

19

The Reproductive System

FOCUS: Reproductive organs in males and females produce sex cells. The reproductive organs sustain the sex cells, transport them to the site where fertilization can occur, and, in the female, nurture the developing offspring both before and, for a time, after birth. Reproductive organs also produce hormones that play

important roles in the development and maintenance of the reproductive system. These hormones help determine sexual characteristics, influence sexual behavior, and play a major role in regulating the physiology of the reproductive system.

CONTENT LEARNING ACTIVITY

Formation of Sex Cells

“The formation of sex cells takes place by meiosis.”

Match these terms or numbers with the correct statement or definition:

Fertilization	2
Oocyte	4
Polar body	23
Sperm cell	46
Zygote	

- _____ 1. The number of cell divisions that occur during meiosis.
- _____ 2. The number of chromosomes in human cells before meiosis.
- _____ 3. The number of chromosomes produced by meiosis in the sex cells of humans.
- _____ 4. In females, the developing sex cell that receives most of the cytoplasm.
- _____ 5. The uniting of a male and female sex cell.
- _____ 6. The cell that results from fertilization.

Scrotum and Testes

“The testes are the male’s primary reproductive organs.”

Match these terms with the correct statement or definition:

Cremaster muscle
Dartos muscle
Interstitial cells

Lobules
Seminiferous tubules
Scrotum

- _____ 1. Sac containing the testes.
- _____ 2. Two structures that regulate the temperature of the testes.
- _____ 3. Subdivisions of the testes.
- _____ 4. Site of sperm cell development.
- _____ 5. Responsible for testosterone production.



If the testes become too warm or too cold, normal sperm cell development does not occur.

Spermatogenesis

“Spermatogenesis is the formation of sperm cells.”

Match these terms with the correct statement or definition:

Acrosome
Primary spermatocytes
Secondary spermatocytes
Sertoli cells

Sperm cell
Spermatid
Spermatogonia

- _____ 1. Large cells that nourish the germ cells and produce hormones.
- _____ 2. Most peripheral cells; they divide by mitosis.
- _____ 3. Germ cells produced from spermatogonia, which divide into two cells during the first meiotic division.
- _____ 4. Formed from primary spermatocytes these cells undergo a second meiotic division.
- _____ 5. Produced from a secondary spermatocyte; each has 23 chromosomes.
- _____ 6. Develop from a spermatid by forming a head, midpiece, and flagellum; spermatozoon.
- _____ 7. Sperm cell vesicle containing enzymes released during fertilization.

Ducts

“Sperm cells leave the testes and pass through a series of ducts to reach the exterior of the body.”

Match these terms with the correct statement or definition:

Ductus deferens
Efferent ductules
Ejaculatory duct
Epididymis

Rete testis
Spermatic cord
Urethra

1. Receive sperm cells from the seminiferous tubules.
2. Tubes that exit the testis.
3. Receives the efferent ductules from the testis; a comma-shaped structure on the outside of the testis.
4. Site of sperm cell maturation.
5. Duct that passes through the abdominal wall.
6. Blood vessels and nerves that supply the testis, the cremaster muscle, and the ductus deferens.
7. Formed by the ampulla of the ductus deferens and a duct from the seminal vesicle; empties into the urethra.
8. Extends to the tip of the penis.



A vasectomy is a surgical procedure for producing sterility in males.

Penis

“The penis is the male organ of copulation and it transfers sperm cells from the male to the female.”

Match these terms with the correct statement or definition:

Erection
External urethral orifice
Circumcision
Corpora cavernosa

Corpus spongiosum
Glans penis
Prepuce

1. Engorgement of penile erectile tissue with blood.
2. Paired columns of erectile tissue in the penis.
3. Single column of erectile tissue in the penis; the urethra passes through it.
4. Expanded distal end of the penis.
5. Opening of the urethra to the exterior.
6. Skin that covers the glans penis; foreskin.
7. Surgical removal of the prepuce.

Glands

“Several glands secrete substances into the ducts of the reproductive system.”

