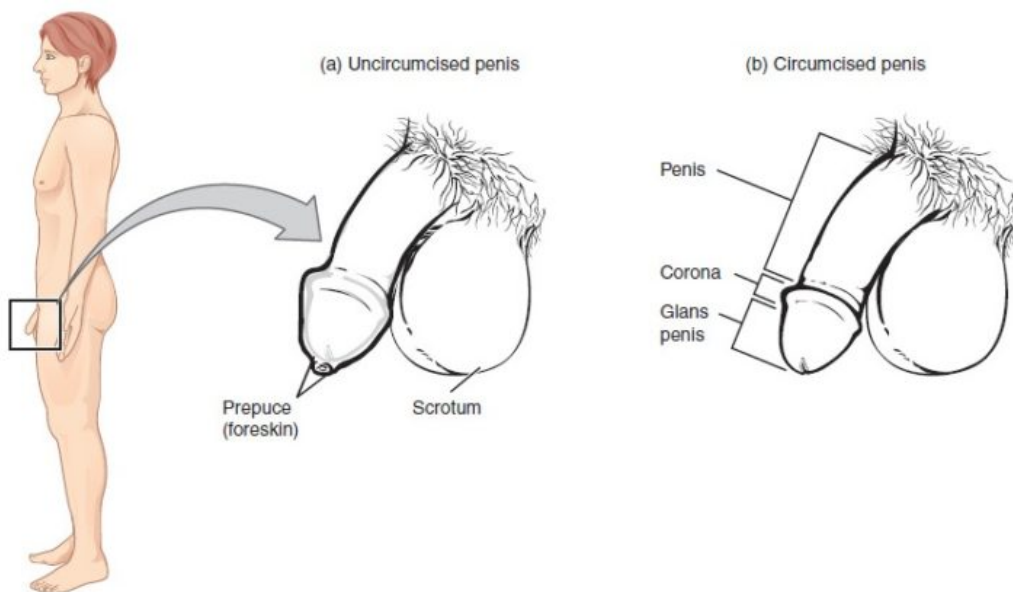


The Male Reproductive System

[See online here](#)

The male reproductive system, including the testicles and spermatic duct, can be divided into different sections, but it is treated as one unit in anatomy studies. This article is concerned with the anatomy and physiology of the male sexual organs. At the end, a section about pathology provides a general view of some common dysfunctions.



The Male Reproductive System

The internal male sexual organs include the following:

- Testicles (testes)
- Epididymis
- Sperm duct (vas deferens)
- Seminal vesicles (also called vesicular or seminal glands)
- Prostate gland (prostate)
- Cowper gland (bulbourethral glands)

The external male sexual organs include the following:

- Penis
- Scrotum

The testicles and the epididymis are considered internal reproductive organs because they are originally located on the posterior abdominal wall and later descend from the abdomen through the inguinal canal during embryonic development. The external organs of the male reproductive system are distinct from external female reproductive organs by the end of the ninth week of embryogenesis.

Development During Puberty

During the adolescent period, there is increased gonadotropin secretion in the male reproductive organs, which stimulates a rise in sex steroids in the testes. This leads to secondary sexual characteristics among male adolescents, including the growth of the testes and pubic hair, as well as an increase in the size of the penis.

