

The Reproductive System

The biological function of the reproductive system is to produce offspring. The essential organs are those producing the germ cells (testes in males and ovaries in females). The male manufactures sperm and delivers them to the female's reproductive tract. The female, in turn, produces eggs. If the time is suitable, the egg and sperm fuse, producing a fertilized egg, which is the first cell of the new individual. Once fertilization has occurred, the female uterus protects and nurtures the developing embryo.

In this chapter, student activities concern the structures of the male and female reproductive systems, germ cell formation, the menstrual cycle, and embryonic development.

ANATOMY OF THE MALE REPRODUCTIVE SYSTEM

1. Using the following terms, trace the pathway of sperm from the testis to the urethra: rete testis, epididymis, seminiferous tubule, ductus deferens. List the terms in the proper order in the spaces provided.

_____ → _____ → _____ → _____.

2. How do the scrotal muscles help maintain temperature homeostasis of the testes?

3. Using the key choices, select the terms identified in the following descriptions. Insert the appropriate term(s) or corresponding letter(s) in the answer blanks.

Key Choices

A. Bulbourethral glands	E. Penis	I. Scrotum
B. Epididymis	F. Prepuce	J. Spermatic cord
C. Ductus deferens	G. Prostate gland	K. Testes
D. Glans penis	H. Seminal vesicles	L. Urethra

- _____ 1. Organ that delivers semen to the female reproductive tract
- _____ 2. Site of testosterone production
- _____ 3. Passageway from the epididymis to the ejaculatory duct
- _____ 4. Conveys both sperm and urine down the length of the penis
- _____ 5. Organs that contribute to the formation of semen
- _____ 6. External skin sac that houses the testes
- _____ 7. Tubular storage site for sperm; hugs the lateral aspect of the testes
- _____ 8. Cuff of skin encircling the glans penis
- _____ 9. Surrounds the urethra at the base of the bladder; produces a milky fluid
- _____ 10. Produces over half of the seminal fluid
- _____ 11. Produces a lubricating mucus that cleanses the urethra
- _____ 12. Connective tissue sheath enclosing the ductus deferens, blood vessels, and nerves.

4. Figure 16–1 is a sagittal view of the male reproductive structures. First, identify the following organs on the figure by placing each term at the end of the appropriate leader line.

Bulbourethral gland	Epididymis	Scrotum
Ductus deferens	Prepuce	Seminal vesicle
Glans penis	Prostate gland	Testis
Ejaculatory duct	Urethra	

Next, select different colors for the structures that correspond to the following descriptions, and color in the coding circles and the corresponding structures on the figure.

- ☐ Spongy tissue that is engorged with blood during erection
- ☐ Portion of the duct system that also serves the urinary system
- ☐ Structure that provides the ideal temperature conditions for sperm formation
- ☐ Structure removed in circumcision
- ☐ Gland whose secretion contains sugar to nourish sperm
- ☐ Structure cut or cauterized during a vasectomy

