

An eText of Human Anatomy and Physiology

Dr. Bruce Forciea

Dr. Bruce Forciea Page 1 Etext of Human Anatomy and Physiology by Dr. Bruce Forciea is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License. 2012

Scientific information continuously progresses and changes. The author has done substantial work in order to ensure the information presented in this book is accurate, up to date, and within acceptable standards at the time of publication. The author is not responsible for errors or omissions, or for consequences from the application of the information contained in this book and makes no warranty, expressed or implied, with regard to the contents of this book.

About the Author

Bruce Forciea is a full-time science instructor at Moraine Park Technical College. He primarily teaches anatomy and physiology. Besides developing courses, teaching, and dabbling in digital media, he enjoys playing guitar and writing music. Dr. Forciea is trained as a chiropractor and attended Parker College of Chiropractic. He ran a full-time practice for more than a dozen years and treated thousands of patients before accepting a teaching position. He has also presented his various projects at regional, national and international conferences.

To Other Instructors and Users

You are free to use all or portions of this text as well as modify it for your needs. You can add or take away what you need, create handouts for your classes and post this information online. All of the images are licensed under various Creative Commons licenses so there may be some restrictions. You will need to check each license by clicking on the hyperlink which accompanies it. The images were selected primarily from Wikimedia Commons and some were modified by the author. The remaining images were produced by the author.

The Reproductive System

One of the primary directives of life is to reproduce and pass on genetic information to future generations. This is the purpose of the human reproductive system. We often think of the differences between males and females but there are striking similarities in reproductive systems of both. Both carry half of the genetic information required to produce a human, both contain a number of the same hormones and both have similar stages of reproductive development. As you get through this chapter you may wish to discover the similarities of both systems.

The Big Picture

The overall function of both male and female reproductive systems is to pass on genetic information to offspring. The male produces half of the genetic information and packages it in sperm cells. These cells develop and travel through the male to the female. Likewise the female also produces half of the genetic information and packages it in an egg cell called an oocyte. The oocyte is cyclically produced and is either fertilized to complete its development or is not and is subsequently discarded. Hormones work to control and support these processes.

The Male Reproductive System

The male reproductive system can be thought of as having two divisions. The primary organs are the testes and the rest of the organs are considered secondary. The function of the male system is to produce and develop sperm cells, transport the sperm to the female and produce and secrete sex hormones (fig. 27.1).

Testes

The testes are considered the primary sex organs of the male. The testes develop in utero in a retroperitoneal location. They descend and pass through the inguinal canal to finally reside in the scrotum. A tissue structure called the gubernaculum connects the developing testes with the scrotum. As the gubernaculum shortens the testes descend to the scrotum. This occurs at between 7-9 months of fetal development. The secretion of testosterone facilitates this process.

The **scrotum** is a sac located outside of the pelvic cavity. The scrotum consists of skin and is divided into two chambers. It also contains a smooth muscle known as the dartos muscles that can contract and draw the testes closer to the body. The abdominal muscles also connect to the testes by way of the **cremaster muscles**. These muscles also work to draw the testes closer to the body when they contract. By adjusting the position of the testes the internal temperature of the testes can be adjusted.

The testes are considered both endocrine and exocrine glands. They produce hormones that travel through the blood and secrete sperm cells that travel through ducts. The adult male has two testes. The testes are covered by a connective tissue membrane called the tunic albuginea. The inside of the testes is arranged in a series of lobules with tubular structures called **seminiferous tubules** within. The seminiferous tubules are surrounded by cell known as interstitial cells of Leydig. The **Leydig cells secrete testosterone**. The seminiferous tubules are coiled structures and empty into straight tubules called tubuli recti which in turn empty into the rete testes which constitutes a tubular network. The rete testes empty into the efferent ductules which in turn move through the tunica albuginea to the **epididymis**.

The testes also contain the sperm cells called **spermatogonia** as well as sustentacular cells (Sertoli cells). The **Sertoli cells** are columnar in shape and **form a barrier between the testes and the blood**. This barrier helps to isolate sperm cells so that the immune system does not attack them. Sertoli cells secrete the hormone called inhibin as well as substances to help sperm mature. Sperm cells have different antigens on their surface than body cells that could trigger an immune response.

Epididymis

The epididymis is a tubular structure that resides on the superior-posterior surface of the testes. These paired structures each have three portions consisting of a head, body and tail. The head connects with the efferent ductules of the testes. The epididymis works to help sperm cells mature as they spend up to 3 weeks in the tubule system within the epididymis. Sperm move through the epididymis to the vas deferens.

