Human Reproduction

Male Reproductive System

Male Reproductive System

The male reproductive system is located in the pelvic region.

It consists of

A pair of Testes

A pair of vas deferens

Accessory ducts

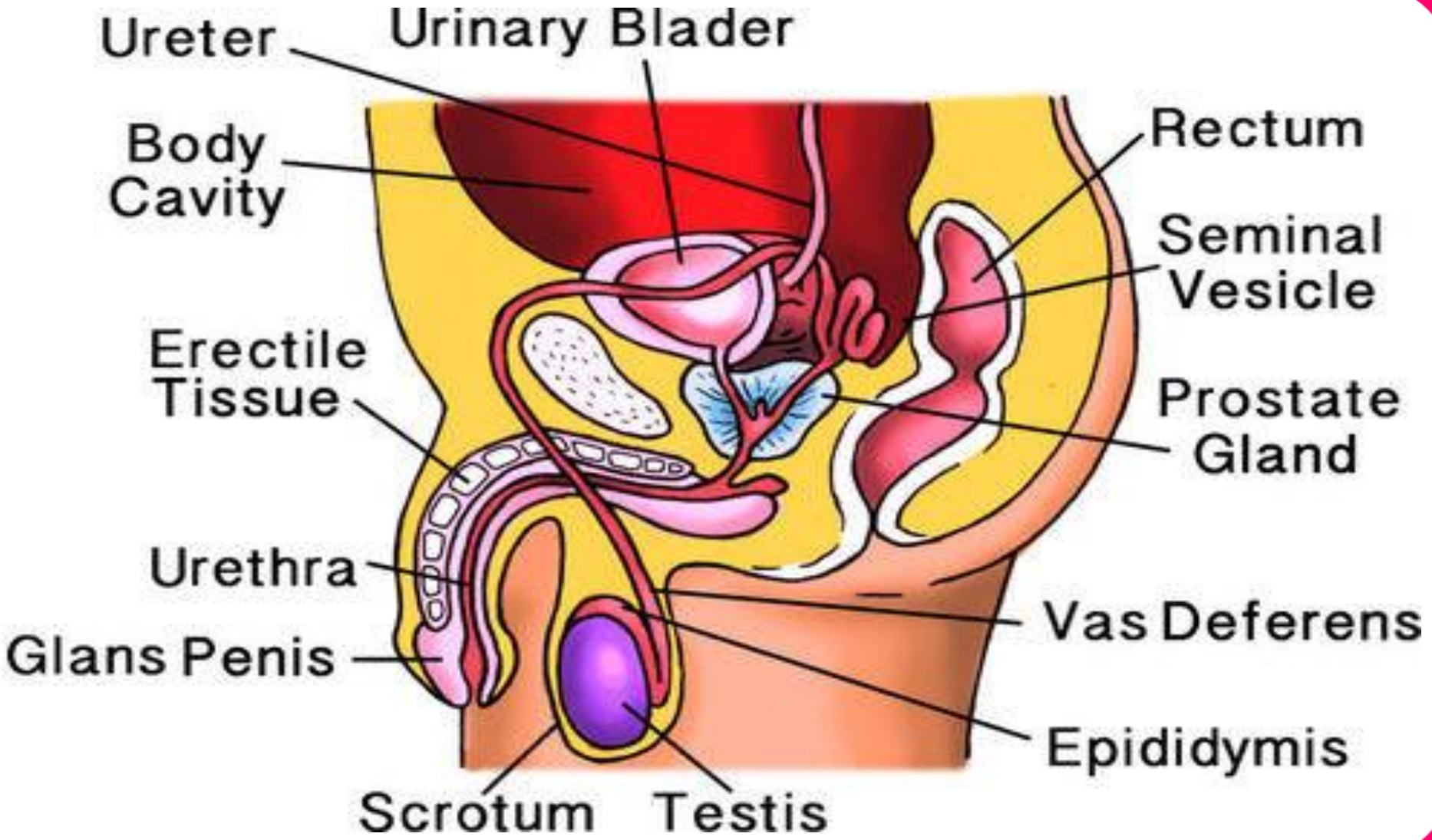
Accessory glands

Urethra and

Penis (external genitalia).

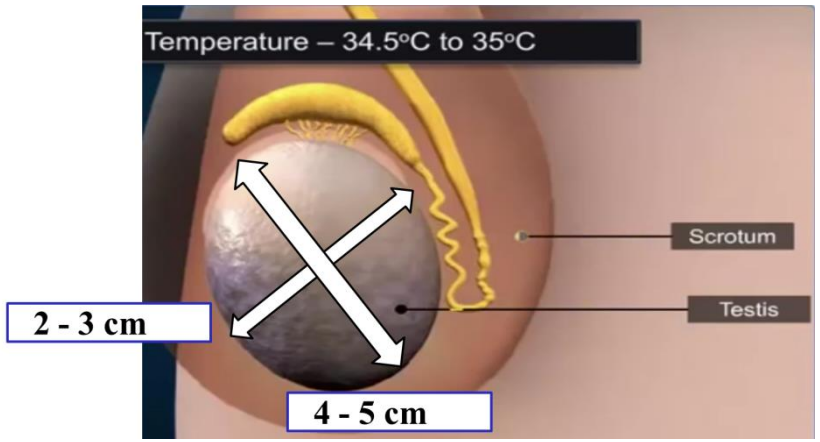
B. John Ebenezer

Male Reproductive System



Testes

Testes



The testes are situated outside the abdominal cavity within a pouch called **scrotum**.

The scrotum helps in maintaining the low temperature of the testes (2-2.5° C lower than the normal internal body temperature) necessary for spermatogenesis.

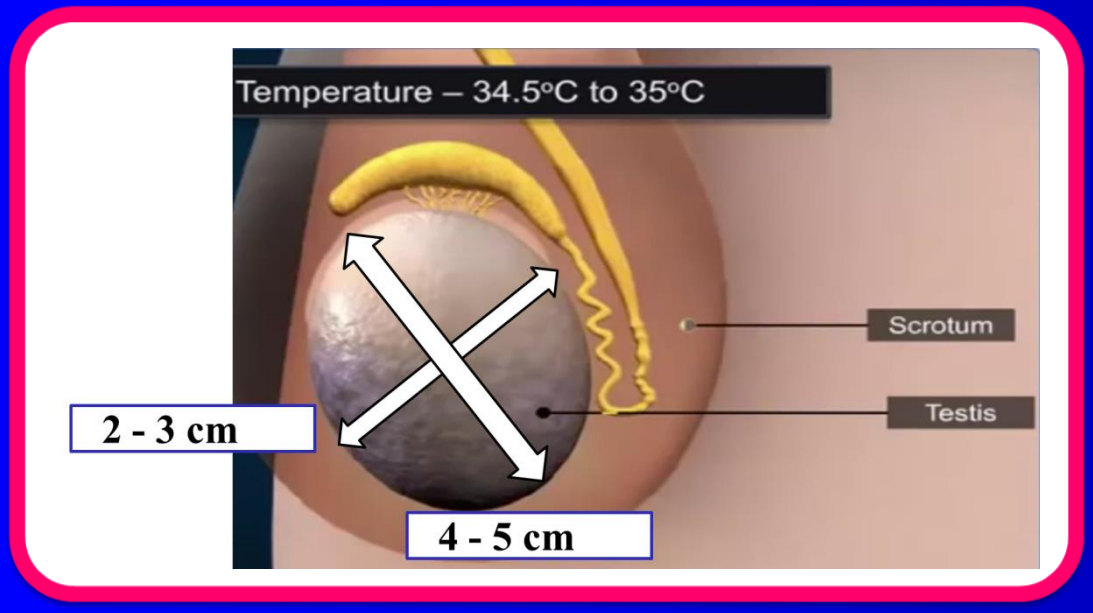
B. John Ebenezer

Testes

Each testis is oval in shape, with a length of about 4 to 5 cm and a width of about 2 to 3 cm.

The testis is covered by a dense covering.

Each testis has about 250 compartments called **testicular lobules**.



Each testicle is covered by tough, fibrous layers of tissue called the tunica.

The outer layer is called the tunica vaginalis.

The inner layer is called the tunica albuginea.

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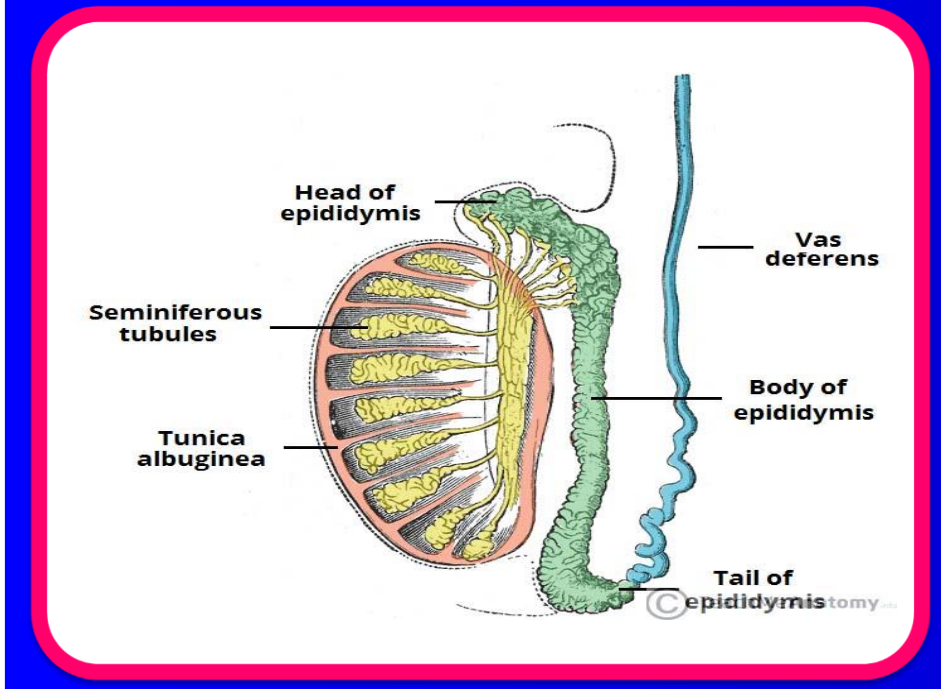


Each lobule contains one to three highly coiled **seminiferous tubules** in which sperms are produced.

Each seminiferous tubule is lined on its inside by two types of cells called **male germ cells** (*spermatogonia*) and **Sertoli cells**.

The **male germ cells** undergo meiotic divisions finally leading to **sperm formation**.

B. John Ebenezer

Testis

250 Testicular Lobules

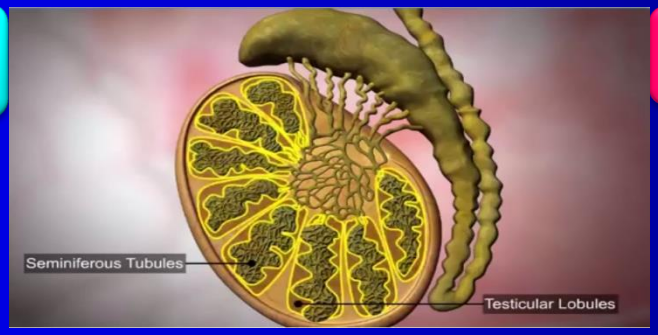
Each Testicular Lobules

1-3 Seminiferous Tubules produce sperms

Spermatogonia (Male germ cells)

Undergo meiosis and produce

Sperms



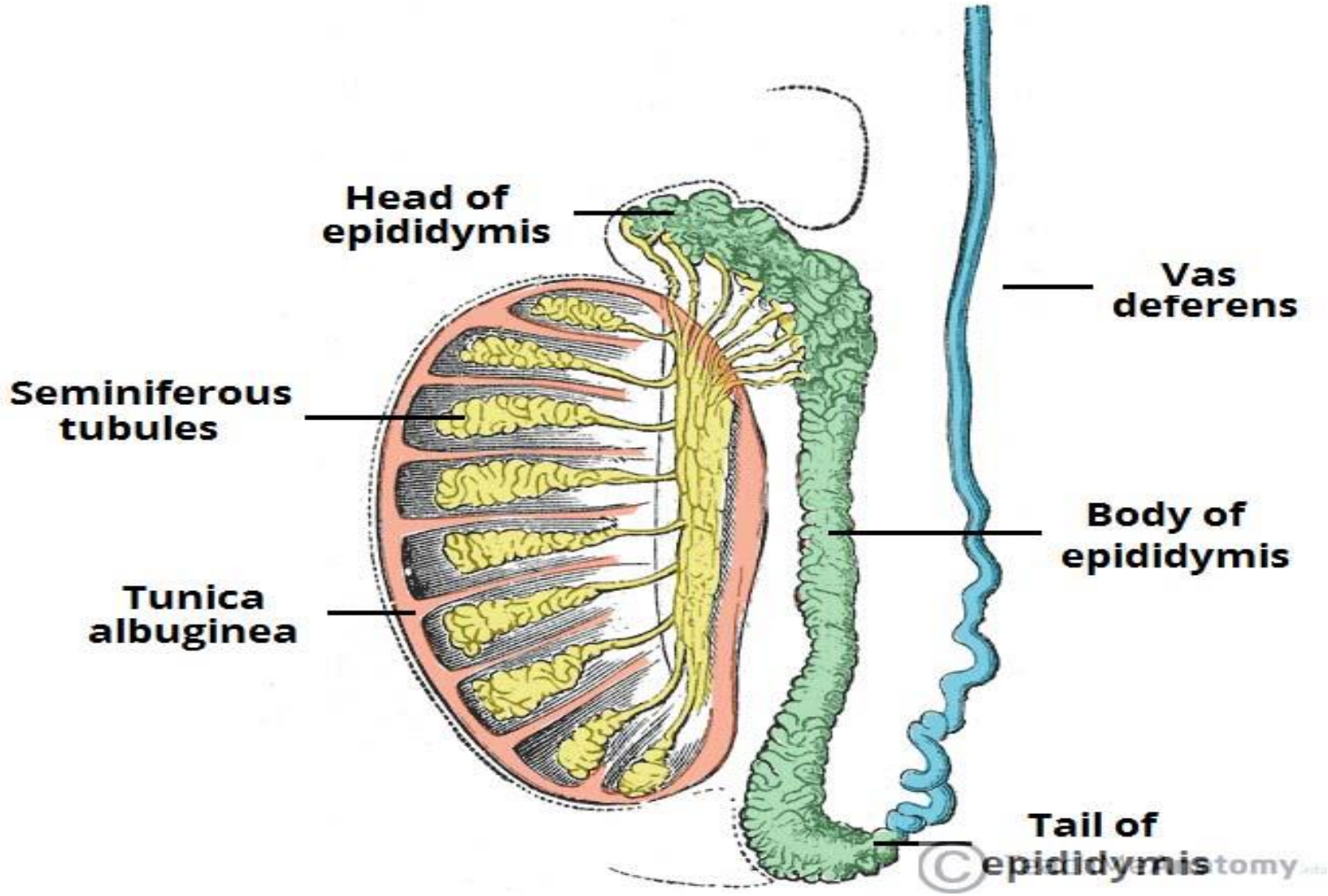
Sertoli Cells

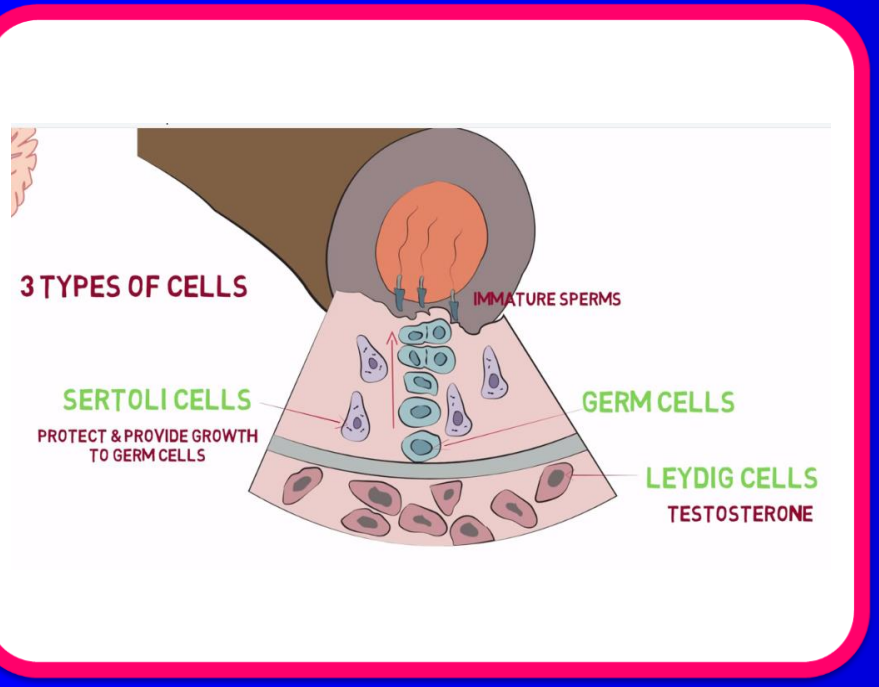
Provide

Nutrition to the germ cells

B. John Ebenezer

L.S of Testis


Head of epididymis
Seminiferous tubules
Tunica albuginea
Vas deferens
Body of epididymis
Tail of epididymis



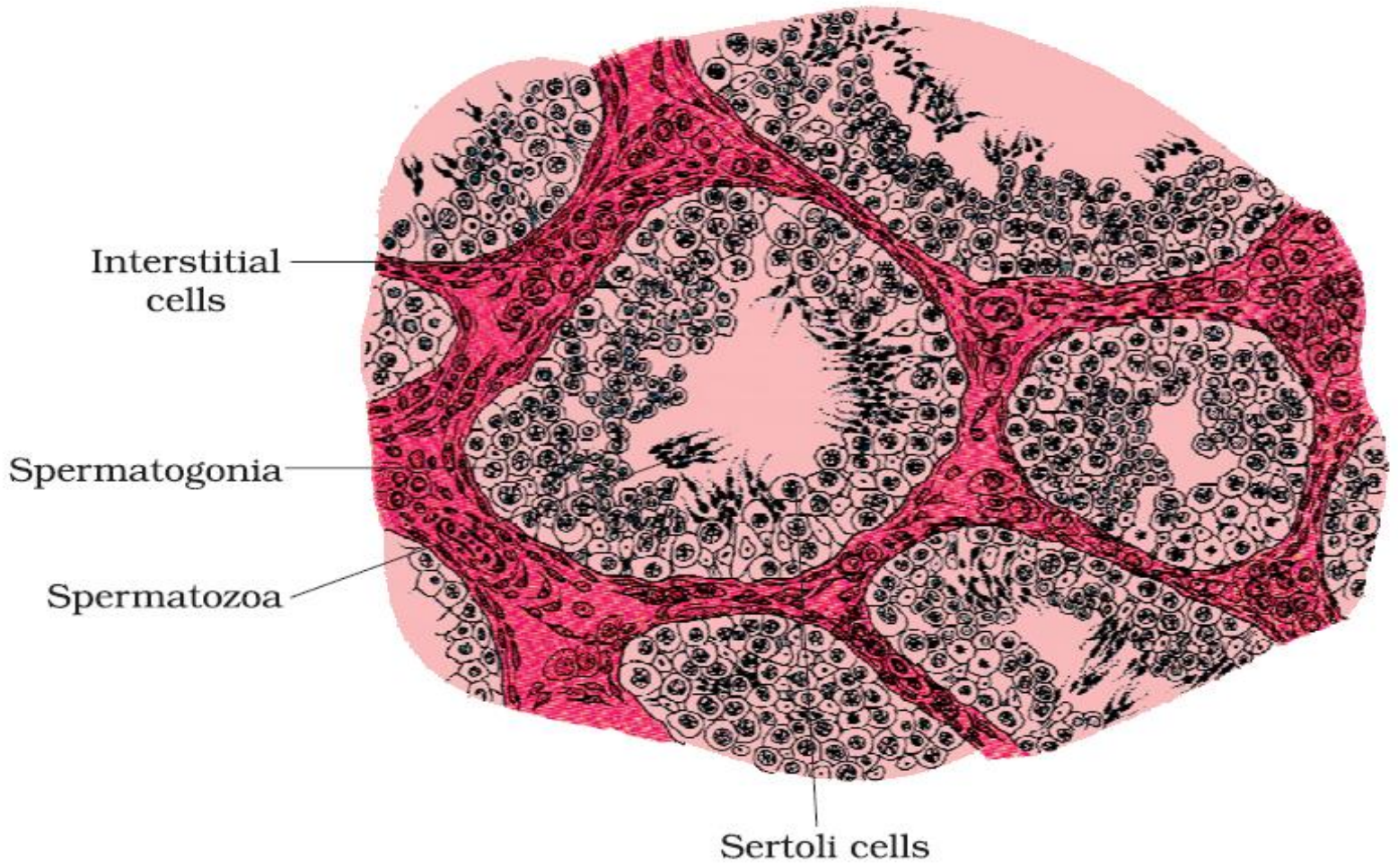
The **Sertoli cells** provide **nutrition** to the germ cells.

The regions outside the seminiferous tubules called interstitial spaces, contain small blood vessels and **interstitial cells** or **Leydig cells.**

Leydig cells secrete testicular hormones called androgens.

B. John Ebenezer

Sectional view of seminiferous tubule



Seminiferous Tubule (Enlarged)

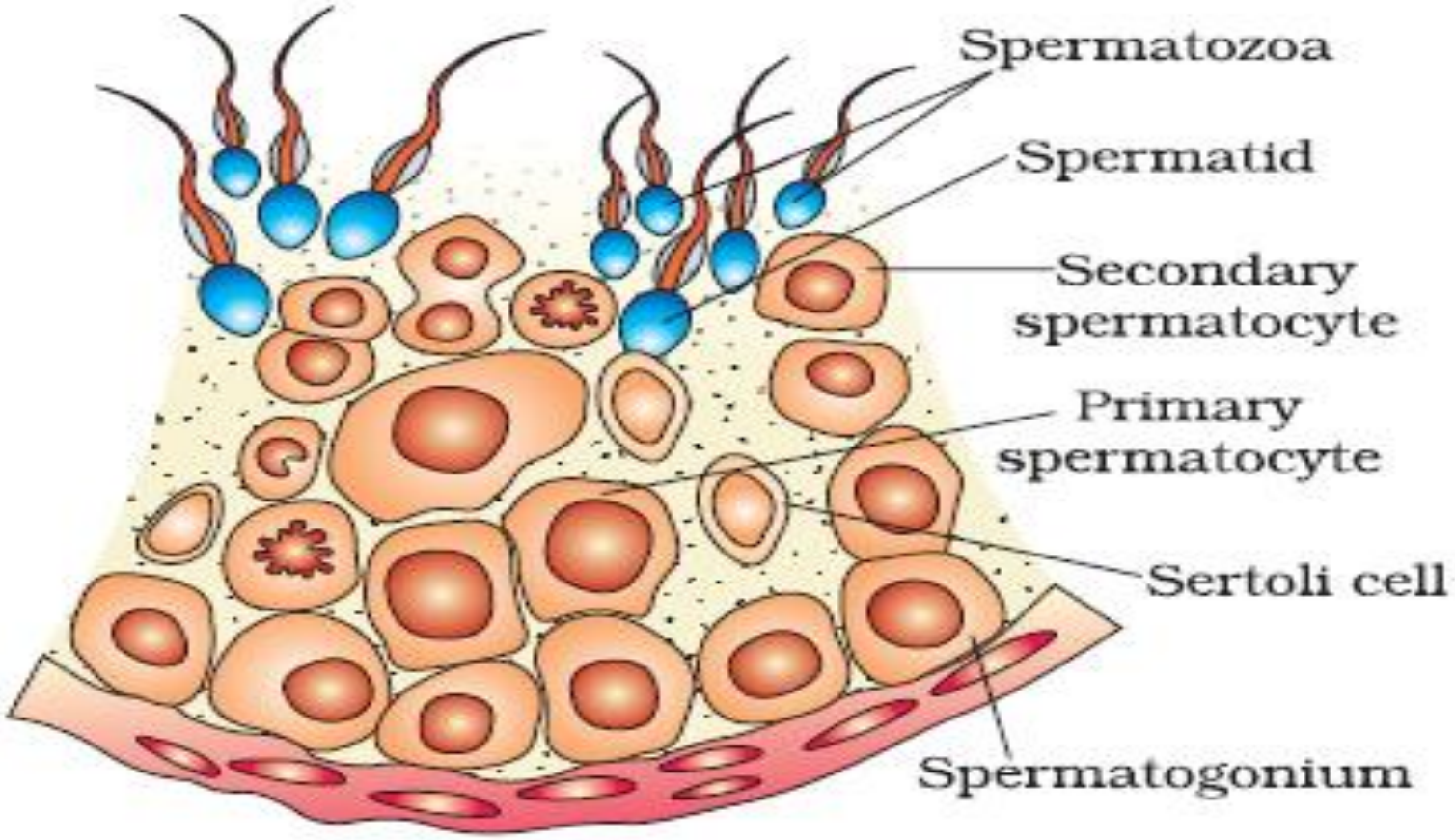


Figure 3.5 Diagrammatic sectional view of a seminiferous tubule (enlarged)

