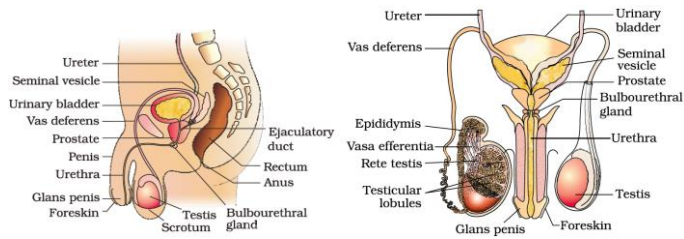


3. HUMAN REPRODUCTION

HUMAN REPRODUCTIVE SYSTEM

1. Male Reproductive System



a. Paired testes

- **Primary sex organs** that produce **sperms & testosterone**.
- Testes are formed within the abdomen. Soon after the birth or at the 8th month of pregnancy they descent into the **scrotal sac (scrotum)**. The low temperature (2-2.5^o C less than the body temperature) of scrotum helps for proper functioning of testes and for **spermatogenesis**.
- Each lobule contains **seminiferous tubules**.
- Seminiferous tubule is lined internally with
 - **Male germ cells (spermatogonia):** They become sperms.
 - **Sertoli cells:** They give nutrition to the germs cells.
- The regions outside the seminiferous tubules contain **interstitial cells (Leydig cells)**. They secrete **androgens**.

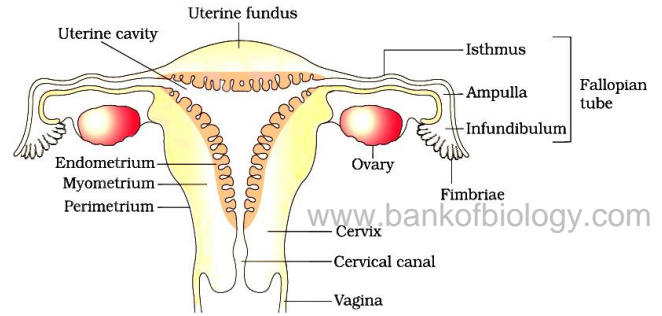
b. Duct system

- Include **rete testis, vasa efferentia, epididymis & vas deferens**. They conduct sperms from testis as follows:
- Seminiferous tubules → **rete testis** (irregular cavities) → **vasa efferentia** → **epididymis** (stores sperms temporarily) → **vas deferens** → join with duct of **seminal vesicle** to form **ejaculatory duct** → **urethra** → **urethral meatus**.

2. Female Reproductive System

Paired ovaries

- Primary sex organs which produce **ova (female gamete) & steroid ovarian hormones (estrogen & progesterone)**.



Accessory ducts (Duct system)

Include 2 **oviducts (Fallopian tubes)**, a **uterus & vagina**.

- **Oviducts:** Each oviduct (10-12 cm long) has 3 parts:
 - **Infundibulum:** Funnel-shaped opening provided with many finger-like **fimbriae**. It helps to collect the ovum.
 - **Ampulla:** Wider part.
 - **Isthmus:** Narrow part. It joins the uterus.

The **ciliated epithelium** lined the lumen of the oviduct drives the ovum towards the uterus.

- **Uterus (womb):** It is inverted pear shaped. It is supported by ligaments attached to the pelvic wall.

Uterus has 3 parts: Upper **fundus**, middle **body** and terminal **cervix**.

The uterine wall has 3 layers:

- **Perimetrium:** External thin membrane.
- **Myometrium:** Middle thick layer of smooth muscle.
- **Endometrium:** Inner glandular and vascular layer.
- **Hymen (Maiden head):** A membrane which partially cover the vaginal opening. It is often torn during the first coitus. It may also be broken by a sudden fall or jolt, insertion of a vaginal tampon; active participation in some sports items etc. In some women, hymen persists after coitus. So the hymen is not a reliable indicator of virginity or sexual experience.