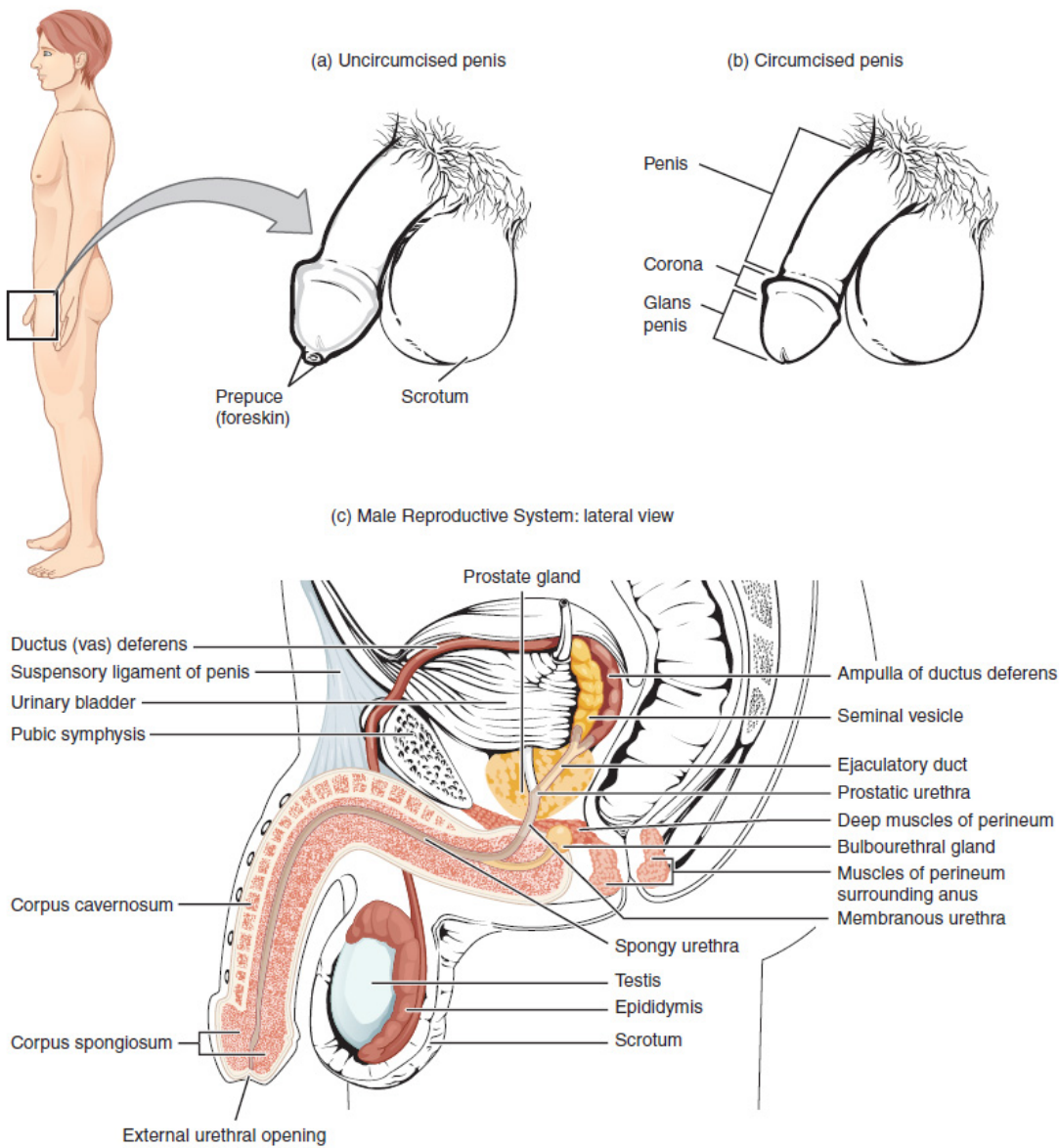


Image: Male reproductive system, by Phil Schatz. License: [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)

Structure of the testes

The testes are oval in shape and have a **diameter of approximately 5 cm**; the pair is suspended elastically in the scrotum. The testes form early in embryogenesis. After the first 1 trimester, the testicles start to descend and remain in the groin until about the seventh month of pregnancy. During this time, the scrotum develops, which is connected to the inguinal canal in the abdomen through the processus vaginalis testis. After the descent of the testes is complete, the canal closes.