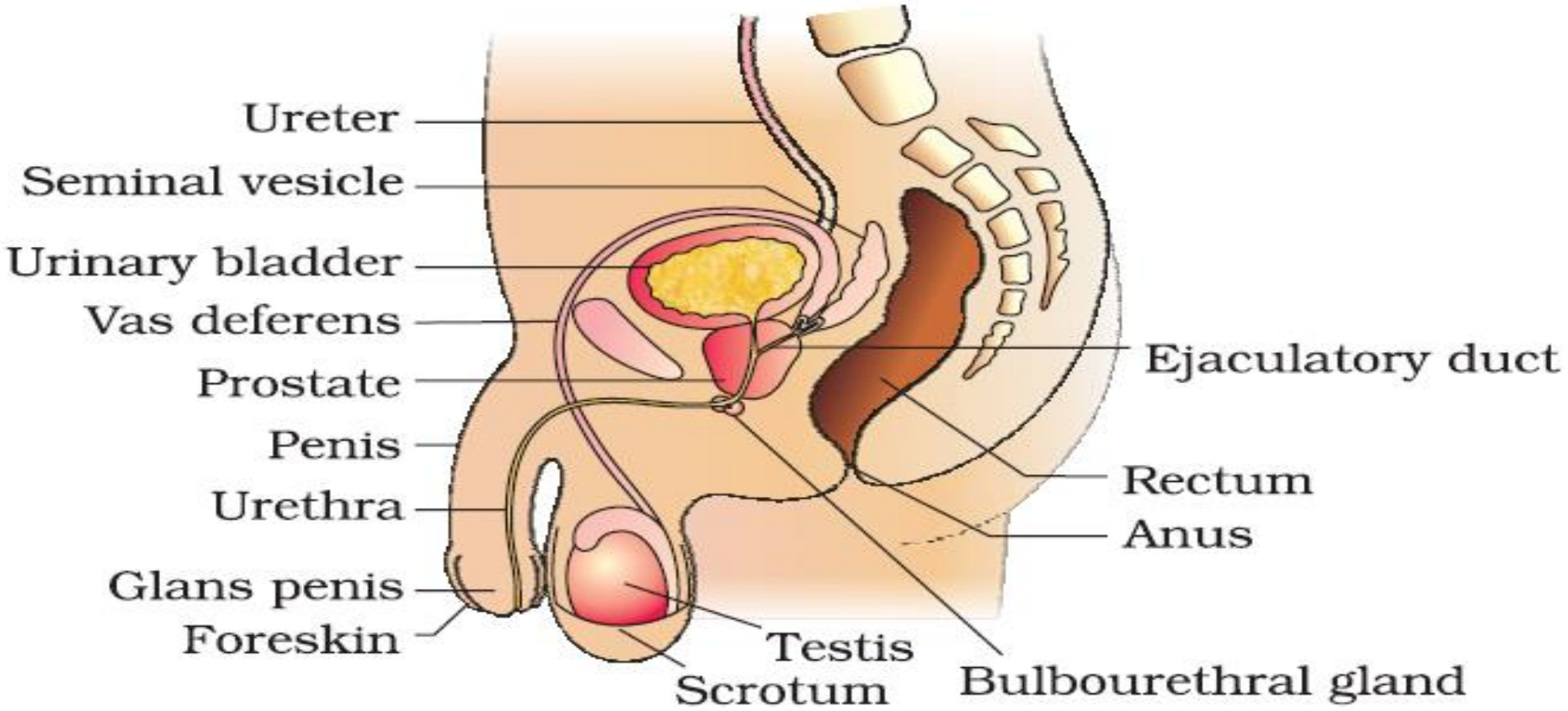
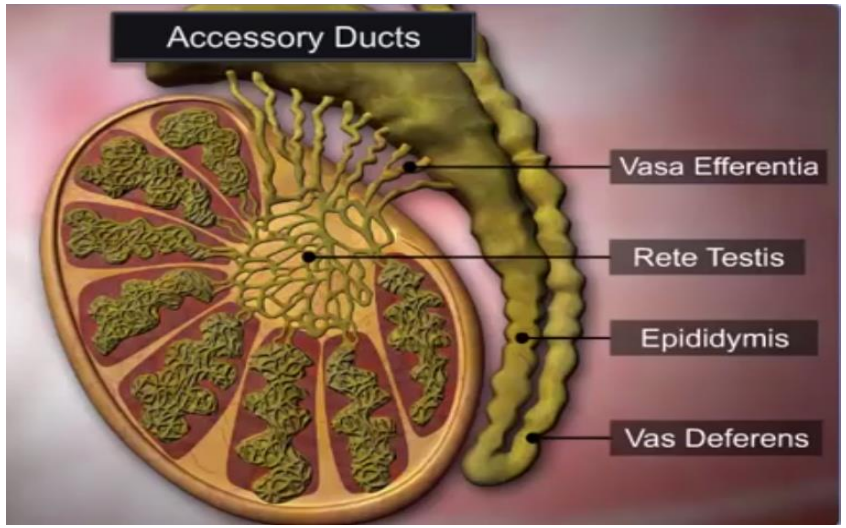


Figure 3.1(a) Diagrammatic sectional view of male pelvis showing reproductive system

Male Accessary Ducts and Glands

Male Accessory Ducts



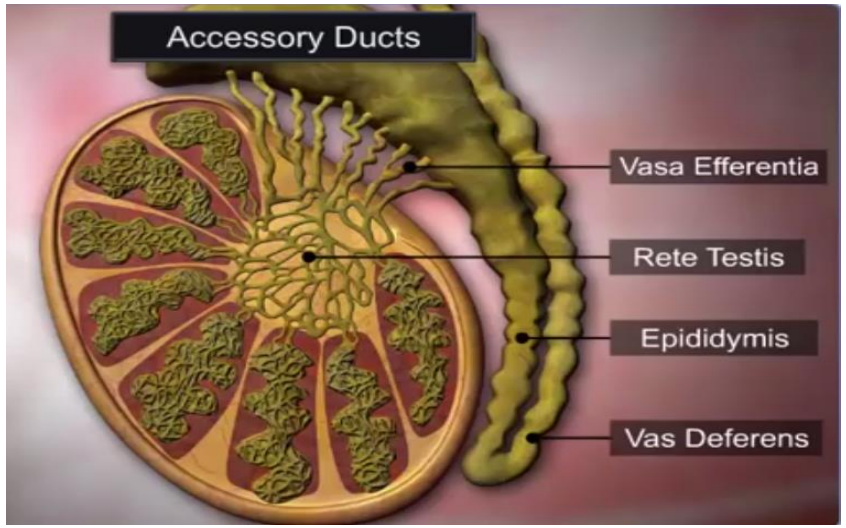
The male sex accessory ducts include **rete testis, vasa efferentia**, **epididymis** and **vas deferens.**

The seminiferous tubules of the testis open into the vasa efferentia through rete testis.

The vasa efferentia leave the testis and open into epididymis located along the posterior surface of each testis.

B. John Ebenezer

Male Accessory Ducts



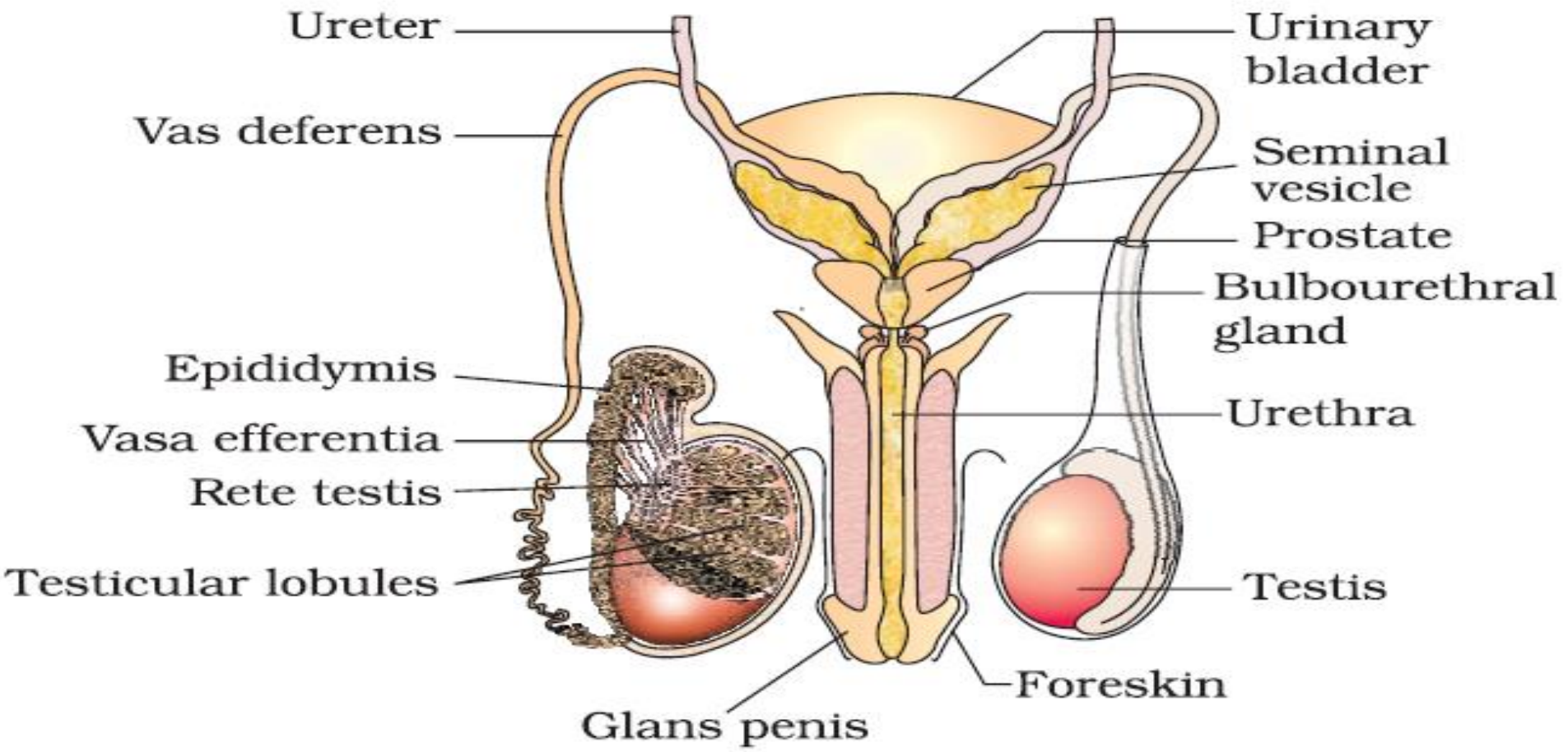
The epididymis leads to vas deferens that ascends to the abdomen and loops over the urinary bladder.

It receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

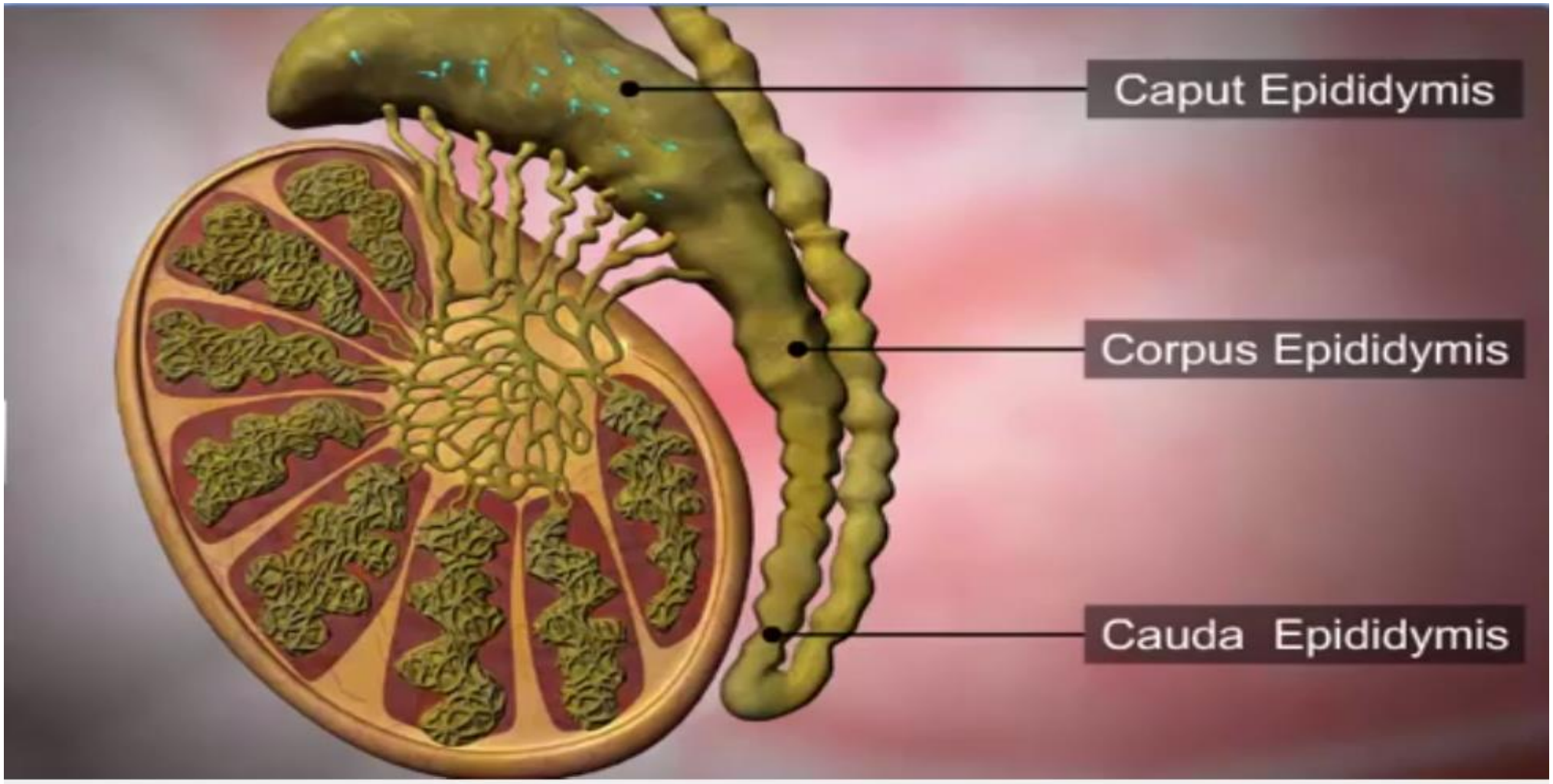
These ducts **store and transport the sperms** from the testis to the outside through urethra.

B. John Ebenezer

Male Reproductive System



Epididymis



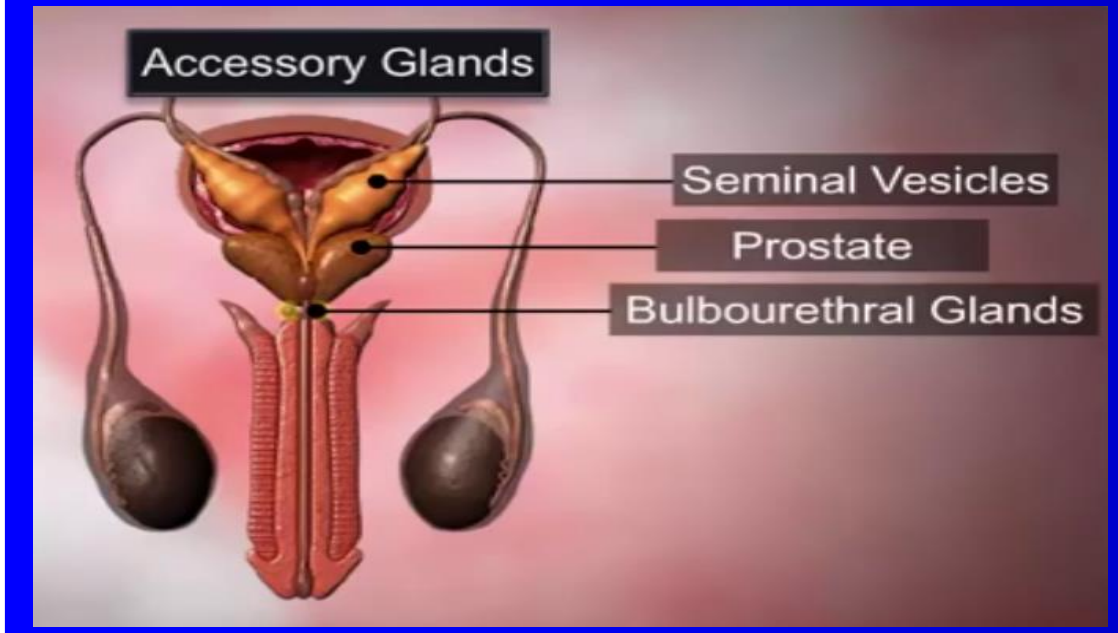
The urethra originates from the urinary bladder and extends through the penis to its external opening called **urethral meatus**.

The penis is the male external genitalia. It is made up of special tissue that helps in erection of the penis to facilitate insemination.

The enlarged end of penis called the glans penis is covered by a loose fold of skin called **foreskin**

B. John Ebenezer

Male Accessory Glands



The male accessory glands include a pair of **seminal vesicles**, a **prostate** and paired **bulbourethral** glands.

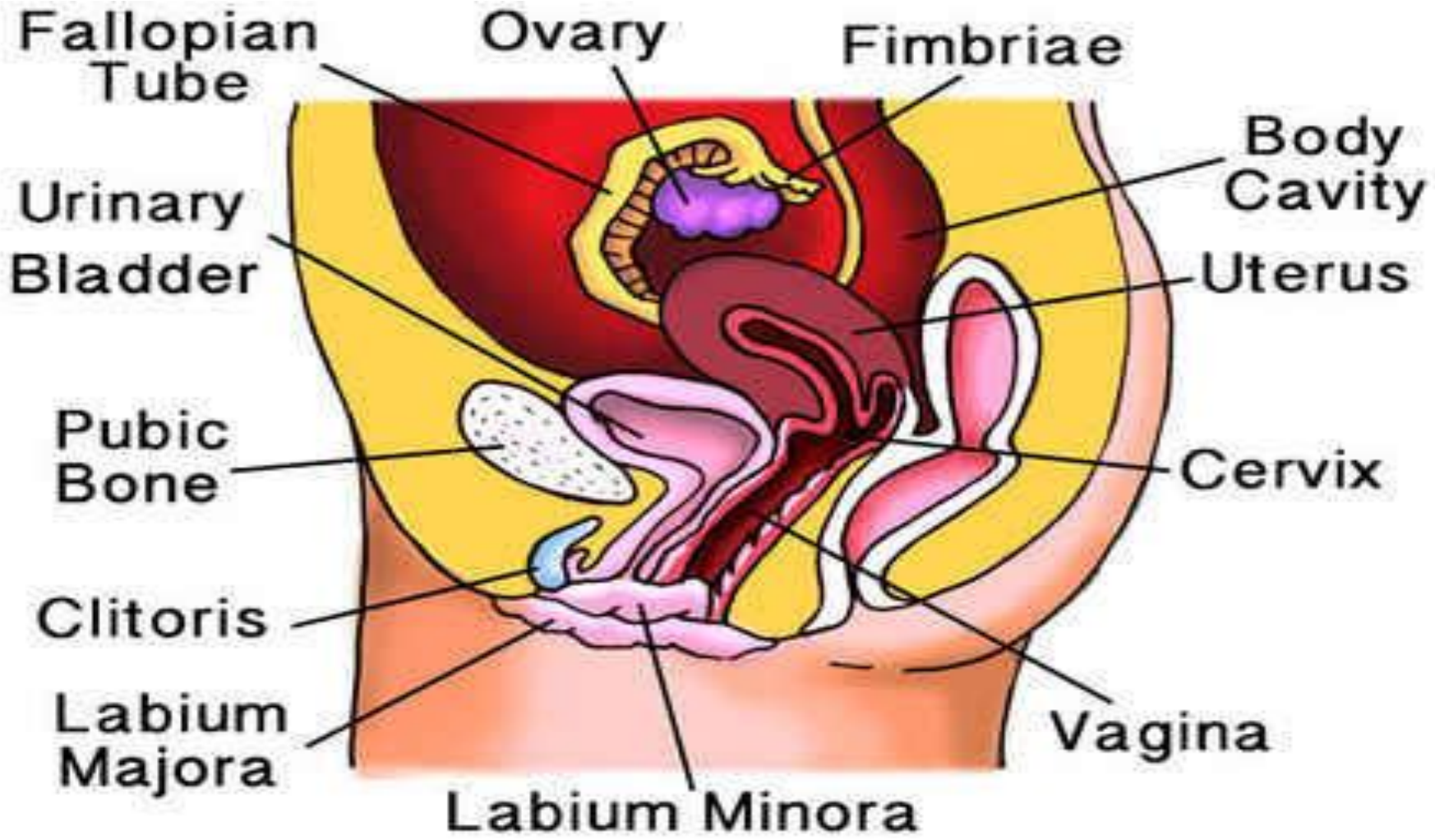
Secretions of these glands form the seminal plasma which is rich in **fructose, calcium** and certain **enzymes**.

The secretions of bulbourethral glands also helps in the lubrication of the penis.

B. John Ebenezer

Female Reproductive System

Female Reproductive System



Female Reproductive System

The female reproductive system consists of a pair of **ovaries** along with a pair of **oviducts, uterus, cervix, vagina** and the **external genitalia** located in pelvic region.

These parts of the system along with a pair of the **mammary glands** are integrated structurally and functionally to support the processes of ovulation, fertilization, pregnancy, birth and child care.

B. John Ebenezer

Ovaries

Ovaries

Ovaries are the primary female sex organs that produce the female gamete (ovum) and several steroid hormones (ovarian hormones).

The ovaries are located one on each side of the lower abdomen.

Each ovary is about 2 to 4 cm in length and is connected to the pelvic wall and uterus by ligaments.