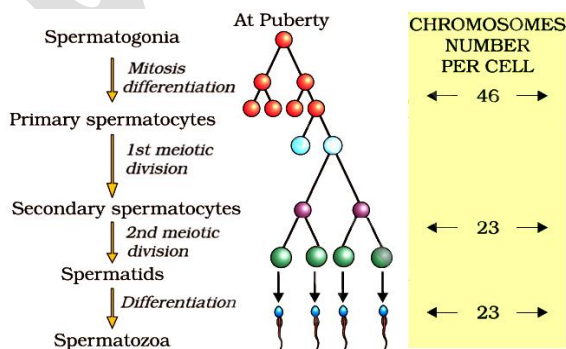
GAMETOGENESIS (Formation of Gametes)

- It is 2 types: **Spermatogenesis** and **Oogenesis**.

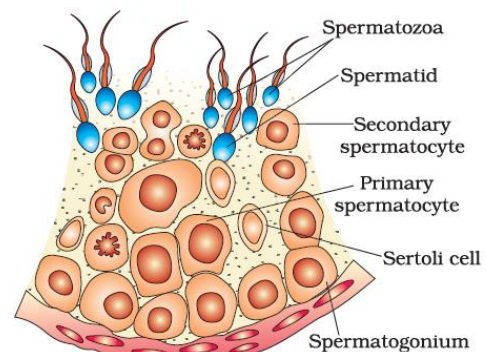
1. Spermatogenesis

It is the formation of sperms in seminiferous tubules of testis.

Schematic representation of spermatogenesis



- After spermiogenesis, sperm heads are embedded in Sertoli cells to get nourishment. Then they are released to lumen of seminiferous tubules. It is called **spermiation**.



Diagrammatic sectional view of a seminiferous tubule

Role of Hormones in Spermatogenesis

- Hypothalamus releases **Gonadotropin releasing hormone (GnRH)**.
- GnRH stimulates the anterior pituitary gland to secrete 2 **gonadotropins** such as **Luteinizing hormone (LH)** and **follicle stimulating hormone (FSH)**.

- LH acts on the **Leydig cells** and stimulates secretion of androgens. Androgens stimulate the spermatogenesis.
- FSH acts on the **Sertoli cells** and stimulates secretion of some factors for the spermiogenesis.

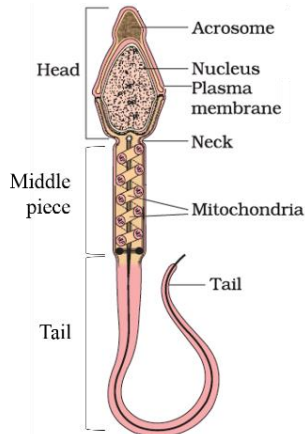
Structure of spermatozoa (Sperm)

- A plasma membrane envelops the whole body of sperm.
- A sperm has 3 regions:

a. Head: Oval shaped. Formed of **nucleus** and **acrosome**. Acrosome is formed from **Golgi complex**. It contains **lytic enzymes**. Behind the head is a neck.

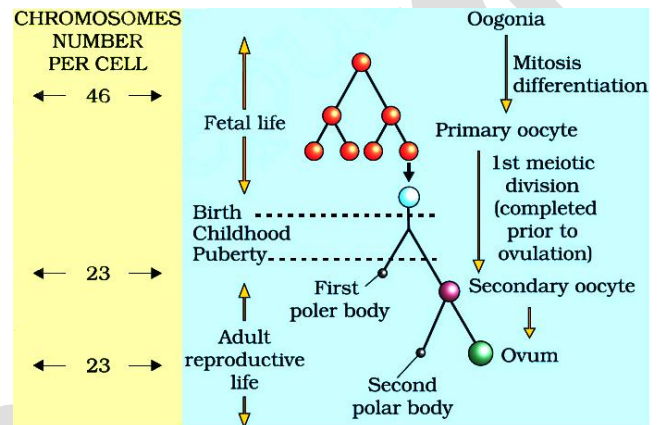
b. Middle piece: Composed of **axial filament** surrounded by **mitochondria** & **cytoplasm**. Mitochondria produce energy for the sperm motility.

c. Tail: Consists of a **central axial filament**. The sperm moves in fluid medium and female genital tract by the **undulating movement** of the tail.



