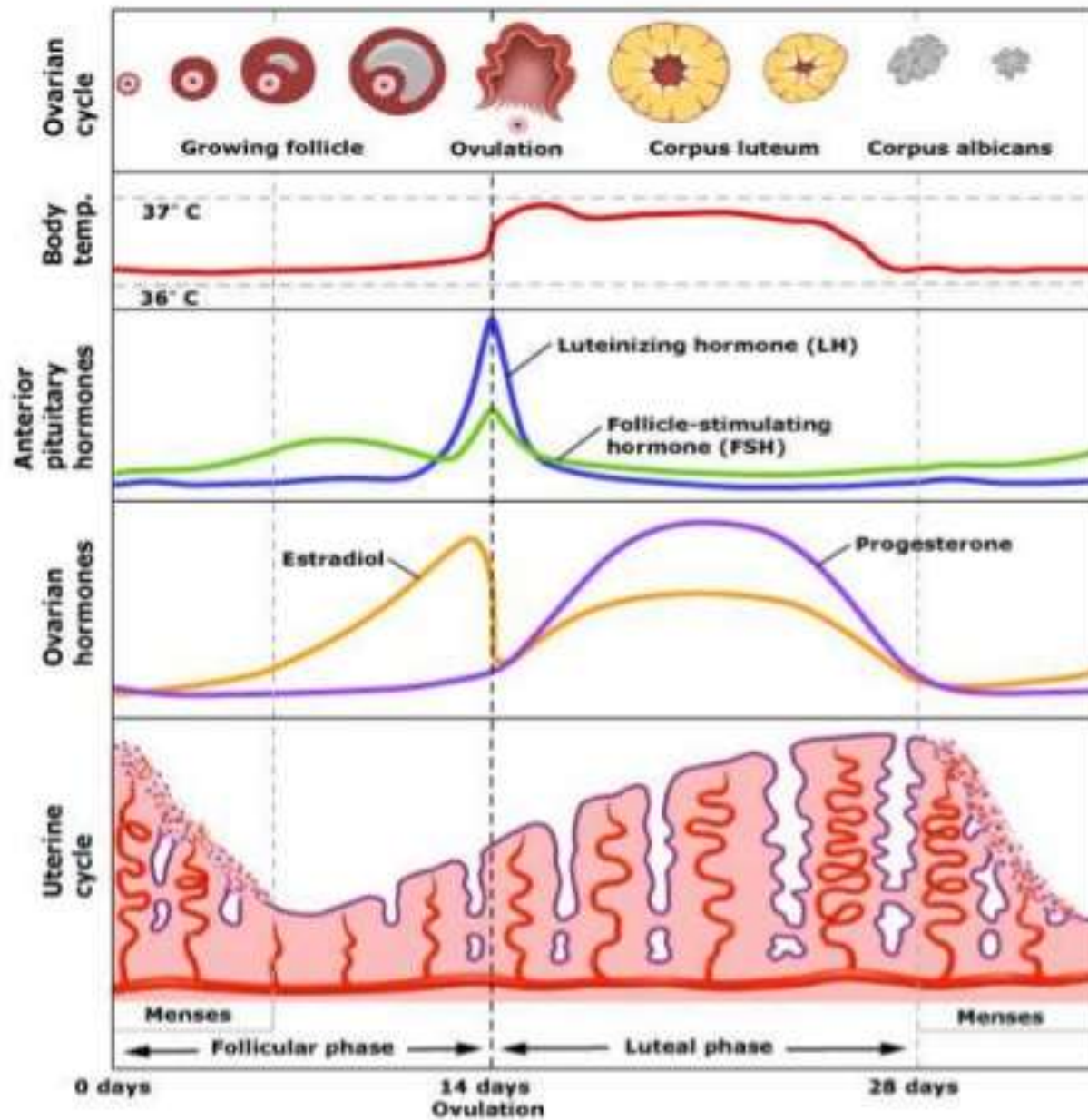
The embryo produces Human Chorionic Gonadotropin (hCG) which will be detected by CL and this Human Chorionic Gonadotropin maintains CL and its Progesterone secretion.

The egg moves to the uterus and attaches itself to the endometrium about six or seven days after ovulation, where it begins to develop into a fetus.

If Egg is not Fertilized

CL destroys after 14 days an new Menstrual Cycle begins

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Human Reproduction system

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WHAT IS OOGENESIS?

- Oogenesis is the formation of ovum or egg, starts in the ovaries of the foetus before birth.