Vas Deferens

The vas deferens or ductus deferens is a tubular structure that is consistent with the tail of the epididymis. The vas deferens has three muscular layers including inner and outer longitudinal layers and a middle circular layer. The muscular layers help to propel sperm cells through the tube. **Each vas deferens moves superiorly through the inguinal canal and travels through the abdominal cavity and over the top of the bladder to the seminal vesicle**. The vas deferens travels in the spermatic cord which is a connective tissue sheath that also contains blood vessels and lymphatics. As the vas deferens nears the seminal vesicle the tube widens into an ampulla.

Seminal Vesicles

The seminal vesicles are located posterior to the bladder and anterior to the rectum (fig. 27.3). They contain epithelium that secretes an alkaline substance, fructose and prostaglandins.

Prostate Gland

The prostate is a walnut shaped gland just inferior to the bladder (fig. 27.2). The prostate gland **secretes an acidic milky fluid** that helps to nourish and mobilize sperm. The fluid also contains enzymes (hyaluronidase) and prostate specific antigen (PSA).

The **urethra** (prostatic urethra) passes through the prostate gland. The prostate also contains another set of paired ducts that connect the seminal vesicles to the urethra called the ejaculatory ducts.

Bulbourethral Glands

The paired bulbourethral glands (Cowper's glands) are pea-shaped glands that **secrete an alkaline substance and mucous to help protect and transport the sperm**.

Urethra

The urethra begins at the base of the urinary bladder and passes through the prostate gland and through the penis ending at the urinary meatus of the penis. The urethra is lined with a mucous membrane. There are three parts to the male urethra. These include the portion traveling through the urethra (prostatic urethra), the portion extending from the base of the prostate gland to the penis (membranous urethra) and the portion running through the center of the penis (penile urethra). Dr. Bruce Forciea Page 686

Penis

The penis consists of three columns of tissue called **erectile columns** surrounded by fibrous coverings surrounded by skin (fig. 27.4). The two superior columns are called the **corpus cavernosum** and the lower column is called the **corpus spongiosum**. Each corpus cavernosum contains a deep artery and is surrounded by a fibrous covering called a tunica albuginea. The corpus spongiosum contains the urethra. The distal portion of the penis contains a slightly larger structure called the glans penis. The **glans penis** is covered by loose skin called the **prepuce** which is sometimes removed by circumcision.

Figure 27.1. Male reproductive system

http://commons.wikimedia.org/wiki/File:Male_anatomy.png Dr. Bruce Forciea Page 687