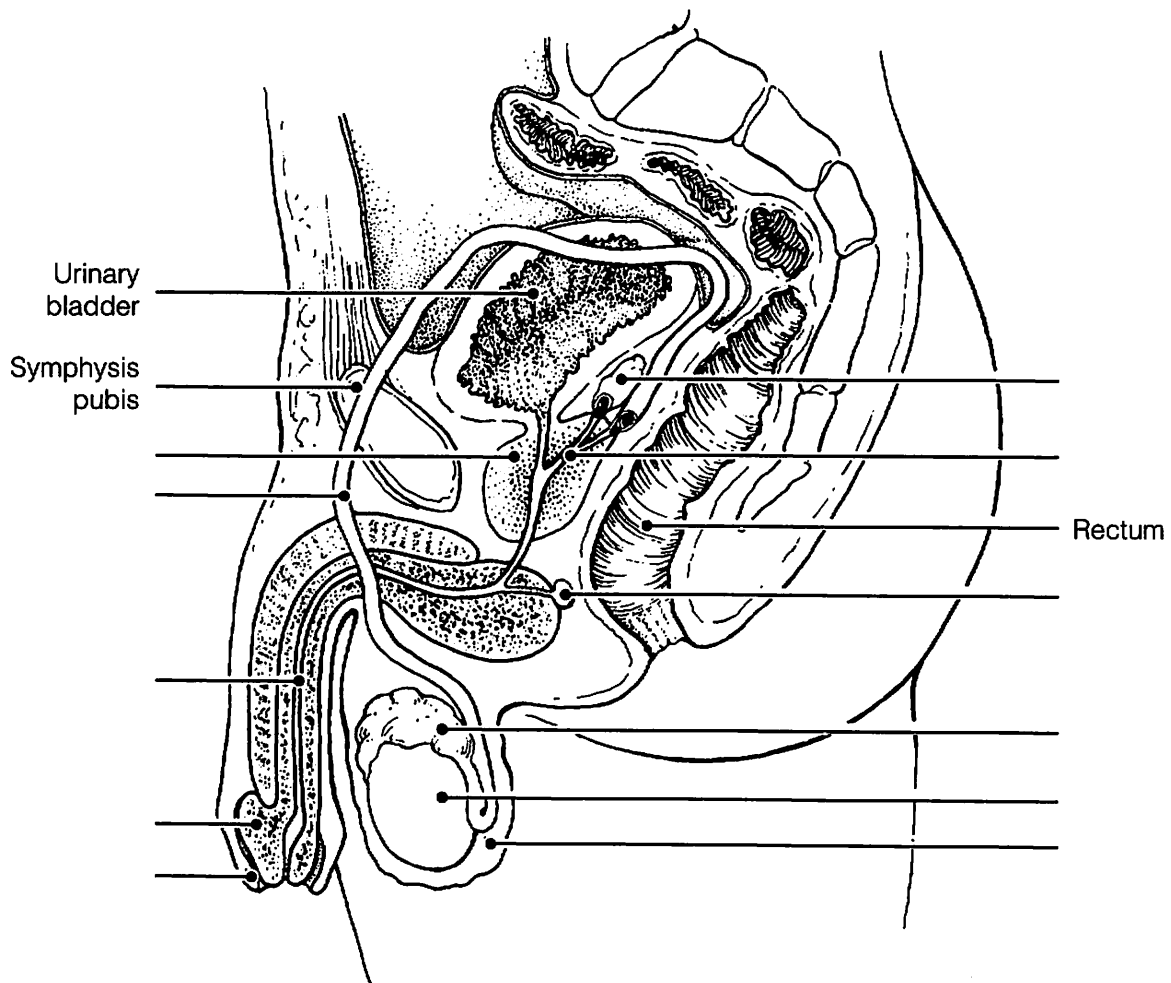


Figure 16-1

5. Figure 16–2 is a longitudinal section of a testis. First, select different colors for the structures that correspond to the following descriptions. Then color the coding circles and color and label the corresponding structures on the figure. *Complete the labeling* of the figure by adding the following terms: lobule, rete testis, and septum.

- ☐ Site(s) of spermatogenesis
- ☐ Tubular structure in which sperm mature and become motile
- ☐ Fibrous coat protecting the testis

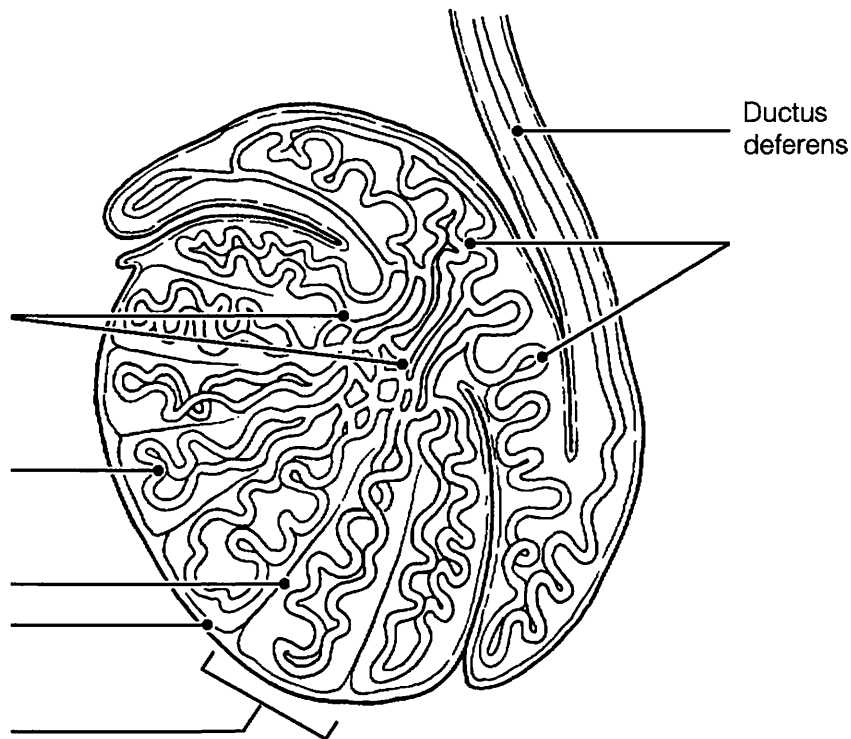


Figure 16–2

MALE REPRODUCTIVE FUNCTIONS

6. This section considers the process of sperm production in the testis. Figure 16–3 is a cross-sectional view of a seminiferous tubule in which spermatogenesis is occurring. First, using key choices, select the terms identified in the following descriptions.

Key Choices

- A. Follicle-stimulating hormone (FSH) E. ☐ Sperm
 B. ☐ Primary spermatocyte F. ☐ Spermatid
 C. ☐ Secondary spermatocyte G. Testosterone
 D. ☐ Spermatogonium

- _____ 1. Primitive stem cell
 _____ 2. Contain 23 chromosomes (3 answers)
 _____ and _____
 _____ 3. Product of meiosis I
 _____ 4. Product of meiosis II
 _____ 5. Functional motile gamete
 _____ 6. Two hormones necessary for sperm production

Then label the cells with leader lines. Select different colors for the cell types with color-coding circles listed in the key choices and color in the coding circles and corresponding structures on the figure. In addition, label and color the cells that produce testosterone.

