As per SPPU New CBCS

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## Department of Zoology

## T. Y. B. Sc.

## ZO 355 : Developmental Biology
## Semester V

## By

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## 1.Gametogenesis-

## spermatogenesis & oogenesis

Gametogenesis, the production of sperm and eggs, takes place through the process of meiosis. During meiosis, two cell divisions separate the paired chromosomes in the nucleus and then separate the chromatids that were made during an earlier stage of the cell's life cycle, resulting in gametes that each contain half the number of chromosomes as the parent. The production of sperm is called spermatogenesis and the production of eggs is called oogenesis.

### 1.1. Spermatogenesis

Spermatogenesis occurs in the wall of the seminiferous tubules, with stem cells at the periphery of the tube and the spermatozoa at the lumen of the tube. Immediately under the capsule of the tubule are diploid, undifferentiated cells. These stem cells, called spermatogonia (singular: spermatagonium), go through mitosis with one offspring going on to differentiate into a sperm cell, while the other gives rise to the next generation of sperm.

Meiosis begins with a cell called a primary spermatocyte. At the end of the first meiotic division, a haploid cell is produced called a secondary spermatocyte. This haploid cell must go through another meiotic cell division. The cell produced at the end of meiosis is called a spermatid. When it reaches the lumen of the tubule and grows a flagellum (or "tail"), it is called a sperm cell. Four sperm result from each primary spermatocyte that goes through meiosis.

Stem cells are deposited during gestation and are present at birth through the beginning of adolescence, but in an inactive state. During adolescence, gonadotropic hormones from the

anterior pituitary cause the activation of these cells and the production of viable sperm. This continues into old age.