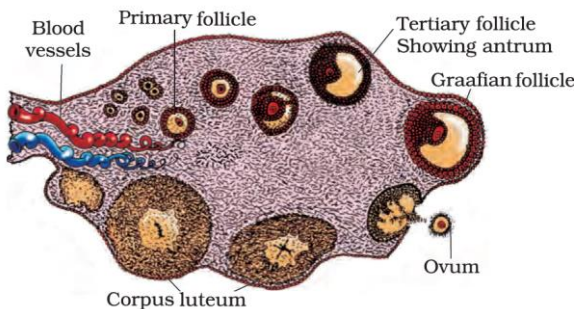
- The primary oocyte in tertiary follicle grows and undergoes first unequal meiotic division to form a large **secondary oocyte (n)** & a tiny first **polar body (n)**. So, secondary oocyte retains nutrient rich cytoplasm of primary oocyte.
- It is unknown that whether the first polar body divides further or degenerates.
- The tertiary follicle further changes into the **mature follicle (Graafian follicle)**.
- Secondary oocyte forms a new membrane (**zona pellucida**).
- Graafian follicle now ruptures to release the **secondary oocyte (ovum)** from the ovary. This is called **ovulation**.

Schematic representation of oogenesis



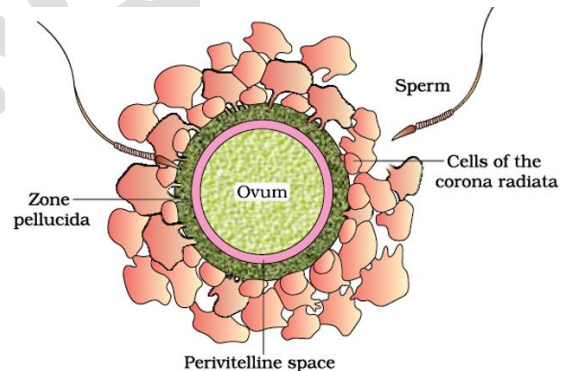
2. Oogenesis

- It is the process of formation and maturation of **ovum**.
- It takes place in **Ovarian follicles**.



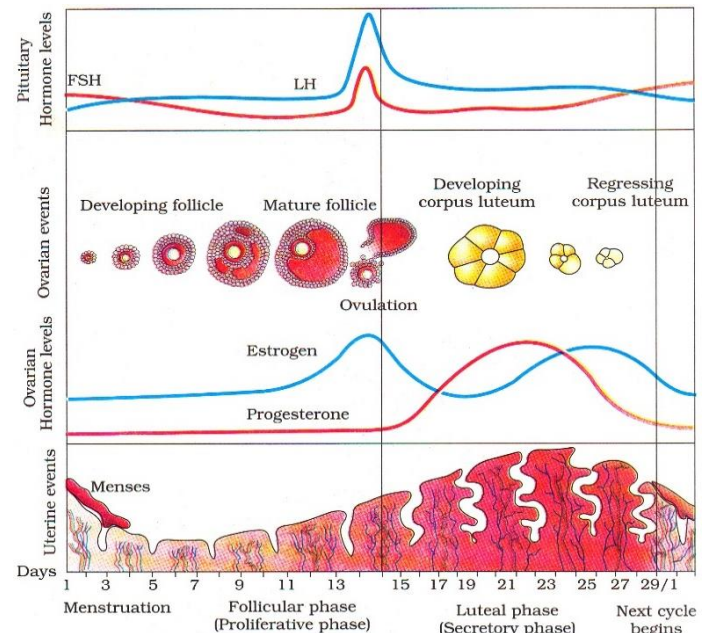
- Oogenesis is initiated in embryonic stage.
- Oogonia multiply to form **primary oocytes**.