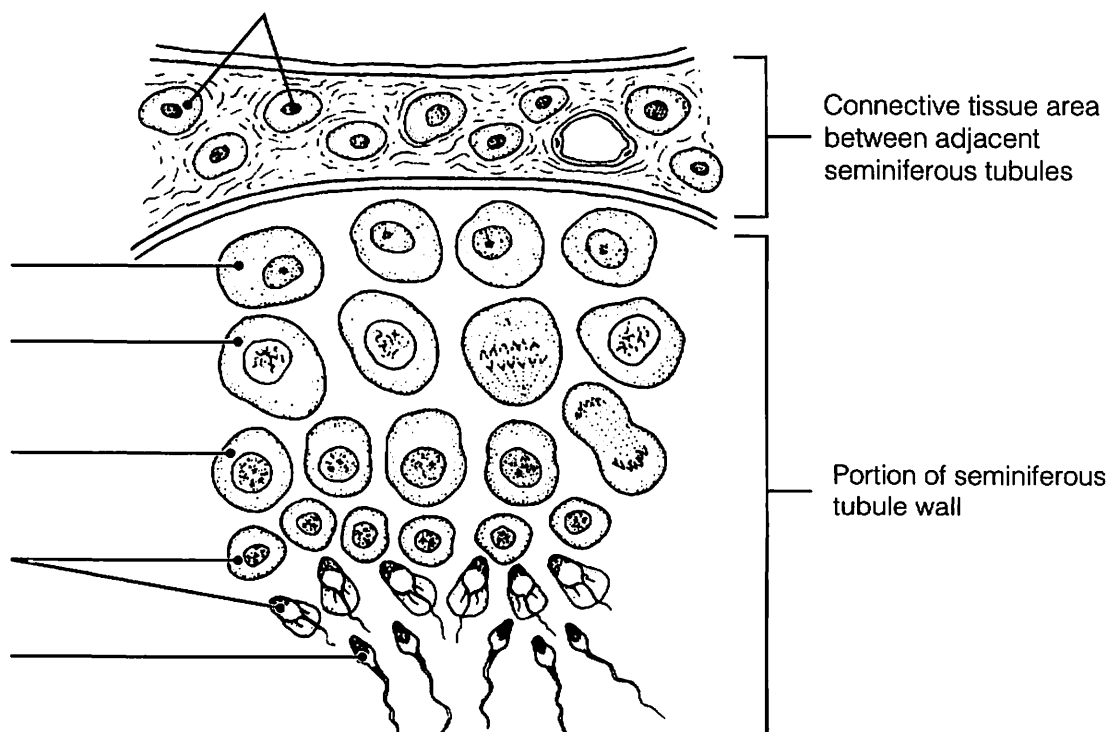


Figure 16-3

7. Figure 16–4 illustrates a single sperm. On the figure, bracket and label the head and the midpiece and circle and label the tail. Select different colors for the structures that correspond to the following descriptions. Color the coding circles and corresponding structures on the figure. Then label the structures, using correct terminology.

- ☐ The DNA-containing area
- ☐ The enzyme-containing sac that aids sperm penetration of the egg
- ☐ Metabolically active organelles that provide ATP to energize sperm movement

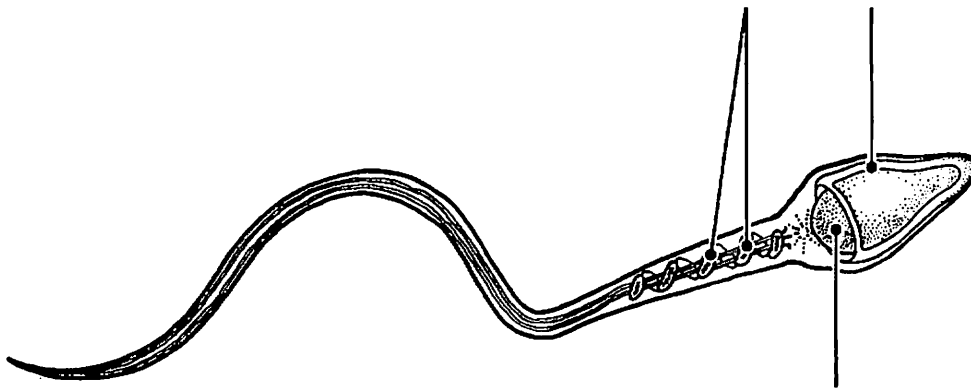


Figure 16–4

8. The following statements refer to events that occur during cellular division. Using key choices, indicate in which type of cellular division the described events occur. Place the correct term or letter response in the answer blanks.

Key Choices

A. Mitosis

B. Meiosis

C. Both mitosis and meiosis

- _____ 1. Final product is two daughter cells, each with 46 chromosomes
- _____ 2. Final product is four daughter cells, each with 23 chromosomes
- _____ 3. Involves the phases prophase, metaphase, anaphase, and telophase
- _____ 4. Occurs in all body tissues
- _____ 5. Occurs only in the gonads
- _____ 6. Increases the cell number for growth and repair
- _____ 7. Daughter cells have the same number and types of chromosomes as the mother cell

- _____ 8. Daughter cells are different from the mother cell in their chromosomal makeup
- _____ 9. Chromosomes are replicated before the division process begins
- _____ 10. Provides cells for the reproduction of offspring
- _____ 11. Consists of two consecutive divisions of the nucleus; chromosomes are not replicated before the second division

9. Name four of the male secondary sex characteristics. Insert your answers on the lines provided.

ANATOMY OF THE FEMALE REPRODUCTIVE SYSTEM

10. Identify the female structures described by inserting your responses in the answer blanks.

- _____ 1. Chamber that houses the developing fetus
- _____ 2. Canal that receives the penis during sexual intercourse
- _____ 3. Usual site of fertilization
- _____ 4. Erects during sexual stimulation
- _____ 5. Duct through which the ovum travels to reach the uterus
- _____ 6. Membrane that partially closes the vaginal canal
- _____ 7. Primary female reproductive organ
- _____ 8. Move to create fluid currents to draw the ovulated egg into the uterine (fallopian) tube

11. Figure 16–5 is a sagittal view of the female reproductive organs. First, label all structures on the figure provided with leader lines. Then select different colors for the following structures, and use them to color the coding circles and corresponding structures on the figure.