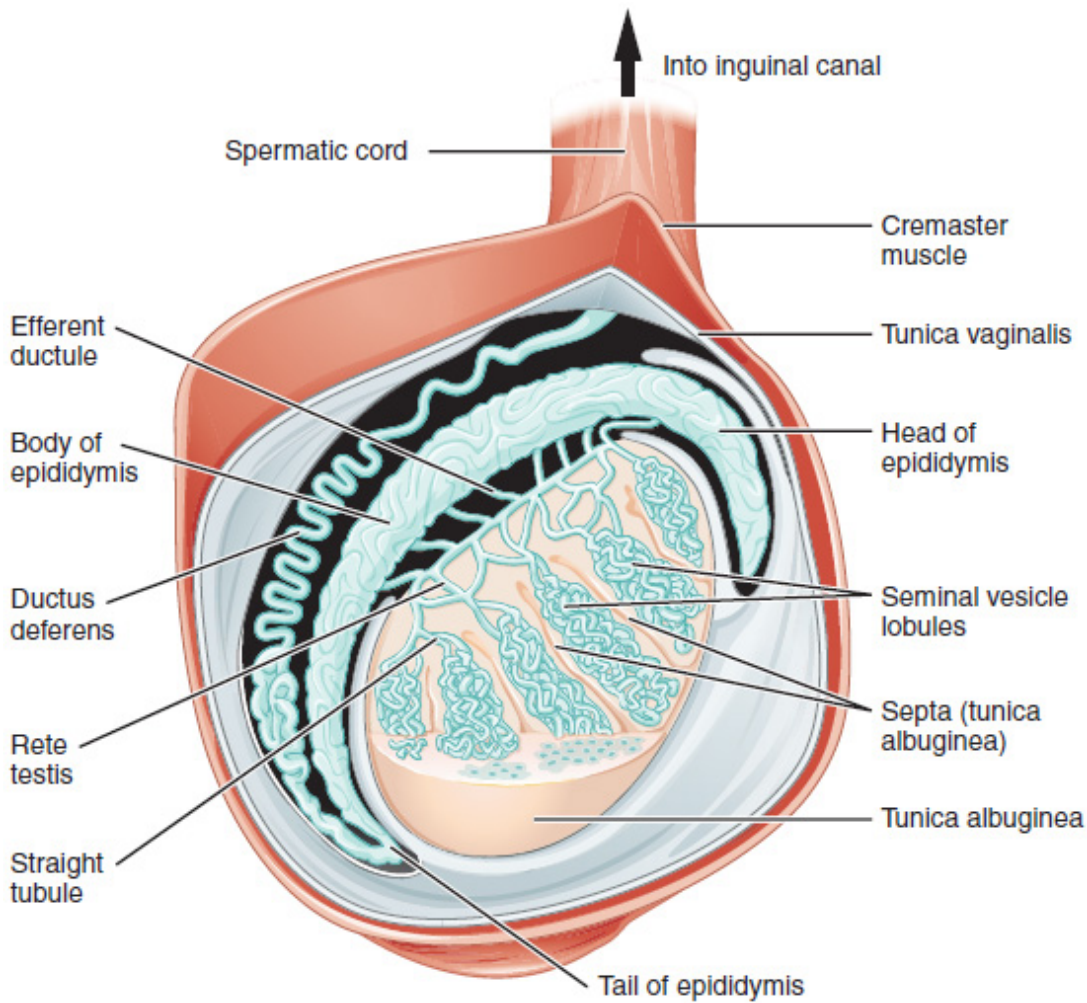


Image: Anatomy of the testis, by Phil Schatz. License: [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)

Internally, the **scrotum** has a connective tissue capsule that is divided by approximately 200 walls. Thus, a large number of chambers are formed. These chambers hold the **seminiferous tubules**, which are organized as a bundle and exit into the excretory duct. These passages are a web-like complex system called the **rete testis**.