A. Match these terms with the correct statement or definition:

Bulbourethral glands Semen
Prostate gland Seminal vesicles

- | | |
|-------|---|
| _____ | 1. Two sac-shaped glands near the ampulla of the ductus deferens. |
| _____ | 2. Gland the size and shape of a walnut that surrounds the urethra and the two ejaculatory ducts. |
| _____ | 3. Small glands located near the base of the penis. |
| _____ | 4. Mixture of sperm cells and glandular secretions. |
| _____ | 5. Glands producing a mucous secretion that neutralizes the acidic urethra. |
| _____ | 6. Glands producing thick, mucuslike secretions containing nutrients that nourish the sperm cells. |
| _____ | 7. Gland producing thin, milky secretions with an alkaline pH that neutralizes acidic secretions of the testes, seminal vesicles, and the vagina. |

B. Match these terms with the correct parts labeled in figure 19.1:

Bulbourethral gland
Ductus deferens
Ejaculatory duct
Epididymis
External urethral orifice
Penis
Prostate gland
Scrotum
Seminal vesicle
Testis
Urethra

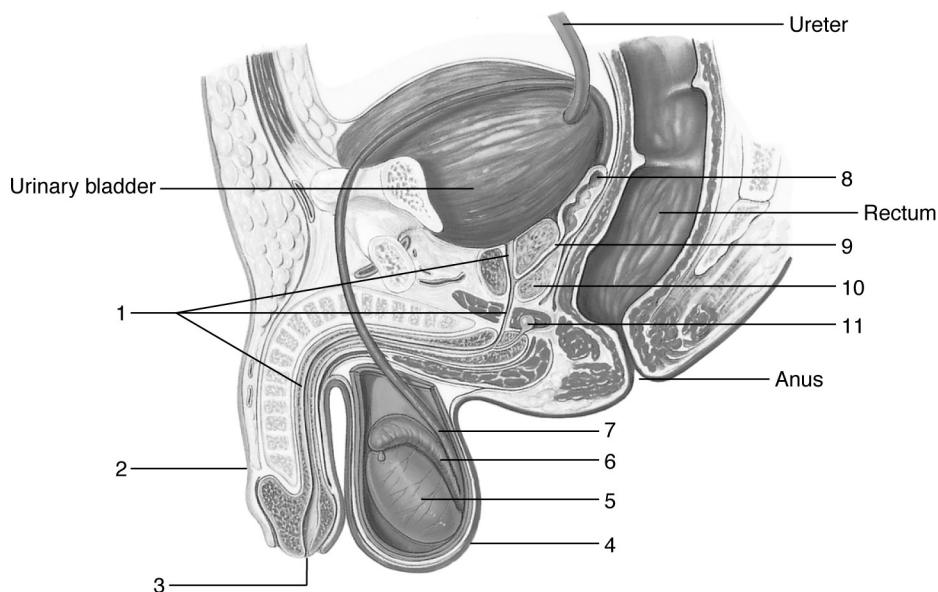


Figure 19.1

- | | | |
|----------|----------|-----------|
| 1. _____ | 5. _____ | 9. _____ |
| 2. _____ | 6. _____ | 10. _____ |
| 3. _____ | 7. _____ | 11. _____ |
| 4. _____ | 8. _____ | |

Male Sex Hormones

“Hormones are responsible for the development and maintenance of reproductive structures.”

Match these terms with the correct statement or definition:

FSH
GnRH
Inhibin

LH
Testosterone

1. Hormone released from the hypothalamus; stimulates the anterior pituitary to secrete two hormones.
2. Released from the anterior pituitary; stimulates interstitial cells to secrete testosterone.
3. Released from the anterior pituitary; binds to Sertoli cells and promotes sperm cell development and inhibin secretion.
4. Secreted by Sertoli cells; inhibits FSH secretion.
5. Before puberty, small amounts are produced by the testes and adrenal gland; inhibits GnRH, LH, and FSH secretion.
6. Causes the enlargement and differentiation of the male genitalia; promotes the development of secondary sexual characteristics; necessary for spermatogenesis.

Male Sexual Behavior and the Male Sex Act

“Neural mechanisms are primarily involved in controlling the sexual act.”

