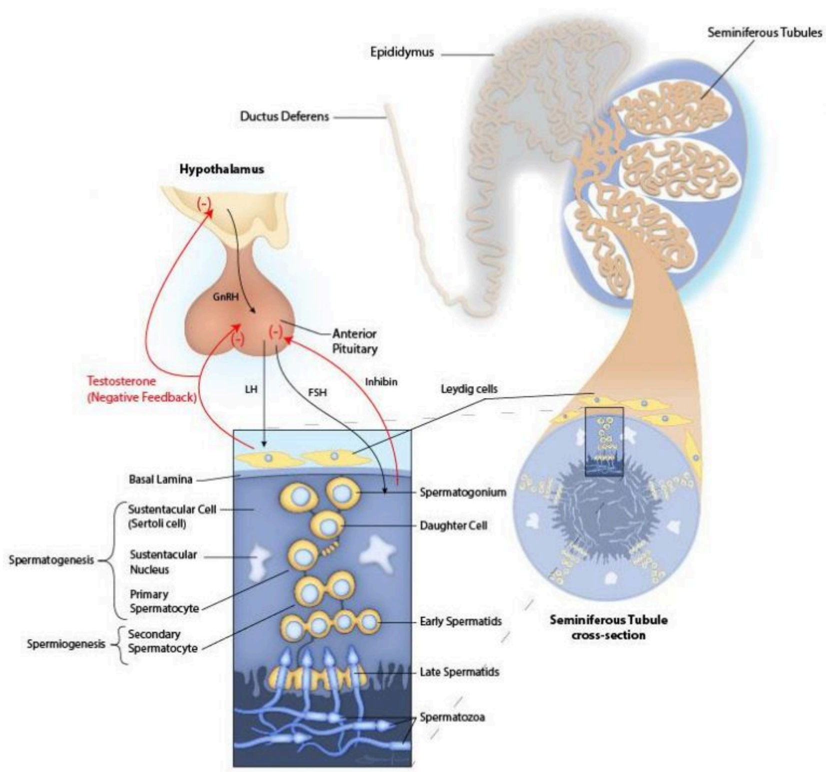
10.2.2

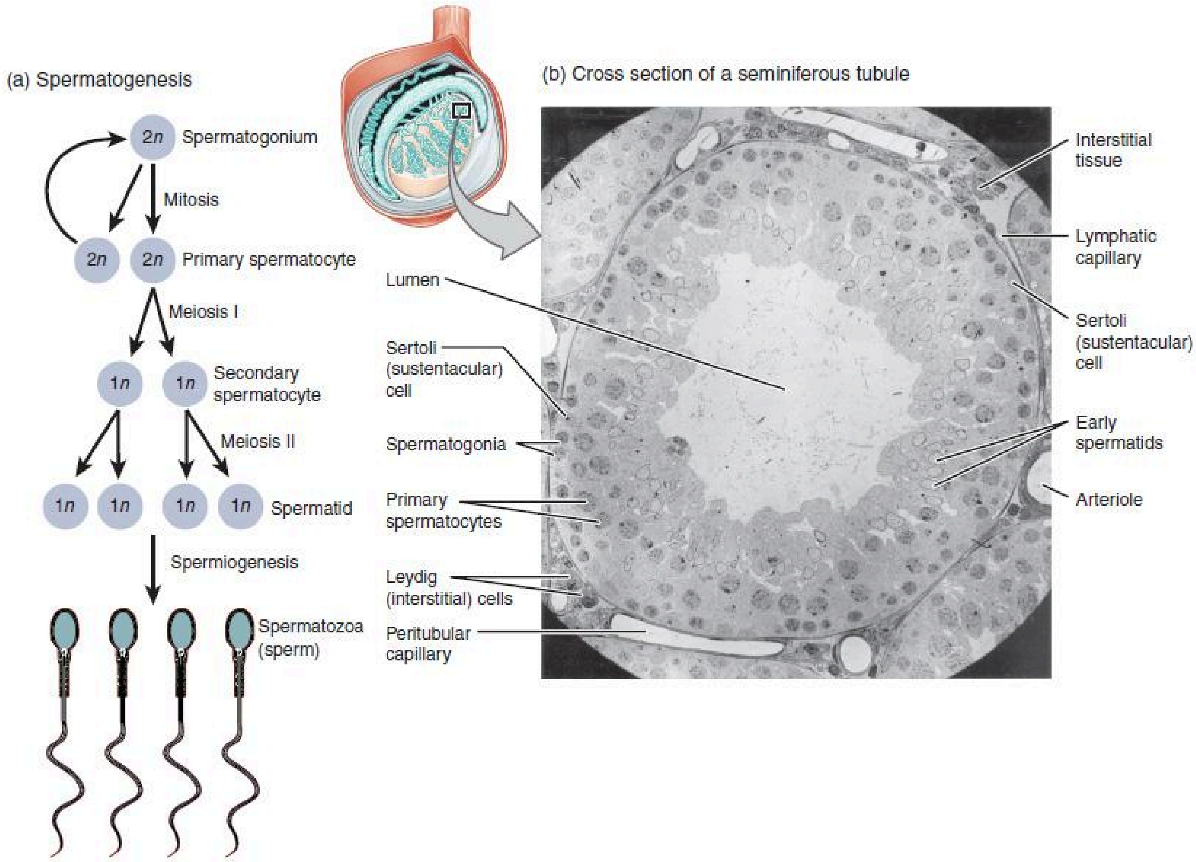
Spermatogenesis



Spermiogenesis in the Seminiferous Tubules. *Image drawn by BYU-Idaho student Fall 2013*

Recall that within the seminiferous tubules two types of cells are found; the Sertoli cells and the germ cells. The Sertoli cells are tightly connected to each other by attachments called tight junctions. This arrangement creates what is known as the blood-testis barrier. This barrier keeps the developing sperm cells "hidden" from the male's immune system (because circulating immune cells cannot cross the Sertoli cell barrier). It also provides the proper environment for the developing sperm. Serious injury or infection can sometimes compromise this barrier and immune cells attack the germ cells. This is a relatively common cause of male infertility.