HOW IT'S OCCURS??

- There are 5 stages of oogenesis process
 1. The germinal epithelial cells divide repeatedly until many **diploid oogonia** are formed.
 2. The oogonia grow to form **primary oocytes** that surrounded by a layer of follicle cells.

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3. The oocytes undergoes the first meiotic division to become a **secondary oocyte and a first polar body.(haploid)**

4. The follicle cells surrounding the primary follicle develop into the **secondary follicle.**

–The follicle layer of the secondary oocyte thickens and folds to form the Graafian follicle

–When the Graafian follicle become matures,it will move towards the surface of the ovary wall and rupture to release the secondary oocyte(n).

5. The secondary oocytes that has complete meiosis II when it is fertilized by a sperm(n).The final product of meiosis II is **the ovum and the second polar body.**



THE DIFFERENCES BETWEEN SPERMATOGENESIS AND OOGENESIS

ASPECT	SPERMATOGENESIS	OOGENESIS
Site of process	In the testes	In the ovaries
Cells produced	Sperm	Ova or egg.
Size of cells	Small	Big
Cell structure	Consist of the head , middle pieces and tail	Round
Number of gamates produced.	Four funcional cells	One funcional cells and three non-funcional polar bodies.

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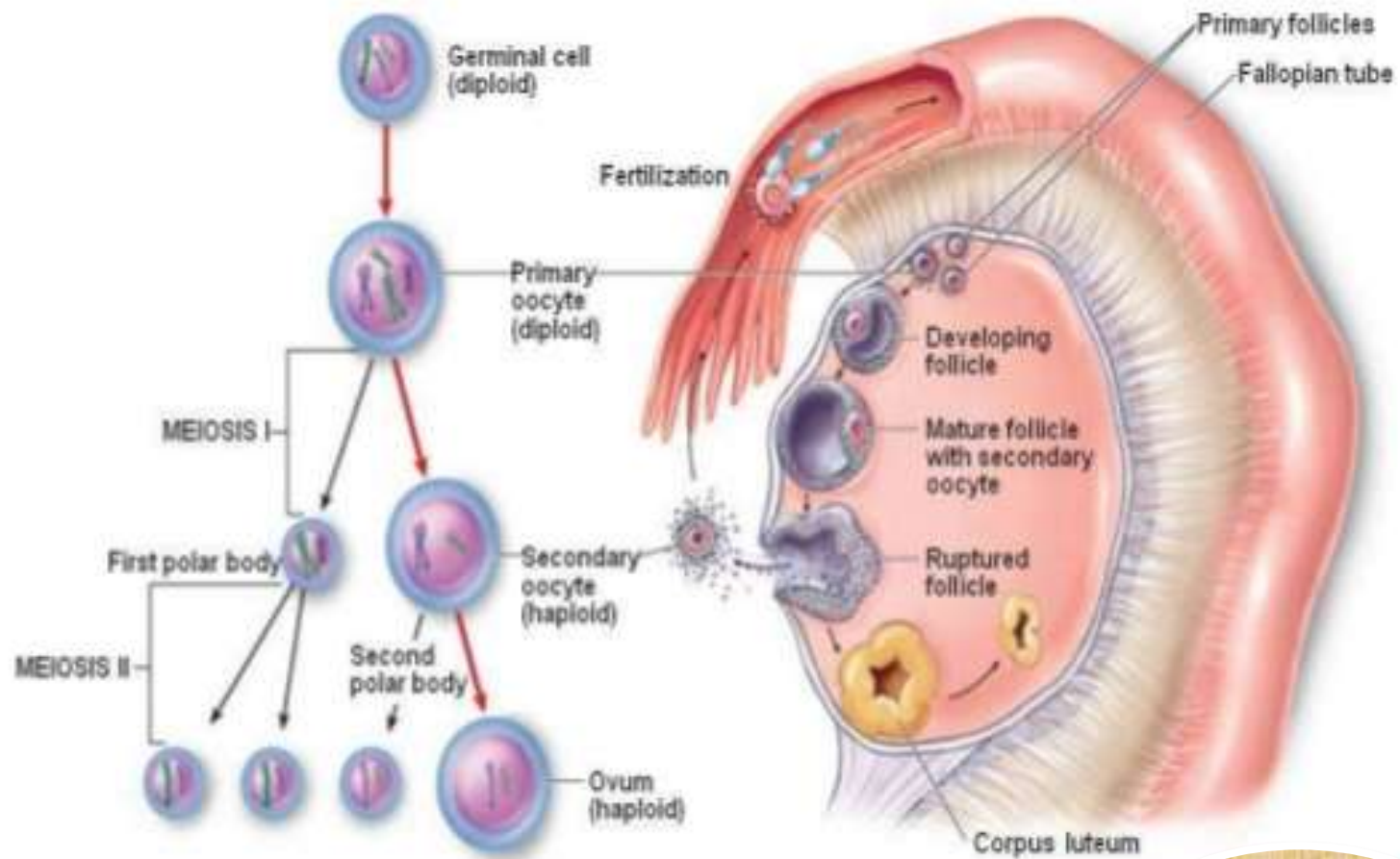
ASPECT	SPERMATOGENESIS	OOGENESIS
Meiosis	Occurs continuously	Not continues. Stops at meiosis I. Meiosis II occurs only if sperm penetrates the secondary oocyte.
Density of organelles	Many mitochondria, less cytoplasm.	Fewer mitochondria, more cytoplasm.
Parent cells	Infinite number of cells can become sperm.	Limited number of cells can become ova.