- ☐ Lining of the uterus, endometrium
- ☐ Muscular layer of the uterus, myometrium
- ☐ Pathway along which an egg travels from the time of its release to its implantation
- ☐ Ligament helping to anchor the uterus
- ☐ Structure producing female hormones and gametes

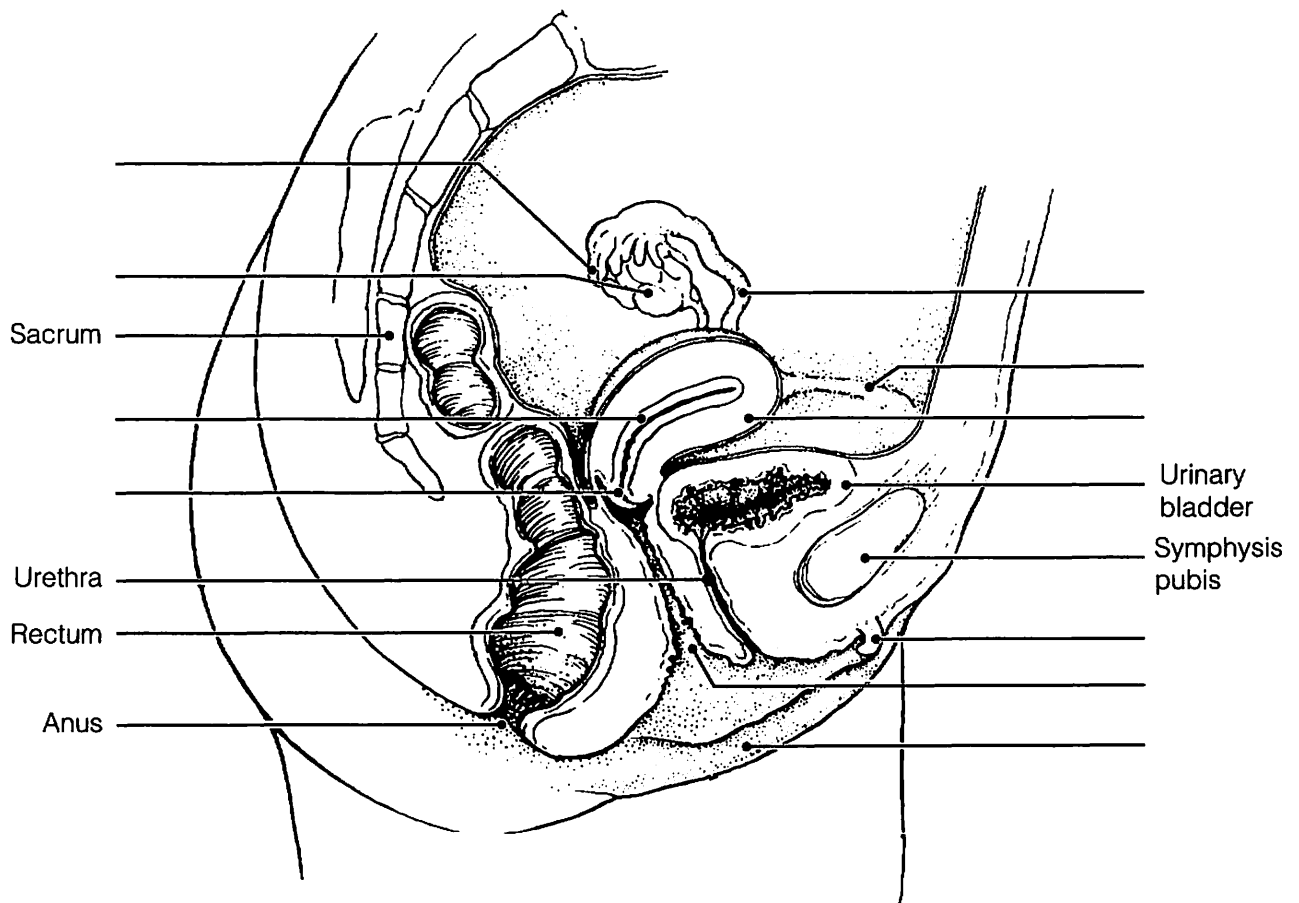


Figure 16–5

- 12.** Figure 16–6 is a ventral view of the female external genitalia. Label the clitoris, labia minora, urethral orifice, hymen, mons pubis, and vaginal orifice on the figure. These structures are indicated with leader lines. Then color the homologue of the male penis blue, color the membrane that partially obstructs the vagina yellow, and color the distal end of the birth canal red.