Match these terms with the correct statement or definition:

Ejaculation
Emission
Erection
Impotence

Orgasm
Resolution
Testosterone

1. Hormone required for normal sexual behavior.
2. Pleasurable sensation associated with ejaculation.
3. Inability to accomplish the sexual act.
4. Occurs when parasympathetic action potentials cause the dilation of the arteries that supply blood to the erectile tissue of the penis.
5. Sympathetic action potentials stimulate the seminal vesicles and prostate gland to release their secretions.
6. Rhythmic contractions that force semen out of the urethra; caused by action potentials sent to skeletal muscles at the base of the penis.



Sensory action potentials from the genitals activate sexual reflexes. Psychic stimuli such as sight, sound, odor, or thoughts, also have a major effect on sexual responses.

Ovaries

“The ovaries are attached to ligaments that suspend them in the pelvic cavity.”

A. Match these terms with the correct statement or definition:

Broad ligament
Mesovarium

Ovarian ligament
Suspensory ligament

1. Holds the uterus, uterine tubes, and ovaries in place.
2. Peritoneum that attaches the ovaries to the broad ligament.
3. Ligament that extends from the lateral body wall to the ovary.
4. Attaches the ovary to the uterus.

B. Match these terms with the correct statement or definition:

Mature follicle
Oocyte
Oogonia
Ovarian follicle

Primary follicle
Primary oocyte
Primordial follicle
Secondary follicle

1. General term for the female germ cell.
2. General term for an oocyte and the cells that surround it.
3. Cells from which oocytes develop.
4. An oocyte that has started the first meiotic division.
5. The primary oocyte surrounded by a single layer of flat granulosa cells.
6. Consists of several layers of granulosa cells surrounding the primary oocyte; a clear layer, the zona pellucida, surrounds the oocyte.
7. Follicle that has just developed an antrum; the oocyte is surrounded by the cumulus mass; the follicle is surrounded by the theca.
6. Enlarged secondary follicle on the surface of the ovary; a Graafian follicle.



The developing follicles secrete estrogen that prepares the uterus to receive the fertilized ovum.

C. Using the terms provided, complete these statements:

Corpus luteum
 Estrogen
 Fertilization
 HCG

Ovulation
 Placenta
 Progesterone
 Secondary oocyte

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Rupture of the mature follicle and release of the oocyte from the ovary is called (1). Near this time the primary oocyte completes the first meiotic division to form the (2), which begins the second meiotic division. The second meiotic division is completed only if (3) occurs. The ruptured follicle becomes the (4), which secretes (5) and (6). If fertilization occurs, the placenta secretes (7), which causes the corpus luteum to persist and continue to produce hormones that are necessary to maintain the pregnancy. After the first trimester the (8) produces hormones and the corpus luteum degenerates.

Uterine Tubes, Uterus, and Vagina

“*The uterus is the site of development of a new individual.*”

A. Match these terms with the correct statement or definition:

Body of uterus
 Cervical canal
 Cervix
 Endometrium
 Fimbriae
 Hymen

Myometrium
 Perimetrium
 Uterine cavity
 Uterine tubes
 Vagina

- | | |
|-------|--|
| _____ | 1. Extend from the ovaries to the uterus; conduct the oocyte to the uterus; also called fallopian tubes or oviducts. |
| _____ | 2. Long processes that surround the ovary and sweep the oocyte into the uterine tube. |
| _____ | 3. Fertilization usually occurs here. |
| _____ | 4. The inferior, narrow neck of the uterus. |
| _____ | 5. Cavity that opens into the vagina. |
| _____ | 6. Outer layer of the uterine wall consisting of peritoneum. |
| _____ | 7. Middle muscular layer of the uterine wall. |
| _____ | 8. Inner epithelial and connective tissue layer of the uterus. |
| _____ | 9. The female organ of copulation; also allows menstrual flow and childbirth. |
| _____ | 10. Mucous membrane covering the opening of the vagina in young females. |

B. Match these terms with the correct parts labeled in figure 19.2:

- Body of uterus
- Cervical canal
- Cervix
- Endometrium
- Myometrium
- Ovary
- Ovarian ligament
- Perimetrium
- Round ligament
- Suspensory ligament
- Uterine cavity
- Uterine tube
- Vagina