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SIMILARITIES OF SPERMATOGENESIS AND OOGENESIS.

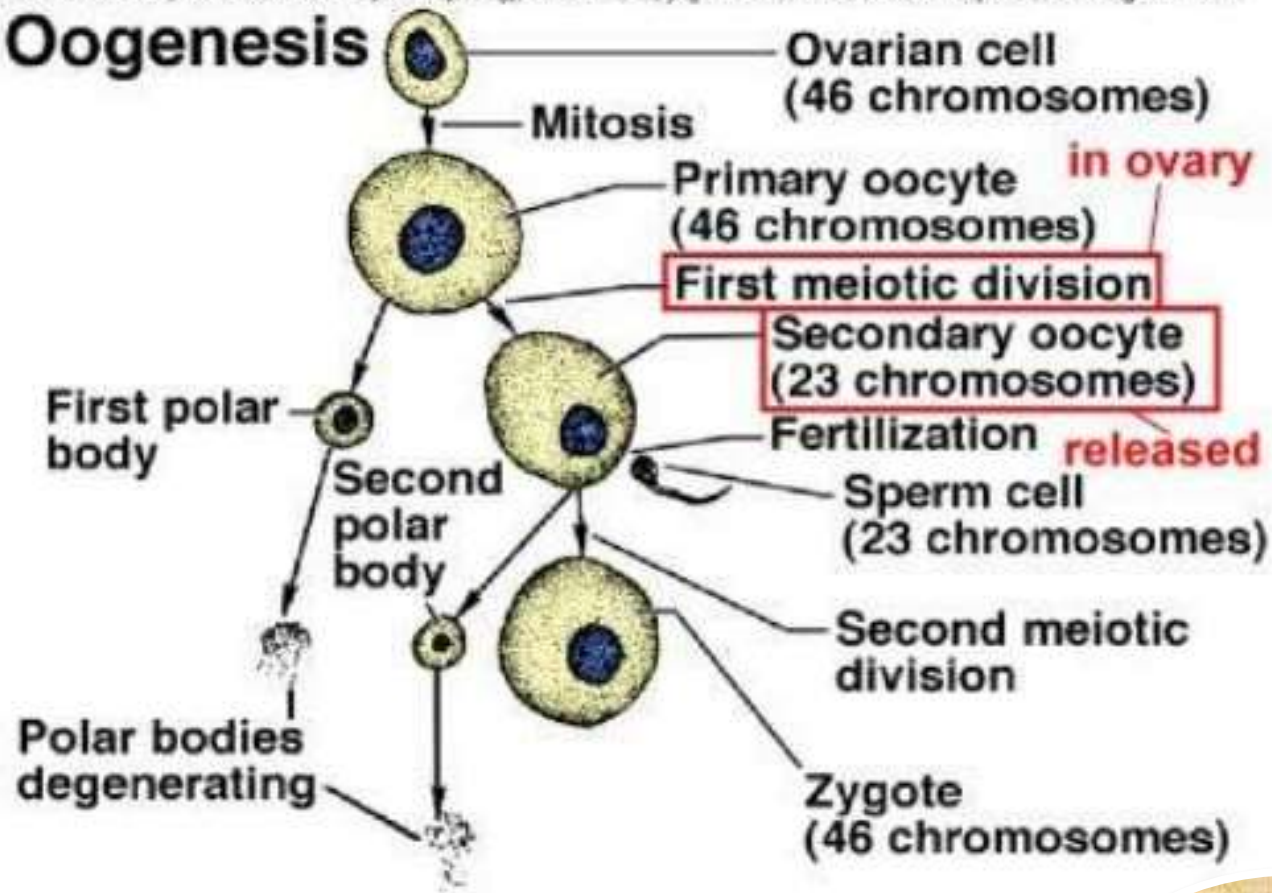
1. Both occur in the reproductive organs.
2. Both produces haploid(n) gametes that are involved in fertilization.
3. Both involve meiosis.