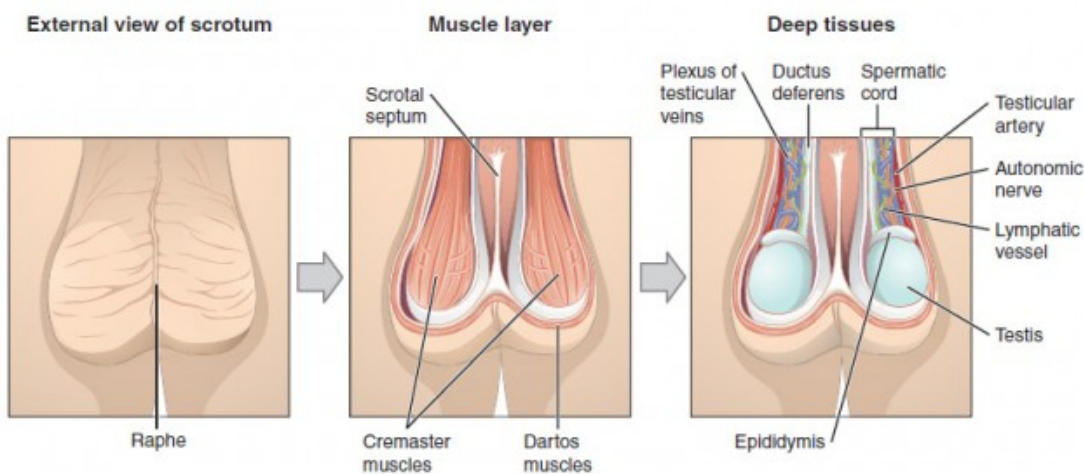


Image: The scrotum and testes, by Phil Schatz. License: [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)

The **seminiferous tubules** are lined with the germinal epithelium, which, in turn, is surrounded by connective **tissue**. Within the germinal epithelium are the **Sertoli cells**,

along with maturing gametes that later develop into the sperm cells. The main function of the **Sertoli cells** is to nourish the developing sperm cells. Without them, the body's immune system would attack the sperm cells. Equally important are the **Leydig cells**, which produce testosterone.

Spermatogenesis

Spermatogenesis describes the process of producing spermatozoa, the male germ cells. The process is initiated during the initial stage of puberty and occurs in the **seminiferous tubules** of the testes, where the spermatozoa undergo various stages of development. It is a continuous process, similar to oocyte maturation in women.

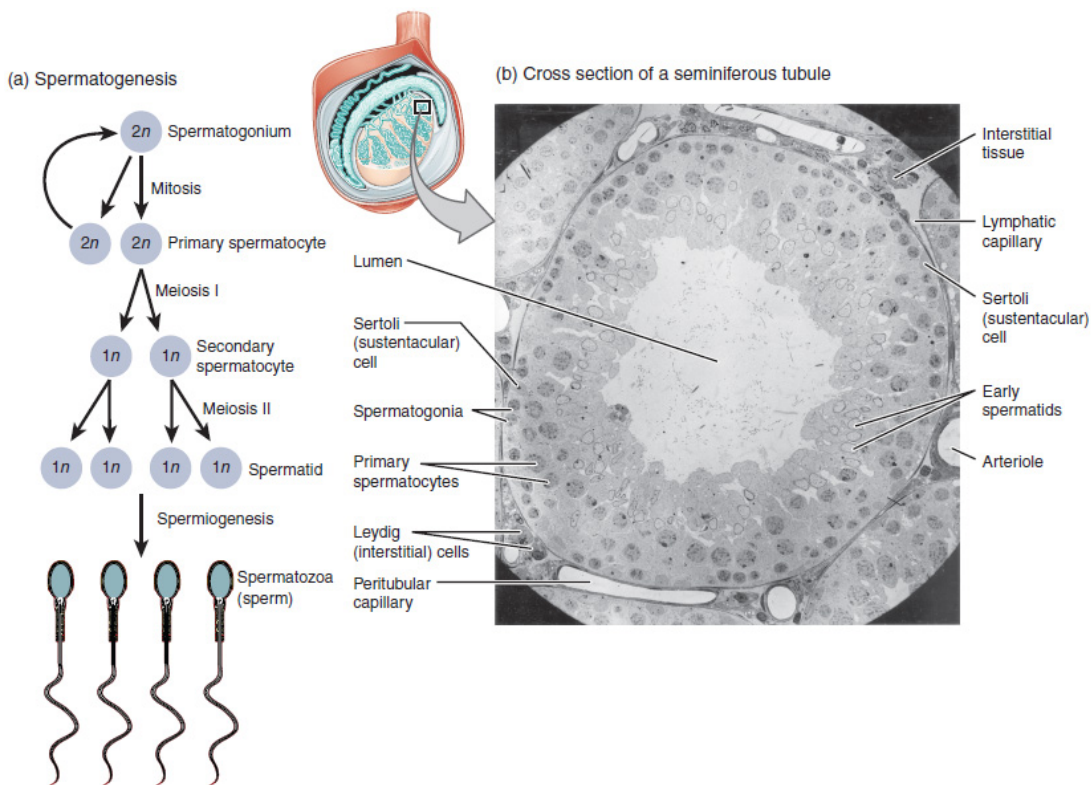


Image: Spermatogenesis, by Phil Schatz. License: [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)