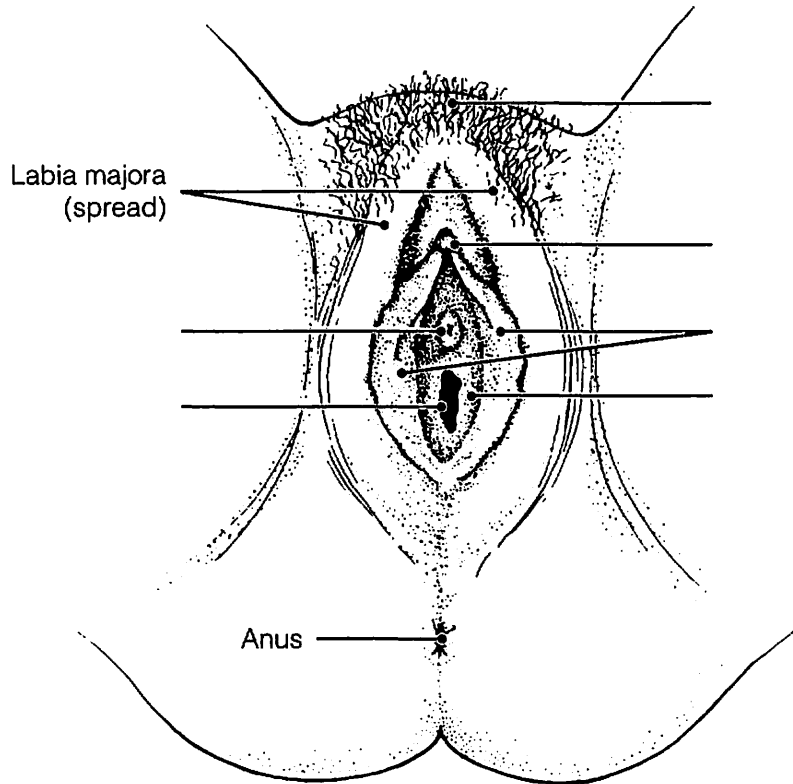


Figure 16–6

FEMALE REPRODUCTIVE FUNCTIONS AND CYCLES

- 13.** Using the key choices, identify the cell type you would expect to find in the following structures. Insert the correct term or letter response in the answer blanks.

Key Choices

- | | |
|-------------------|---------------------|
| A. Oogonium | C. Secondary oocyte |
| B. Primary oocyte | D. Ovum |

- | | |
|-------|--|
| _____ | 1. Forming part of the primary follicle in the ovary |
| _____ | 2. In the uterine tube before fertilization |
| _____ | 3. In the mature, or Graafian, follicle of the ovary |
| _____ | 4. In the uterine tube shortly after sperm penetration |

14. Figure 16–7 is a sectional view of the ovary. First, identify all structures indicated with leader lines on the figure. Second, select different colors for the following structures, and use them to color the coding circles and corresponding structures on the figure.

- ☐ Cells that produce estrogen
- ☐ Glandular structure that produces progesterone
- ☐ All oocytes

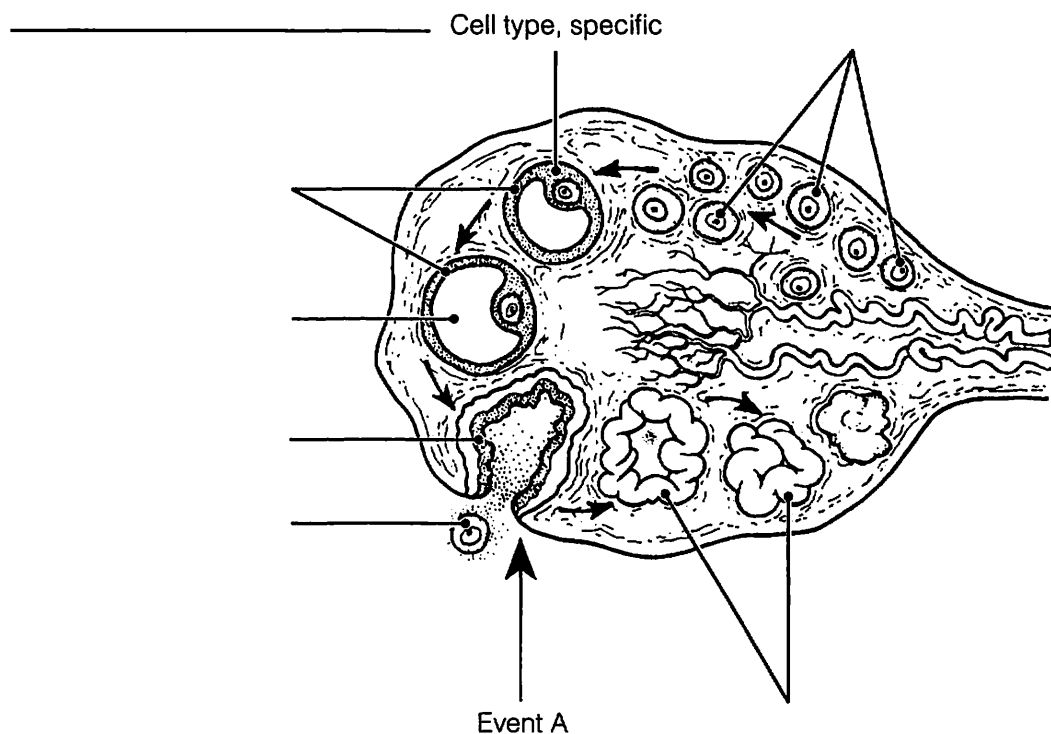


Figure 16–7

Third, in the space provided, name the event depicted as “Event A” on the figure. _____

Fourth, answer the following questions by inserting your answers in the spaces provided.

1. Are there any oogonia in a mature female's ovary? _____
2. Into what area is the ovulated cell released? _____
3. When is a mature ovum (egg) produced in humans? _____
4. What structure in the ovary becomes a corpus luteum? _____
5. What are the four final cell types produced by oogenesis in the female? (Name the cell type and number of each.) _____

6. How does this compare with the final product of spermatogenesis in males? _____

7. What happens to the tiny cells nearly devoid of cytoplasm ultimately produced during oogenesis? _____

8. Why? _____

9. What name is given to the period of a woman's life when her ovaries begin to become nonfunctional? _____

- 15.** What is the significance of the fact that the uterine tubes are not structurally continuous with the ovaries? Address this question from both reproductive and health aspects.

- 16.** The following statements deal with anterior pituitary and ovarian hormonal interrelationships. Name the hormone(s) described in each statement. Place your answers in the answer blanks.

