Spermatogenesis

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The process of sexual reproduction ensures the formation of a diploid zygote which could constitute the next generation. A zygote is a single celled structure. By an ontogenetic process the zygote undergoes various developmental phases resulting in multicellular embryonic organisation. These phases include **cleavage**, **gastrulation**, **neurulation**, **organogenesis** and the period of **growth** and **histological differentiation**. Inspite of the fact that organisms vary in their structure, form and mode of life, the processes of embryogenesis, development and differentiation are remarkably similar in all metazoans. Till later stages of development a fundamental uniform pattern in development can be observed. The ontogenetic stages also reflect the historical development of species or **phylogenetic development**.

The process of embryonic development in sexually reproducing multicellular organisms is made possible through processes of **gametogenesis** and **fertilization**. Gametogenesis is the formation of **sex cells** or **reproductive cells** or **gametes**. It happens in primary sex organs called **gonads**. The male and female gonads, namely the testis and ovary contain **primordial germ cells**. These cells are responsible for the production of gametes.

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. The spermatogenesis occurs in two

steps which is discussed below, i.e.,[A]Formation of Spermatids and [B] Spermiogenesis

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.

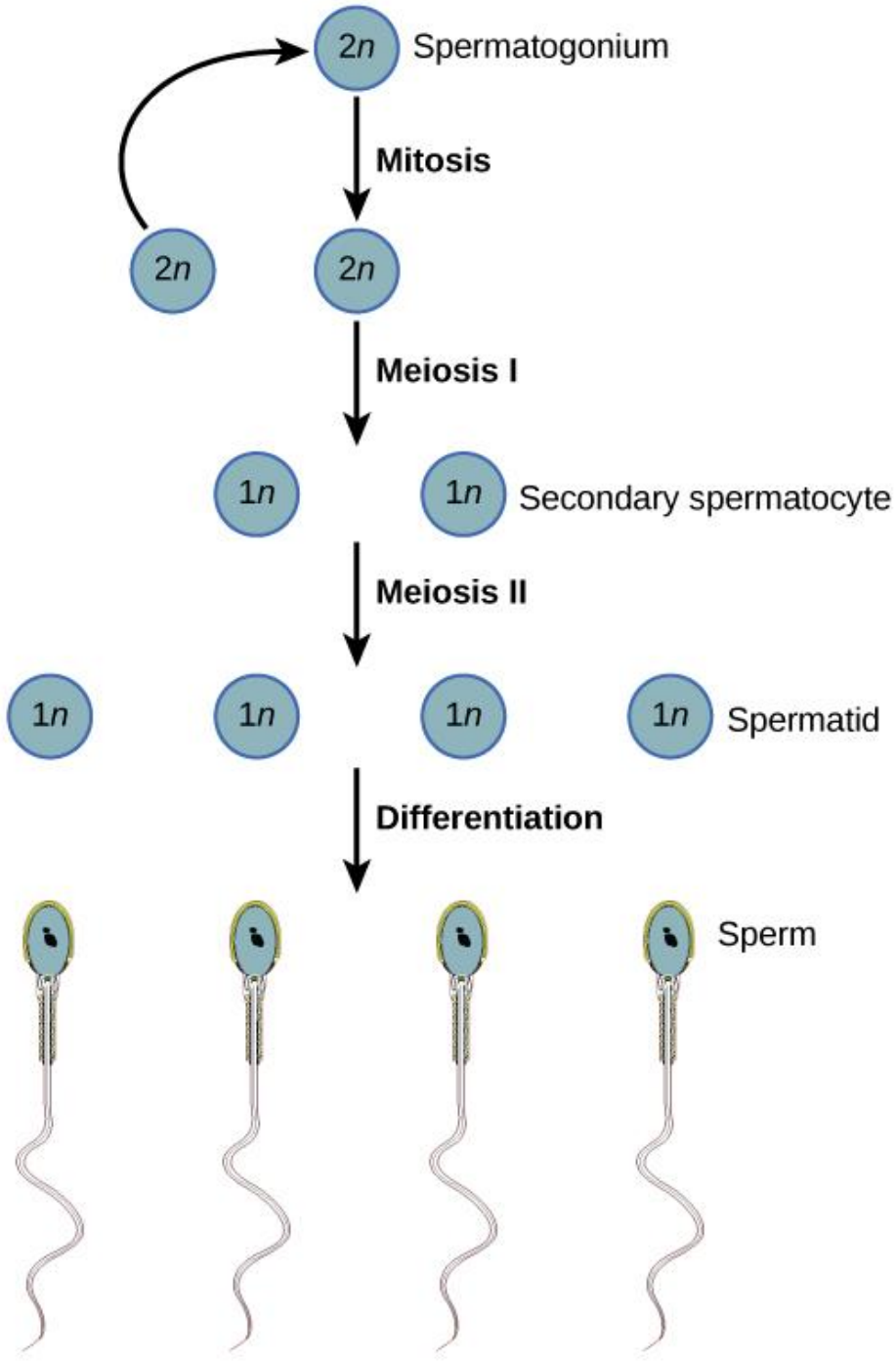

Figure : **Spermatogenesis**: During spermatogenesis, four sperm result from each primary

The entire process of spermatogenesis can be divided into following two phases:

(A) Formation of Spermatid:

The male gonad known as testis is the site of spermatogenesis. In each vertebrate a pair of testes remains attached to dorsal body wall by a connective tissue called mesorchium. Each testis is formed of thousands of minute elongated and coiled tubules called seminiferous tubules. The inner lining of seminiferous tubules is called as germinal epithelium and is made of primordial germ cells (Primary germ cells) as well as some supporting nutritive cells. The primordial germ cells give rise to spermatids through the following steps.

1.Multiplication Phase:

The primary germ cells multiply by repeated mitotic division. The cells produced after the final mitotic divisions are known as spermatogonia or sperm mother cells.

2. Growth Phase:

The spermatogonia do not divide for sometime but increase in size by accumulating nutritive materials from the supporting cells. In mammals such supporting cells are called cells of Sertoli. The enlarged spermatogonia are now called primary spermatocytes.

3. Maturation Phase:

During the phase of maturation, the primary spermatocytes divide by meiosis consisting of two successive divisions. The first division is reductional or disjunctional reducing the chromosome number from '2n' to 'n'. These cells are celled secondary spermatocytes. Second division is equational resulting in formation of four daughter cells called spermatids.

(B) Spermiogenesis (Spermatoleosis):

This is the second phase of spermatogenesis during which the spermatids produced at the end of first phase are metamorphosed into sperm cells. The spermatid is a typical cell containing a nucleus and cytoplasmic organelles such as mitochondria,

golgi bodies, centriole etc, but the nucleus only contains haploid number of chromosomes.

During spermiogenesis or spermatoleosis the following transformations occur in the spermatids:

- The large spherical nucleus becomes smaller by losing water and usually changes its shape into elongated structure.
- The Golgi bodies condense into a cap called acrosome in front of the nucleus.
- Nucleus and the acrosome combined to form the head of the developing sperm while the cytoplasm with mitochondria and centrioles move downwards and form the cylindrical middle piece behind the head.
- The two centrioles of middle piece develop axial filaments which are bunched into a single thread and extend behind in the form of a long vibratile tail. Thus, spermatid is transformed into a motile sperm divisible into head, middle piece and tail.