B. John Ebenezer

Female Reproductive System

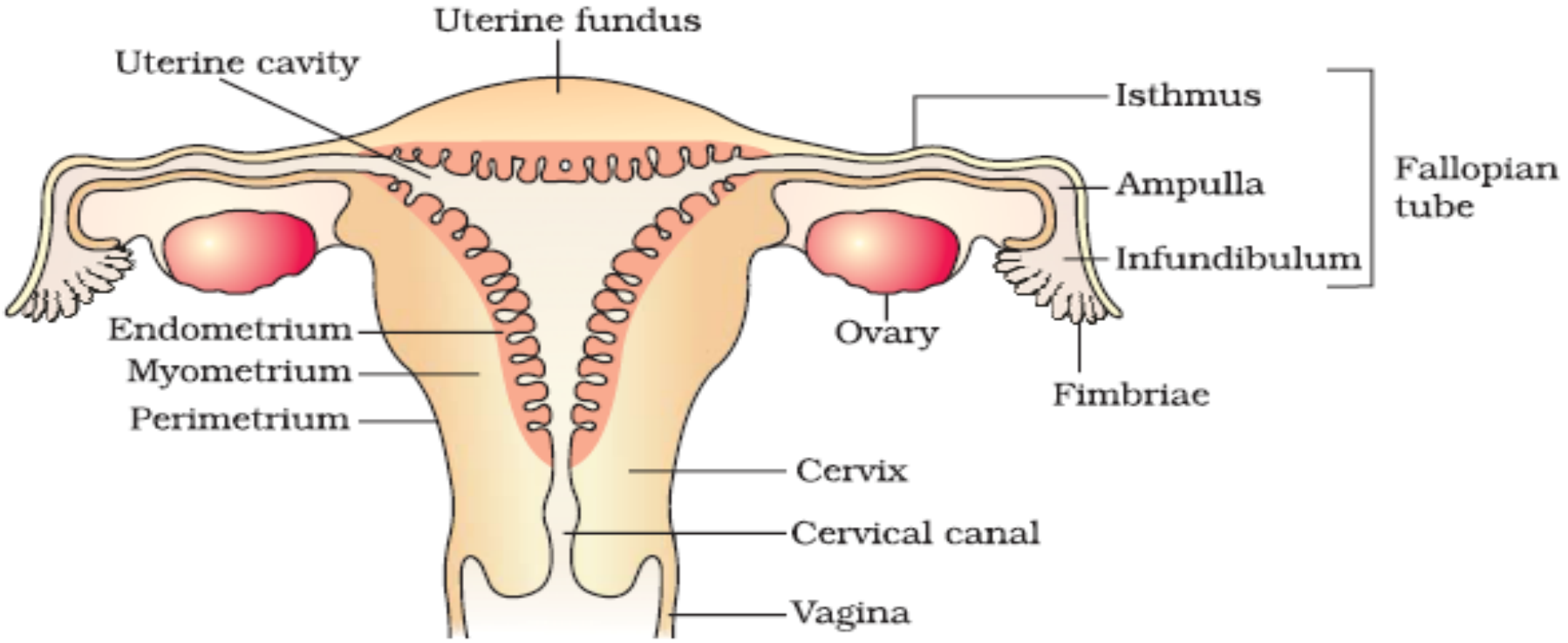
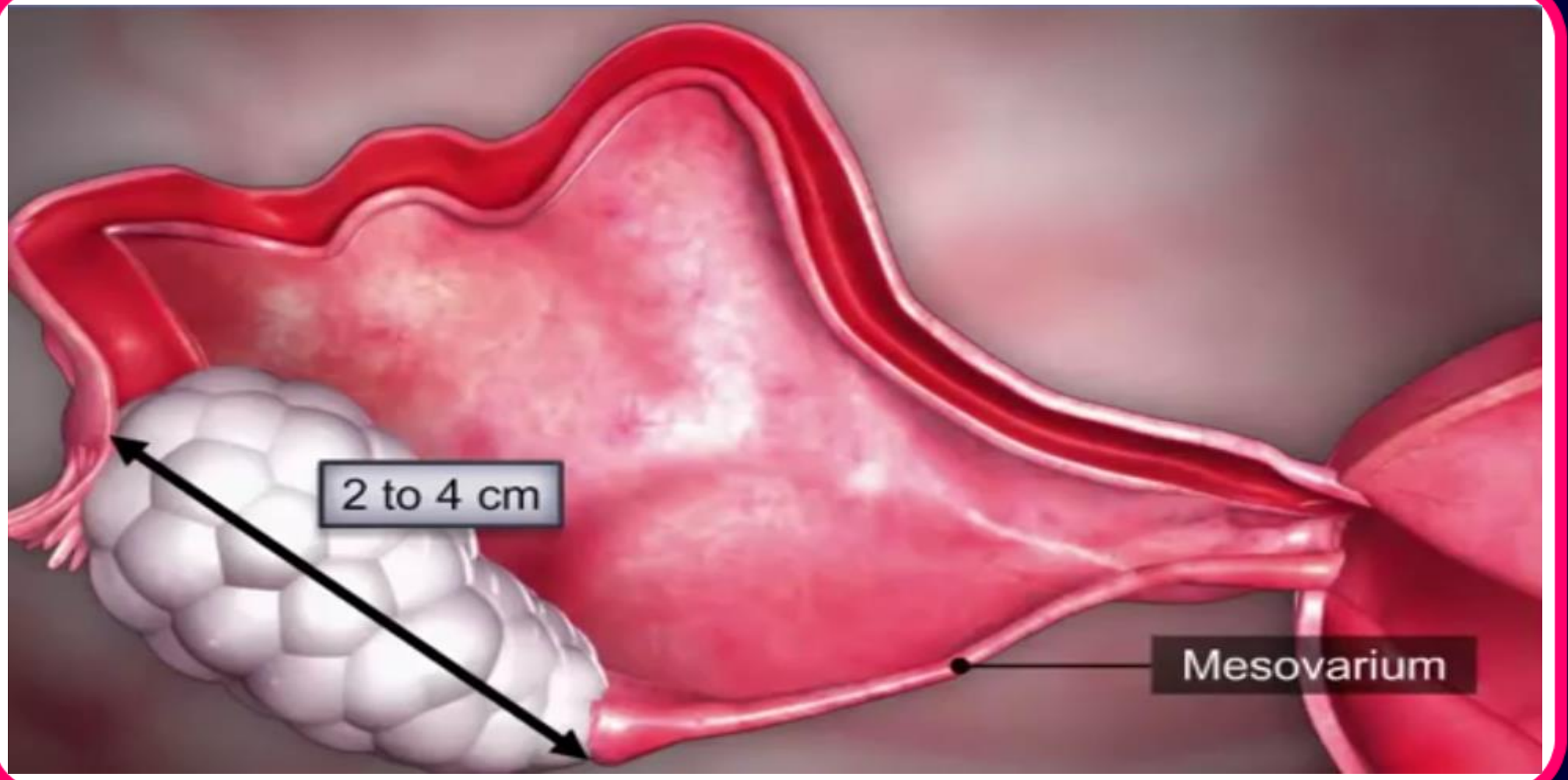
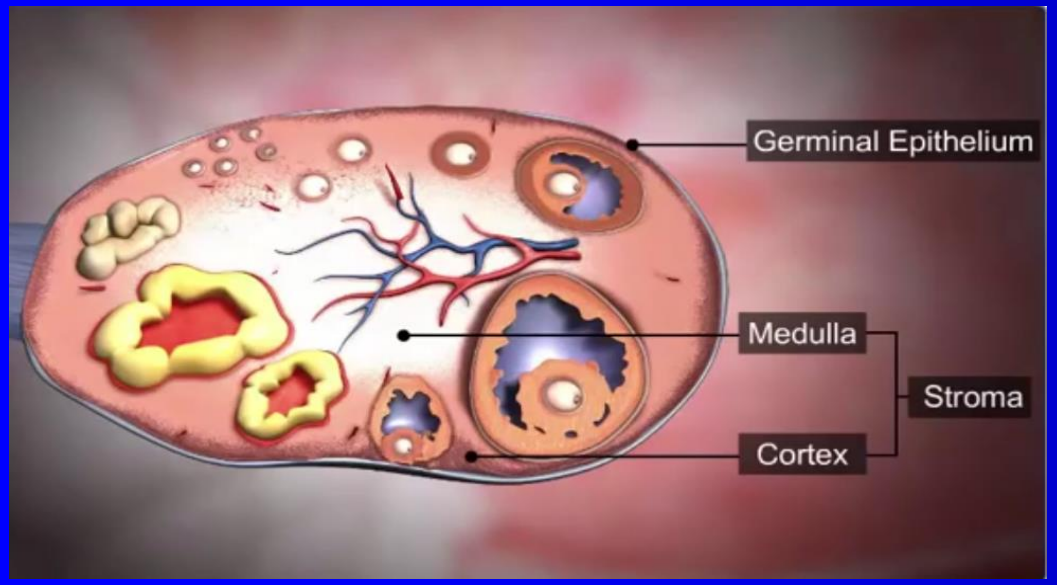


Figure 3.3 (b) Diagrammatic sectional view of the female reproductive system

Ovary

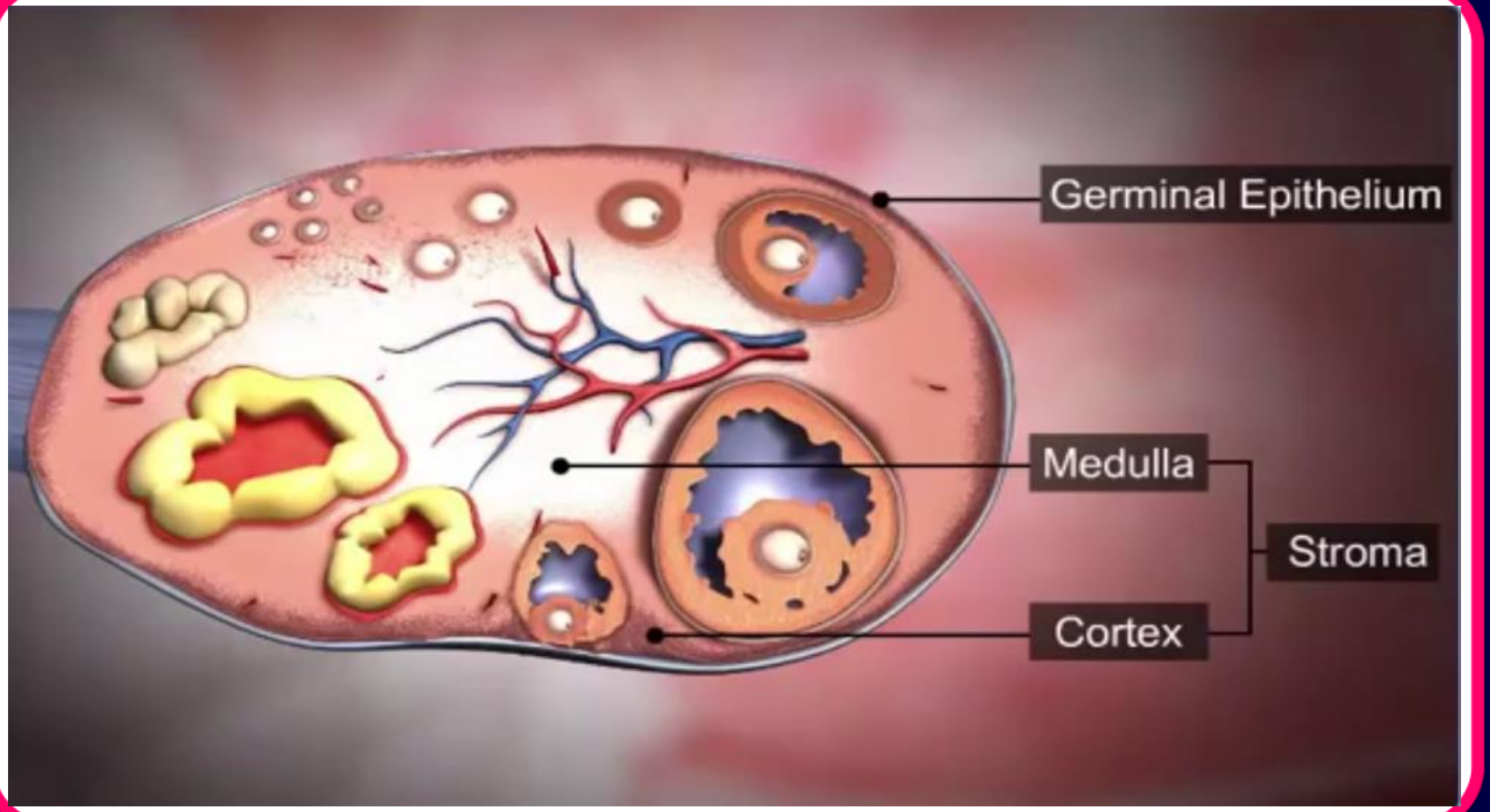




- Each ovary is covered by a thin epithelium which encloses the ovarian stroma.
- The stroma is divided into two zones – a peripheral cortex and an inner medulla.
- The oviducts (fallopian tubes), uterus and vagina constitute the female accessory ducts.

B. John Ebenezer

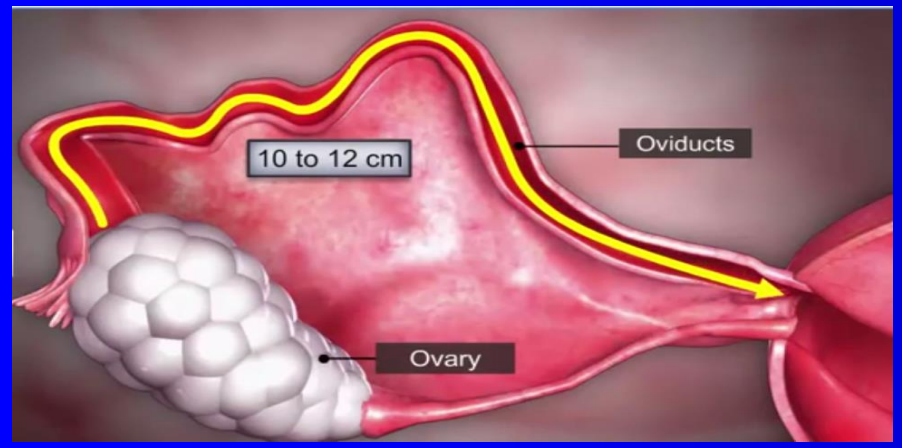
L.S of Ovary

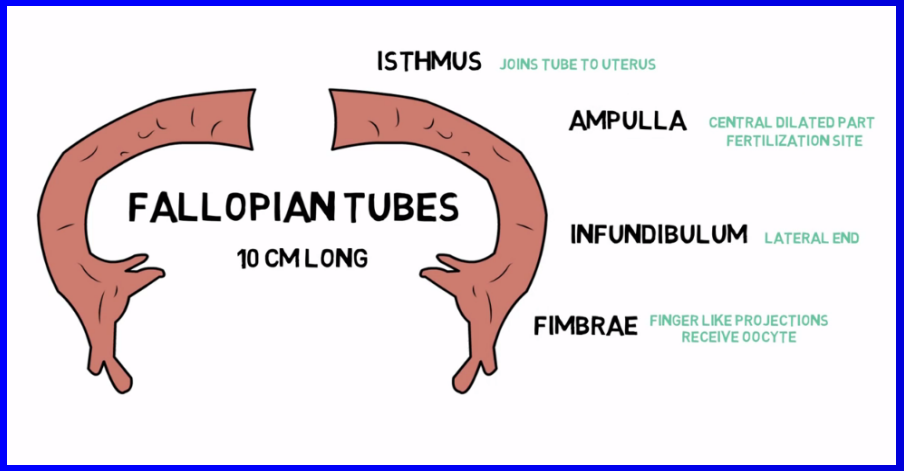


B. John Ebenezer

Fallopian Tube

Fallopian Tube





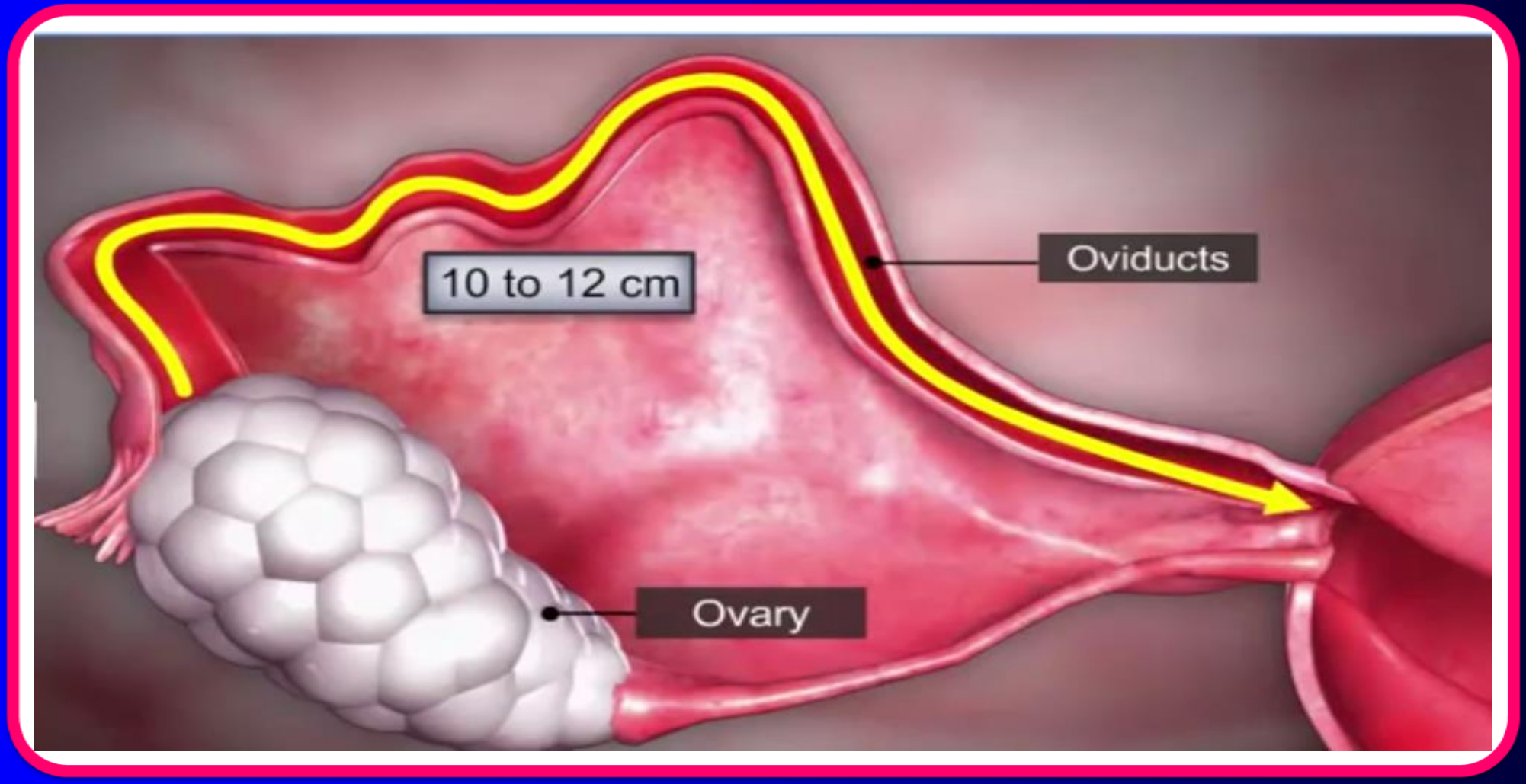
Each fallopian tube is about 10-12 cm long and extends from the periphery of each ovary to the uterus.

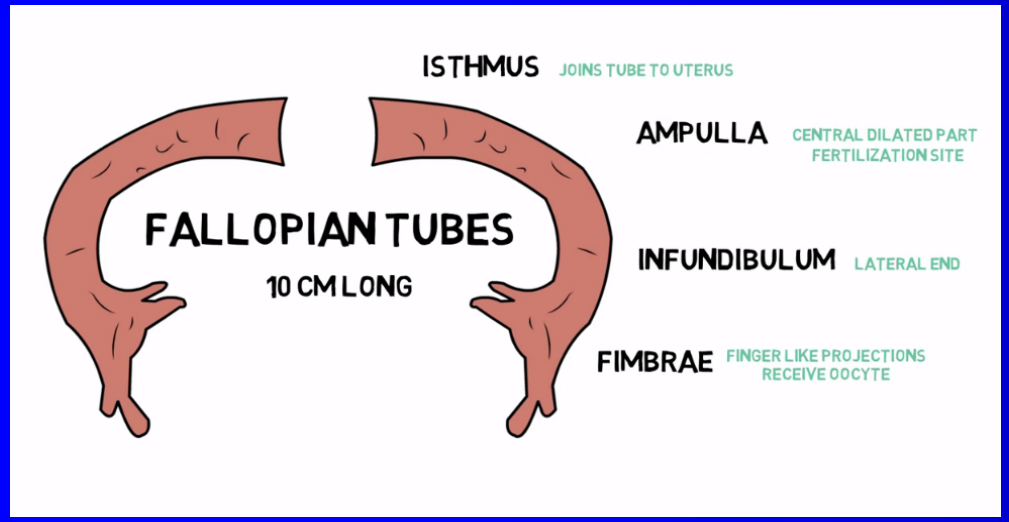
The part of fallopian tube, closer to the ovary is the funnel-shaped **infundibulum**.

The edges of the infundibulum possess finger-like projections called **fimbriae**, which help in collection of the ovum after ovulation.

B. John Ebenezer

Fallopian Tube





The infundibulum leads to a wider part of the oviduct called **ampulla**.

The last part of the oviduct, **isthmus** has a narrow lumen and it joins the uterus.

The uterus is single and it is also called **womb**.

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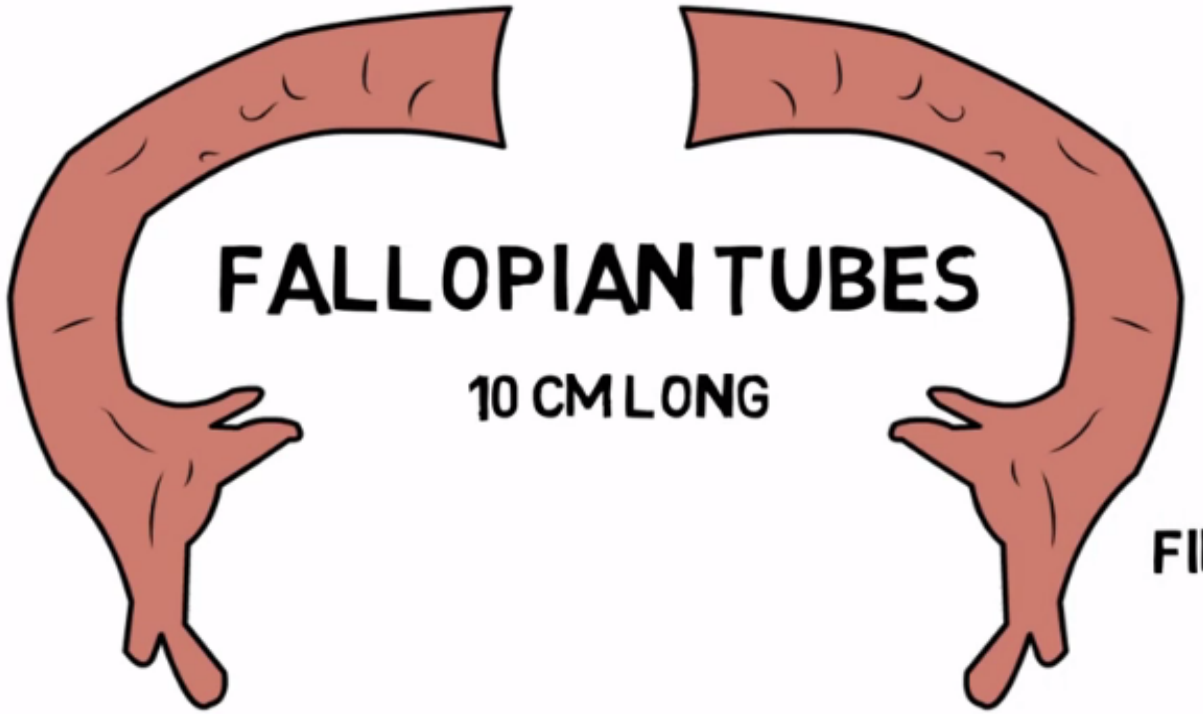
Fallopian Tube



ISTHMUS JOINS TUBE TO UTERUS

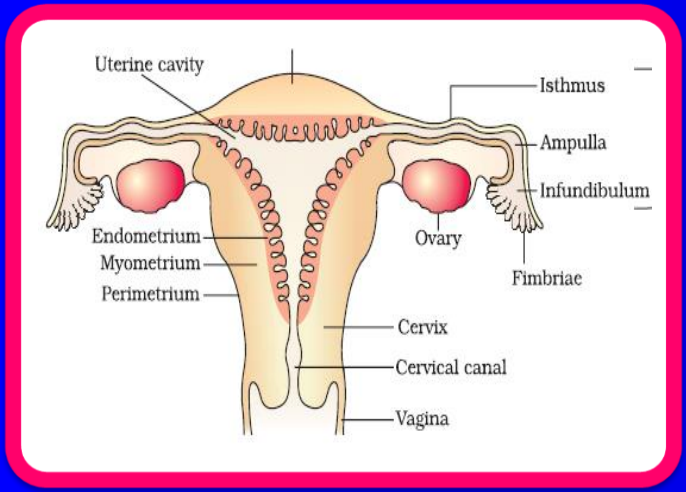
AMPULLA CENTRAL DILATED PART
FERTILIZATION SITE

INFUNDIBULUM LATERAL END

FIMBRAE FINGER LIKE PROJECTIONS
RECEIVE OOCYTE

Uterus

Uterus



The shape of the uterus is like an inverted pear.

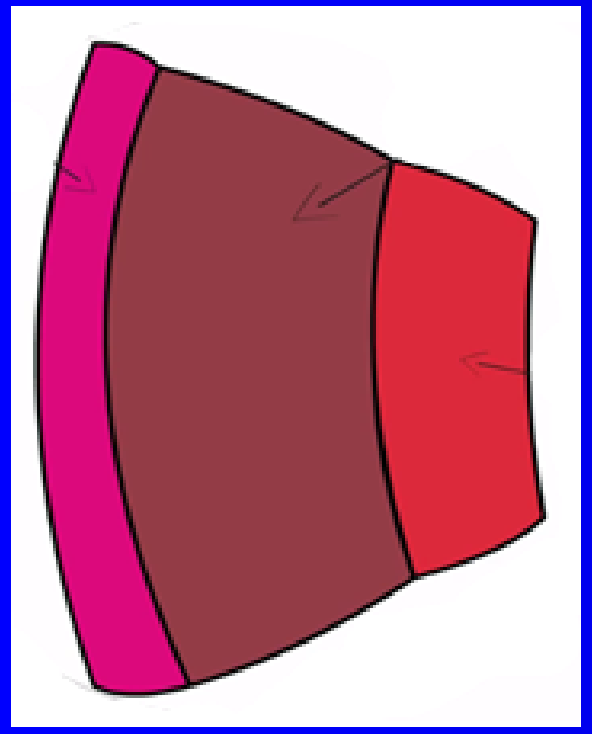
It is supported by ligaments attached to the pelvic wall.

The uterus opens into vagina through a narrow cervix.

The cavity of the cervix, called **cervical canal** along with vagina forms the birth canal.

B. John Ebenezer

Uterus



The wall of the uterus has three layers of tissue.

Perimetrium:

It is the external thin membranous layer.

Myometrium:

It is the middle thick layer of smooth muscle.

It exhibits strong contraction during delivery of the baby.

Endometrium:

It is the inner glandular layer that lines the uterine cavity. The endometrium undergoes cyclical changes during menstrual cycle.