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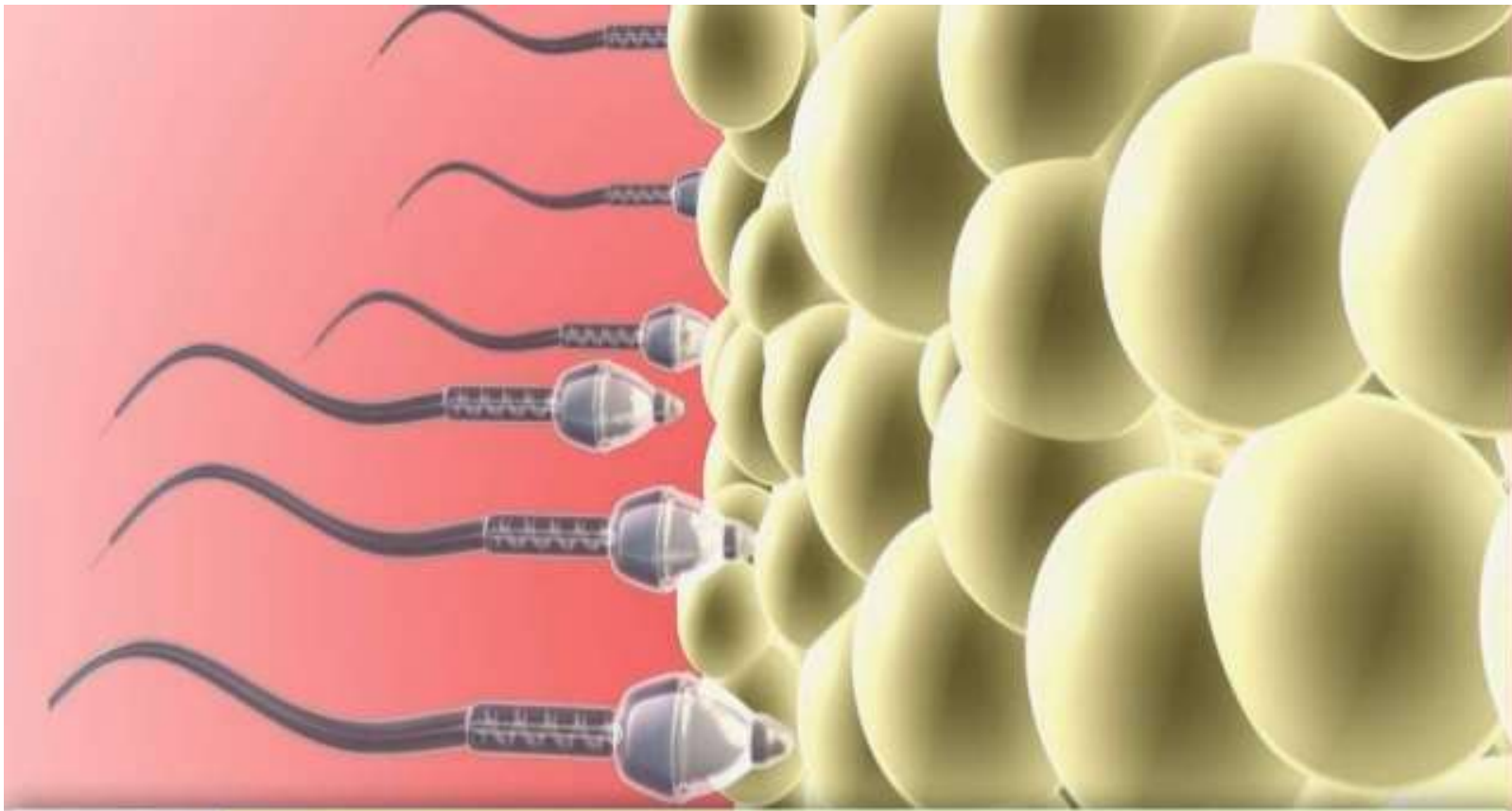