Development stages of the spermatozoa

An anatomic requirement for spermatogenesis is the presence of the **seminiferous tubules**, which develop during puberty in the presence of the follicle-stimulating hormone (FSH). FSH binds to the **Sertoli cells**, triggering the production of various mediators that, in turn, stimulate spermatogenesis.

The development stages are as follows:

1. **Type A spermatogonia**
2. **Type B spermatogonia**
3. **Primary spermatocytes**
4. **Secondary spermatocytes**

In the first stage, type A spermatogonia are formed from the primordial germ cells in the seminiferous tubules through mitotic division. The nucleus contains diploid cells, which

have a diploid chromosome set and one chromatid per chromosome.

As a result of further mitotic division, type B spermatogonia are created, leaving the basement membrane during the process. The primary spermatocytes are formed from type B spermatogonia and approach the seminiferous tubules. They duplicate the DNA, which results in 2 meiotic divisions. At this stage, they are secondary spermatocytes.

Until the process of spermatozoa production is complete, it is dependent on testosterone. Spermatozoa consist of a head and a tail. The nucleus of the head is highly condensed and partially covered by the acrosome. This cap-like structure contains the enzymes that later play an important role in breaking down the outer membrane of the ovum, which is necessary for fertilization. Mitochondria are located in the tail, providing energy to the cell and, therefore, enabling the spermatozoa to move at a speed of 7-25 cm per minute.

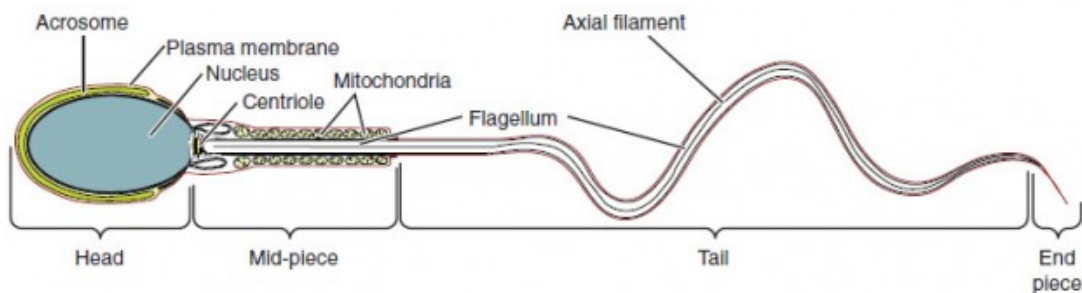


Image: Structure of sperm, by Phil Schatz. License: [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)

Duration of spermatozoa formation

The process of developing from undifferentiated germ cells all the way to spermatozoa takes 60–70 days. It is a continuous process without interruption. On average, an adult man produces several hundred million spermatozoa per day. However, the temperature needs to be approximately 35°C; when temperature increases, spermatozoa production is inhibited. At cooler temperatures, the testes are drawn up, closer to the body, whereas they hang lower when the temperature is warmer. This movement is performed by the muscles of the **scrotum**.

Epididymis

The epididymis is located adjacent to the testes, within the scrotal sac, and it has 2 main functions: to mature and store sperm. It contains the epididymal duct, which is shaped like a highly convoluted tube. The tunica albuginea of the testis and the epiorchium (lamina visceralis) are located on the exterior.

The exception is the point where the epididymis and testes are joined together. The connection between the epididymis and each testis is called the mesepididymis, which secures the testis in the scrotum. The epiorchium is the inner layer of the tunica vaginalis testis. The epididymis contains connective tissue, with plenty of nerve fibers and [blood vessels](#). The sperm cells are pushed out of the testes through the seminiferous tubules into the tubules of the epididymis. From there, they reach the vas deferens.