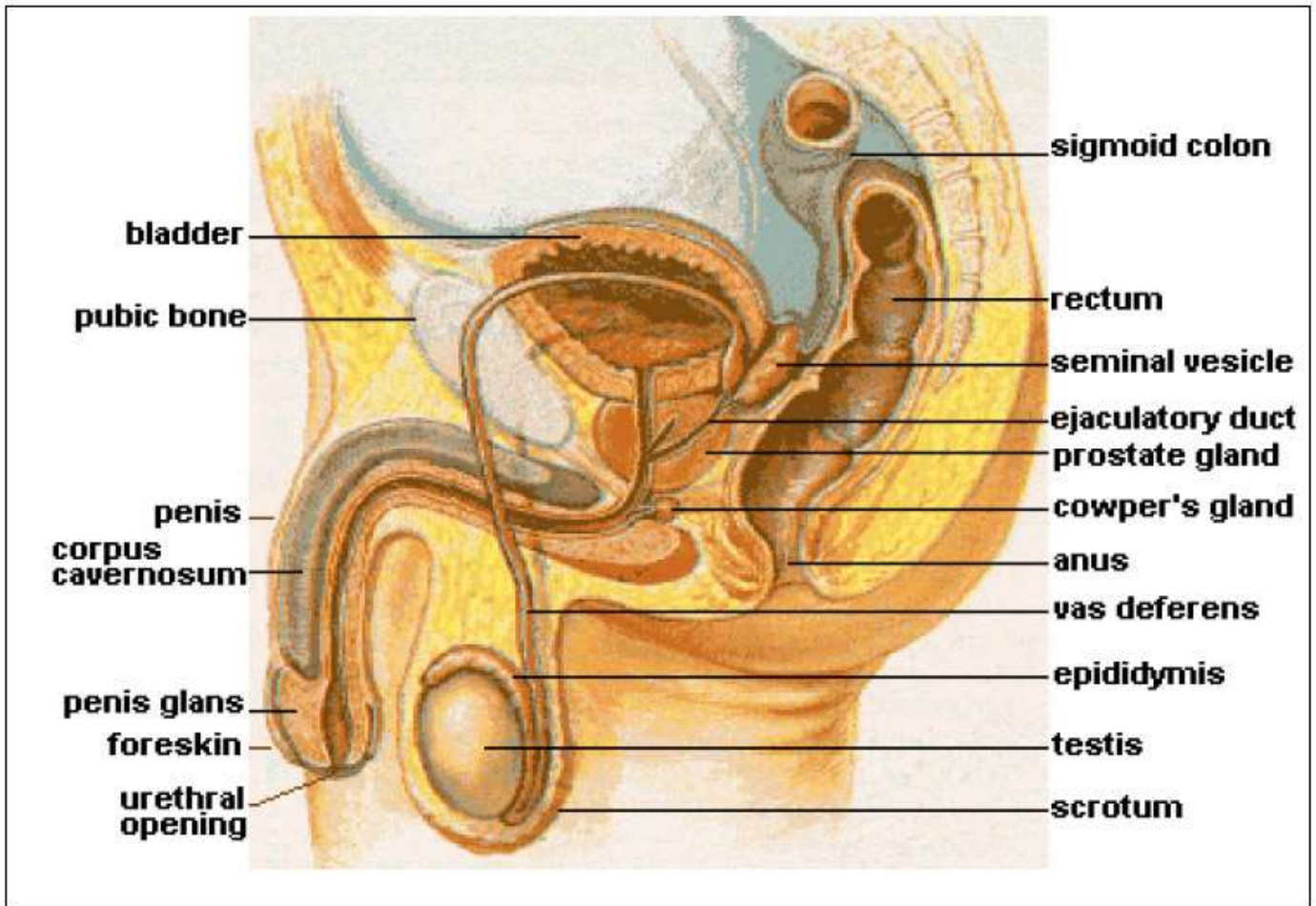


Figure 27.1. Male reproductive system

http://commons.wikimedia.org/wiki/File:Male_anatomy.png

Figure 27.2. Prostate gland

http://commons.wikimedia.org/wiki/File:Illu_prostate_lobes.jpg Dr. Bruce Forcica Page 688

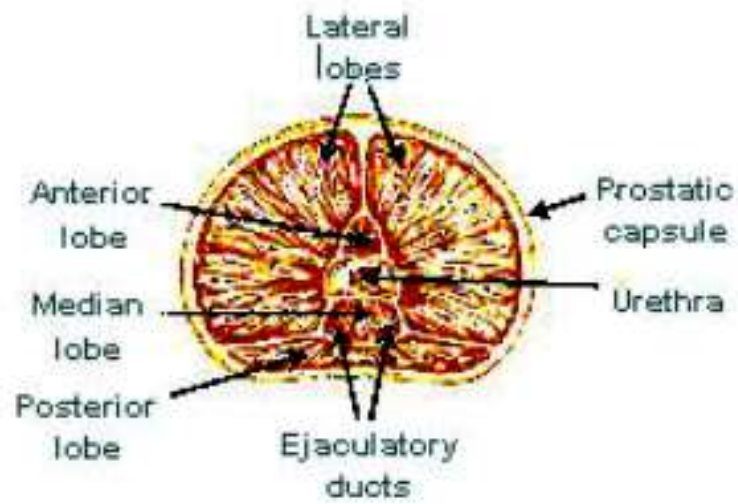
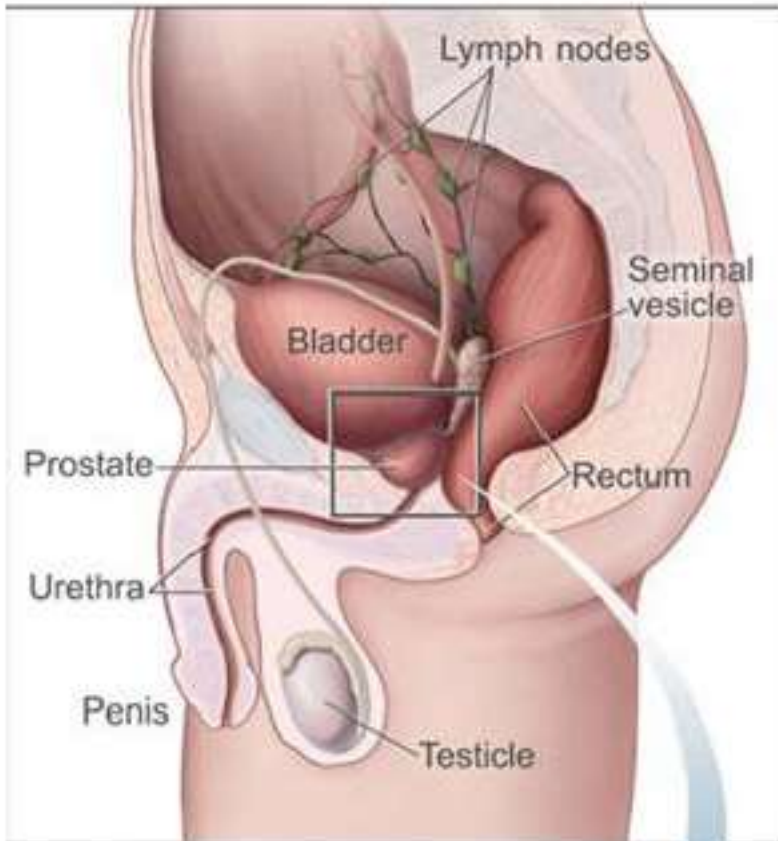