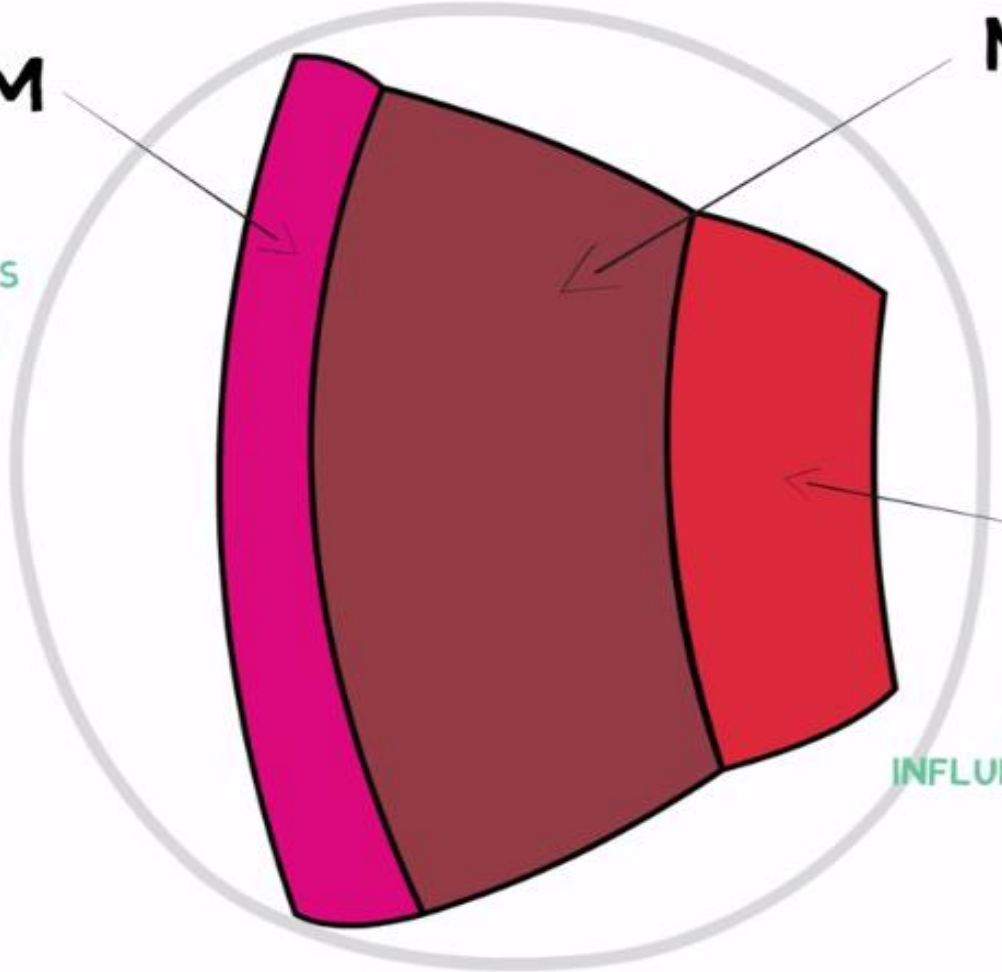
B. John Ebenezer

Wall Layers of Uterus

PERIMETRIUM

THIN LAYER MADE OF EPITHELIAL CELLS THAT COVERS THE UTERUS

VISCERAL PERITONEUM



MYOMETRIUM

THICKEST LAYER

SMOOTH MUSCLES

VERY IMPORTANT ROLE IN CHILD BIRTH

FIBROIDS, ADENOMYOSIS

ENDOMETRIUM

INNER & MOST ACTIVE LAYER

UNDERGOES SERIES OF CHANGES THROUGHOUT THE MONTH UNDER INFLUENCE OF ESTROGEN AND PROGESTERONE

ENDOMETRIAL HYPERPLASIA & CANCER

Female External Genitalia

Female External Genitalia

The female external genitalia include mons pubis, labia majora, labia minora, hymen and clitoris.

Mons pubis is a cushion of fatty tissue covered by skin and pubic hair.

Labia majora are fleshy folds of tissue, which extend down from the mons pubis and surround the vaginal opening.

Labia minora are paired folds of tissue under the labia majora.

B. John Ebenezer

The Female External Genitalia

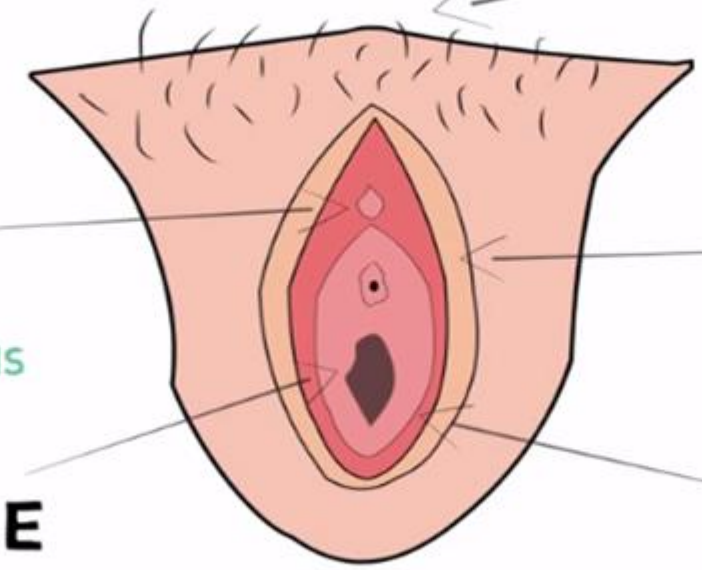
The female external genitalia is called vulva.

The opening of the vagina is covered partially by a membrane called **hymen**.

The **clitoris** is a tiny finger-like structure which lies at the upper junction of the two labia minora above the urethral opening.

B. John Ebenezer

Female External Genitalia - Vulva



MONS PUBIS

SOFT MOUND OF FATTY TISSUE

CLITORIS

HIGHLY SENSITIVE
HOMOLOGOUS TO GLANS PENIS

LABIA MAJORA

PROTECT OTHER EXTERNAL SEX ORGANS

VULVAL VESTIBULE

VAGINAL & URETHRAL OPENING

LABIA MINORA

SURROUND THE VAGINAL & URETHRAL OPENING

Hymen

The opening of the vagina is covered partially by a membrane called **hymen**.

The hymen is often torn during the first coitus (intercourse).

However, it can also be broken by a sudden fall or jolt, insertion of a vaginal tampon, active participation in some sports like horseback riding, cycling, etc.

In some women the hymen persists even after coitus.

In fact, the presence or absence of hymen is not a reliable indicator of virginity or sexual experience.

B. John Ebenezer

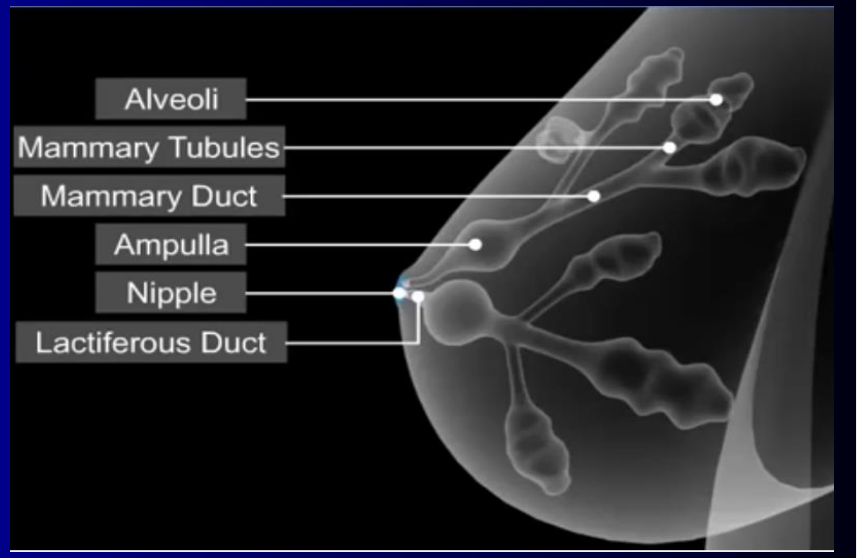
Mammary Glands

Mammary Glands

A pair of mammary glands are found in breasts that contain glandular tissue and variable amount of fat.

The glandular tissue of each breast is divided into 15-20 **mammary lobes** containing clusters of cells called alveoli.

The cells of alveoli secrete milk, which is stored in the cavities (lumens) of alveoli.



B. John Ebenezer

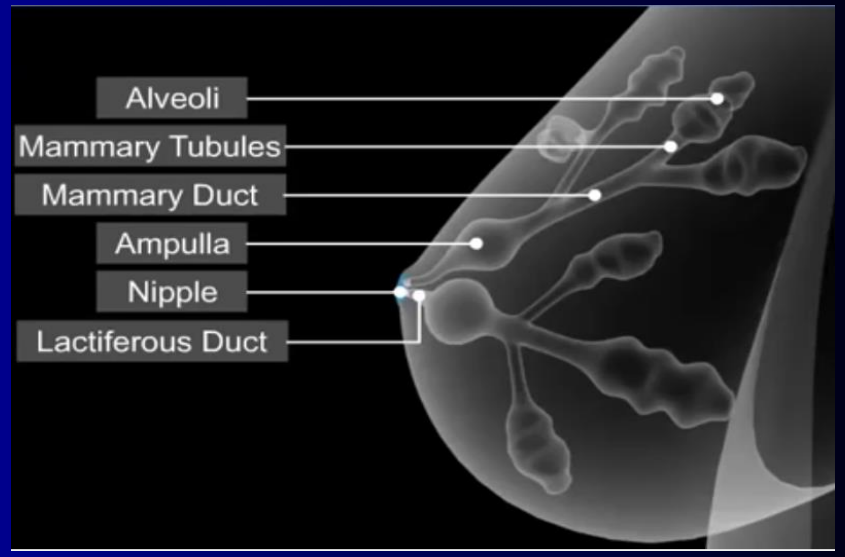
Mammary Gland

The alveoli open into mammary tubules.

The tubules of each lobe join to form a **mammary duct**.

Several mammary ducts join to form a wider **mammary ampulla**

The ampulla is connected to **lactiferous duct** through which milk is sucked out.



B. John Ebenezer

Mammary Gland

Mammary Gland

Consists of

- Glandular Tissue
- Variable amount of Fat

Glandular Tissue

Divided into

15-20 Mammary Lobes

Contain

Cluster of cells - Alveoli

Secrete

Milk

Stored in

Lumens of Alveoli

Open into

Mammary Tubules

Join to form

Mammary Ducts

Join to form a

Wider Mammary Ampulla

Many Ampulla — Join to form

Lactiferous Duct

Opens into

Nipple

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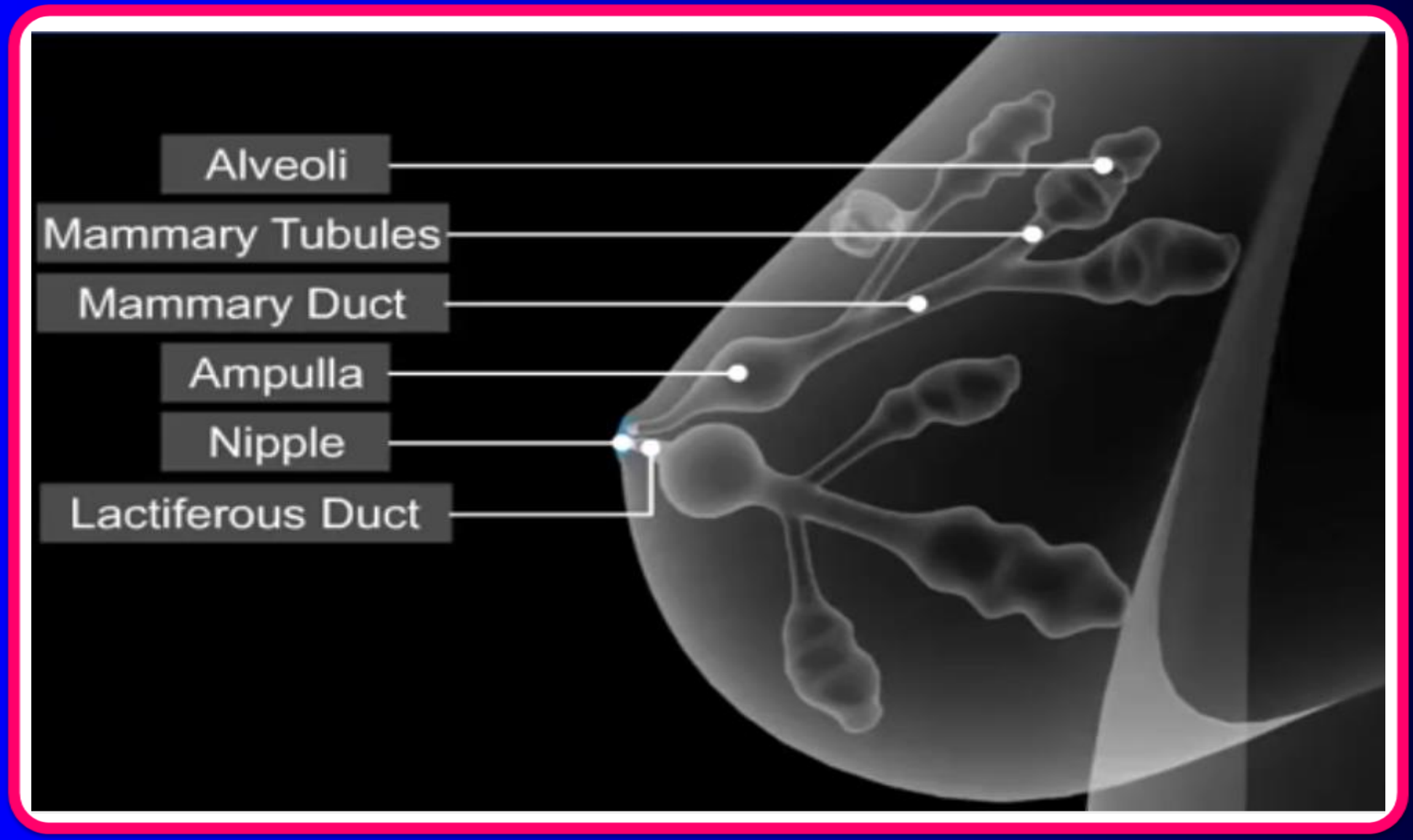
Mammary Gland



Mammary Gland

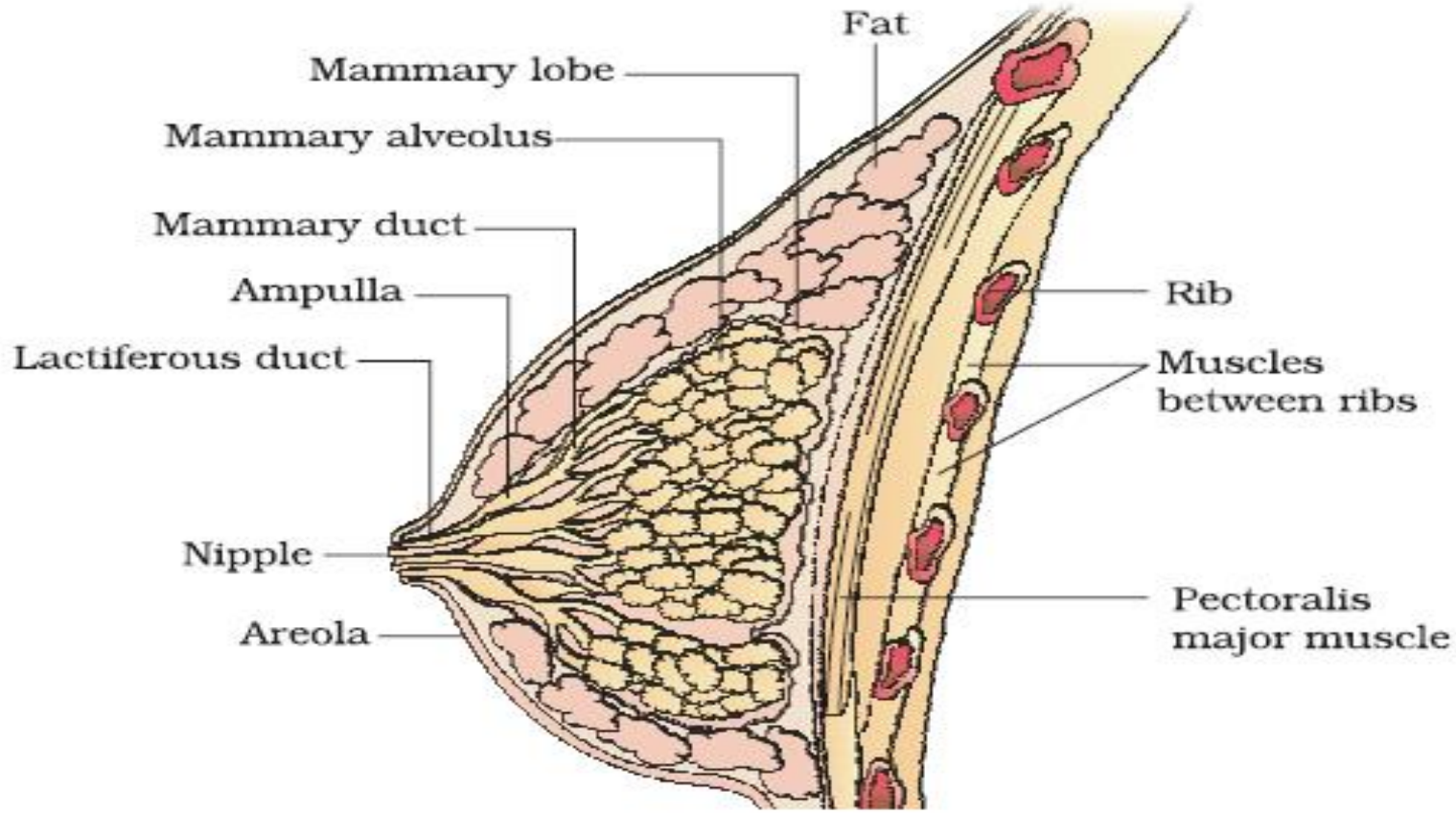


Figure 3.4 A diagrammatic sectional view of Mammary gland

Spermatogenesis

Spermatogenesis

The process by which the immature male germ cells (spermatogonia) produce sperms in testis, is called spermatogenesis.

The **spermatogonia** present on the inside wall of seminiferous tubules multiply by mitotic division and increase in numbers.

B. John Ebenezer

Spermatogenesis

Each spermatogonium is diploid and contains 46 chromosomes. Some of the spermatogonia, called **primary spermatocytes** periodically undergo meiosis.

A primary spermatocyte completes the **first meiotic division** leading to formation of two equal, haploid cells called **secondary spermatocytes**, which have only 23 chromosomes each.

B. John Ebenezer

Spermatogenesis

The secondary spermatocytes undergo the **second meiotic division** to produce four equal, haploid **spermatids.**

The process by which spermatids are transformed into **spermatozoa** (**sperms**) is called **spermiogenesis**.

After spermiogenesis, sperm heads become embedded in the **Sertoli cells**, and are finally released from the seminiferous tubules by the process called **spermiation**.

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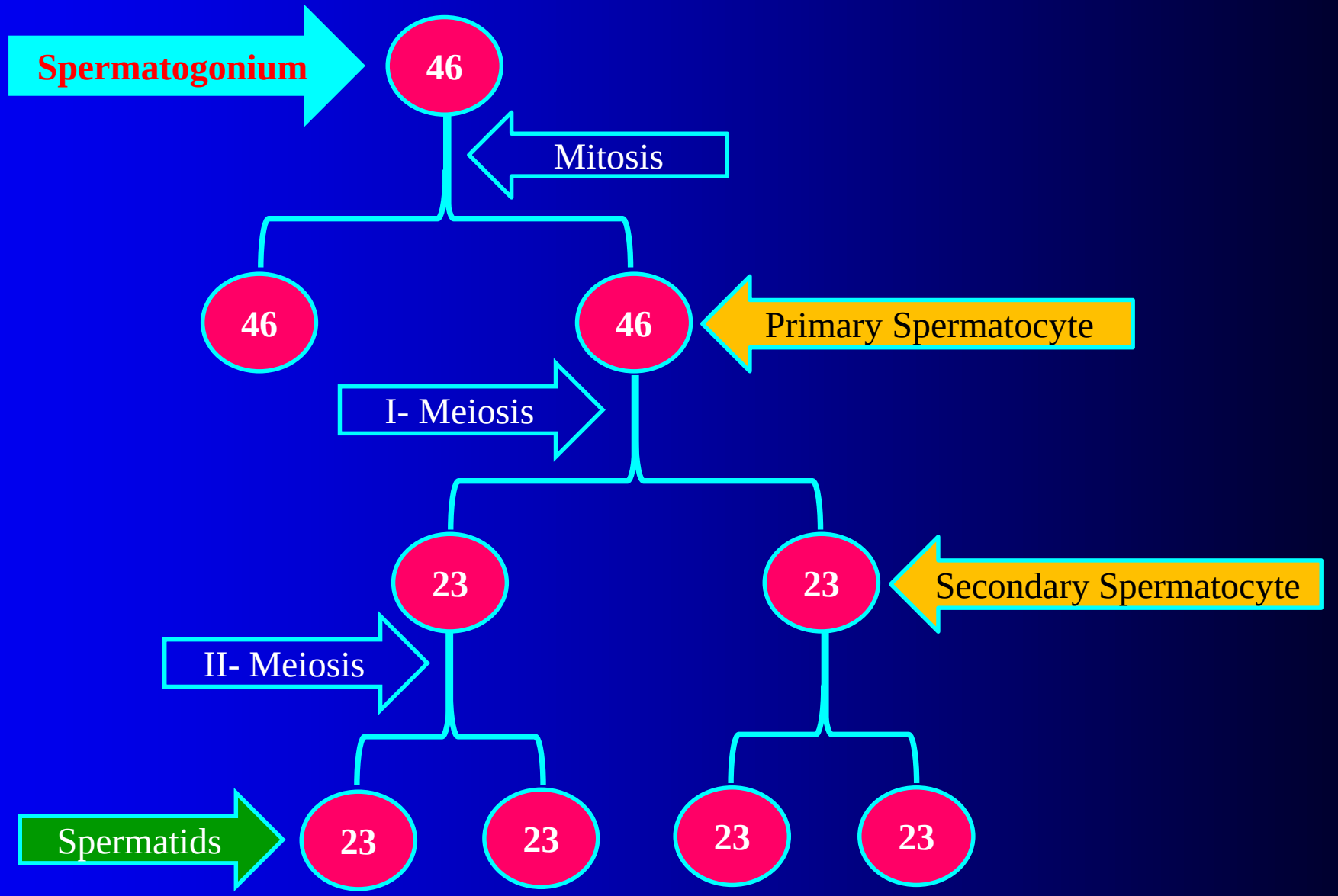
Spermatogenesis