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Oogenesis



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FERTILIZATION AND IMPLANTATION

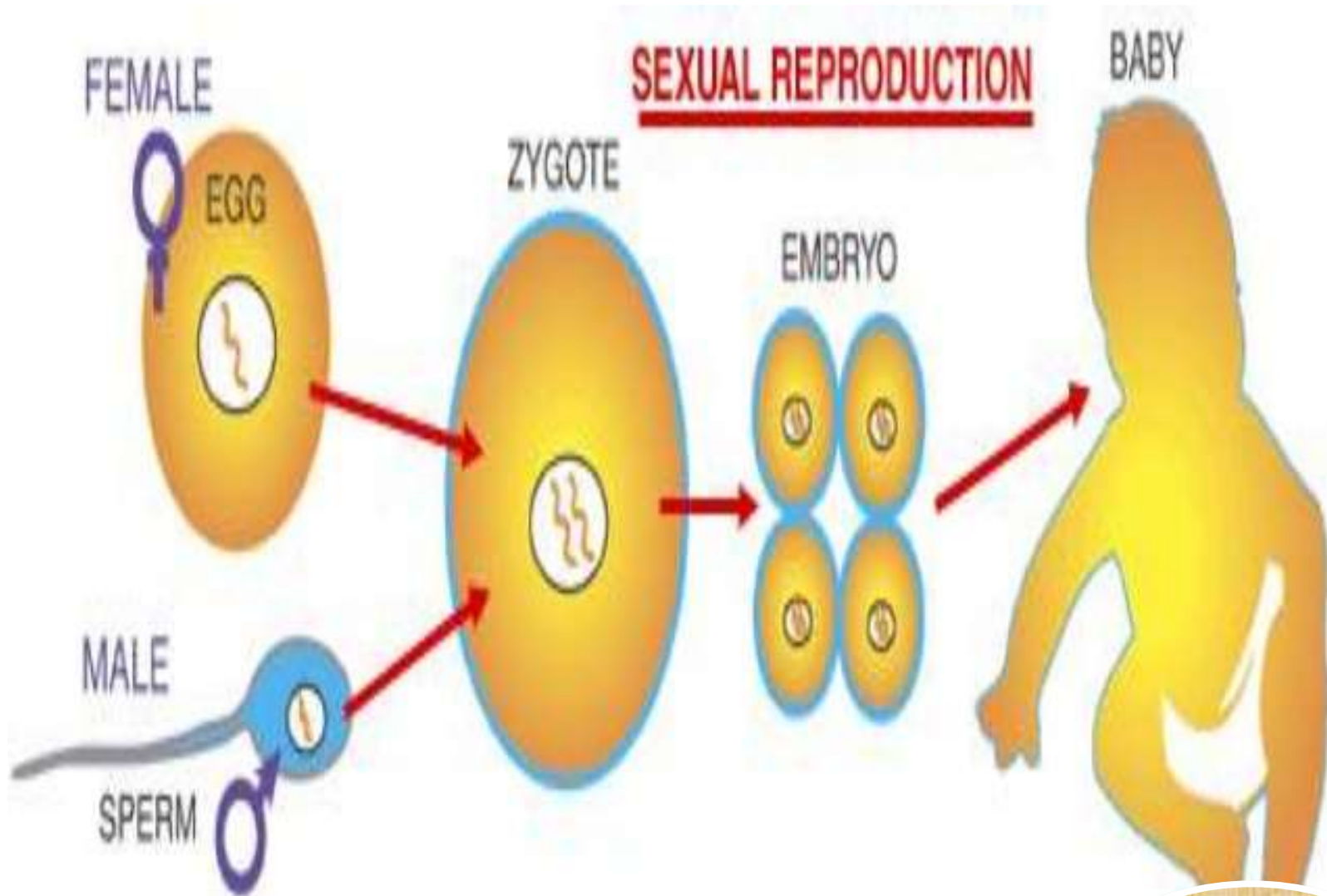
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FERTILIZATION