Figure 27.2. Prostate gland

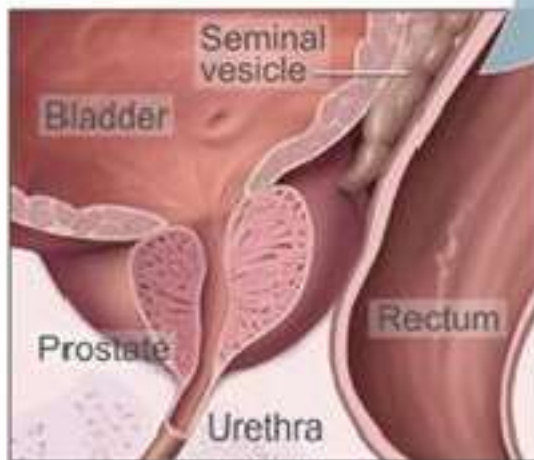
http://commons.wikimedia.org/wiki/File:Illu_prostate_lobes.jpg

Figure 27.3. Prostate and seminal vesicle

<http://commons.wikimedia.org/wiki/File:Prostatelead.jpg> Dr. Bruce Forciea Page 689



This shows the prostate and nearby organs.



This shows the inside of the prostate, urethra, rectum, and bladder.

Figure 27.3. Prostate and seminal vesicle

<http://commons.wikimedia.org/wiki/File:Prostatelead.jpg>

Figure 27.4. Penis

http://commons.wikimedia.org/wiki/File:Penile-Clitoral_Structure.JPG Dr. Bruce Forcica Page 690