Structure of ovum (egg)



MENSTRUAL CYCLE (REPRODUCTIVE CYCLE)

- It involves gonadotropins (**FSH & LH**) from pituitary occurs. FSH stimulates
 - o Development of primary follicles into **Graafian follicles**.
 - o Secretion of **oestrogens** by **Graafian follicles**.
- Oestrogens stimulate
 - o **Proliferation of ruptured uterine endometrium**.
 - o Suppression of FSH secretion.
 - o Secretion of LH (Luteinizing hormone).
- Rapid secretion of LH (**LH surge**) induces rupture of Graafian follicle and thereby **ovulation** (on 14th day).
- After ovulation, Graafian follicle is transformed to **Corpus luteum**. It secretes **progesterone**.
- **Functions of progesterone:**
 - o Makes endometrium **maximum vascular, thick and soft**.
 - o Inhibits the FSH secretion to prevent development of a second ovarian follicle.



FERTILIZATION AND IMPLANTATION

- Fusion of a sperm with ovum is called **fertilization**. It occurs in **Ampullary region** of fallopian tube.

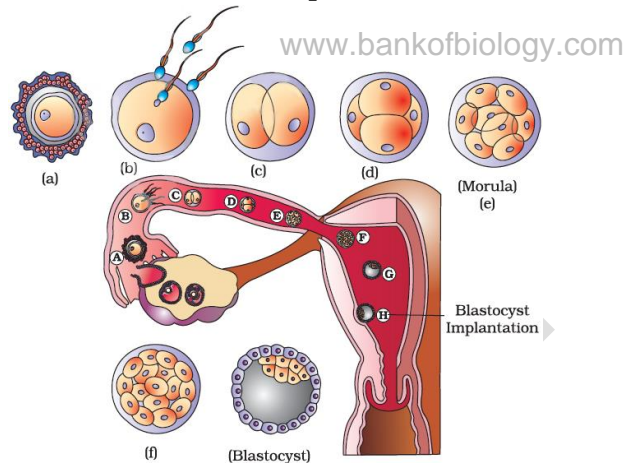
Sperms → vagina → cervical canal → uterus → isthmus

↓
Fertilization ← Ampullary region

↑
Ovum (from ovary) → fimbriae → infundibulum

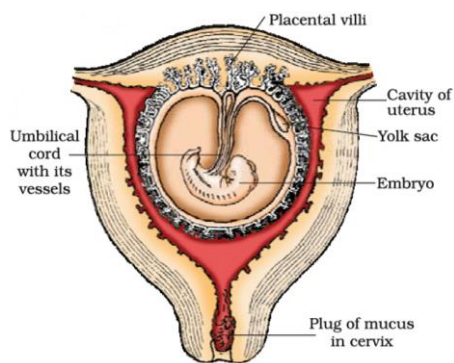
- Zygote undergoes mitotic division (**cleavage**) as it moves through the isthmus towards the uterus and forms 2, 4, 8, 16 daughter cells called **blastomeres**.
- The embryo with 8-16 blastomeres is called a **morula**.
- Morula continues to divide and transforms into **blastocyst**.
- In blastocyst, blastomeres are arranged into **trophoblast** (outer layer) and an **inner cell mass** attached to trophoblast.
- The trophoblast layer gives nourishment to inner cell mass. Also, it gets attached to endometrium.

- After attachment, uterine cells divide rapidly and cover the blastocyst. Thus, the blastocyst becomes embedded in the endometrium. This is called **implantation**.



PREGNANCY AND EMBRYONIC DEVELOPMENT

- After implantation, finger-like projections (**chorionic villi**) appear on the trophoblast.
- Chorionic villi & uterine tissue are interdigitated to form **placenta**. It is a structural and functional unit b/w embryo (foetus) and maternal body.



Functions of placenta

- Acts as **barrier** between the foetus and mother.
- Supply **O₂**, **nutrients** etc. from mother to foetus.
- Remove **CO₂** and **excretory wastes** from foetus.
- Acts as an endocrine gland. It secretes **Human chorionic gonadotropin (hCG)**, **human placental lactogen (hPL)**, **oestrogens**, **progesterone** & **relaxin**. Relaxin is also secreted by ovary.

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PARTURITION AND LACTATION

- **Parturition (labour)**: Process of giving birth to young ones.
- The mammary glands produce milk towards the end of pregnancy. It is called **lactation**.

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

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