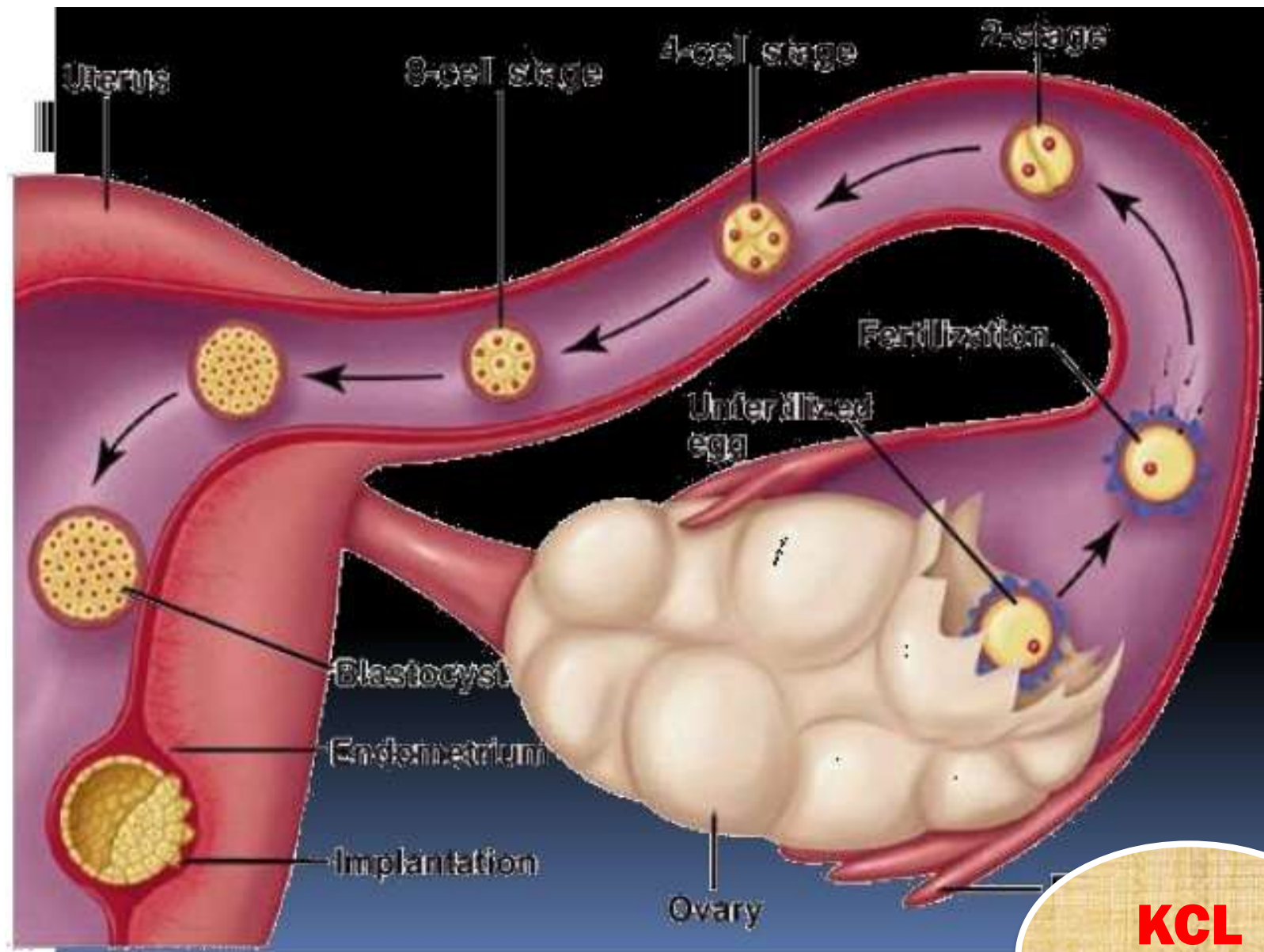
- Fertilization is the process of fusion of the spermatazoon with the mature ovum. It begins with sperm and egg collision and ends with the production of mononucleated single cell called ZYGOTE.

■ Almost always fertilization occurs in AMPULLARY portion of fallopian tubes.

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- The ovum is rapidly transported to the ampullary part.
- Fertilisable life span of oocyte ranges from 12 to 24 hours where as that of **sperm** is 48 to 72 hours.
- Out of hundred of millions of sperms deposited in the vagina at single ejaculation. Only thousands capacitated spermatazoa enter the uterine tube while only 300-500 reach the ovum.
- The tubal transport is facilitated by muscular contraction and aspiration action of the uterine tube.