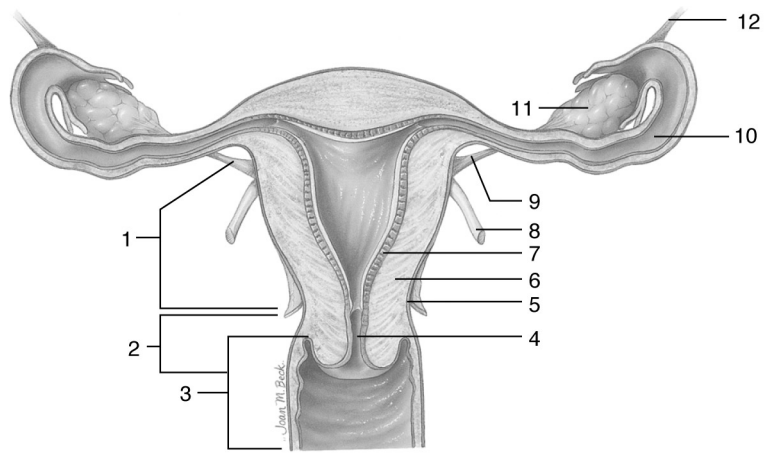


Figure 19.2

- | | | |
|----------|----------|-----------|
| 1. _____ | 5. _____ | 9. _____ |
| 2. _____ | 6. _____ | 10. _____ |
| 3. _____ | 7. _____ | 11. _____ |
| 4. _____ | 8. _____ | 12. _____ |

External Genitalia

“The external genitalia is also called the vulva or pudendum.”

A. Match these terms with the correct statement or definition:

- | | |
|-------------------|-------------------|
| Clinical perineum | Mons pubis |
| Clitoris | Pudendal cleft |
| Labia majora | Vestibular glands |
| Labia minora | Vestibule |

- | | |
|-------|---|
| _____ | 1. The space into which the vagina and urethra open. |
| _____ | 2. Thin, longitudinal skin folds bordering the vestibule. |
| _____ | 3. Small erectile structure covered by the prepuce. |
| _____ | 4. Glands that maintain the moistness of the vestibule. |
| _____ | 5. Rounded folds of skin lateral to the labia minora. |
| _____ | 6. Elevation of tissue located over the pubic symphysis. |
| _____ | 7. Space between the labia majora. |
| _____ | 8. The region between the vagina and anus; the location where an episiotomy is performed. |

B. Match these terms with the correct parts labeled in figure 19.3:

- Clinical perineum
- Clitoris
- Labia majora
- Labia minora
- Mons pubis
- Prepuce
- Urethra
- Vagina
- Vestibule

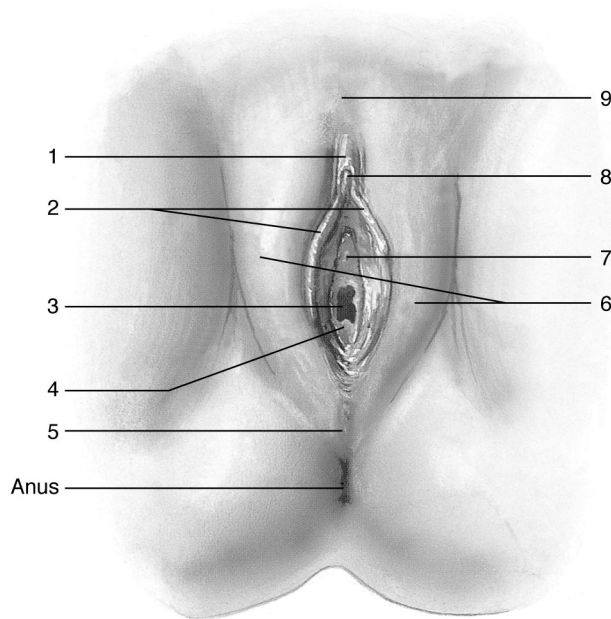


Figure 19.3

- | | | |
|----------|----------|----------|
| 1. _____ | 4. _____ | 7. _____ |
| 2. _____ | 5. _____ | 8. _____ |
| 3. _____ | 6. _____ | 9. _____ |

Mammary Glands

“The mammary glands are the organs of milk production and are located in the breasts or mammae.”