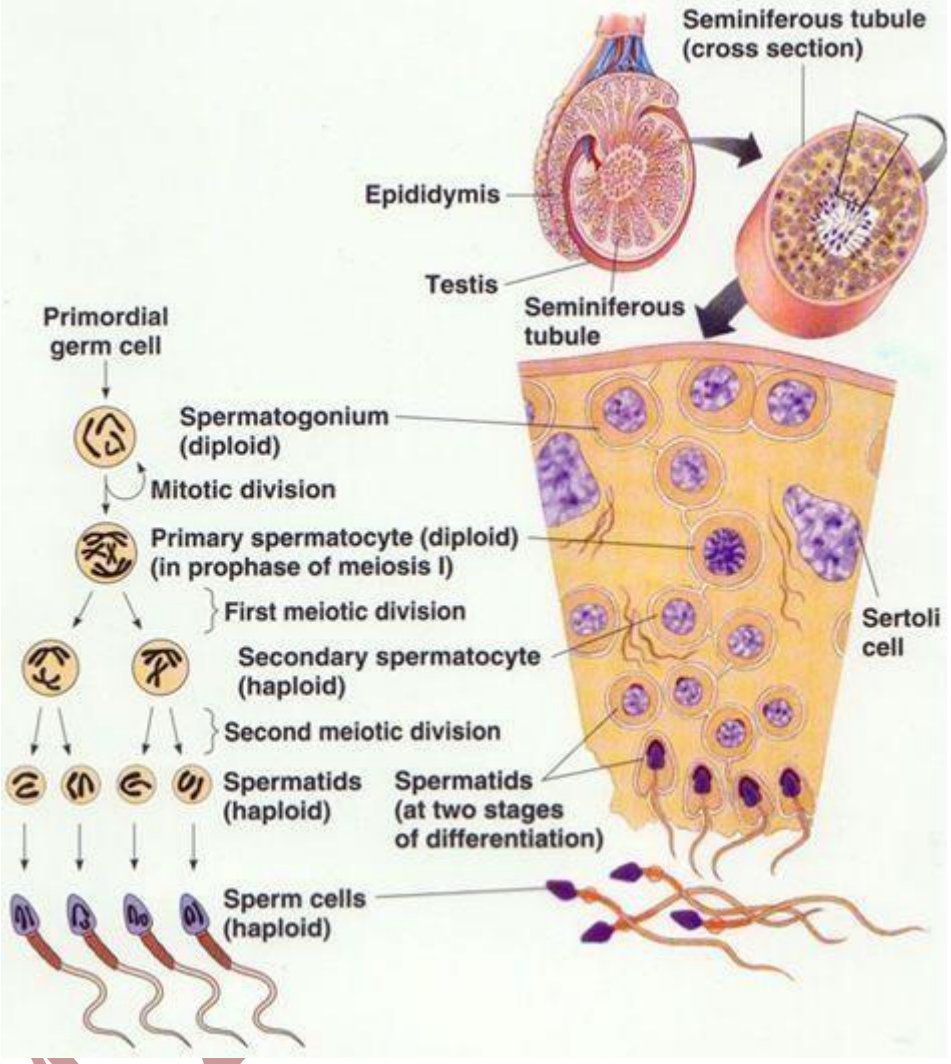
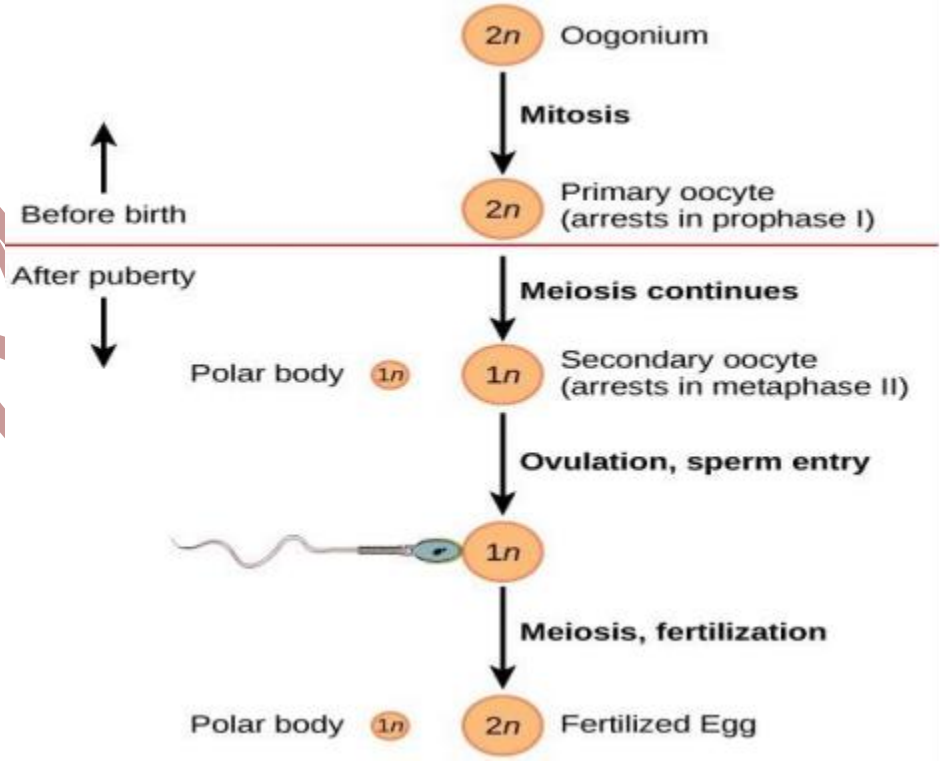



**Figure. 1.** Spermatogenesis**: During spermatogenesis, four sperm result from each primary spermatocyte, which divides into two haploid secondary spermatocytes; these cells will go through a second meiotic division to produce four spermatids.**

### 1.2. Oogenesis

Oogenesis occurs in the outermost layers of the ovaries. As with sperm production, oogenesis starts with a germ cell, called an oogonium (plural: oogonia), but this cell undergoes mitosis to increase in number, eventually resulting in up to one to two million cells in the embryo.