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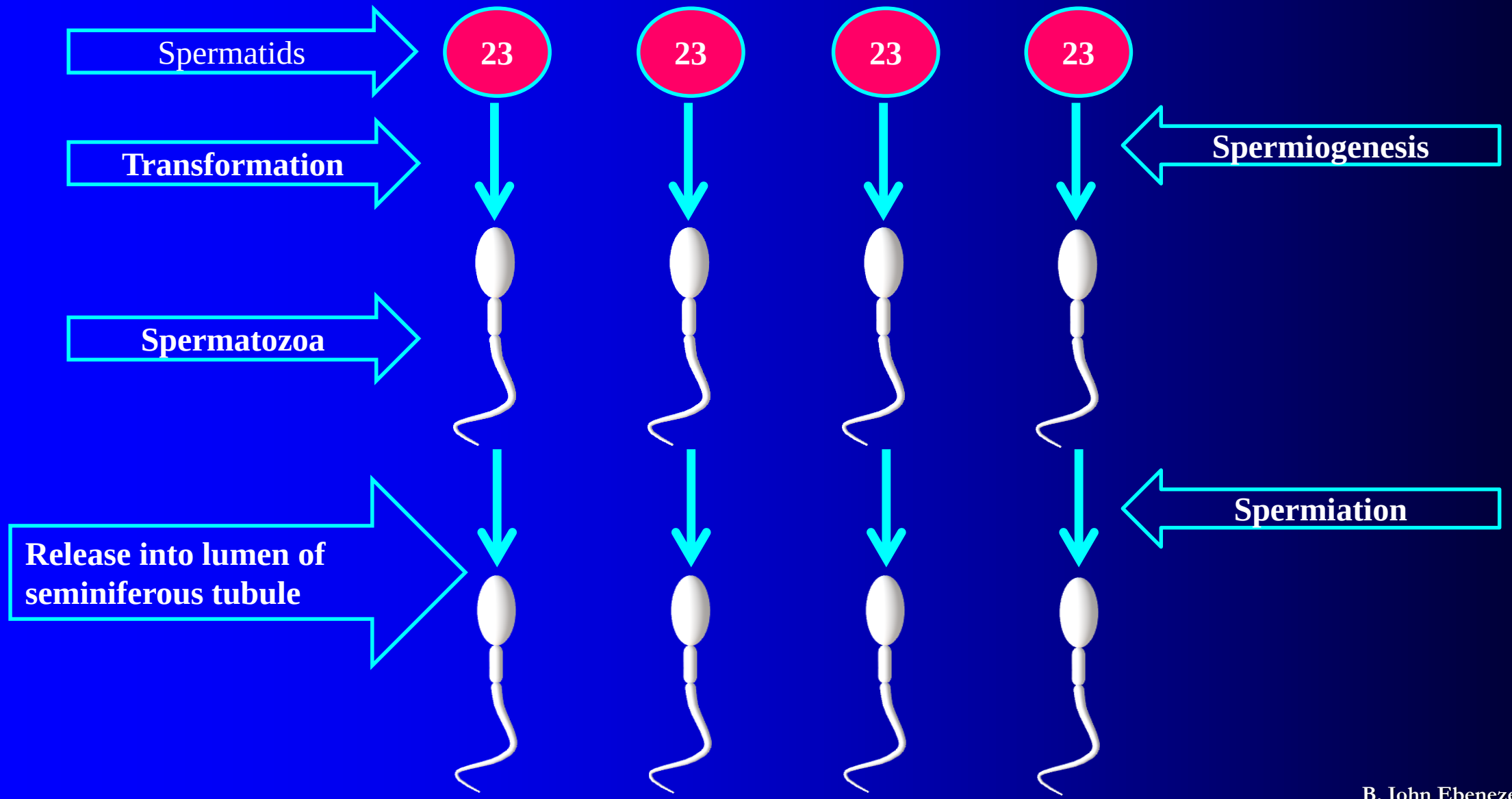
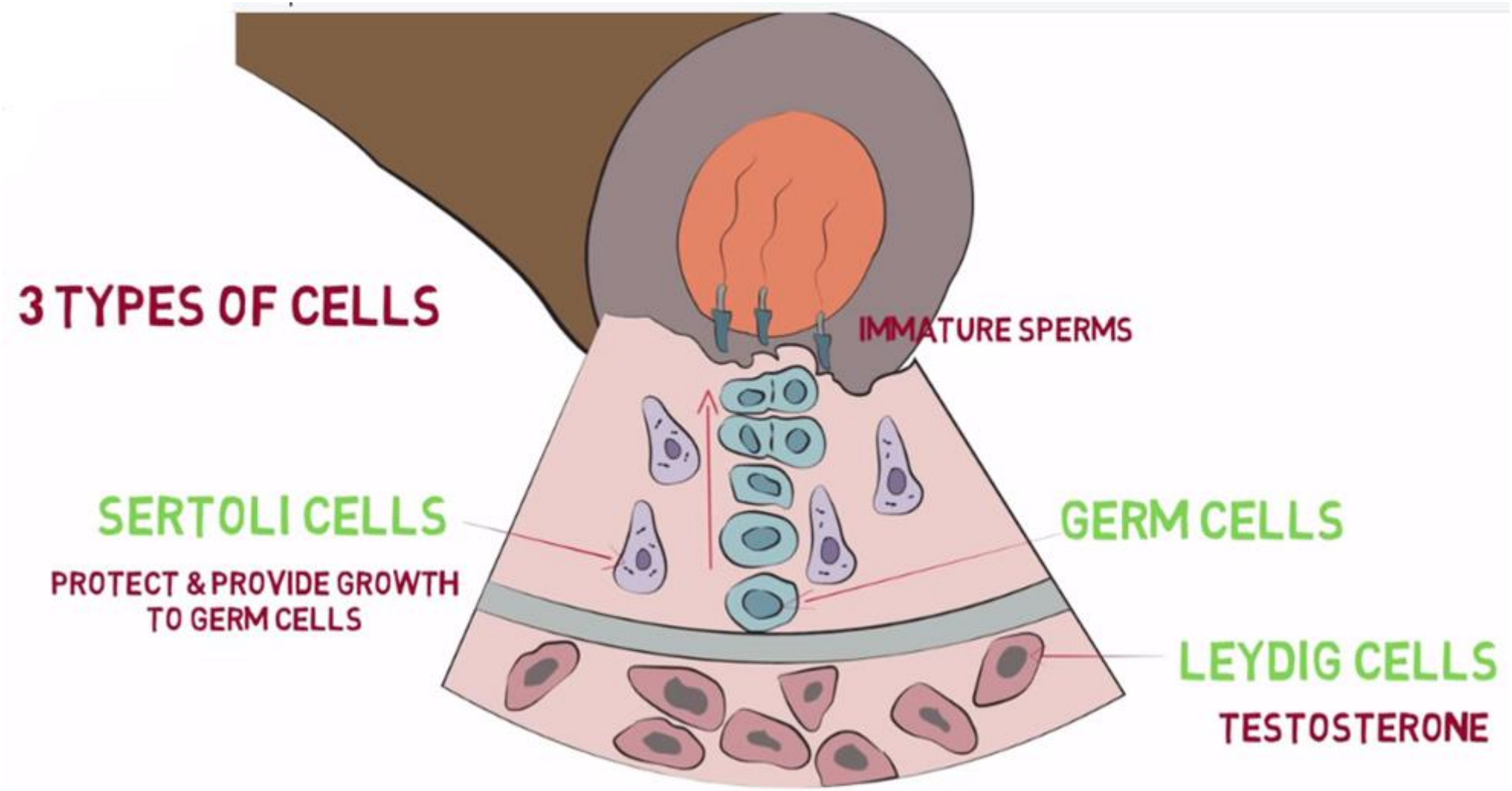
Spermatogenesis

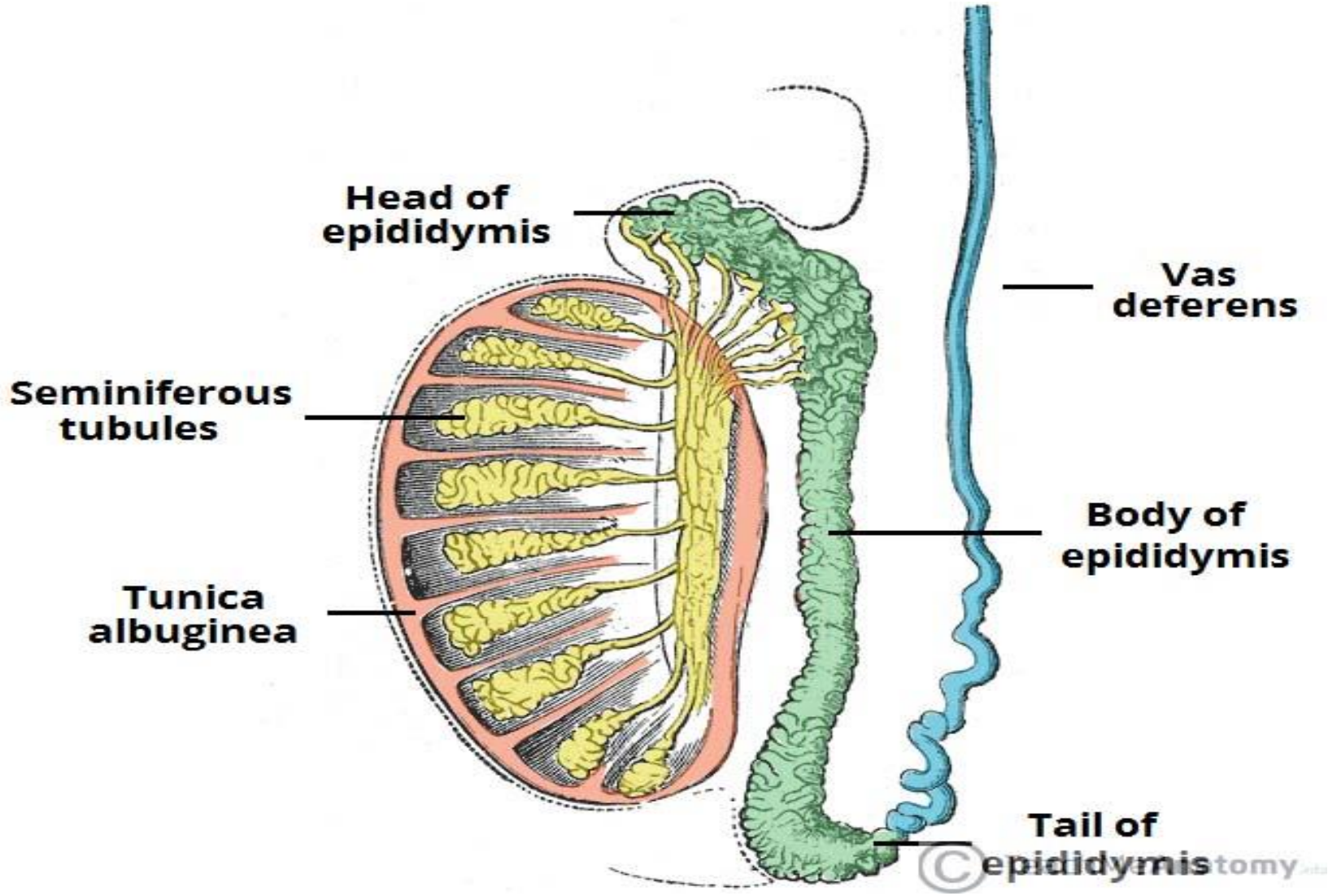


B. John Ebenezer

Seminiferous Tubule



L.S of Testis


Head of epididymis
Seminiferous tubules
Tunica albuginea
Vas deferens
Body of epididymis
Tail of epididymis

Spermatogenesis and Oogenesis

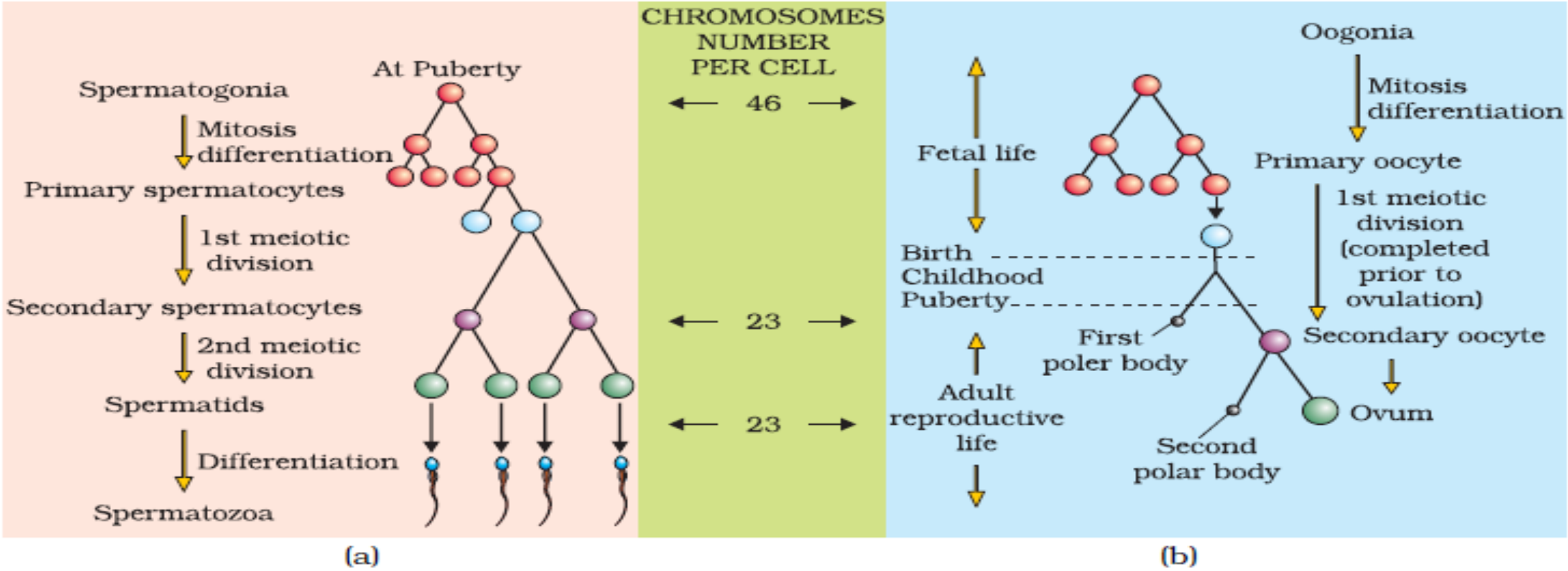


Figure 3.8 Schematic representation of (a) Spermatogenesis; (b) Oogenesis

Spermatogenesis

Spermatogenesis starts at the age of puberty due to increase in the secretion of gonadotropin releasing hormone (GnRH).

The increased levels of GnRH then acts at the anterior pituitary gland and stimulates secretion of two gonadotropins – luteinising hormone (LH) and follicle stimulating hormone (FSH).

LH acts at the **Leydig cells** and stimulates synthesis and secretion of **androgens**. Androgens, in turn, stimulate the process of spermatogenesis.

FSH acts on the **Sertoli cells** and stimulates the secretion of **some factors** which help in the process of spermiogenesis.

B. John Ebenezer

Hormonal Control of Male Reproductive System

B. John Ebenezer

Hypothalamus

↓

GnRH

↓

Stimulates

Anterior Pituitary

LH ⟷ Gonadotropins ⟷ FSH

Acts on

Leydig Cells

Secretes

Androgens

Stimulates

Spermatogenesis

Sertoli Cells

Some Factors

Spermiogenesis

Structure of Sperm

Sperm is a microscopic structure composed of a **head**, **neck,** a **middle piece** and a **tail**.

A plasma membrane envelops the whole body of sperm.

Head

The sperm head contains an **elongated haploid nucleus**, the anterior portion of which is covered by a cap-like structure, **acrosome**.

The acrosome is filled with **enzyme**s that help fertilization of the ovum.

B. John Ebenezer

Structure of Sperm

Neck

The neck contains **proximal centriole** towards the nucleus which is necessary for the first cleavage division of zygote and **distal centriole** that is connected to the tail filament.

Middle piece

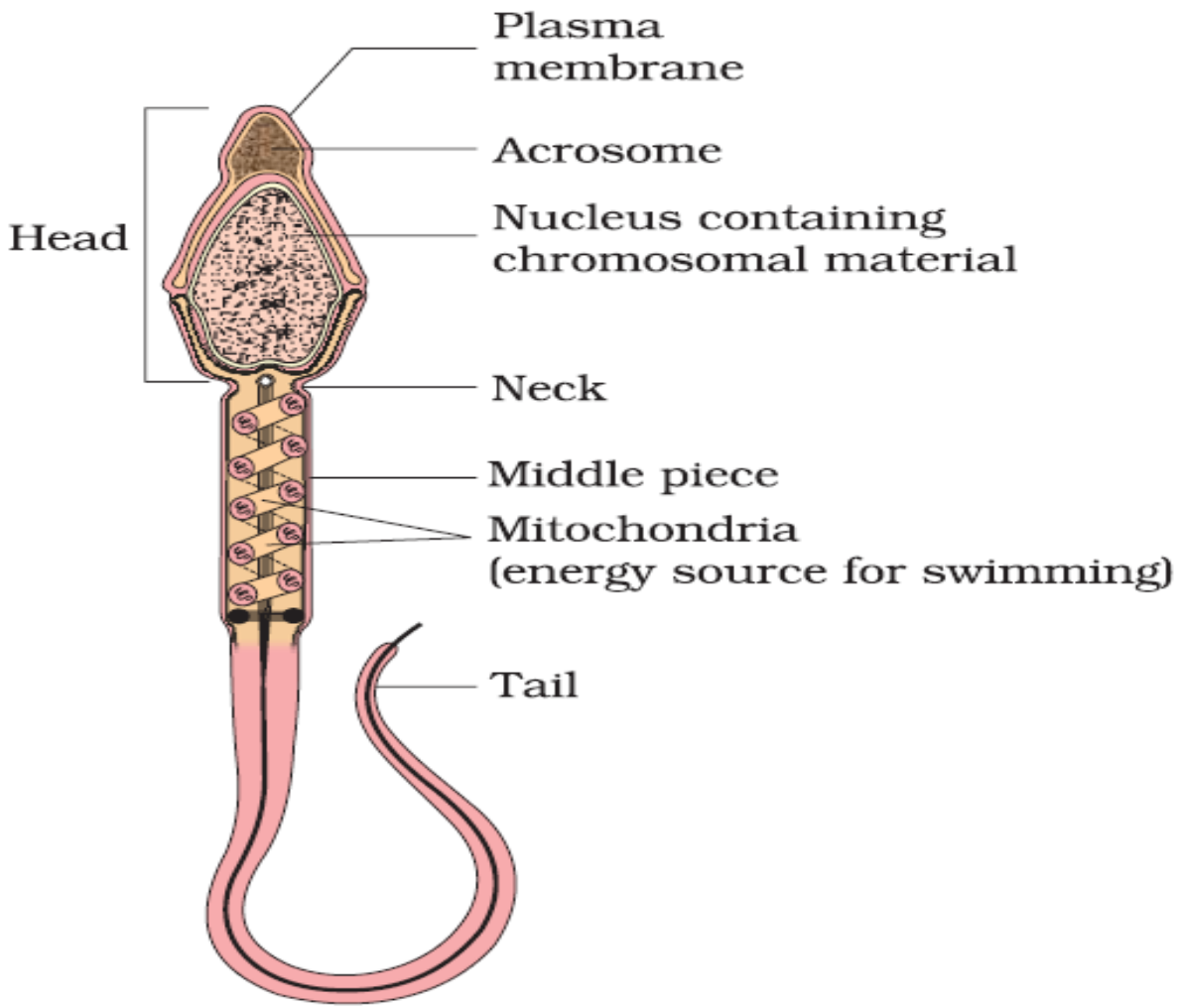
The middle piece possesses numerous mitochondria, which produce energy for the movement of sperm.

Tail

Tail facilitates sperm motility essential for fertilization.

B. John Ebenezer

Structure of Sperm



Spermatogenesis

The human male ejaculates about **200 to 300 million sperms** during a coitus.

At least 60 per cent sperms must have **normal shape and size** for normal fertility.

At least 40 per cent of sperms must show **vigorous motility**.

Sperms released from the seminiferous tubules are transported by the accessory ducts.

B. John Ebenezer

Spermatogenesis

Secretions of epididymis, vas deferens, seminal vesicle and prostate are essential for **maturation and motility** of sperms.

The seminal plasma along with the sperms form the **semen**.

The functions of male sex accessory ducts and glands are maintained by the testicular hormones (androgens).

Seminal plasma + Sperms = Semen

B. John Ebenezer

Oogenesis

Oogenesis

The process of formation of a mature female gamete is called **oogenesis**.

Oogenesis is initiated during the embryonic development stage when a couple of million gamete mother cells (**oogonia**) are formed within each fetal ovary.

No more oogonia are formed and added after birth.

These cells start division and enter into prophase-I of the meiotic division and get temporarily arrested at the stage, called **primary oocytes**.

Each primary oocyte then gets surrounded by a layer of granulosa cells and then called the **primary follicle.**

B. John Ebenezer

Oogenesis

A large number of these follicles degenerate during the phase from birth to puberty.

Therefore, at puberty only **60,000 - 80,000 primary follicles** are left in each ovary.

The **primary follicles** get surrounded by more layers of granulosa cells and a new theca and called **secondary follicles**.

The **secondary follicle** soon transforms into a tertiary follicle which is characterised by a fluid filled cavity called **antrum**.

B. John Ebenezer

Oogenesis

The theca layer is organised into an inner theca interna and an outer theca externa.

The **primary oocyte** within the tertiary follicle grows in size and completes its first meiotic division.

It is an unequal division resulting in the formation of a large haploid **secondary oocyte** and a tiny **first polar body**.

The secondary oocyte retains bulk of the nutrient rich cytoplasm of the primary oocyte.

B. John Ebenezer

Oogenesis

The **tertiary follicle** further changes into the mature follicle or **Graafian follicle**.

The secondary oocyte forms a new membrane called **zona pellucida** surrounding it.

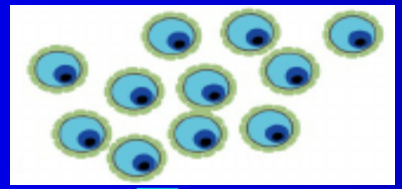
The Graafian follicle now ruptures to release the secondary oocyte (ovum) from the ovary by the process called **ovulation.**

B. John Ebenezer

Oogenesis

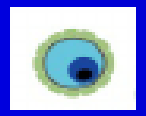
Oogonia

Oogonia enter into prophase-I of the meiotic division and get temporarily arrested at the stage, called **primary oocytes**.



Primary Oocyte

Primary oocyte gets surrounded by a layer of granulosa cells and become **Primary Follicle.**

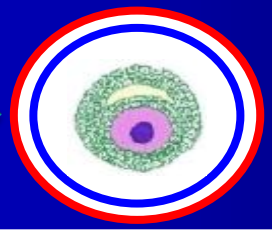


Primary Follicle

Primary follicles surrounded by more layers of **granulosa cells** and a new **theca** and called **secondary follicles**.

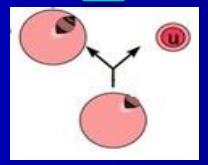
Secondary Follicle

Meiosis



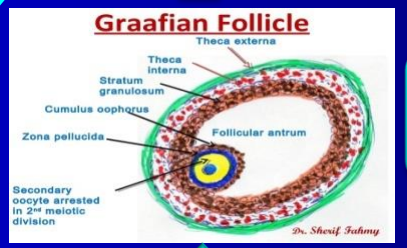
Tertiary Follicle

Secondary follicle transforms into **Tertiary follicle** consists of a fluid filled cavity called **antrum** and surrounded by **Theca Interna & Theca Externa.**



Secondary Oocyte

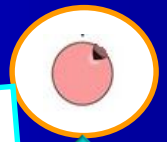
Primary Oocyte within Tertiary Follicle undergoes **Meiosis-I,** develops **Secondary Oocyte** & **Polar body**



Graffian Follicle

GF ruptures & release Secondary Oocyte, surrounded by Zonza Pellucida

Tertiary Follicle changes into mature **Graffian Follicle.**



Zona pellucida

Menstrual Cycle

Menstrual Cycle

The cycle of events starting from one menstruation till the next one is called the **menstrual cycle**.

The menstrual cycle occurs in the female primates e.g. monkeys, apes and human beings.

The first menstruation begins at puberty and is called **menarche**. In human females, menstruation is repeated at an interval of about 28/29 days.

The menstrual cycle ceases to operate at the age of 50 years. This phase is known as the **menopause**.

One ovum is released (ovulation) during the middle of each menstrual cycle.

B. John Ebenezer

Menstrual Phase

During this phase, the menstrual flow occurs due to breakdown of endometrial lining of the uterus and its blood vessels which forms liquid that comes out through vagina. It lasts for 3-5 days.

Menstruation occurs only if the released ouvm is not fertilised.

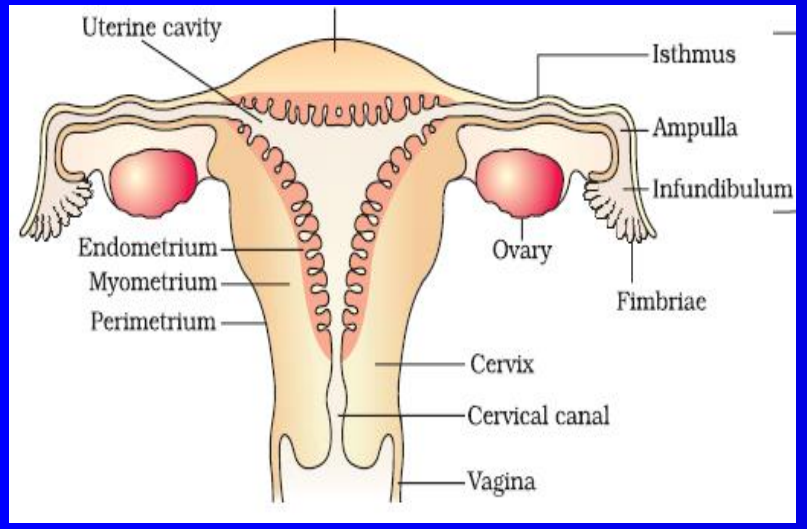
Lack of menstruation may be indicative of pregnancy.

However, it may also be caused due to stress, poor health etc

B. John Ebenezer

Menstrual Phase

Days 1 to 5



Absence of Fertilization

↓

Degeneration of Corpus Luteum

↓

Break down of Endometrium and its Blood Vessels

↓

Discharge of Blood and Mucus through Vagina

B. John Ebenezer

Follicular Phase

During this phase, the primary follicles in the ovary grow to become a fully matured Graafian follicle and simultaneously the endometrium of uterus regenerates through proliferation.

These changes in the ovary and the uterus are induced by changes in the levels of **pituitary** and **ovarian** hormones.

The secretion of gonadotropins (LH and FSH) increases gradually during the follicular phase, and stimulates **follicular development** as well as secretion of **estrogens** by the growing follicles.

B. John Ebenezer

Days 6 to 13
Follicular Phase

Hypothalamus

Release

GnRH

Stimulate

Anterior Pituitary

FSH ⟷ Gonadotropins ⟷ **LH**

Stimulates

Primary Follicle

Matures

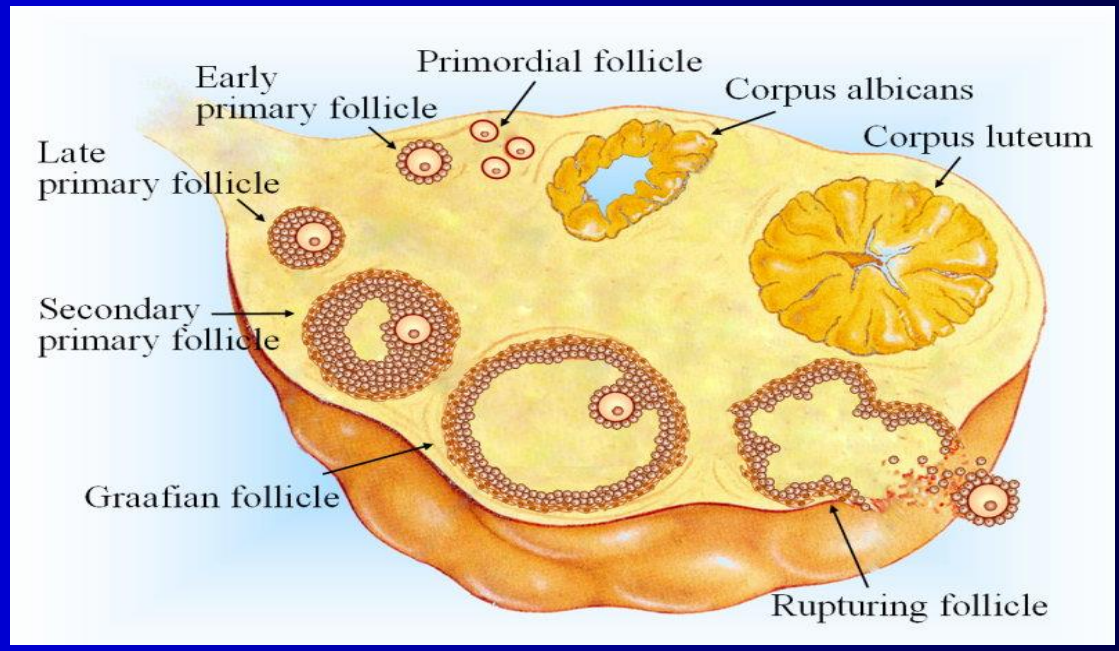
Graafian Follicle

Secretes

Oestrogen

Causes

Regeneration of Endometrium



Ovulatory Phase

Both LH and FSH attain a peak level in the middle of the cycle (about 14th day).