A. Match these terms with the correct statement or definition:

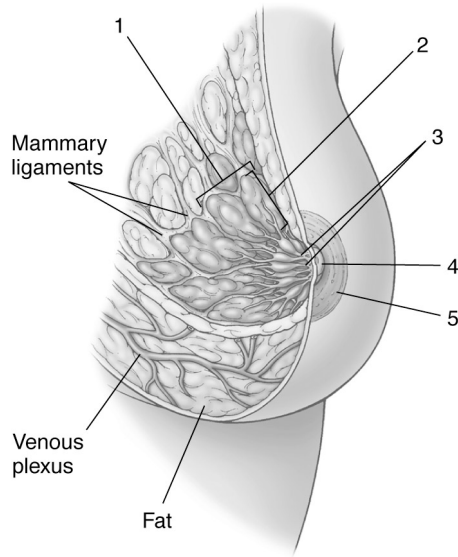
- Alveoli
- Areola
- Gynecomastia
- Lobe
- Lobule

- | | |
|-------|--|
| _____ | 1. Circular, pigmented area surrounding the nipple. |
| _____ | 2. Enlarged breasts in males. |
| _____ | 3. Glandular compartment of the mammary glands, each of which possesses a single duct that opens on the surface of the nipple. |
| _____ | 4. Subdivision of the lobes; contains the milk-producing structures. |
| _____ | 5. Secretory sacs that produce milk. |

B. Match these terms with
with the correct parts
labeled in figure 19.4:

Areola
Lactiferous duct
Lobe

Lobule
Nipple



1. _____
2. _____
3. _____
4. _____
5. _____

Figure 19.4

Puberty

“Puberty in females is marked by the first episode of menstrual bleeding, which is called menarche.”

Using the terms provided, complete these statements:

Cyclic	GnRH
Estrogen and progesterone	High
FSH and LH	Low

1. _____
2. _____
3. _____
4. _____
5. _____

The changes associated with puberty in the female are primarily the result of elevated levels of (1) secreted by the ovaries. Before puberty, the rate of secretion of (2) from the hypothalamus, and (3) from the anterior pituitary are very (4). After puberty the rate of secretion of GnRH, FSH, and LH increases and becomes (5), and is responsible for the pattern of estrogen and progesterone secretion of the adult.

Menstrual Cycle

“The term menstrual cycle refers to the series of changes that occur in sexually mature, nonpregnant women that culminate in menses.”

A. Match these terms with the correct statement or definition:

Female climacteric
Menopause
Menses

Ovulation
Proliferative phase
Secretory phase

- | | |
|-------|--|
| _____ | 1. Phase in which the endometrium of the uterus is sloughed; day 1 to days 4 or 5 of the cycle. |
| _____ | 2. Phase in which the endometrium begins to thicken and form glands; time between ending of menses and ovulation; days 4 or 5 to day 14 of the cycle. |
| _____ | 3. Release of the oocyte from the ovary; day 14 of the cycle. |
| _____ | 4. Phase in which the endometrium reaches its greatest degree of development and glands secrete a small amount of fluid; time between ovulation and the next menses; days 14 to 28 of the cycle. |
| _____ | 5. Phase in which a mature follicle is produced. |
| _____ | 6. Phase in which the corpus luteum is formed. |
| _____ | 7. Cessation of menstrual cycles. |
| _____ | 8. Period from the onset of irregular menstrual cycles to their complete cessation. |



During the climacteric, some women experience "hot flashes," irritability, fatigue, anxiety, and occasionally severe emotional disturbances. Many of these symptoms can be effectively treated with estrogen.

