

CONCEPT MAP

# GAMETOGENESIS

Gametogenesis is the process by which male and female sex cells or gametes *i.e.*, sperms and ova are formed respectively in the male and female gonads (testes and ovaries). It is the major reproductive event in sexual reproduction.

## Spermatogenesis

- Process of sperm formation in testes after puberty.
- Occurs in seminiferous tubules of testes, which are lined by germinal epithelium, consisting of primordial germ cells (PGCs) and Sertoli (nurse) cells.
- Includes formation of spermatids and formation of spermatozoa.
- PGCs are largely cuboidal in outline, which divide first by **mitosis** and later by **meiosis**.
- Four sperms are produced from one spermatogonial cell.
- Consists of multiplication, growth, maturation and differentiation phases.

### Multiplication phase

- At sexual maturity, the PGCs divide several times by mitosis to produce a large number of **spermatogonia (2n)**.
- Spermatogonia are of two types: **Type A spermatogonia**, which serve as stem cells, and **type B spermatogonia**, which are the **precursors of sperms**.

### Growth phase

- Each type B spermatogonium actively grows to a larger **primary spermatocyte (2n)** by obtaining nourishment from the Sertoli cells.

### Maturation phase

- Each primary spermatocyte undergoes two successive divisions of meiosis.
- As a result of I<sup>st</sup> meiotic division, which is reductional division, two haploid **secondary spermatocytes (n)** are produced.
- Secondary spermatocytes undergo the II<sup>nd</sup> meiotic division, which is an equational mitotic division, producing four haploid **spermatids (n)**.

### Differentiation phase or Spermiogenesis

- It is the transformation of the spermatids into **spermatozoa**, or **sperms** in about 64 days, and involves the following changes:
  - Formation of acrosome by Golgi apparatus; elongation and condensation of nucleus; formation of axial filament from distal centriole; separation of centrioles; development of mitochondrial spiral; formation of flagellum.
- **Sperm/Spermatozoan**: Sperms are microscopic, motile and remain viable for 24 to 48 hrs, after their release in the female genital tract.
- A typical spermatozoan consists of head, neck, middle piece and tail.
- **Head**: Contains anterior acrosome and posterior nucleus; acrosome contains sperm lysins for egg penetration during fertilisation.
- **Neck**: Very short; connects head to middle piece; contains proximal centriole towards the nucleus, which has a role in the first cleavage of the zygote and distal centriole, that gives rise to the axial filament of the sperm.
- **Middle piece**: Bears the mitochondrial spiral, therefore called 'power house of sperm'; ring centriole or annulus, with unknown function at the end of middle piece.
- **Tail**: It is several times longer than the head; the sperm swims about by its tail in a fluid medium.

### Spermiation

It is the process of release of sperms from the Sertoli cells. Sperms, after release are stored in epididymis and upper portion of vasa deferentia for upto one month, where they obtain nourishment from epithelium of epididymis and gain motility.

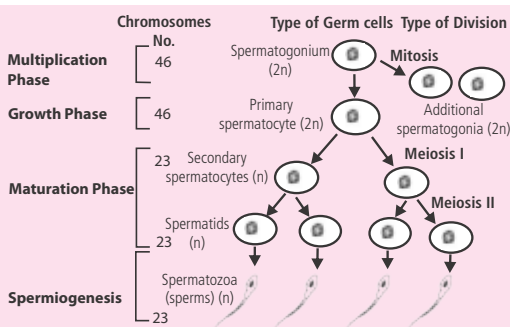


Fig.: Stages in spermatogenesis (diagrammatic)

## Oogenesis

- Process of ovum formation, which starts in the foetal ovary (25 weeks old) and is completed after puberty.
- Occurs in the germinal epithelium of the foetal ovary.
- Results in the formation of one ovum and three polar bodies, every month, after puberty.
- Cells of germinal epithelium, larger than the others, function as **germ cells**.
- Germ cells divide first by **mitosis** and then by **meiosis**.
- Consists of multiplication, growth and maturation phases.