Prostate Gland

The prostate is located beneath the urinary bladder and surrounds the urethra. The urethra transports urine and sperm. The **Cowper glands**, seminal vesicles, and prostate all permanently release small volumes of secretions that dilute the sperm concentrate in the vas deferens.

The secretions and the sperm are ejected through the urethra simultaneously. After the prostate, the urethra passes through the pelvic floor, the penis, and the glans. Shortly before ejaculation, the secretion of the **Cowper glands** also cleans the urethra. This way, the acidic environment in the vaginal tract is neutralized, prolonging the lifespan of the sperm and providing mobility for them.

Erection and Sexual Intercourse

Without penile erection, sexual intercourse would be impossible. The erection is prompted by stimuli (visual or physical). Subsequently, the corpus cavernosa fills with arterial blood. At the same time, due to the stimulation of previously smooth muscles, venous drainage of the blood is prevented.

This process can take place within a few seconds. During ejaculation, smooth muscle contracts in the following:

- Epididymis
- Vas deferens
- Seminal vesicle
- Prostate

Through this pressure, the seminal fluid is pushed into the urethra. With the contraction of the pelvic floor, 60-120 million spermatozoa are released.

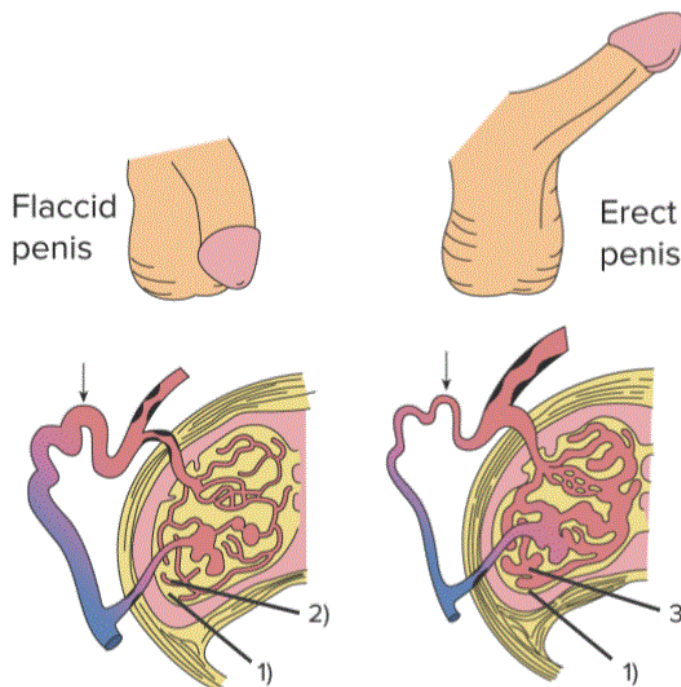


Image: Blood circulation to the flaccid and erect penis, by Lecturio

Hormones Influencing the Male Reproductive System

The hormones controlling the male sexual organs are the androgenic and gonadotropic hormones of the pituitary gland. Testosterone is an androgen and is produced in the **Leydig cells** of the testes. **Follicle-stimulating hormone (FSH)** and **luteinizing hormone (LH) (lutropin)** are formed in the pituitary gland. They play a crucial role in female hormonal balance, but in men, they affect only the tissue of the testes. The effect of testosterone is considerably more complex. It influences the following:

- Testes
- Accessory glands
- Secondary sexual characteristics
- Sexual behavior
- General metabolism