B. Match these terms with the correct parts labeled in figure 19.5:

Corpus luteum
Degenerated corpus luteum
Estrogen
FSH
GnRH
LH
Mature follicle

Menses
Primary follicle
Primordial follicle
Progesterone
Proliferative phase
Secondary follicle
Secretory phase

- | | | |
|----------|-----------|-----------|
| 1. _____ | 6. _____ | 11. _____ |
| 2. _____ | 7. _____ | 12. _____ |
| 3. _____ | 8. _____ | 13. _____ |
| 4. _____ | 9. _____ | 14. _____ |
| 5. _____ | 10. _____ | 15. _____ |

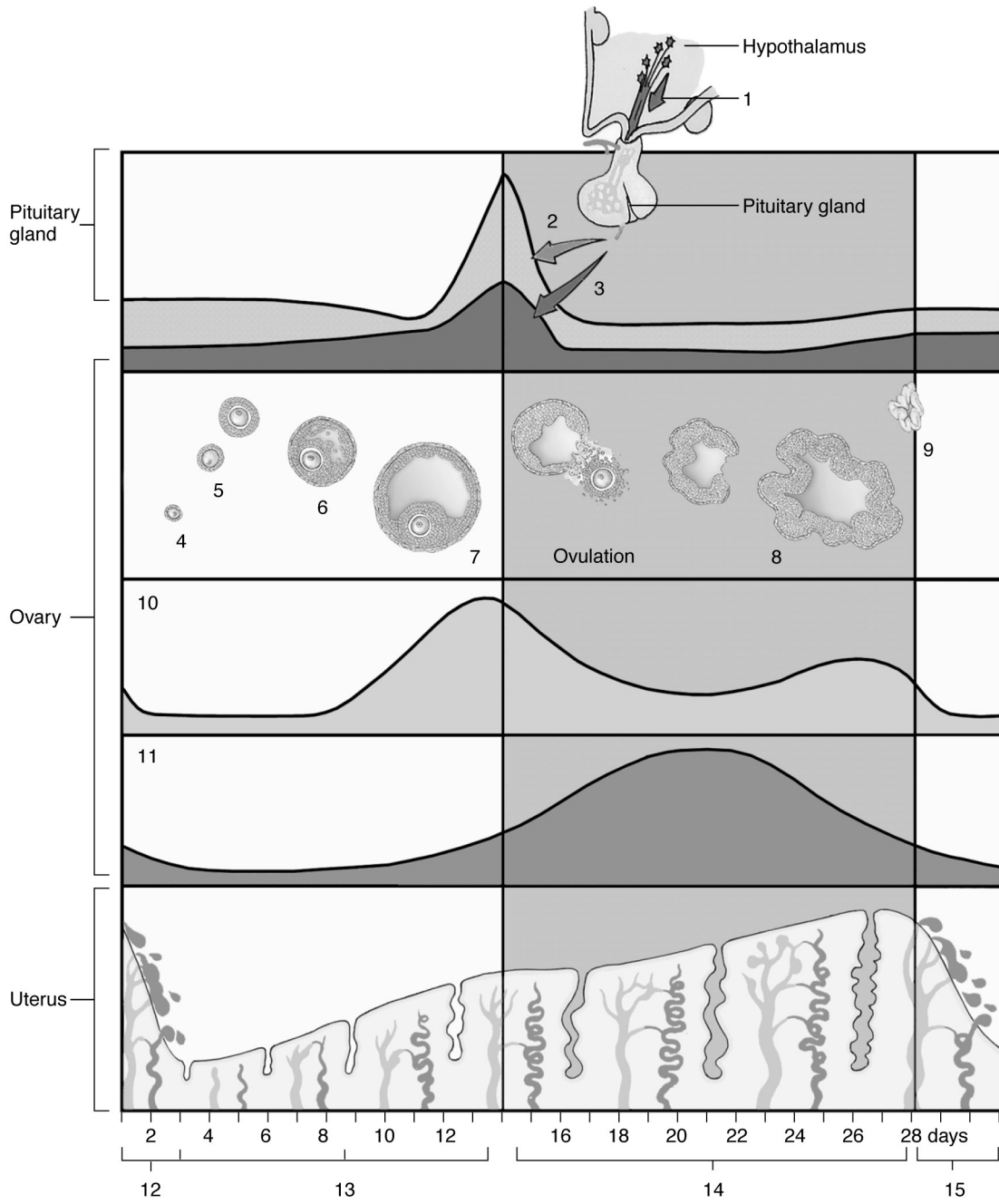


Figure 19.5

C. Match these terms with the correct statement or definition:

Estrogen
FSH
GnRH

LH
Progesterone

1. Decline in this hormone causes the endometrium to be sloughed and results in menses.
2. Increased secretion of this hormone from developing follicles causes the endometrium to thicken during the proliferative phase.
3. A large increase in this hormone results in ovulation.
4. At the time of ovulation this hormone acts on immature follicles and stimulates them to start developing; the follicles mature in the next menstrual cycle.
5. Produced by the corpus luteum; primarily responsible for the secretory phase of the uterus.
6. Stimulates the secretion of FSH and LH from the anterior pituitary.
7. Hormone that stimulates the secretion of estrogen from follicles.



Premenstrual syndrome results in mood changes just before menses. In severe cases, aggression and other socially unacceptable behaviors may occur. The cause of premenstrual syndrome is unknown, but it may be caused by fluctuations in estrogen and progesterone.

Female Sexual Behavior and the Female Sex Act

“Sexual drive in females, like sexual drive in males, is dependent upon hormones.”

Using the terms provided, complete these statements:

Clitoris
Fertilization
Orgasm

Psychic factors
Resolution
Vagina

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Testosteronelike hormone and possibly estrogens affect brain cells and influence sexual behavior; however, (1) also play a role in sexual behavior. During sexual excitement parasympathetic stimulation causes erectile tissue in the (2) and around the vaginal opening to become engorged with blood. Secretions from the (3) provide lubrication for the movement of the penis. Tactile stimulation during intercourse, as well as psychological stimuli, can trigger a(n) (4), the female climax. After the sexual act, there is a period of (5), characterized by an overall sense of satisfaction and relaxation. Although orgasm is a pleasurable component of sexual intercourse, it is not required for (6) to occur.