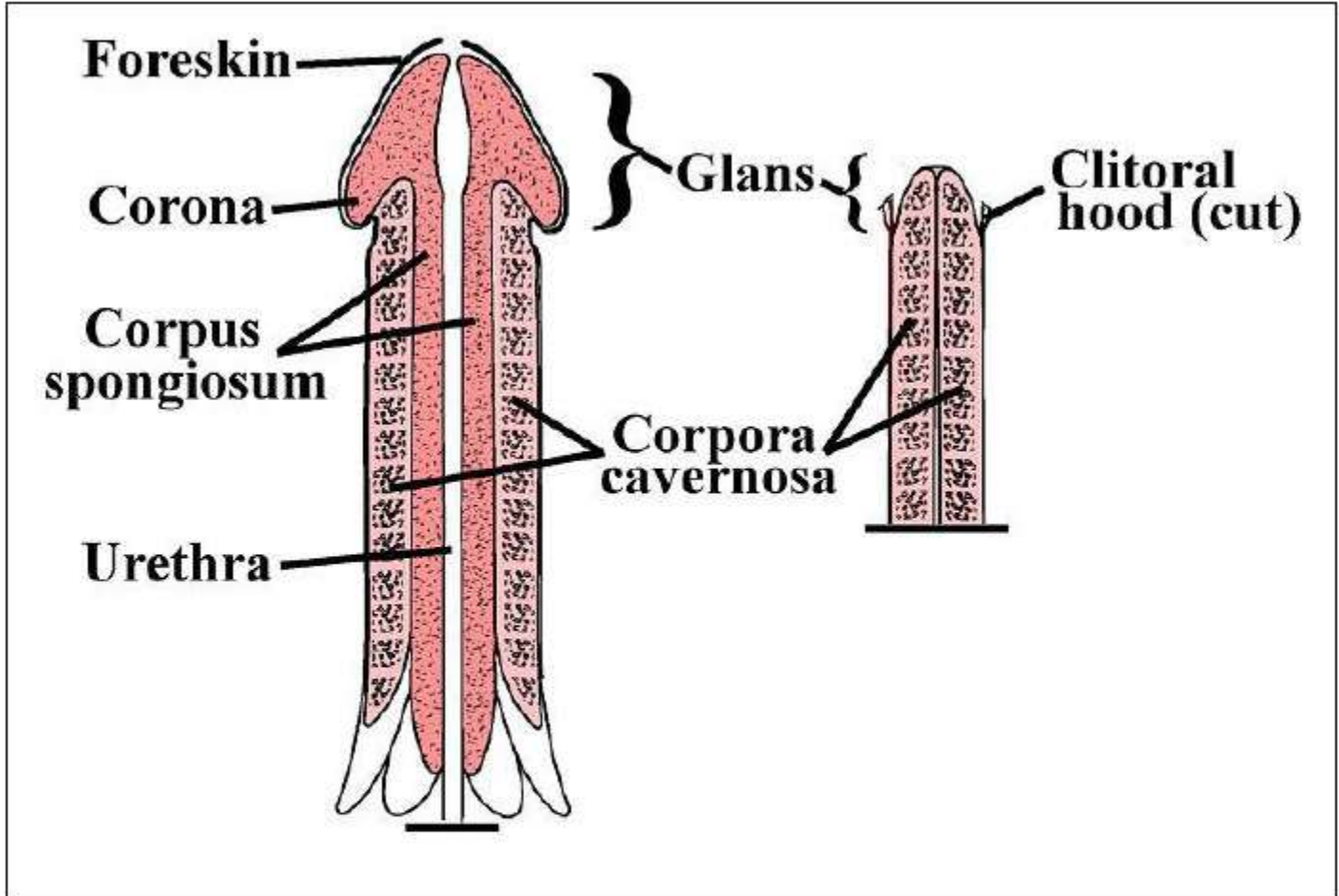


Figure 27.4. Penis

http://commons.wikimedia.org/wiki/File:Penile-Clitoral_Structure.JPG

Female Reproductive System

The female reproductive system not only carries the genetic information for offspring but is also capable of providing an environment for the early stages of growth and development of the human (fig. 27.5).

Ovaries

The primary sex organs of the female reproductive system are the ovaries. All of the other structures are considered secondary organs. The ovaries are similar in structure to the testes. The ovaries begin in utero as masses of tissue located posterior to the abdominal cavity (retroperitoneal). They descend slightly and reside in the pelvic cavity on either side of the uterus. They are ovoid structures located inferior to the uterine tubes (Fallopian tubes). The ovaries are covered by a thin layer of epithelium called germinal epithelium. The inner region of the ovaries contains structures known as ovarian follicles surrounded by a connective tissue matrix. The ovarian follicle contains the egg cells known as oocytes. The oocytes are released at about half way through the menstrual cycle in what is known as ovulation.

Fallopian Tubes

The Fallopian tubes or uterine tubes extend from the lateral areas of the uterus and continue to near the ovaries but do not contact it. The tubes contain three layers including an inner mucous membrane, a middle muscular layer and an outer serous layer. The inner mucous membrane is continuous with the peritoneal membrane surrounding the pelvic cavity. This membrane is also continuous with the walls of the vagina and can be susceptible to infection by microorganisms.

The Fallopian tubes have three sections. These include the first third that extends from the isthmus of the uterus, the second third which ends in a widened area called the infundibulum and the final third which ends in finger-like projections called fimbriae.

The Fallopian tubes work to transport the oocyte to the uterus after fertilization and are the sites for fertilization by sperm cells. Most fertilized oocytes move to the uterus but occasionally they will deposit somewhere in the pelvic cavity causing what is known as an ectopic pregnancy.

Uterus

The uterus is a pear shaped structure about three inches long and two inches in width. The uterus has two divisions including the body and cervix. The body ends anteriorly as a narrow region called the cervix and posteriorly as a rounded structure called the fundus (figs. 27.6, 27.7).

The uterus has three layers. The inner layer is called the endometrium. The endometrium varies in thickness and is thinner just after menstruation and thicker at the end of the cycle. The endometrium has an extensive blood supply and contains mucous secreting cells. The mucous changes its consistency during various times of the menstrual cycle. It is normally thicker during most of the cycle and more watery near the time of ovulation to help move sperm cells through. The middle layer or myometrium is a thick smooth muscle layer. The smooth muscle is capable of producing very strong contractions during childbirth. The outer layer or perimetrium consists of a serous membrane.

The body of the uterus lies on top of the bladder in what is called an anteflexed position. The cervix of the uterus connects with the vagina at an upward right angle. This connection allows for pockets around the cervix called the anterior and posterior fornix that allow for pooling of semen to increase the chances of fertilization.

The uterus can lie in retroflexion in which the uterus tilts backward. Retroflexion can sometimes cause prolapsed of the uterus. The uterus is held in place by a series of ligaments. These include two broad ligaments, two uterosacral ligaments, a posterior, anterior and two round ligaments.

The posterior ligament forms a pouch called the posterior cul de sac or rectouterine pouch (of Douglas). Likewise the anterior ligament also forms a pouch called the anterior cul de sac or vesicouterine pouch.

Vagina

The vagina is located between the rectum and urethra. It is a tubular structure about 3 inches long that opens to the outside and extends superior and posterior to the cervix of the uterus. The vagina is primarily smooth muscle lined with an epithelial mucous membrane. The mucous membrane can form around the opening of the vagina. This structure is called a hymen. In some cases the opening to the vagina can be completely covered by the hymen (imperforate hymen). An imperforate hymen needs to be medically punctured to allow discharge of the menstrual flow.

Vulva

The vulva consists of several externally located structures of the female reproductive system. These include the **labia majora and minora**, mons pubis, **clitoris, vestibule**, urinary meatus, greater and lesser vestibular glands.