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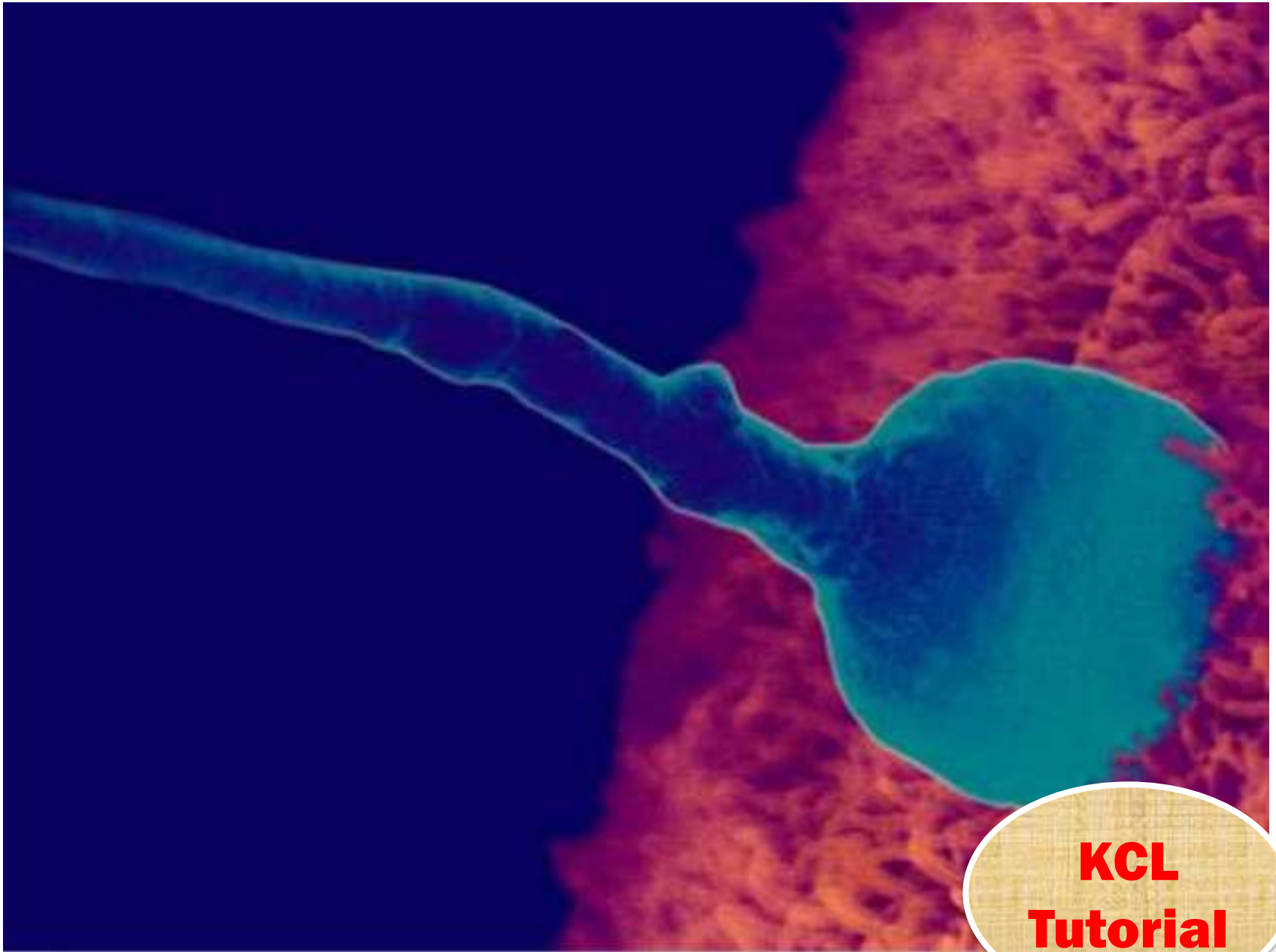


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CONTACT AND FUSION OF THE GAMETES

- Complete dissolution of the cells of the corona radiata occurs by the chemical action of the **HYALURONIDASE** liberated from the Acrosomal cap of the hundreds of sperm present at the site.
- Penetration of Zona pellucida is facilitated by Hyaluronidase from the acrosomal cap.
- Soon after the Sperm fusion ,penetration of other sperm is prevented by **ZONA REACTION** and **COLEMA BLOCK**.