QUICK RECALL

1. List three functions of the male reproductive system.
2. List four functions of the female reproductive system.
3. List in the order of their formation the cells that are formed during spermatogenesis.
4. Starting at the site of sperm cell production, name in order the ducts sperm cells pass through to reach the exterior of the body.

5. Name the three types of glands in the male reproductive system and describe their secretions.

6. State the functions of GnRH, FSH, and LH in males.

7. List six effects that testosterone has in the male.

8. List in the order of their formation the follicles of the ovary. Name the structure that develops from the follicle after ovulation.

9. Name the three phases of the menstrual cycle.

10. State the functions of GnRH, FSH, and LH in females.

11. List the effects of estrogen and progesterone on the uterus.

WORD PARTS

Give an example of a new vocabulary word that contains each word part.

WORD PART	MEANING	EXAMPLE
semin-	semen	1. _____
-fer	to bear	2. _____
men-	month	3. _____
sperm-	seed	4. _____
oo-	an egg	5. _____
-genesis	origin	6. _____

MASTERY LEARNING ACTIVITY

Place the letter corresponding to the correct answer in the space provided.

- _____ 1. If an adult male jumped into a swimming pool of cold water, which of the following would be expected to happen?
- a. the cremaster muscles contract
 - b. the dartos muscles relax
 - c. the skin of the scrotum becomes loose and thin
 - d. the testes descend away from the body
- _____ 2. Which of the following is correctly matched with its function?
- a. interstitial cells (cells of Leydig) - testosterone production
 - b. Sertoli cells - nourish developing sperm cells
 - c. seminiferous tubules - site of spermatogenesis
 - d. all of the above

- _____ 3. Given the following structures:
1. ductus deferens
 2. efferent ductule
 3. epididymis
 4. ejaculatory duct
 5. rete testis

Choose the arrangement that lists the structures in the order sperm cells pass through them from the seminiferous tubules to the urethra.

- a. 2, 3, 5, 4, 1
- b. 2, 5, 3, 4, 1
- c. 3, 2, 4, 1, 5
- d. 3, 4, 2, 1, 5
- e. 5, 2, 3, 1, 4

- _____ 4. Given the following glands:
1. prostate gland
 2. bulbourethral gland
 3. seminal vesicle

Choose the arrangement that shows the order in which the glands contribute their secretions during the formation of semen.