The labia majora are skin covered structures consisting of primarily adipose and connective tissue. The outer surface of the labia majora contain hair while the inner surface does not. They also contain a mucous lining. **They are analogous to the scrotum of the male.** The labia minora are hairless structures located medially to the labia majora. The space between both labia minor is known as the vestibule.

The **clitoris** is an organ consisting of erectile tissue. It is located just superior and behind the labial junction. The **clitoris contains two corpus cavernosum** but no corpus spongiosum so it is similar in structure to the penis. The superior aspect of the clitoris contains a covering of tissue known as the prepuce. Between the clitoris and opening to the vagina (vaginal orifice) is the urinary meatus which is the external opening of the urethra.

On the sides of the vagina are the greater vestibular glands or Bartholin's glands that open into the area between the labia minor and hymen. The lesser vestibular glands or Skene's glands are located near the urinary meatus.

Perineum

The perineum is the area between the vagina and anus. The perineum helps to form the muscular floor of the pelvis and can be torn during vaginal childbirth. The perineum contains the urogenital triangle which is formed by drawing a line between the ischial tuberosities with the anterior point of the triangle just superior to the prepuce.

Mammary Glands

The mammary glands or breasts are superficial to the pectoral muscles. Internally they consist of a series of lobes separated by connective tissue. The lobes subdivide into lobules containing secretory cells. The cells are arranged in clusters around a central duct. The smaller ducts combine to form larger ducts called lactiferous ducts for each lobe. The lactiferous ducts open to the outside at the nipple. The breasts also contain suspensory ligaments (of Cooper) that help to support it. Each breast contains a circular pigmented area called an areola. The areola contains sebaceous (oil secreting) glands to help protect the nipple. The breast also contains adipose tissue and lymphatics that drain into the axillary region.