### Multiplication phase

- Germ cells in the foetal ovary divide by mitosis to form millions of egg mother cells or **oogonia**.
- Oogonia form **egg tubes** into the stroma of ovary, which form a multicellular mass called **egg nest**.
- All the oogonia are formed in the foetal ovary, and no more are formed after birth.

### Growth phase

- One oogonium of the egg nest grows in size forming **primary oocyte**, surrounded by layer of granulosa cells, forming **primary follicle**.
- Total number of **primary follicles** in foetal ovary is about 60 lakhs.
- Large number of primary follicles undergo **follicular atresia**, so that a young adult woman has only about 4 lakhs primary follicles in both ovaries.

### Maturation phase

- Primary oocyte begins meiosis I, but division is arrested at diakinesis of prophase I.
- Ovarian follicle containing primary oocyte occurs in the foetal ovary and remains so, till puberty.
- At puberty, primary oocyte grows and completes meiosis I, producing large **secondary oocyte (n)** and small **polar body or polocyte (n)**.
- Secondary oocyte proceeds with meiosis II, but the division gets arrested in metaphase II, followed by ovulation.
- Meiosis II is completed only after entry of sperm, resulting in the formation of ovum and another polar body.

### Ovulation

- It is the release of secondary oocyte, after puberty, once every month from Graafian follicle, by any one ovary. Only 450 secondary oocytes are produced during the entire reproductive span. Ruptured Graafian follicle forms corpus luteum.
- **Ovum**: Spherical, aleithal, with cytoplasm containing germinal vesicle or nucleus, nucleolus and cortical granules; cytoplasm protected by plasma membrane; shows polarity, differentiated into an animal pole and a vegetal pole; centrioles absent, protected by two coverings.
- **Corona radiata**: Outer, multicellular covering of radially elongated follicular cells, held together by hyaluronic acid.
- **Zona pellucida**: Inner, noncellular, glycoprotein rich covering with receptor proteins; bears in growth of follicular cells for transfer of nutrients to the egg.
- **Perivitelline space**: Narrow space present between plasma membrane and zona pellucida.

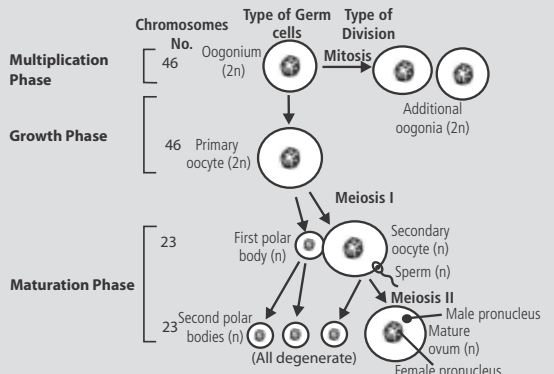
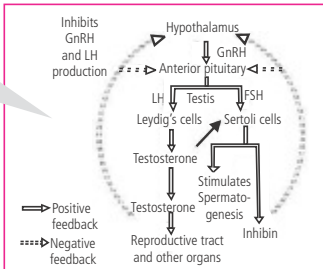


Fig.: Stages in oogenesis (diagrammatic)

### Hormonal control

- Spermatogenesis is initiated due to increase in GnRH by hypothalamus.
- GnRH acts on anterior lobe of pituitary to secrete LH and FSH.
- LH acts on Leydig's cells to secrete testosterone.
- FSH acts on Sertoli cells to secrete ABP and inhibin.
- FSH also stimulates spermatogenesis, thus promoting sperm production.
- ABP concentrates testosterone in the seminiferous tubules.
- Inhibin suppresses FSH synthesis.



### Hormonal control

- Oogenesis is initiated due to increase in GnRH by hypothalamus; GnRH acts on anterior lobe of pituitary to secrete FSH and LH; FSH stimulates follicular growth and maturation of oocyte; FSH stimulates the follicular granulosa cells to secrete estrogen; LH stimulates corpus luteum to secrete progesterone.