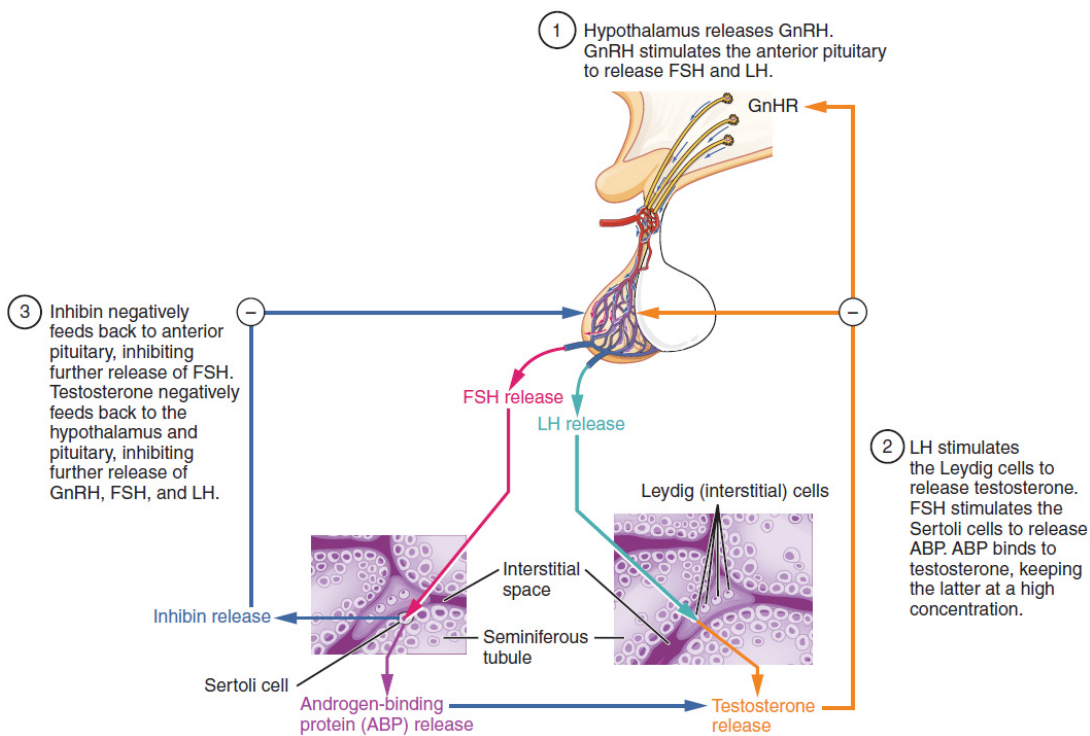


Image: Regulation of testosterone production, by Phil Schatz. License: [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)

FSH and LH are important for sperm production and testosterone formation, and LH indirectly affects the Leydig cells. The production of LH and FSH is constant in men; cyclic fluctuations do not occur.

Pathology of the Male Reproductive System

Testes

One of the most common complications that can occur with the testes is a problem with their descent. Therefore, checking for this complication is part of the standard physical examinations conducted for boys, from infancy through adolescence. One possible disorder occurs when the testes do not completely descend into the scrotum. This should

be observed and, if necessary, corrected through a surgical procedure to move the testes into place.

Another complication occurs when the inguinal canal does not close after the descent of the testes. This results in an **inguinal hernia**, which can lead to abdominal organs being forced through the canal. In this case, too, surgical intervention might be necessary.

Impotence

Impotence specifically describes the inability to reproduce (sterility). However, because an erection is necessary for intercourse, the term 'impotence' is often used to describe erectile dysfunction. Common medications to treat erectile dysfunction directly influence the physiologic process of blood accumulation in the corpus cavernosum. They do not act to produce sexual stimulation; this means that without sexual stimulation, even with drugs for erectile dysfunction, there will be no erection.

Impotence can have many causes. Increasing age may decrease the ability to achieve or maintain an erection, but stress and relationship problems can also cause erectile dysfunction. In addition, several diseases can cause erectile dysfunction; one common example of this is diabetes.

Infertility (sterility)

In approximately 30% of cases in which a woman is unable to conceive, the cause is male fertility problems. Infertility can be caused by low sperm count or immotile sperm. In a healthy fertile man, at least 30% of the sperm per ejaculation should be formed normally, and at least 50% should be sufficiently mobile. Abnormalities are an important indication of existing infertility. The quality of sperm decreases with age. Other factors that can adversely affect sperm quality include the following:

- Mumps with testes infection
- Injury of the testes
- Heavy smoking
- High alcohol consumption
- Diabetes
- Poisoning
- Tumors
- Varicose veins
- Overheating of the testes

Infertility can also be congenital. The quality of sperm can easily be determined by a simple test.

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