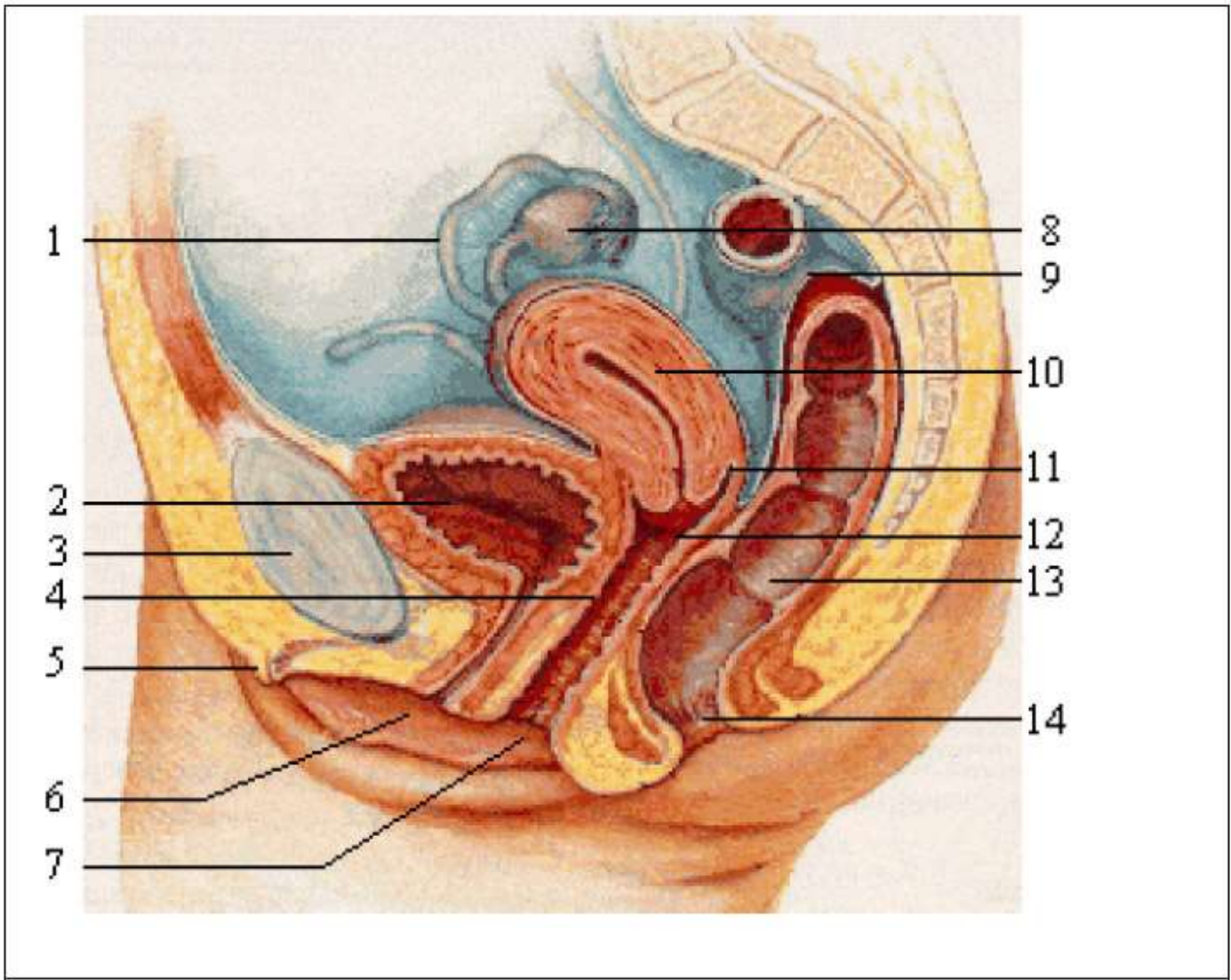


Figure 27.5. Female reproductive system

http://commons.wikimedia.org/wiki/File:Female_reproductive_system_lateral_nolabel.png

1: fallopian tube

- 2: bladder
- 3: pubic bone (pubic symphysis)
- 4: g-spot
- 5: clitoris
- 6: urethra
- 7: vagina

- 8: ovary
- 9: sigmoid colonti
- 10: uterus
- 11: fornix of vagina (including anterior and posterior)
- 12: cervix
- 13: rectum
- 14: anus

Rohen, Yokochi, and Lutjen-Drecoll. *Color Atlas of Anatomy*. Lippincott Williams & Wilkins. 2002. "Regional relations of female internal genital organs". "Midsagittal section through the female trunk".