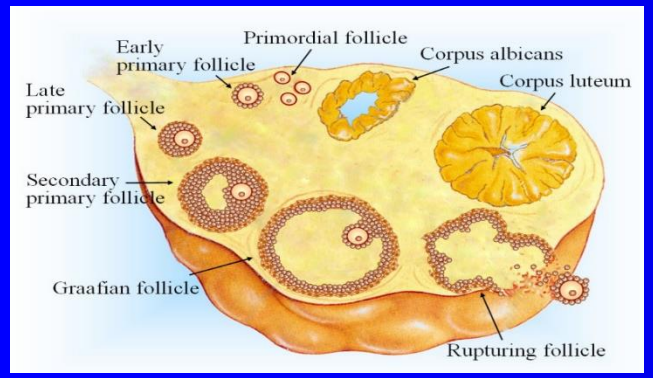
Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge that induces rupture of Graafian follicle and thereby the release of ovum (**ovulation**).

B. John Ebenezer

Ovulatory Phase

Day 14

LH & FSH are at the peak - LH Surge in the Mid Cycle (14th Day)



Higher Level of LH

Leads to

Rupture of Graafian Follicle

Leads to

Ovulation

B. John Ebenezer

Luteal Phase

During this phase the remaining parts of the Graafian follicle transform into **corpus luteum**.

The **corpus luteum** secretes large amounts of **progesterone** which is essential for the maintenance of endometrium.

Such an endometrium is necessary for implantation of the fertilized ovum and other events of pregnancy.

B. John Ebenezer

Luteal Phase

Days 15-28

After Ovulation

Graffian Follicle

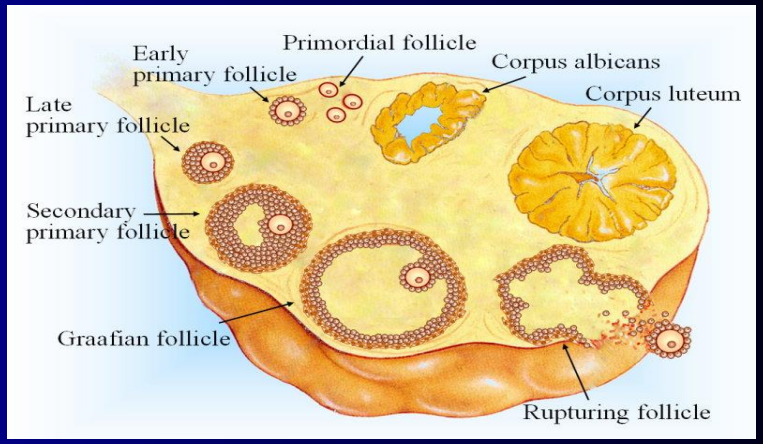
Transforms

Corpus Luteum

Secretes

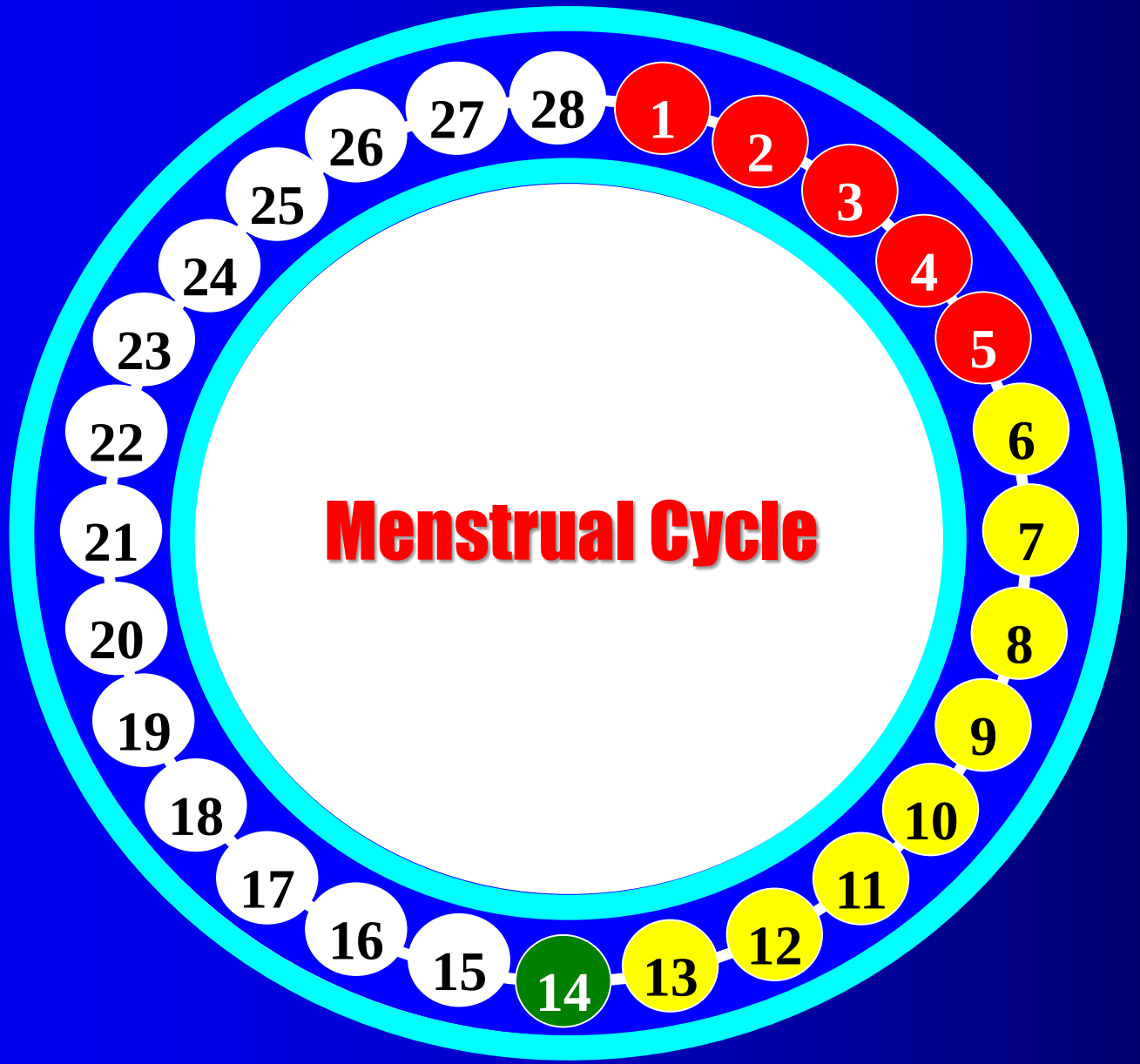
Progesterone

Maintains Endometrium



The endometrium is necessary for Implantation & Pregnancy

Phases of Menstrual Cycle



1-5 Menstrual Phase

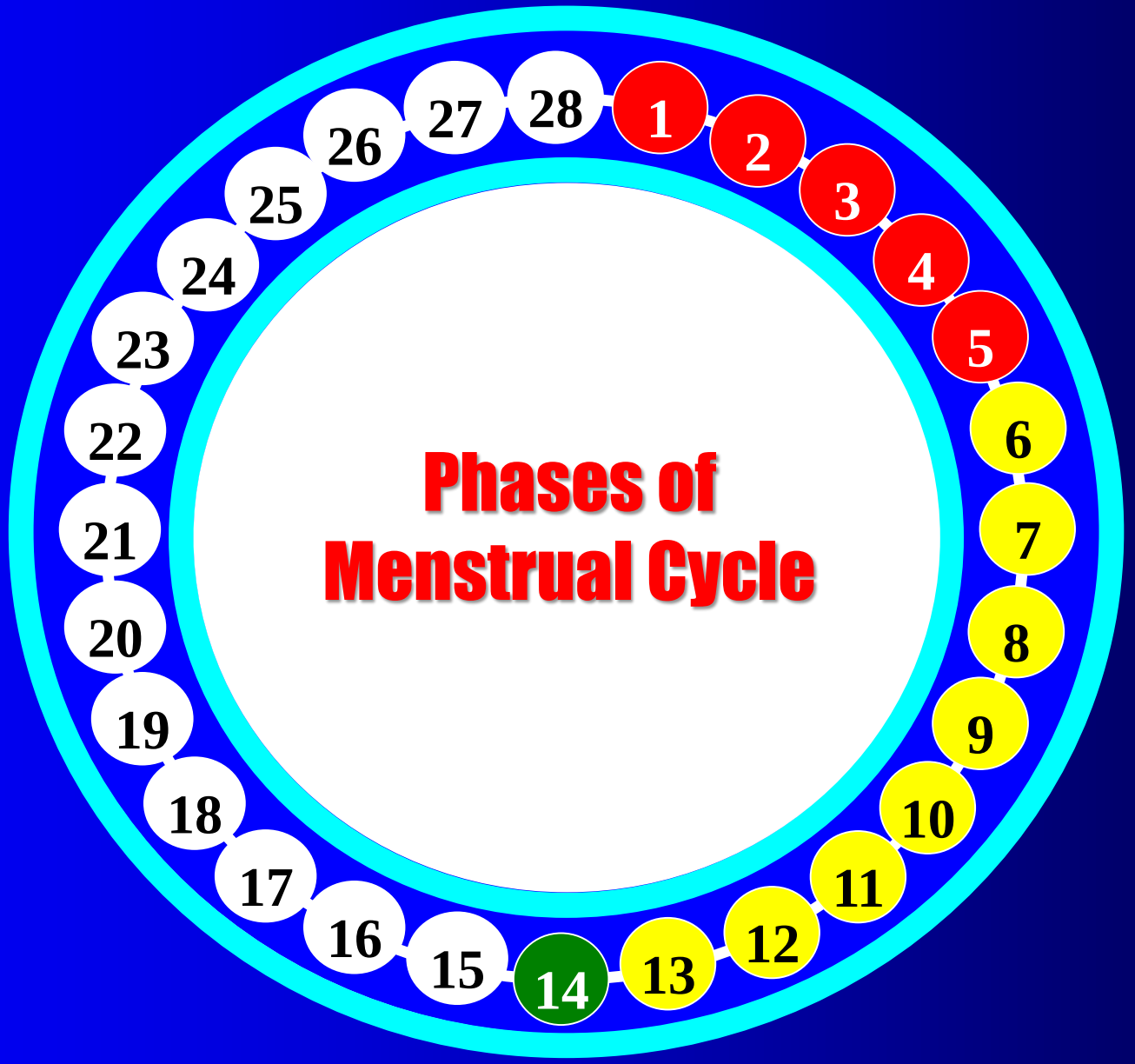
6-13 Follicular Phase

14 Ovulatory Phase

15-28 Luteal Phase

B. John Ebenezer

Phases of Menstrual Cycle



1-5 Menstrual Phase

Menstrual flow occurs due to breakdown of endometrial lining of the uterus and its blood vessels which forms liquid that comes out through vagina. It lasts for 3-5 days.

6-13 Follicular Phase

Primary follicles in the ovary grow to become a fully matured Graafian follicle.

Graafian Follicle releases Oestrogen, which causes the Regeneration of Endometrium.

14 Ovulatory Phase

Rapid secretion of LH leading to its maximum level called LH surge.

LH induces the rupture of Graafian follicle, leading to **ovulation**.

15-28 Luteal Phase

After Ovulation, Graafian follicle transforms into **corpus luteum,** which secretes **progesterone**, essential for the maintenance of endometrium, which is necessary for implantation.

Phases of Menstrual Cycle

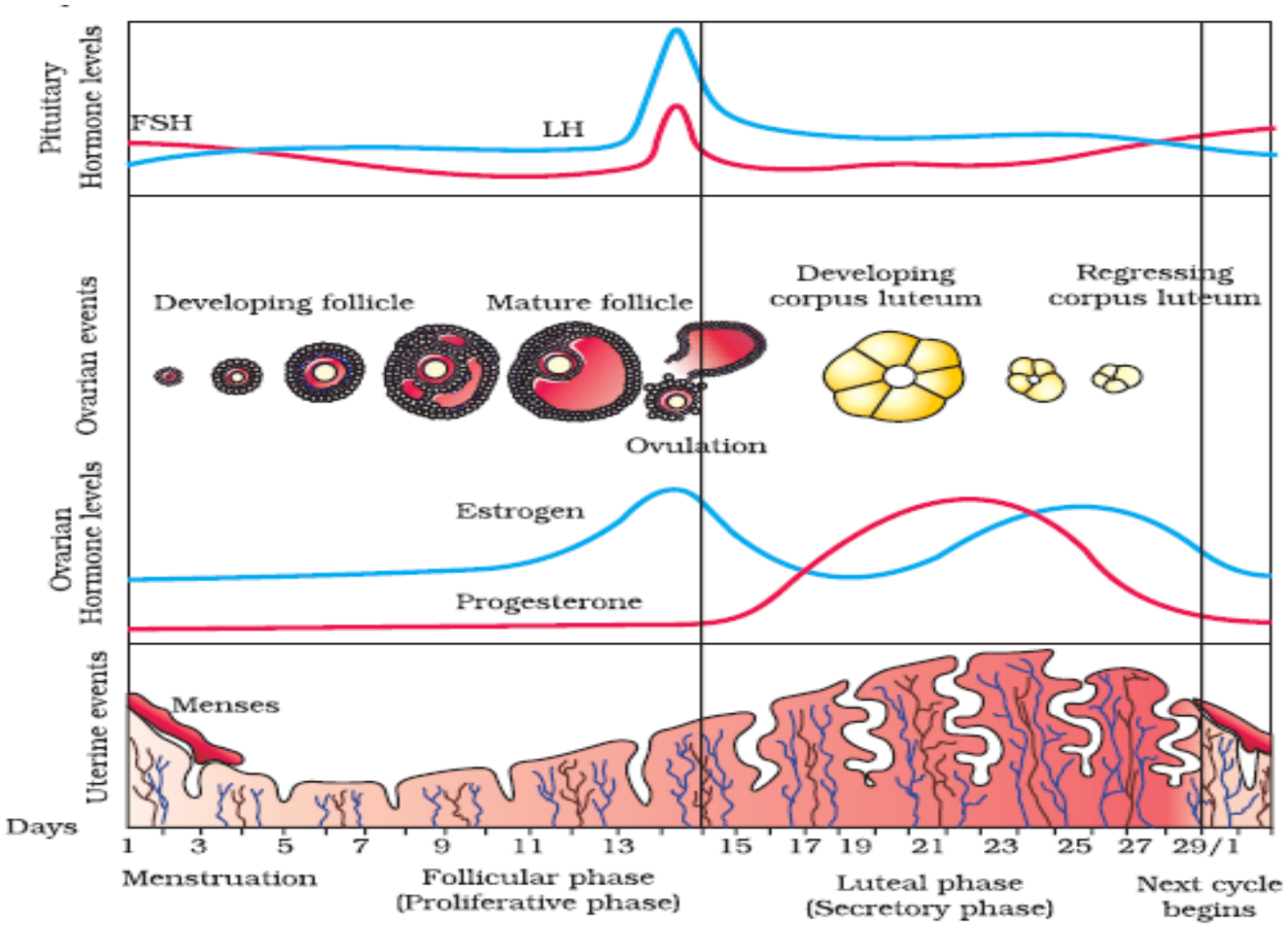
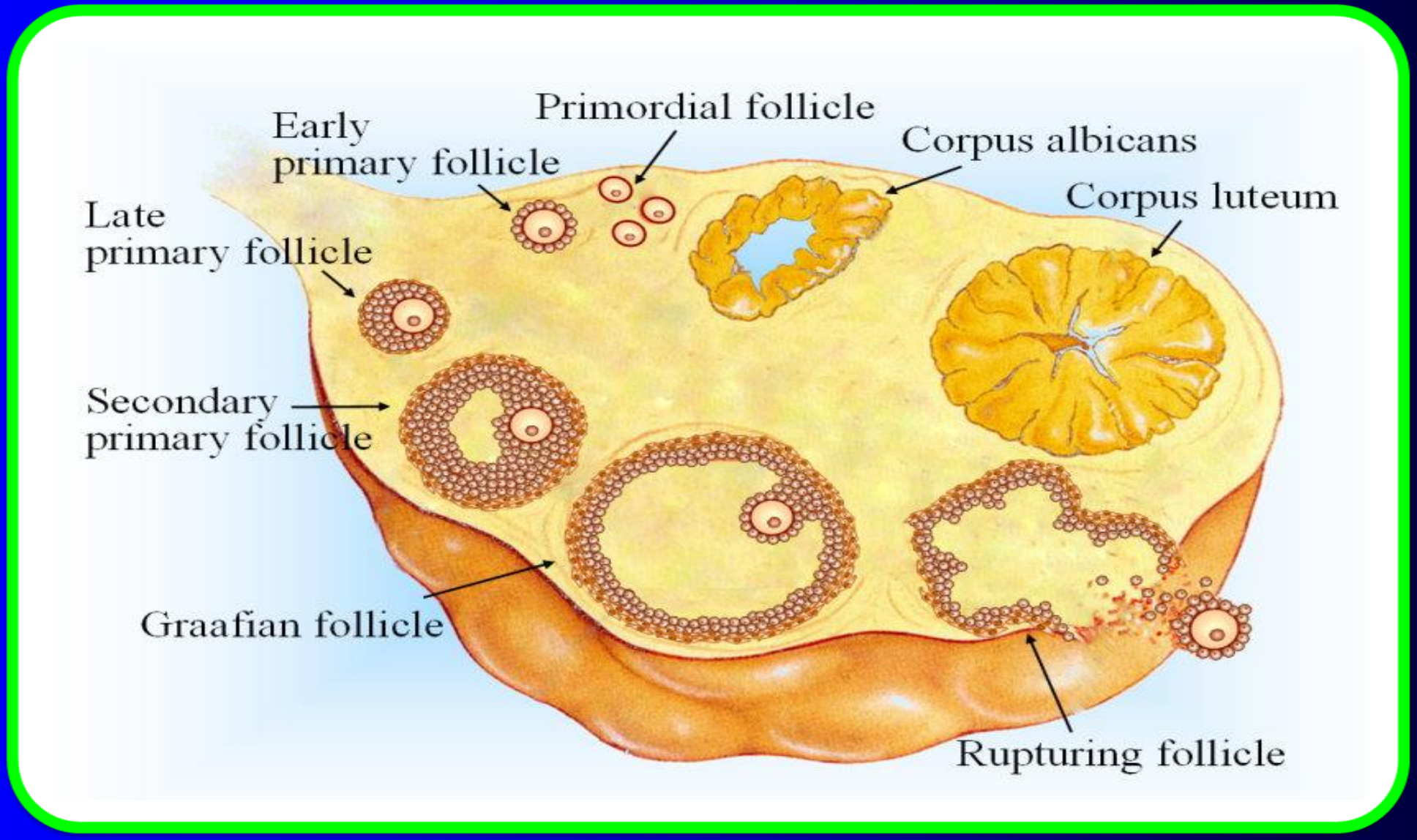


Figure 3.9 Diagrammatic presenation of various events during a menstrual cycle

B. John Ebenezer

Phases of Menstrual Cycle



Overall Hormonal Control of Menstrual Phase

Hypothalamus

Release

GnRH

Stimulate

Anterior Pituitary

FSH

Gonadotropins

LH

Stimulates

Primary Follicle

Becomes

Secondary Follicle

Becomes

Tertiary Follicle

Matures into

Graafian follicle

Secretes

Endometrium

Regeneration

Oestrogen

LH Surge causes Rupture of GF & leads to

Ovulation

Thickening of Endometrium

Causes

Progesterone

Secretes

Corpus Luteum

Transforms into

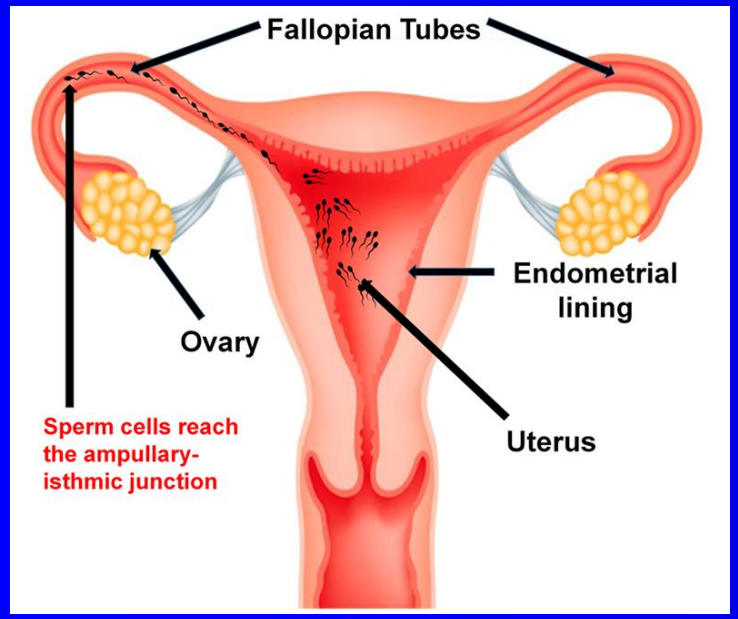
LH

Remnant of Graafian follicle

B. John Ebenezer

Fertilization

Fertilization



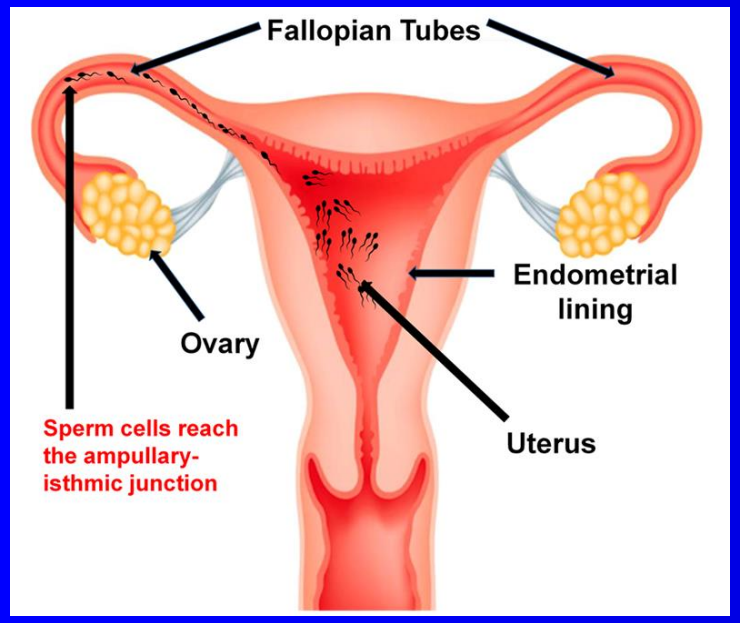
During copulation (coitus) semen is released by the penis into the vagina (insemination).

The motile sperms swim rapidly, pass through the cervix, enter into the uterus and finally reach the junction of the isthmus and ampulla (**ampullary-isthmic junction**) of the fallopian tube.

The ovum released by the ovary is also transported to the ampullary-isthmic junction where fertilisation takes place.

B. John Ebenezer

Fertilization

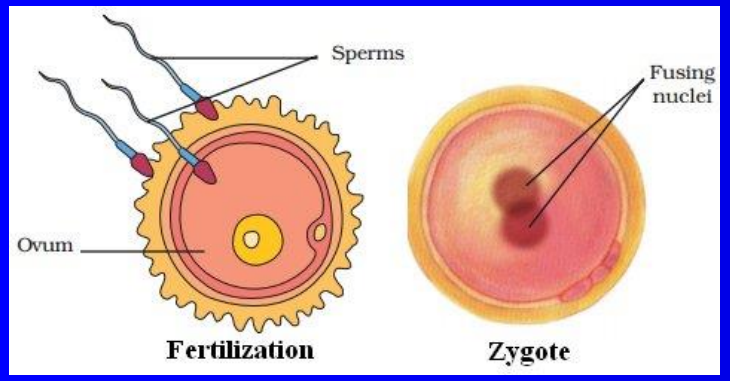


Fertilisation can only occur if the ovum and sperms are transported simultaneously to the **ampullary-isthmic junction**.

This is the reason why not all copulations lead to fertilisation and pregnancy.