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Process of Fertilization

(1) Chemo attraction

(2) Release of acrosomal enzymes

(3) Binding of sperm to extra cellular envelopes

(4) Passage through extra cellular envelopes

(5) Fusion of sperm and egg pronuclei

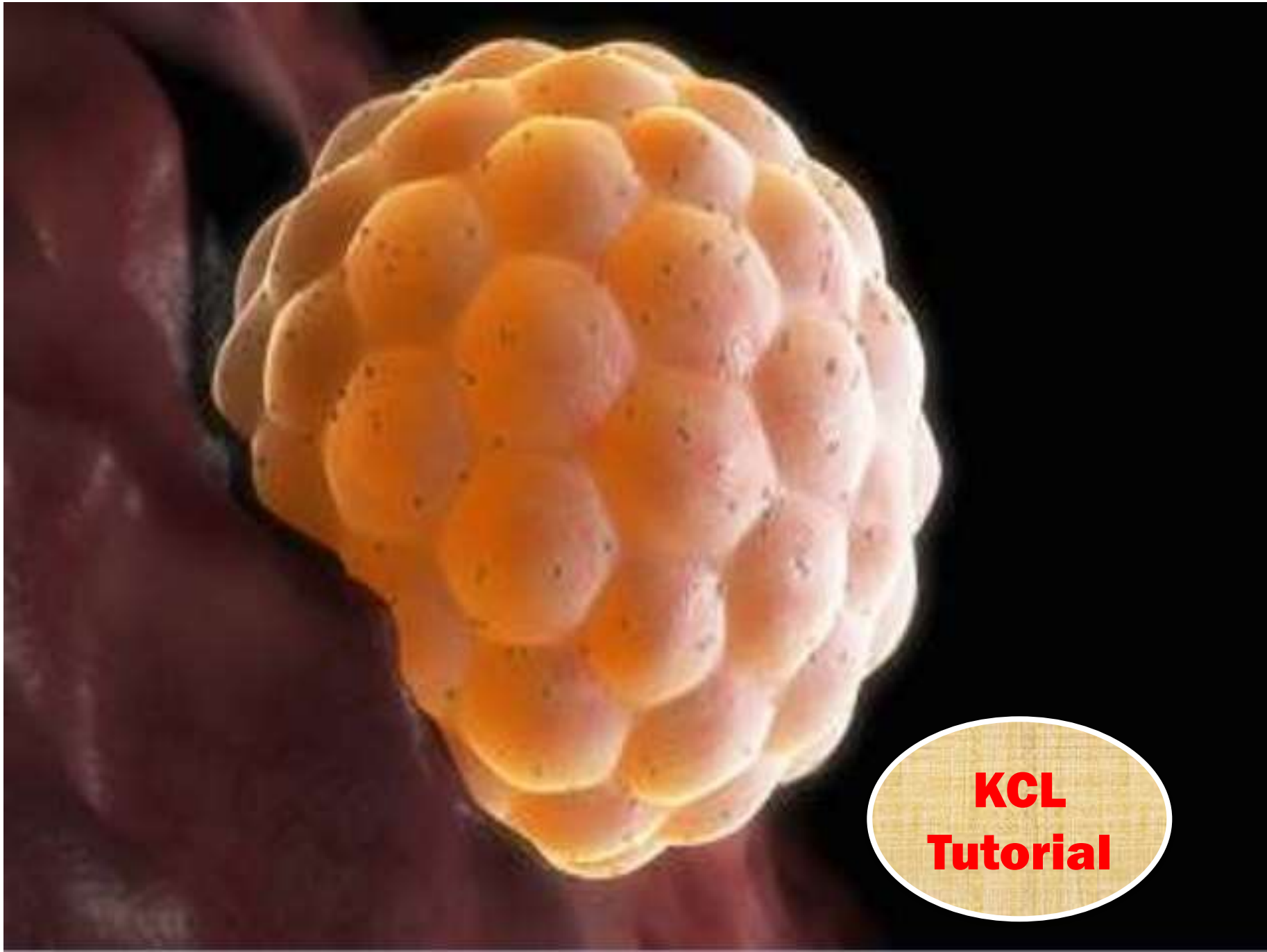
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IMPLANTATION/NIDATION/NESTING

- Implantation occurs in the endometrium of the anterior or posterior wall of the body near the fundus on the 6th day which corresponds to the 20th day of regular menstrual cycle.
- IMPLANTATION occurs through four stages.
- Apposition
- Adhesion
- Penetration
- Invasion

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- The implantation process is completed by 10th or 11th day.
- This type of deeper penetration of human blastocyst is called as IMPLANTATION.
- Now the blastocyst is covered all sides by the endometrium (DECIDUA).



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