- a. 1, 2, 3
 - b. 2, 1, 3
 - c. 2, 3, 1
 - d. 3, 1, 2
 - e. 3, 2, 1
- _____ 5. Which of the following glands is correctly matched with the function of the gland's secretion?
- a. bulbourethral gland - neutralizes acidic contents of the urethra
 - b. seminal vesicles - contains nutrients that nourish the sperm cells
 - c. prostate gland - alkaline pH that neutralizes the acidic secretions of the seminal vesicles and vagina
 - d. all of the above
- _____ 6. LH in the male
- a. stimulates GnRH secretion.
 - b. Sertoli cells to divide.
 - c. is higher before puberty than after puberty.
 - d. stimulates testosterone production.
- _____ 7. Which of the following is consistent with erection?
- a. parasympathetic stimulation of penile blood vessels
 - b. vasodilation of arteries
 - c. sinusoids fill with blood
 - d. compression of veins
 - e. all of the above
- _____ 8. A polar body
- a. is normally formed before fertilization.
 - b. is normally formed after fertilization.
 - c. is a sunbathing Eskimo.
 - d. normally receives most of the cytoplasm.
 - e. a and b

- _____ 9. The corpus luteum
- a. is formed from a primary follicle.
 - b. produces large amounts of testosterone.
 - c. degenerates in a few days if fertilization occurs.
 - d. functions until the placenta produces progesterone.

- _____ 10. Given the following structures:
1. cervical canal
 2. peritoneal cavity
 3. uterine cavity
 4. uterine tube

Assume a couple has just consummated the sex act and the sperm cells of the male have been deposited in the vagina. Trace the pathway of the sperm cells through the female's reproductive tract to the ovary.

- a. 1, 3, 2, 4
 - b. 1, 3, 4, 2
 - c. 3, 1, 2, 4
 - d. 3, 1, 4, 2
 - e. 4, 2, 1, 3
- _____ 11. Given the following structures:
1. vaginal opening
 2. clitoris
 3. urethral opening
 4. anus

Choose the arrangement that lists the structures in their proper order from the anterior to the posterior aspect.

- a. 2, 3, 1, 4
 - b. 2, 4, 3, 1
 - c. 3, 1, 2, 4
 - d. 3, 1, 4, 2
 - e. 4, 2, 3, 1
- _____ 12. Concerning the breasts,
- a. even before puberty the female breast is quite different from the male breast.
 - b. the female breast enlarges in response to estrogens and progesterone.
 - c. ducts from the mammary glands open on the areola.
 - d. the alveoli subdivide to form lobules.

- _____ 13. The major secretory product of the mature follicle is
- estrogen.
 - progesterone.
 - LH.
 - FSH.
 - GnRH.
- _____ 14. Which of the following processes or phases in the menstrual cycle occur at the same time?
- maximal LH secretion and menstruation
 - regression of the corpus luteum and an increase in ovarian progesterone production
 - menstruation and an increase in ovarian progesterone production
 - ovulation and menstruation
 - proliferative phase of the uterus and increased estrogen production by the ovary
- _____ 15. Menopause
- happens whenever a woman pauses to think about a man.
 - occurs when a woman stops a man from making a pass.
 - develops when follicles become less responsive to FSH and LH.
 - results from high estrogen levels in 40 - 50 year old women.



FINAL CHALLENGES



Use a separate sheet of paper to complete this section.

1. What would happen to testosterone production in the testes in response to an injection of a large amount of testosterone in an adult male? Explain.
2. Suppose a 9 year-old boy had an interstitial cell tumor that resulted in very high levels of testosterone production. Describe the effects this would have on his development.
3. Birth control pills that consist of estrogen or progesterone are only taken for 21 days. The woman stops taking the birth control pill or takes a placebo pill for 7 days. Then she resumes taking the birth control pill. Why does she do this?
4. Sexually transmitted diseases such as gonorrhea can sometimes cause peritonitis in females. In males, however, sexually transmitted diseases do not cause peritonitis. Explain.