B. John Ebenezer

Fertilization



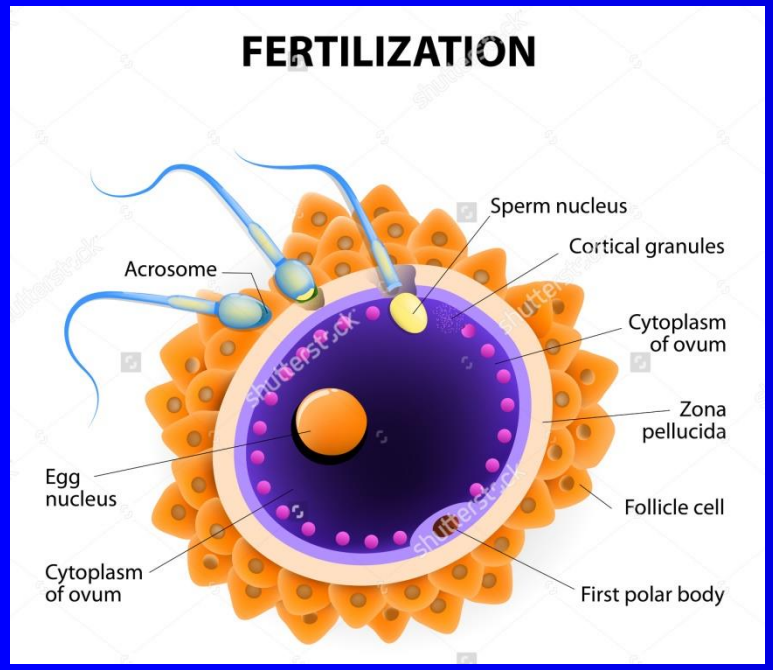
The process of fusion of a sperm with an ovum is called **fertilisation**.

During fertilisation, a sperm comes in contact with the *zona pellucida* layer of the ovum and induces changes in the membrane that block the entry of additional sperms.

Thus, it ensures that only one sperm can fertilise an ovum.

B. John Ebenezer

Fertilization

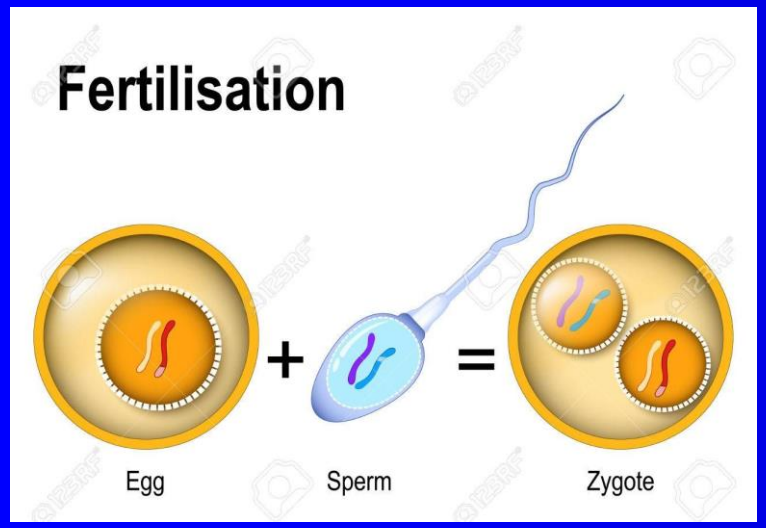


The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane.

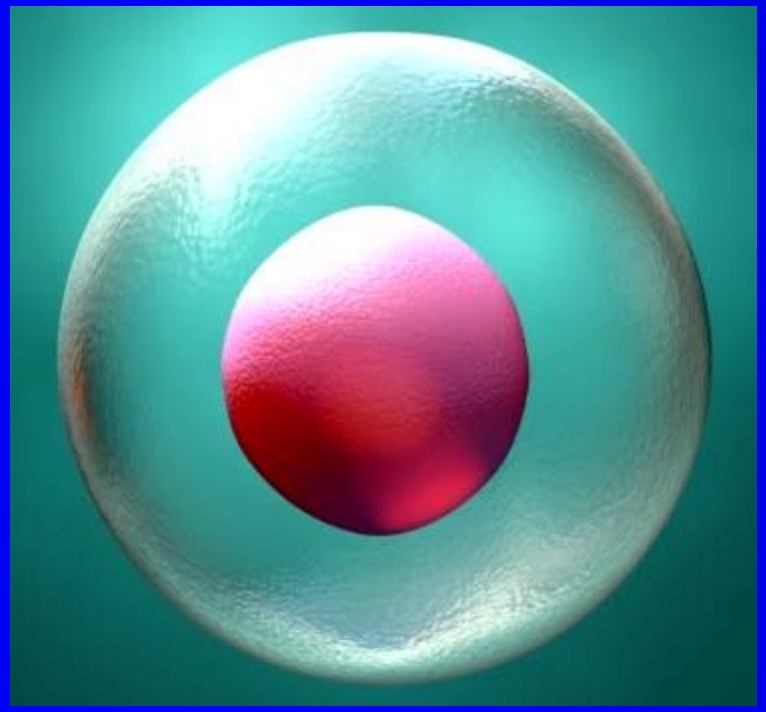
This induces the completion of the meiotic division of the secondary oocyte.

The second meiotic division is also unequal and results in the formation of a **second polar body** and **a haploid ovum** (ootid).

B. John Ebenezer



Fertilization

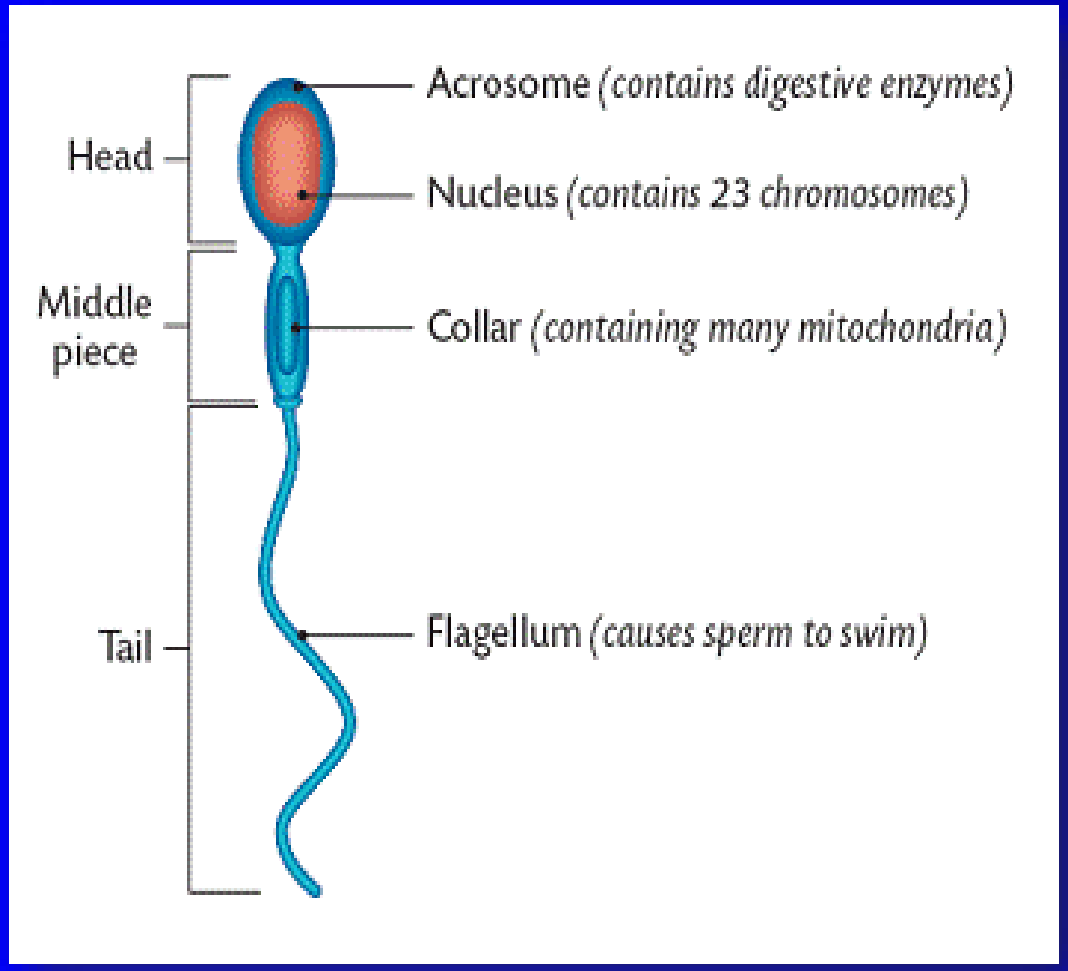


Soon the haploid nucleus of the sperms and that of the ovum fuse together to form a diploid **zygote**.

The sex of the baby has been decided at this stage itself.

B. John Ebenezer

Ovum surrounded by sperms



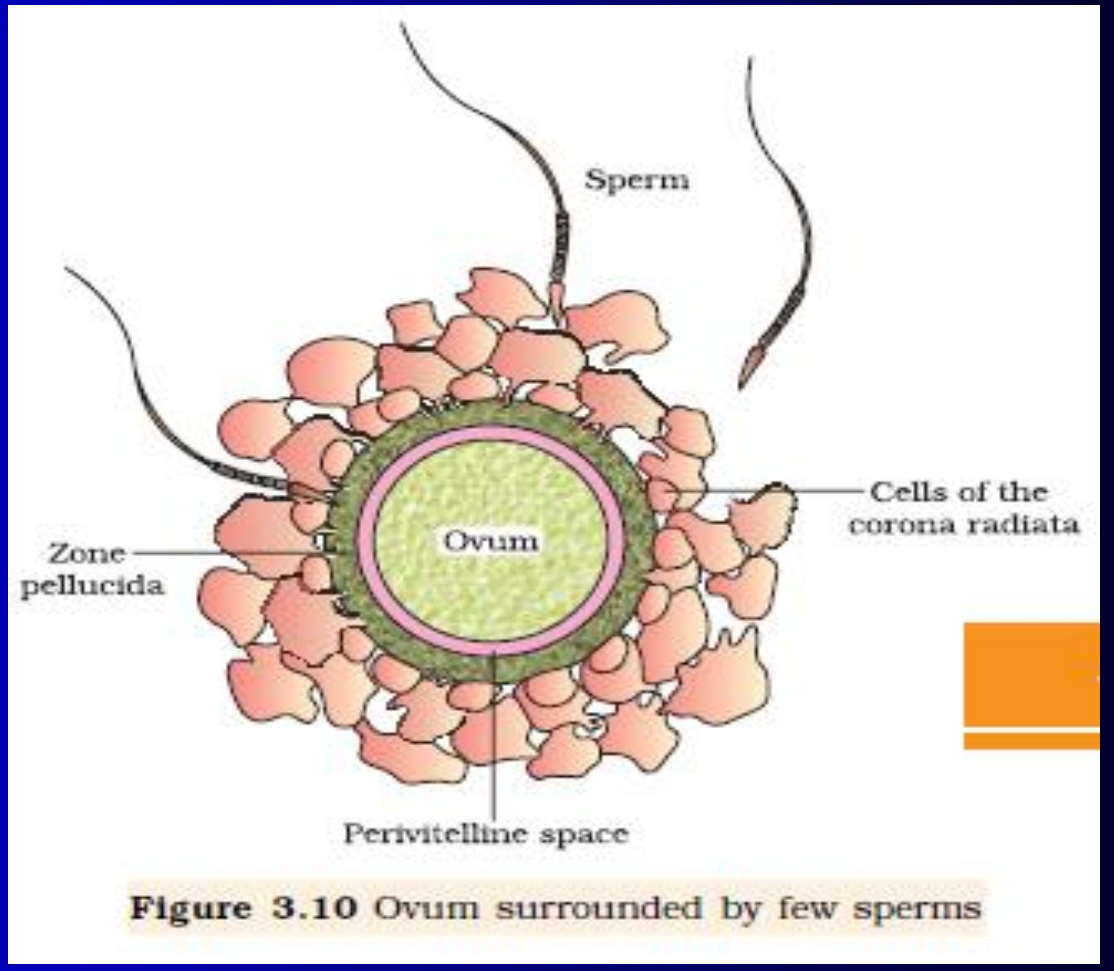


Figure 3.10 Ovum surrounded by few sperms

B. John Ebenezer

Sex Determination

Sex determination

The chromosome pattern in the human female is XX and that in the male is XY.

Therefore, all the haploid gametes produced by the female (ova) have the sex chromosome X.

In male gametes (sperms) the sex chromosome could be either X or Y, hence, 50 per cent of sperms carry the X chromosome while the other 50 per cent carry the Y.

B. John Ebenezer

22 + X

22 + Y

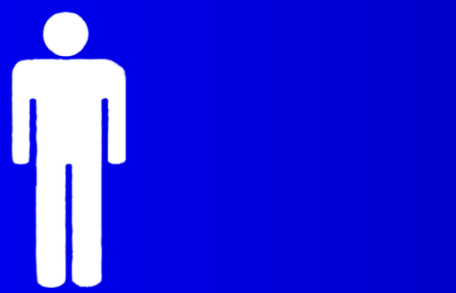
After fusion of the male and female gametes the zygote would carry either XX or XY depending on whether the sperm carrying X or Y fertilised the ovum.

The zygote carrying XX would develop into a female baby and XY would form a male.

That is why, scientifically it is correct to say that the sex of the baby is determined by the father and not by the mother!

B. John Ebenezer

Sex Determination in Human beings

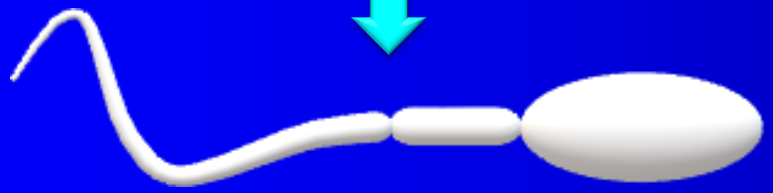


44 + XY

44 + XX

Meiosis

Chromosome number is reduced to a half during gametogenesis by meiosis and maintained during fertilization



22 + X 22 + Y

22 + X

22 + X
22 + X

44 + X X
Female

22 + X
22 + Y

44 + X Y
Male

50% Possibility for having Male and Female Babies

Male \ Female	X	X
X	XX	XX
Y	XY	XY

Men produce two kinds of sperms.

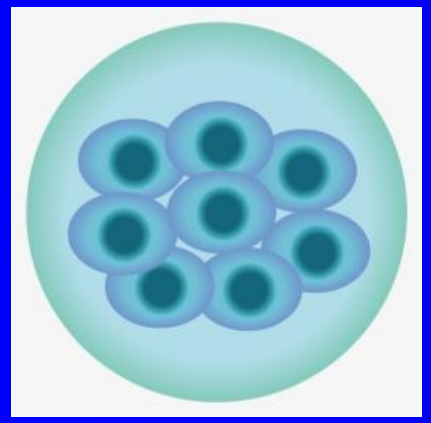
50% of the sperms contain X chromosomes and the other 50% of the sperms contain Y chromosomes.

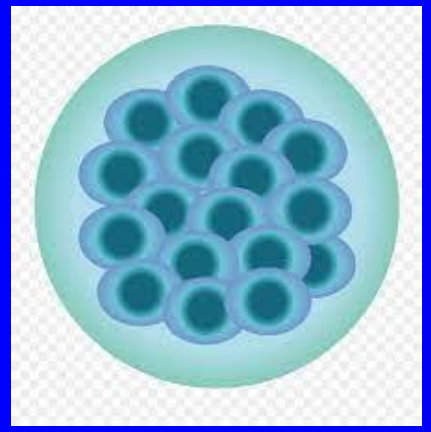
Hence there is 50% possibility for having male babies and 50% possibility for having female babies.

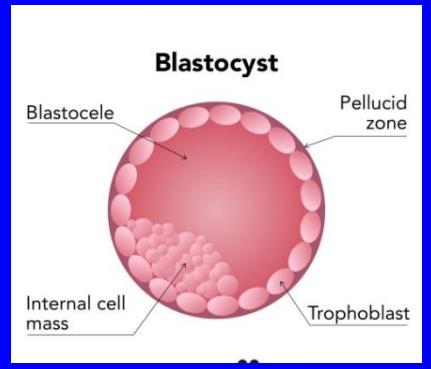
B. John Ebenezer

Implantation

Implantation







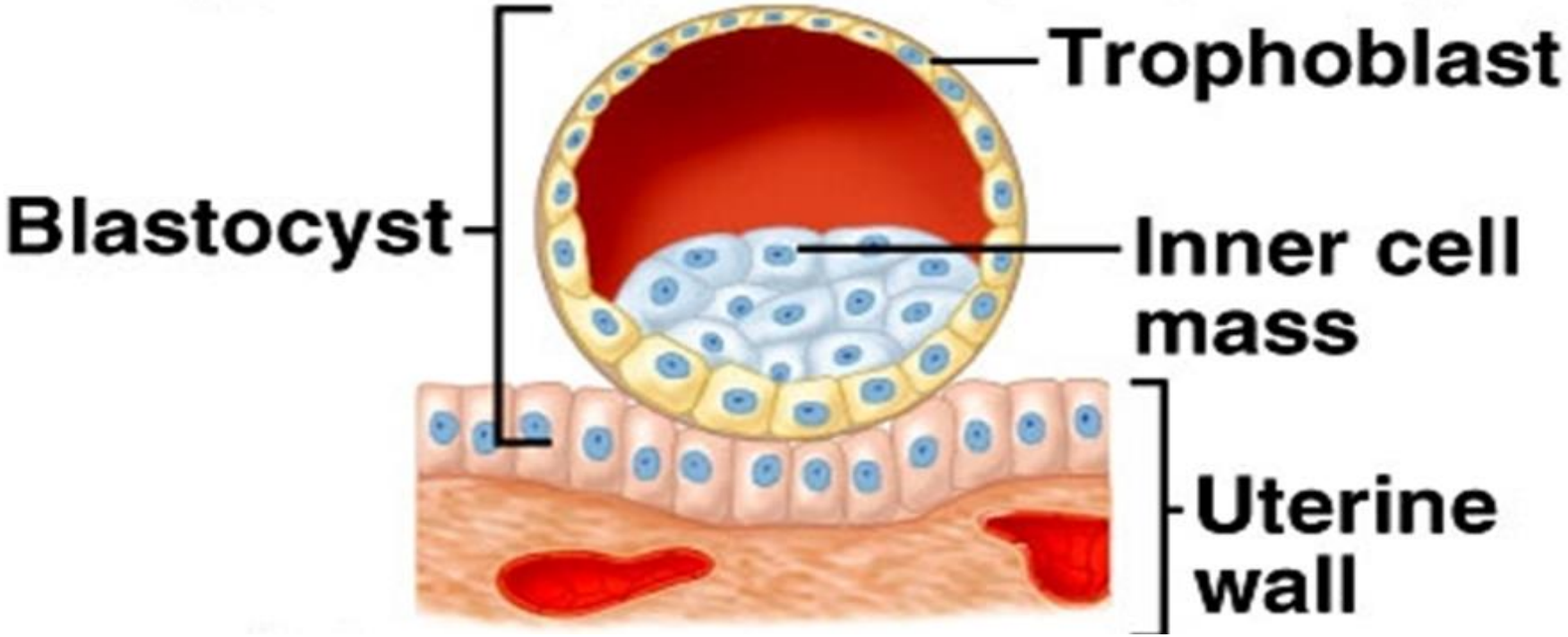
The mitotic division starts as the zygote moves through the isthmus of the oviduct called **cleavage** towards the uterus and forms 2, 4, 8, 16 daughter cells called **blastomeres**.

The embryo with **8 to 16 blastomeres** is called a **morula.** The morula continues to divide and transforms into blastocyst as it moves further into the uterus.

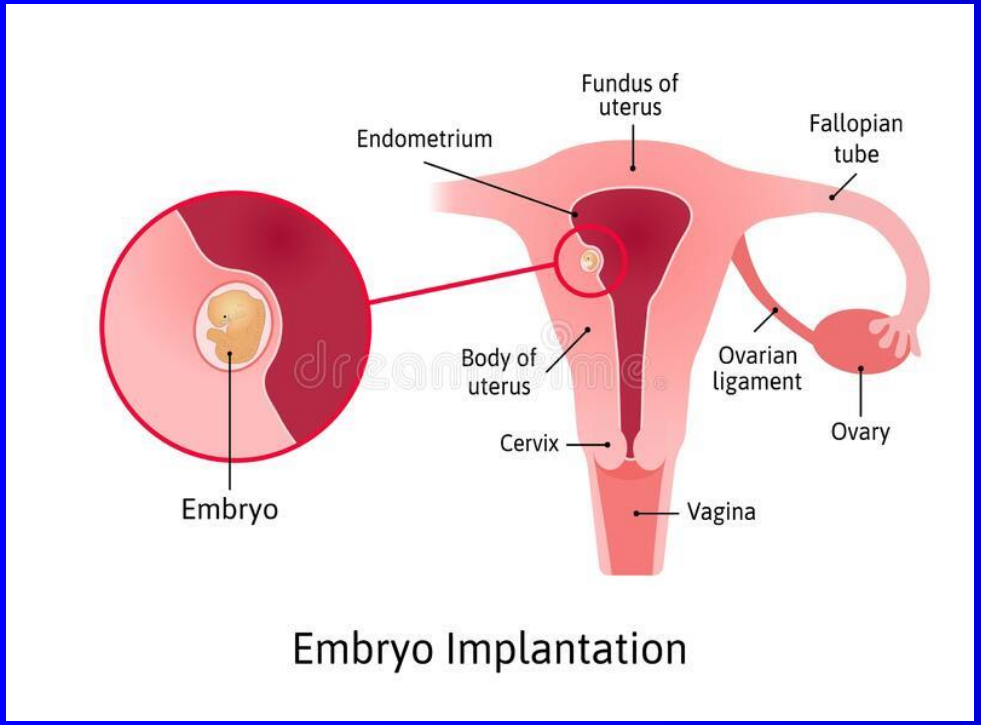
The blastomeres in the blastocyst are arranged into an outer layer called **trophoblast** and an inner group of cells attached to trophoblast called the **inner cell mass**.

B. John Ebenezer

Implantation



B. John Ebenezer



The trophoblast layer then gets attached to the endometrium and the inner cell mass gets differentiated as the embryo.

After attachment, the uterine cells divide rapidly and covers the blastocyst.

As a result, the blastocyst becomes embedded in the endometrium of the uterus.

This is called **implantation** and it leads to pregnancy.

B. John Ebenezer

The cells in the blastocyst are arranged into:-

an outer **trophoblast**

an **inner cell mass**.

The trophoblast gets attached to the uterine endometrium

This process is called **implantation**. This leads to pregnancy.

The inner cell mass gets differentiated to form the embryo.

B. John Ebenezer

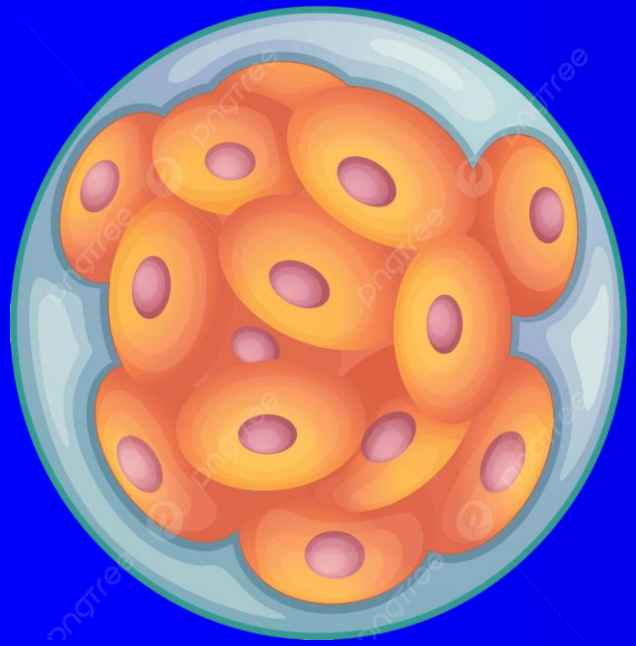
Embryogenesis

- The zygote undergoes a series of mitotic cell divisions called ***cleavage***.