- _____ 1. Promotes growth of ovarian follicles and production of estrogen
- _____ 2. Triggers ovulation
- _____ 3. Inhibit follicle-stimulating hormone (FSH) release by the anterior pituitary
- _____ 4. Stimulates luteinizing hormone (LH) release by the anterior pituitary
- _____ 5. Converts the ruptured follicle into a corpus luteum and causes it to produce progesterone and estrogen
- _____ 6. Maintains the hormonal production of the corpus luteum

- 17.** Name four of the secondary sex characteristics of females. Place your answers in the spaces provided.

18. Use the key choices to identify the ovarian hormone(s) responsible for the following events. Insert the correct term(s) or letter(s) in the answer blanks.

Key Choices

A. Estrogens

B. Progesterone

- | | |
|--|---|
| | 1. Lack of this (these) causes the blood vessels to kink and the endometrium to slough off (menses) |
| | 2. Causes the endometrial glands to begin the secretion of nutrients |
| | 3. The endometrium is repaired and grows thick and velvety |
| | 4. Maintains the myometrium in an inactive state if implantation of an embryo has occurred |
| | 5. Glands are formed in the endometrium |
| | 6. Responsible for the secondary sex characteristics of females |

19. The following exercise refers to Figure 16–8 A–D.

On Figure 16–8A, the blood levels of two gonadotropic hormones (FSH and LH) of the anterior pituitary are indicated. Identify each hormone by appropriately labeling the blood level lines on the figure. Then select different colors for each of the blood level lines and color them in on the figure.

On Figure 16–8B, identify the blood level lines for the ovarian hormones, estrogens and progesterone. Then select different colors for each blood level line, and color them in on the figure.

On Figure 16–8C, select different colors for the following structures and use them to color in the coding circles and corresponding structures in the figure.

- | | |
|--|--|
| ☐ Primary follicle | ☐ Growing follicle |
| ☐ Vesicular follicle | ☐ Corpus luteum |
| ☐ Ovulating follicle | |

On Figure 16–8D, identify the endometrial changes occurring during the menstrual cycle by color-coding and coloring the areas depicting the three phases of that cycle.

- | | | |
|---------------------------------------|------------------------------|---|
| ☐ Secretory stage | ☐ Menses | ☐ Proliferative stage |
|---------------------------------------|------------------------------|---|

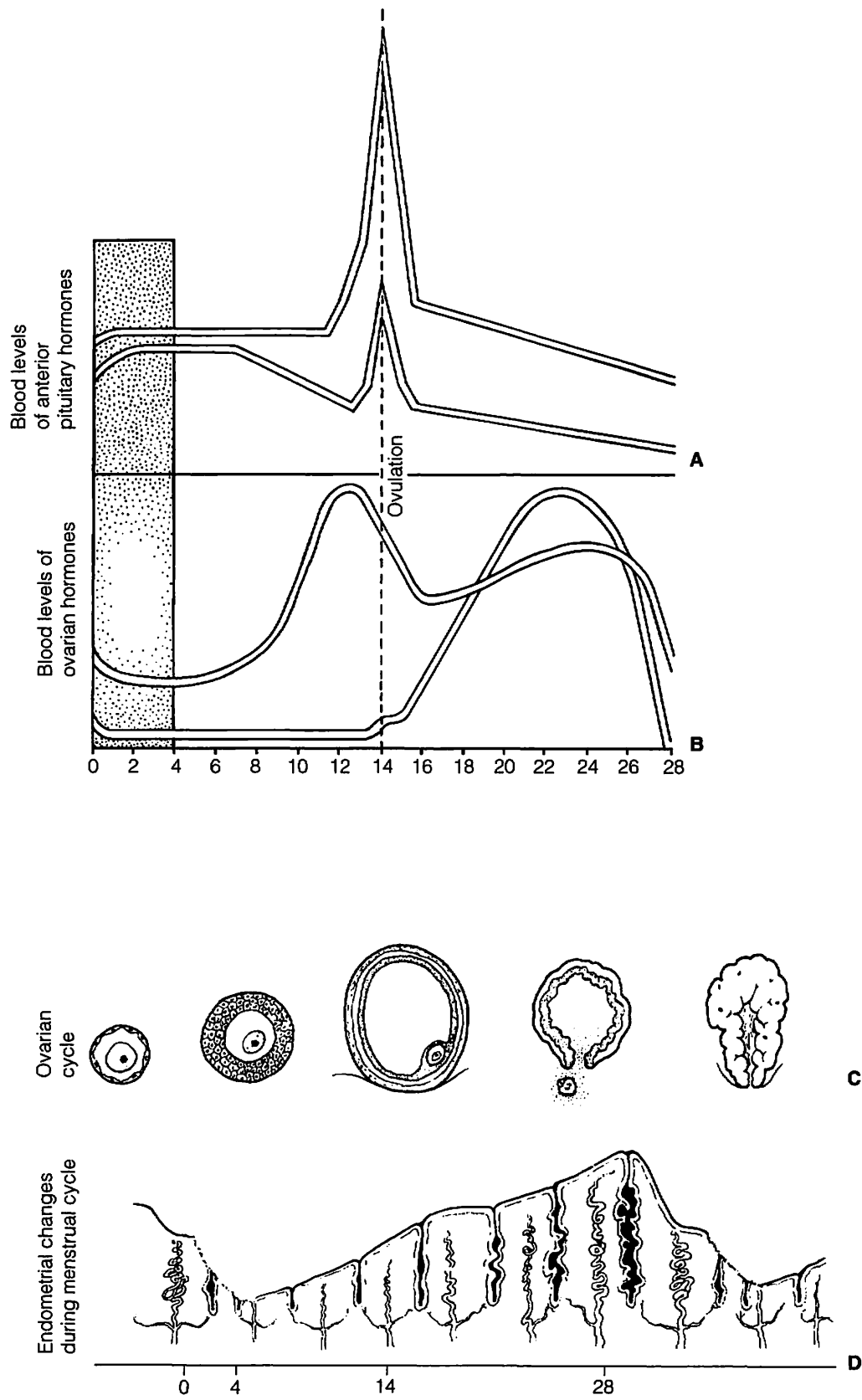


Figure 16-8

MAMMARY GLANDS

20. Figure 16–9 is a sagittal section of a breast. First, use the following terms to correctly label all structures provided with leader lines on the figure.