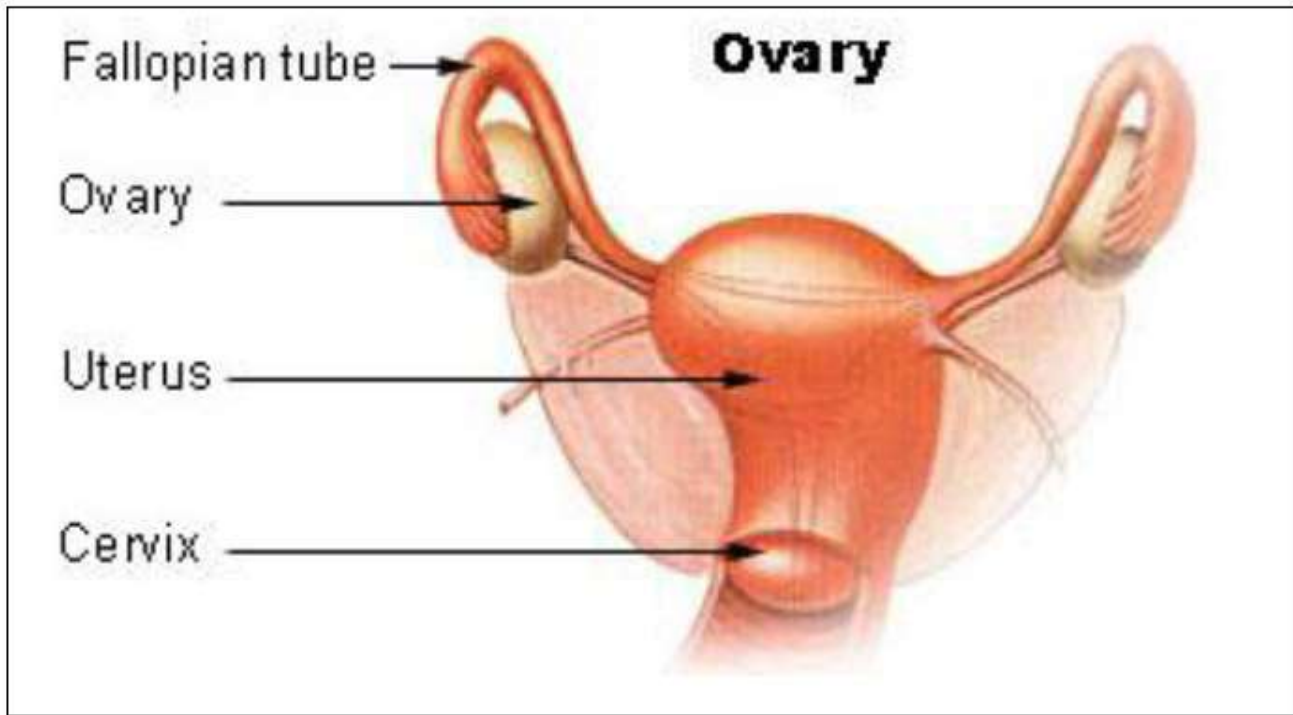


Figure 27.6. Uterus and Ovaries

http://commons.wikimedia.org/wiki/File:Illu_ovaryb.jpg

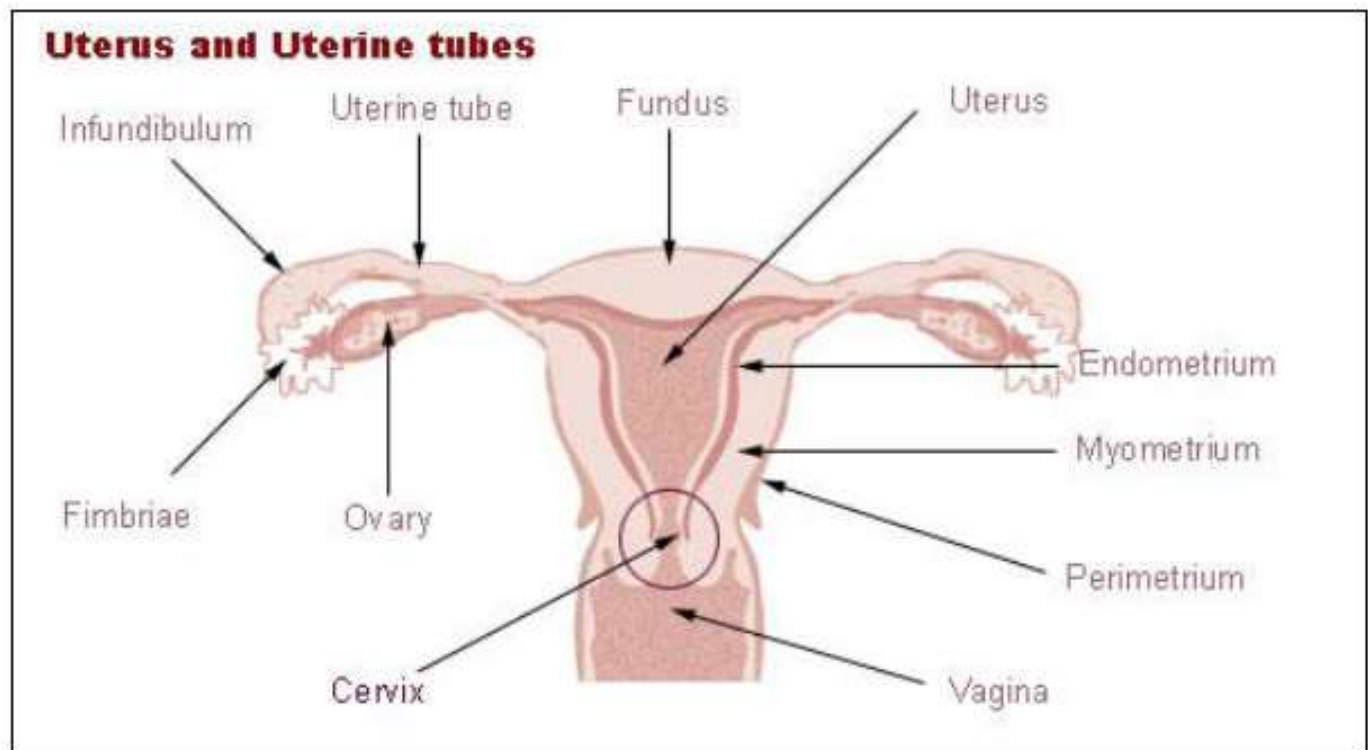


Figure 27.7. Uterus

http://commons.wikimedia.org/wiki/File:Illu_cervix.jpg

Chapter Review Questions

1. Which of the following cells secrete testosterone?
 - a. Sustentacular
 - b. Leydig
 - c. Seminiferous
 - d. Tubular

2. Which of the following is a correct statement?
 - a. Sperm move from the vas deferens to the epididymis
 - b. Sperm move from the seminal vesicle to the ejaculatory duct
 - c. Sperm move from the epididymis to the vas deferens
 - d. Sperm move from the prostate to the seminal vesicle

3. Which of the following structures secretes fructose?
 - a. Epididymis
 - b. Testes
 - c. Seminal vesicle
 - d. Prostate gland

4. Which of the following is correct regarding the erectile columns?
 - a. 1 corpora cavernosum and 2 corpora spongiosum
 - b. 1 corpora cavernosum and 1 copora spongiosum
 - c. 2 corpora cavernosum and 2 corpora spongiosum
 - d. 2 copora cavernosum and 1 corpora spongiosum

5. This mucous secreting gland is located at the base of the penis:
 - a. Prostate
 - b. Bulbourethral
 - c. Seminal vesicle
 - d. Epididymis

6. Which are considered primary sex organs in the female?
 - a. Vagina
 - b. Ovaries
 - c. Uterus
 - d. Fallopian tubes

7. Which of the following is the thickest layer of the uterus?
 - a. Myometrium
 - b. Endometrium
 - c. Ectometrium
 - d. Perimetrium