- The stages of development are:

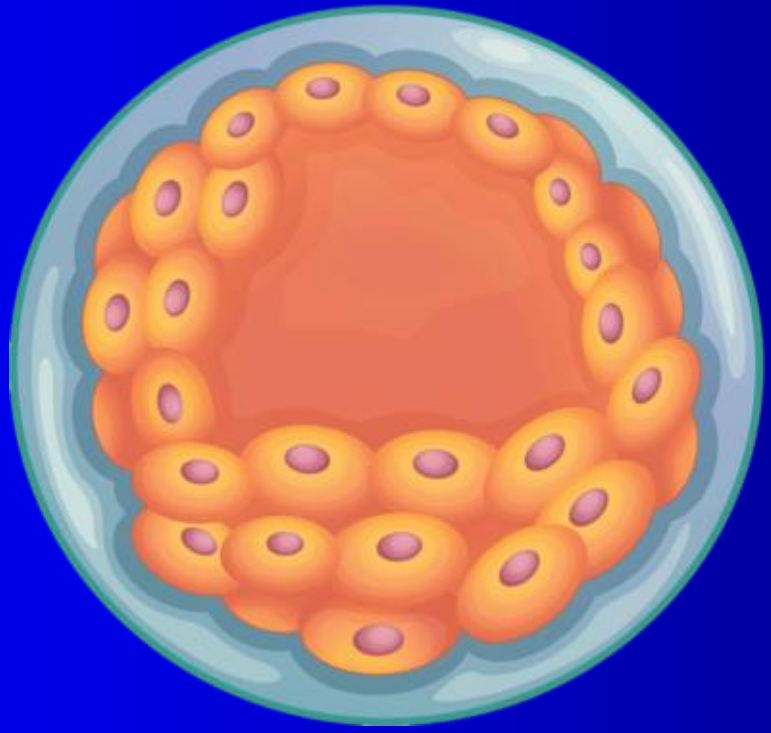
Fertilized ovum (zygote)
→2-cell stage
→4-cell stage
→8-cell stage
→Morula
→Blastula
→ Gastrula

Morula



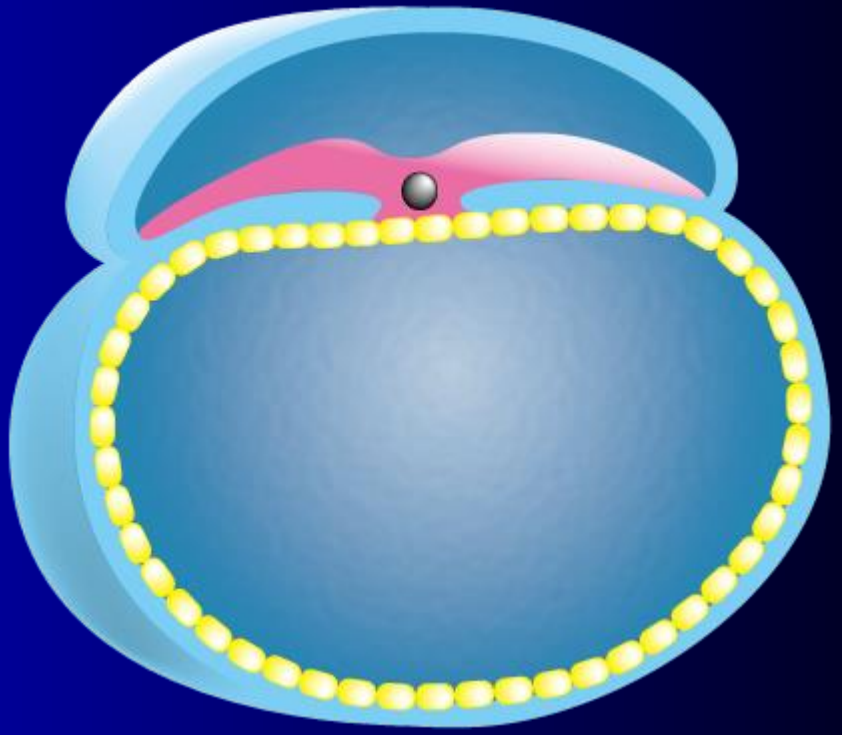
16–32 cells

Blastula



100–200 cells

Gastrula

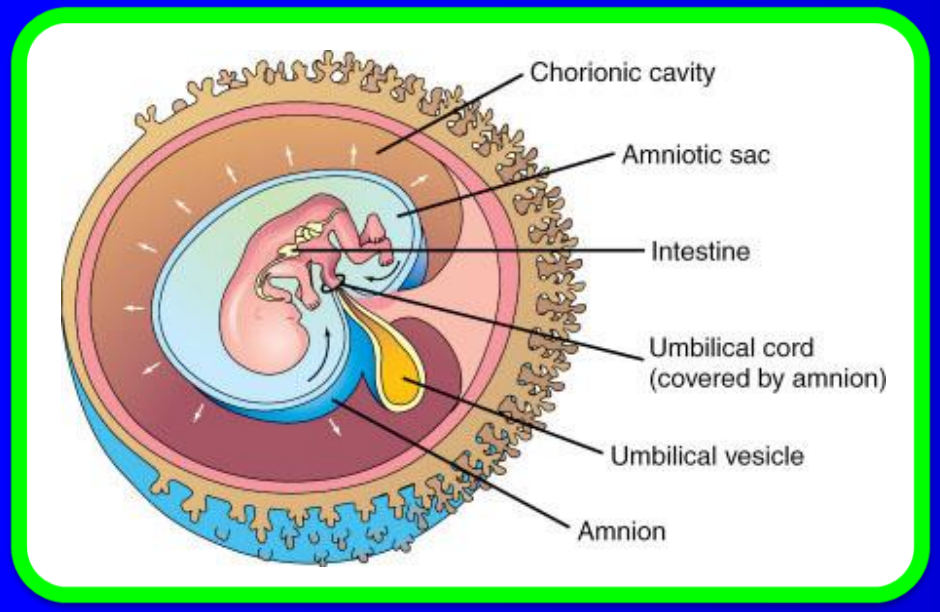


High Number

rearrangement and differentiation
of cells into three primary germ layers

Pregnancy
and
Embryonic Development

Pregnancy and Embryonic Development



After implantation, finger-like projections appear on the trophoblast called **chorionic villi** which are surrounded by the uterine tissue and maternal blood.

The **chorionic villi and uterine tissue** become join with each other and form a structural and functional unit between developing embryo (foetus) and maternal body called **placenta.**

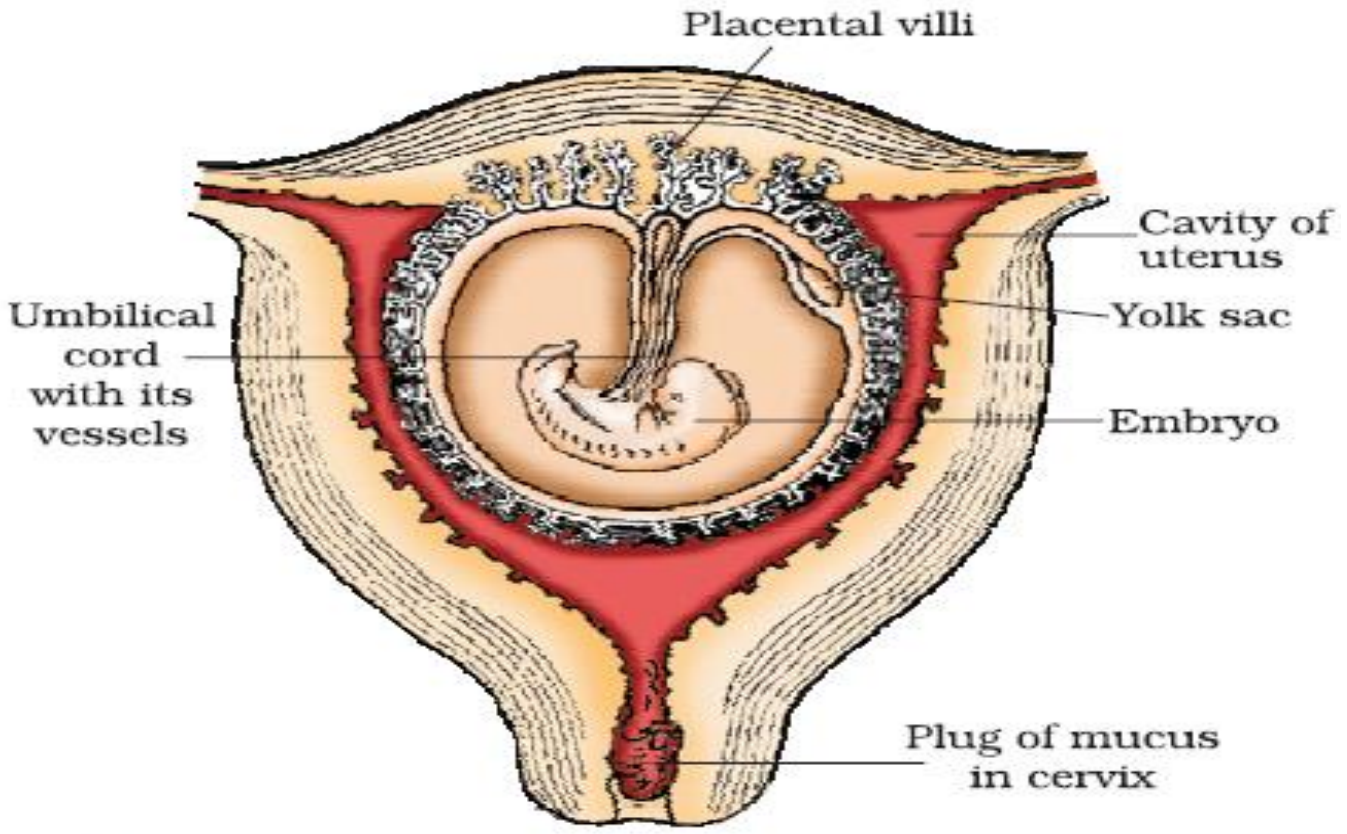


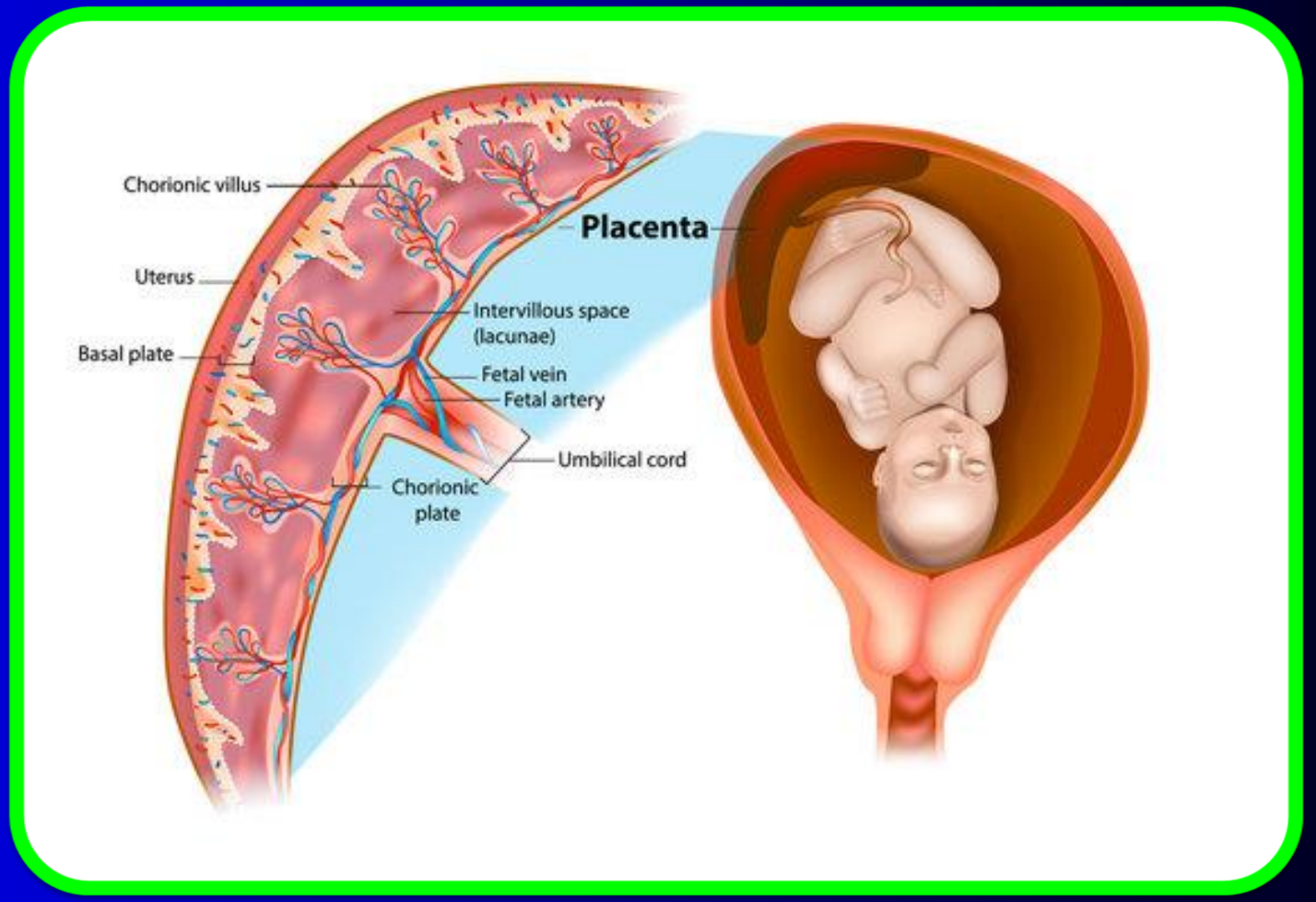
Figure 3.12 The human foetus within the uterus

Pregnancy and Embryonic Development

The placenta facilitate the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory/waste materials produced by the embryo.

The placenta is connected to the embryo through an umbilical cord which helps in the transport of substances to and from the embryo.

Pregnancy and Embryonic Development



Placenta also acts as an endocrine tissue and produces several hormones like

human chorionic gonadotropin (hCG),

human placental lactogen (hPL),

estrogens, progestogens, etc.

In the later phase of pregnancy, a hormone called **relaxin** is also secreted by the ovary.

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Hormones of Placenta

Placenta also acts as an endocrine tissue and produces several hormones.

The hormones produced by placenta are;

a. Human chorionic gonadotropins (hCG),
b. Human placental lactogen (hPL),
c. Oestrogen,
d. Progesterone
e. Relaxin (later stages of pregnancy).

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Human chorionic gonadotropin is a hormone produced primarily by the placenta during pregnancy. The hormone stimulates the corpus luteum to produce progesterone to maintain the pregnancy.

Human placental lactogen (hPL). This hormone is also known as human chorionic somatomammotropin. It is made by the placenta. It gives nutrition to the fetus. It also stimulates milk glands in the breasts for breastfeeding.

Estrogen. This group of hormones helps develop the female sexual traits. It is normally formed in the ovaries. It is also made by the placenta during pregnancy to help maintain a healthy pregnancy.

Progesterone. This hormone is made by the ovaries and by the placenta during pregnancy. It stimulates the thickening of the uterine lining for implantation of a fertilized egg.

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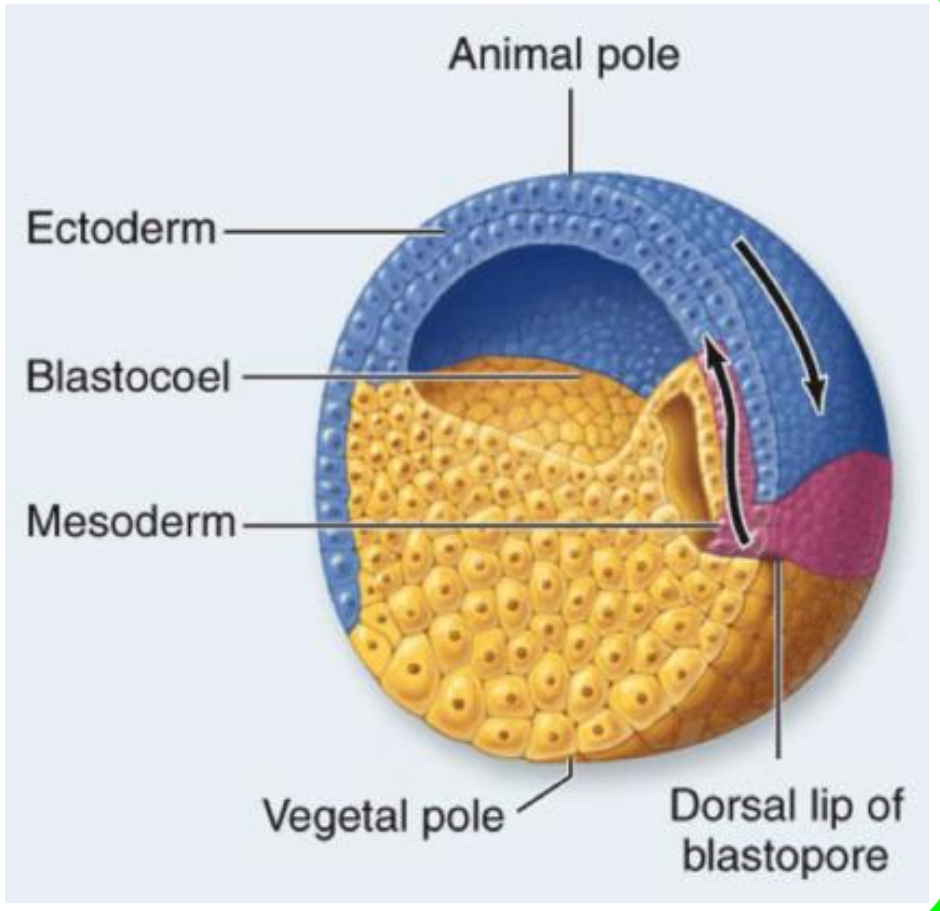

During pregnancy the levels of other hormones like estrogens, progestogens, cortisol, prolactin, thyroxine, etc., are increased several folds in the maternal blood.

Increased production of these hormones is essential for supporting the **fetal growth, metabolic changes in the mother and maintenance of pregnancy.**

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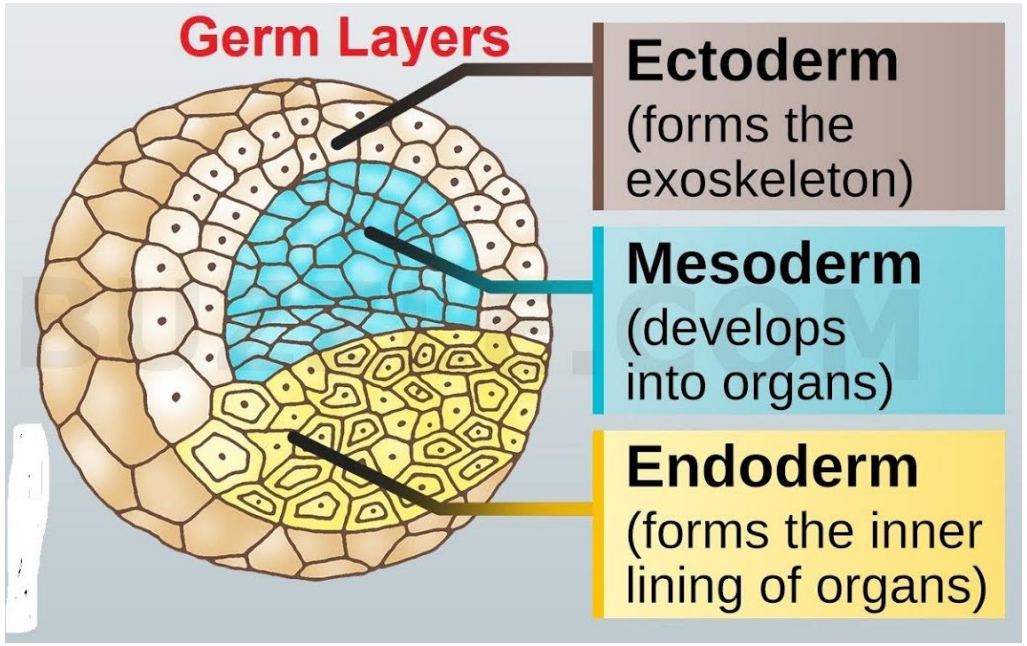

Immediately after implantation, the inner cell mass (embryo) differentiates into

outer layer called **ectoderm** and an inner layer called **endoderm**.

A **mesoderm** soon appears between the ectoderm and the endoderm.

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Functions of the Placenta

Supply of oxygen and removal of Carbon dioxide.

Transport nutrients to the embryo.

Excretion of wastes produced by embryo.

Hormone production.

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Development of Foetus

Development of foetus during pregnancy

The three layers give rise to all tissues (organs) in adults.

The inner cell mass contains **stem** cells which have the potency to give rise to all the tissues and organs.

The human pregnancy lasts for 9 months.

In human beings, after one month of pregnancy, the embryo's heart is formed.

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Development of foetus during pregnancy

The first sign of growing foetus may be noticed by listening to the **heart sound** carefully through the stethoscope.

By the end of the second month of pregnancy, the foetus develops **limbs and digits**.

By the end of 12 weeks (first trimester), most of the major organ systems are formed, for example, the **limbs and external genital organs** are well-developed.

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Development of foetus during pregnancy

The first **movements of the foetus** and **appearance of hair on the head** are usually observed during the fifth month.

By the end of 24 weeks (second trimester), the body is covered with **fine hair, eye-lids separate, and eyelashes are formed**.

By the end of nine months of pregnancy, the foetus is fully developed and is ready for delivery.

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12 weeks (First Trimester)

24 weeks (Second Trimester)

B. John Ebenezer

Parturition

Parturition

The average duration of human pregnancy is about 9 months which is called the gestation period.

Vigorous contraction of the uterus at the end of pregnancy causes expulsion or delivery of the foetus.

This process of delivery of the foetus (childbirth) is called **parturition**. Parturition is induced by a complex neuroendocrine mechanism.

The signals for parturition originate from the fully developed fetus and the placenta which induce mild uterine contractions called **foetal ejection reflex.**

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This triggers release of oxytocin from the maternal pituitary.

Oxytocin acts on the uterine muscle and causes stronger uterine contractions, which in turn stimulates further secretion of oxytocin.

The stimulatory reflex between the uterine contraction and oxytocin secretion continues resulting in stronger and stronger contractions.

This leads to expulsion of the baby out of the uterus through the birth canal – parturition. Soon after the infant is delivered, the placenta is also expelled out of the uterus.

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Mild uterine contractions induced by fully developed fetus and the placenta **foetal ejection reflex**

Foetal Ejection Reflex

Stimulate ↓

Pituitary

Release ↓

Oxytocin

Acts on ↓

Uterine Muscle

Leads to ↓

Stronger Uterine Contraction

→

Parturition

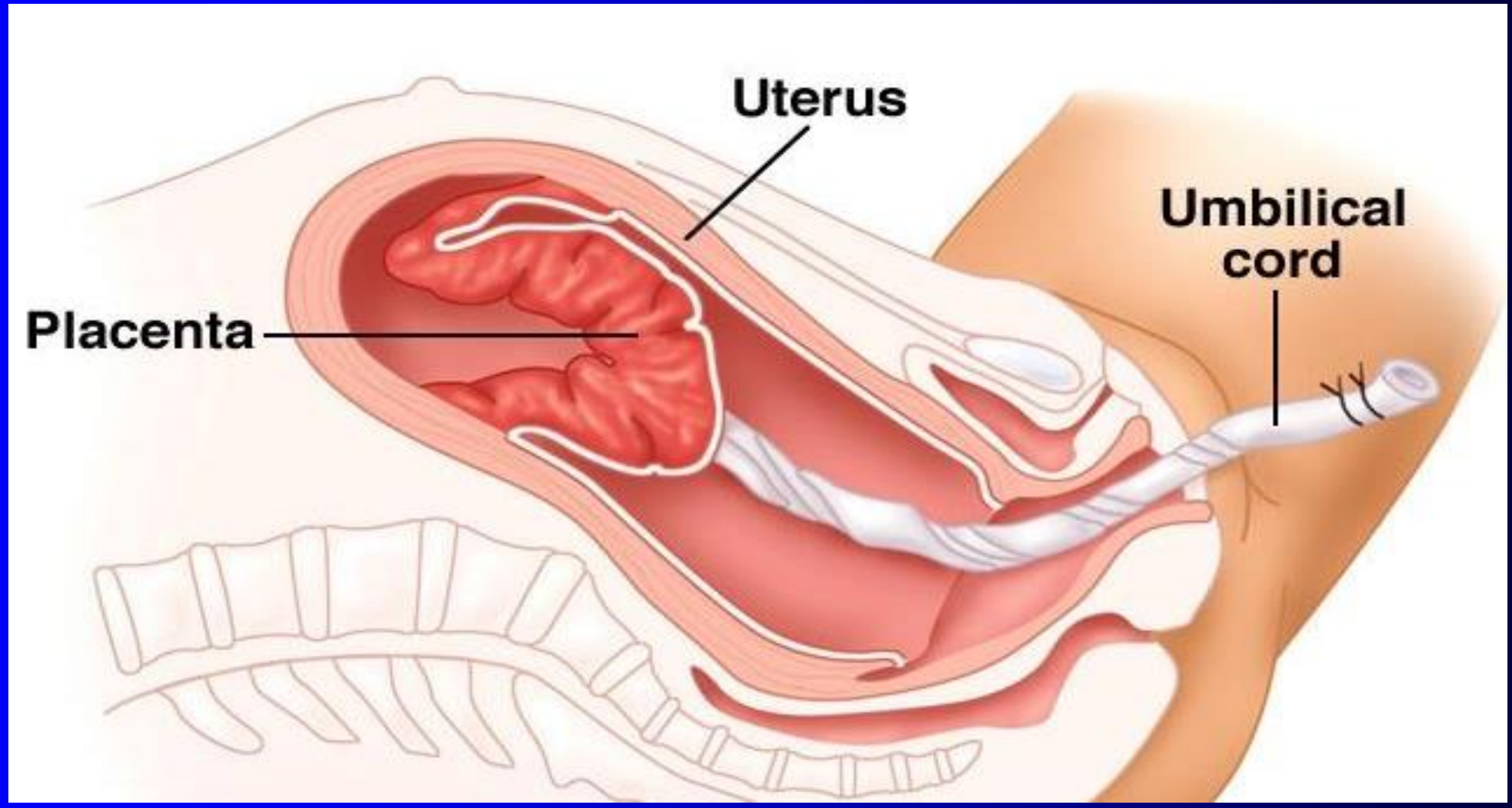
Stimulatory Reflex + Oxytocin Secretion

↑

Much Stronger Contraction

↑

Expulsion of Baby


Uterus
Umbilical cord
Placenta

Lactation

Lactation

The mammary glands of the female undergo differentiation during pregnancy and starts producing milk towards the end of pregnancy by the process called **lactation**. This helps the mother in feeding the newborn.

The milk produced during the initial few days of lactation is called **colostrum** which contains several antibodies absolutely essential to develop resistance for the new-born babies.

Breast-feeding during the initial period of infant growth is recommended by doctors for bringing up a healthy baby.

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Lactation

B. John Ebenezer


God Bless You!