Alveolar glands Areola Lactiferous duct Nipple

Then color the structures that produce milk blue and color the fatty tissue of the breast yellow.

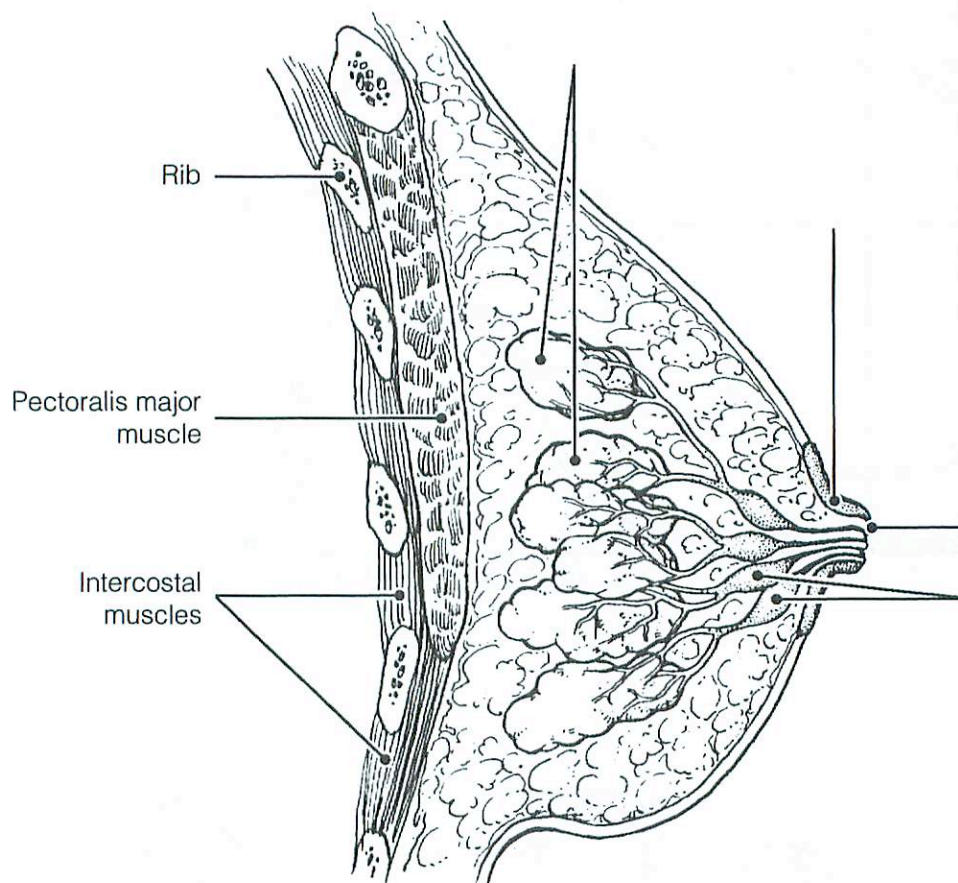


Figure 16–9

SURVEY OF PREGNANCY AND EMBRYONIC DEVELOPMENT

21. Relative to events of sperm penetration:

1. What portion of the sperm actually enters the oocyte? _____

2. What is the functional importance of the acrosomal reaction? _____

22. Figure 16–10 depicts early embryonic events. Identify the following, referring to the figure. Place your answers in the spaces provided.

1. Event A _____
2. Cell resulting from event A _____
3. Process B _____
4. Embryonic structure B₁ _____
5. Completed process C _____