Prior to puberty the seminiferous tubules are relatively small in diameter and do not have patent lumens. Also, during this time, the germ cells are in a quiescent state. With the onset of puberty, FSH begins to increase. Sertoli cells have FSH receptors and when FSH stimulates these receptors, the Sertoli cells increase in number and size. They also produce fluid that begins to expand the seminiferous tubule lumen, creating a lumen in the center. This is why testicular size increases rapidly during puberty. Also, the increase in FSH and testosterone initiate spermatogenesis. The stem cells that will eventually develop into mature sperm are the **spermatogonia.** These cells, like other body cells, have 23 pairs of chromosomes for a total of 46 (diploid). At puberty, they begin to divide by mitosis, producing daughter cells that also have 46 chromosomes. When a spermatogonium undergoes mitosis, one of the new daughter cells remains a spermatogonium to divide by mitosis again. The other daughter cell becomes a **primary spermatocyte** and begins the journey to become a sperm cell. The primary spermatocyte undergoes the first meiotic division, resulting in the production of two **secondary spermatocytes.** These secondary spermatocytes will then undergo the second meiotic division, resulting in the production of four **spermatids.** The process of meiosis results in cells that have only one copy of each chromosome or a total of 23 (haploid).



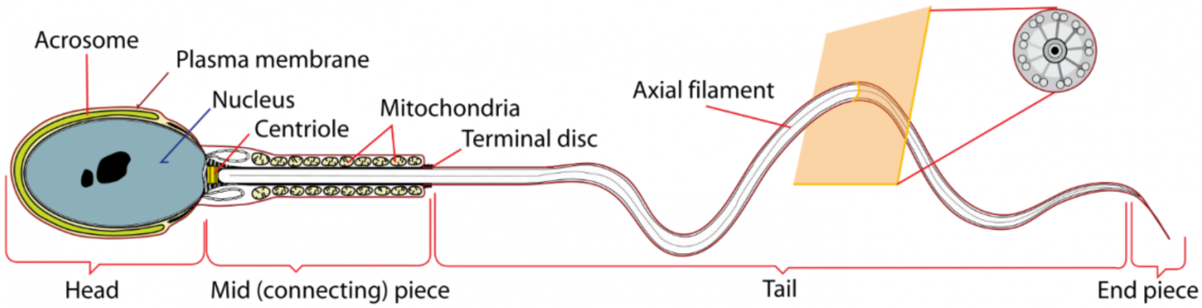
Spermatogenesis. *Author: OpenStax Anatomy and Physiology. License: [Creative Commons Attribution License 4.0](#) license.Link: https://books.byui.edu/-ibd*

At this stage, the spermatids do not look like a mature sperm but are essentially a round cell. To become a mature sperm, the spermatids undergo a complex process, known as **spermiogenesis,** resulting in the characteristic shape of the sperm cell (also called spermatozoa). Sertoli cells literally surround the developing germ cells and influence sperm cell development along the entire process from a spermatogonium to a fully formed sperm cell. From beginning to end this process takes roughly 74 days. The sperm then move into the epididymis, where they must spend another 10-14 days to become a fully functional sperm and are temporarily stored. The typical 20-year-old male produces around 6.5 million sperm per gram of testicular parenchyma per day. As men age this number goes down and by age 50 is around 3.8 million per gram per day.

Structure of a Spermatocyte

As described above, the spermatozoon or sperm cell (male **gamete**) is a haploid cell with one copy of each chromosome pair or a total of 23 individual chromosomes. Following spermiogenesis the mature sperm cell has very little in the way of cytoplasm and cell organelles, but it does have a very long flagellum that can propel it quite vigorously. In the first image below, you see that a sperm cell consists of three segments, the **head, midpiece** and **tail.**

The head contains the nucleus (very highly condensed DNA of 23 chromosomes). The nucleus is capped by the remnants of a cell organelle called the Golgi body. This remnant is called the **acrosome** and it is filled with hydrolytic enzymes that will be used to help digest through the protective layers surrounding the egg. The process of activating the acrosome is called **capacitation.** Capacitation is necessary for sperm viability and is considered the final process in the maturation of the sperm. This process occurs naturally within the female reproductive tract. The midpiece contains a centriole and many mitochondria that will be used to generate the ATP that powers the long tail (flagellum) for the swimming motion. The tail is a flagellum which consists of an array of microtubules that slide past each other under the influence of ATP. This sliding motion causes waves of curvature or bending in the tail, propelling the sperm forward.



Spermatozoon. *By Mariana Ruiz [Public domain], via Wikimedia Commons Link: https://books.byui.edu/-LZG*