The cell starting meiosis is called a primary oocyte. This cell will begin the first meiotic division, but be arrested in its progress in the first prophase stage. At the time of birth, all future eggs are in the prophase stage. At adolescence, anterior pituitary hormones cause the development of a number of follicles in an ovary. This results in the primary oocyte finishing the first meiotic division. The cell divides unequally, with most of the cellular material and organelles going to one cell, called a secondary oocyte, and only one set of chromosomes and a small amount of cytoplasm going to the other cell. This second cell is called a polar body and usually dies. A secondary meiotic arrest occurs, this time at the metaphase II stage. At ovulation, this secondary oocyte will be released and travel toward the uterus through the oviduct. If the secondary oocyte is fertilized, the cell continues through the meiosis II, completing meiosis, producing a second polar body and a fertilized egg containing all 46 chromosomes of a human being, half of them coming from the sperm.



1. **Number of cells produced**

- In spermatogenesis, the cells divide equally during meiosis to produce *four* functional gametes
- In oogenesis, the cells do not divide equally and as a result only *one* functional gamete is formed(plus 2 – 3 polar bodies)

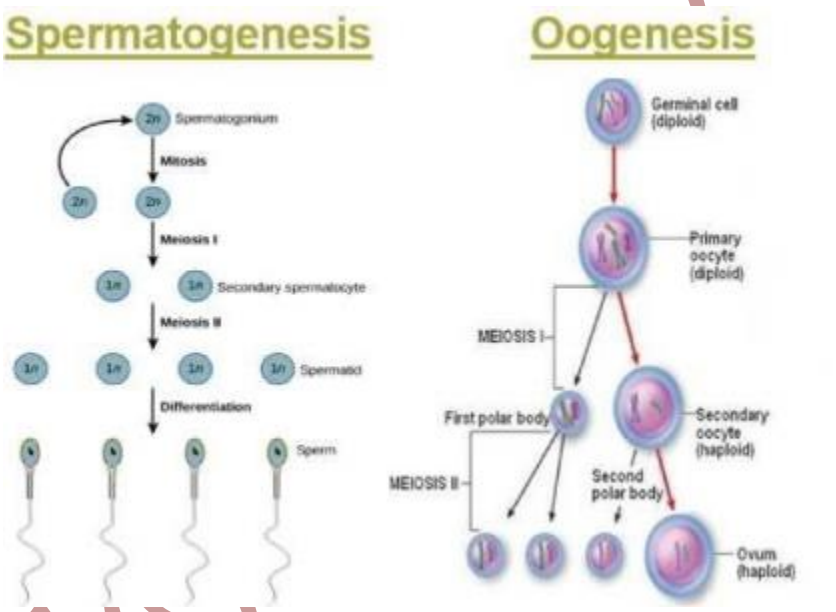
2. **Size of cells produced**

- In spermatogenesis, the cells that are formed following differentiation are all of equal size withequal amounts of cytoplasm
- In oogenesis, one daughter cell (the ovum) retains all of the cytoplasm, while the other daughtercells form polar bodies
- The polar bodies remain trapped within the surrounding layer of follicle cells until they eventuallydegenerate

3. **Timing of the process**

- In spermatogenesis, the production of gametes is a continuous process that begins at puberty andcontinues until death
- In oogenesis, the production of gametes is a staggered and finite process:
- It begins before birth (prenatally) with the formation of a fixed number of primary oocytes(~40,000)
- It continues with the onset of puberty according to a monthly menstrual cycle
- It ends when hormonal changes prevent the further continuance of the menstrual cycle(menopause)

Figure.3. S**ummary of the Differences between Spermatogenesis and Oogenesis**




| | Spermatogenesis | Oogenesis |
|---|---|---|
| **Process** | | |
| *Location* | Occurs *entirely* in testes | Occurs *mostly* in ovaries |
| *Meiotic divisions* | Equal division of cells | Unequal division of cytoplasr |
| *Germ line epithelium* | Is involved in gamete production | Is not involved in gamete pro |
| **Gametes** | | |
| *Number produced* | Four | One (plus 2 – 3 polar bodies) |
| *Size of gametes* | Sperm smaller than spermatocytes | Ova larger than oocytes |
| **Timing** | | |
| *Duration* | Uninterrupted process | In arrested stages |
| *Onset* | Begins at puberty | Begins in foetus (pre-natal) |
| *Release* | Continuous | Monthly from puberty (menst |
| *End* | Lifelong (but reduces with age) | Terminates with menopause |