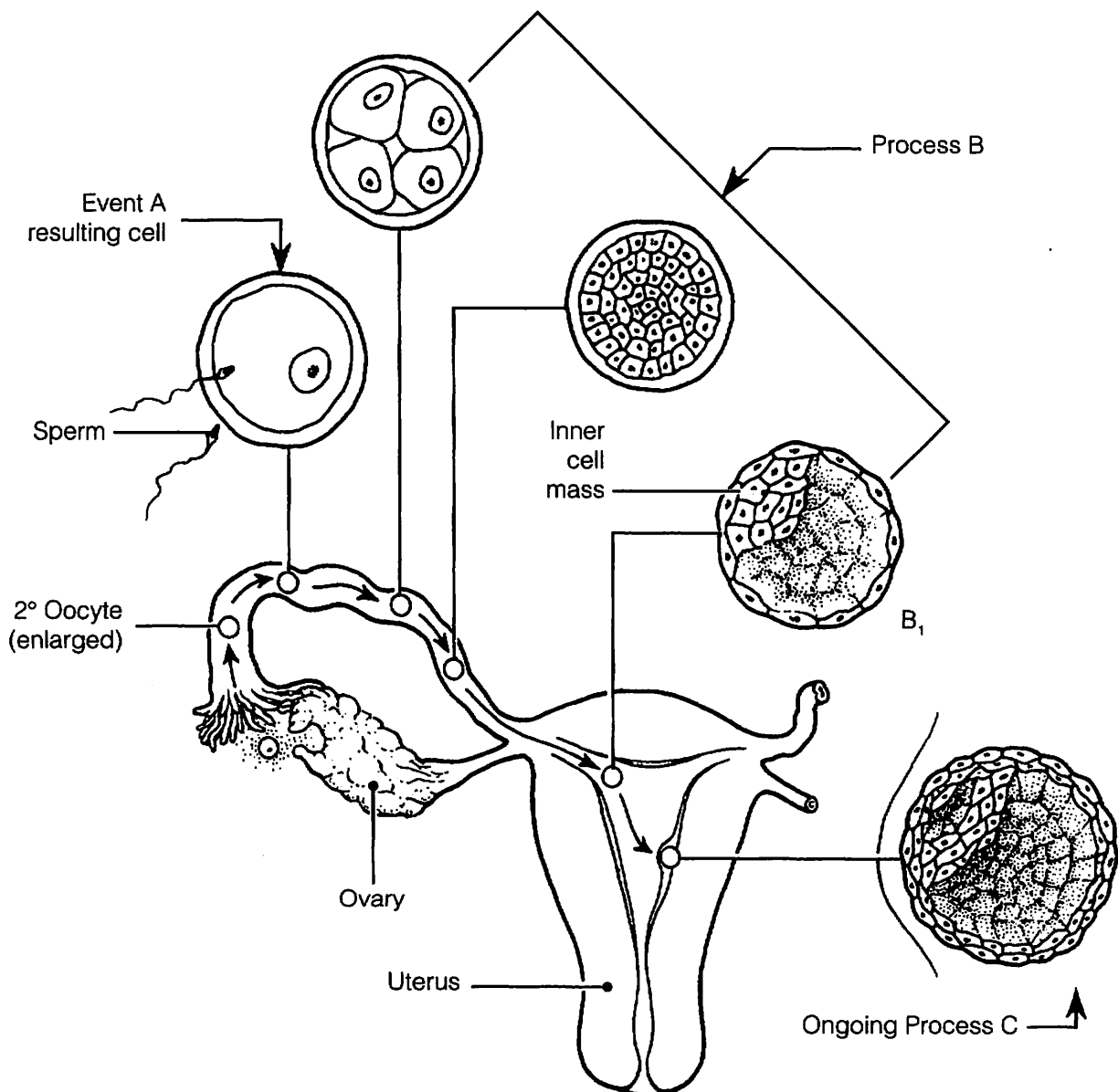


Figure 16–10

23. Using the key choices, select the terms that are identified in the following descriptions. Insert the correct term or letter response in the answer blanks.

Key Choices

- | | | |
|--------------------|------------------|-------------------|
| A. Amnion | D. Fertilization | G. Umbilical cord |
| B. Chorionic villi | E. Fetus | H. Zygote |
| C. Endometrium | F. Placenta | |

- | | |
|-------|--|
| _____ | 1. The fertilized egg |
| _____ | 2. Secretes estrogen and progesterone to maintain the pregnancy |
| _____ | 3. Cooperate to form the placenta |
| _____ | 4. Fluid-filled sac, surrounding the developing embryo/fetus |
| _____ | 5. Attaches the embryo to the placenta |
| _____ | 6. Fingerlike projections of the blastocyst |
| _____ | 7. The embryo after 8 weeks |
| _____ | 8. The organ that delivers nutrients to and disposes of wastes for the fetus |
| _____ | 9. Event leading to combination of ovum and sperm "genes" |

24. Explain why the corpus luteum does not stop producing its hormones (estrogens and progesterone) when fertilization has occurred.

25. The first "tissues" of the embryo's body are the primary germ layers:

- | | | |
|-------------|-------------|-------------|
| A. Ectoderm | B. Mesoderm | C. Endoderm |
|-------------|-------------|-------------|

Indicate which germ layer gives rise to each of the following structures by placing the corresponding letter in the answer blank.

- | | |
|----------------------------------|------------------------------------|
| _____ 1. Heart and blood vessels | _____ 5. Skin epidermis |
| _____ 2. Digestive system mucosa | _____ 6. Bones |
| _____ 3. Brain and spinal cord | _____ 7. Respiratory system mucosa |
| _____ 4. Skeletal muscles | _____ 8. Liver and pancreas |

26. What two hormones are essential to initiate labor in humans?

27. 1. What hormone is responsible for milk production? _____

2. For milk ejection? _____

28. A pregnant woman undergoes numerous changes during her pregnancy—
anatomical, metabolic, and physiological. Several such possibilities are listed
below. Check (✓) all that are commonly experienced during pregnancy.

_____ 1. Diaphragm descent is impaired

_____ 7. Metabolic rate declines

_____ 2. Breasts decline in size

_____ 8. Increased mobility of GI tract

_____ 3. Pelvic ligaments are relaxed
by relaxin

_____ 9. Blood volume and cardiac
output increase

_____ 4. Vital capacity decreases

_____ 10. Nausea, heartburn, constipation

_____ 5. Lordosis

_____ 11. Dyspnea may occur

_____ 6. Blood pressure and pulse rates
decline

_____ 12. Urgency and stress incontinence

29. What are Braxton Hicks contractions, and why do they occur?

30. Name the three phases of parturition, and briefly describe each phase.

1. _____

2. _____

3. _____

- 31.** The very simple flowchart in Figure 16–11 illustrates the sequence of events that occur during labor. Complete the flowchart by filling in the missing terms in the boxes. Use color as desired.

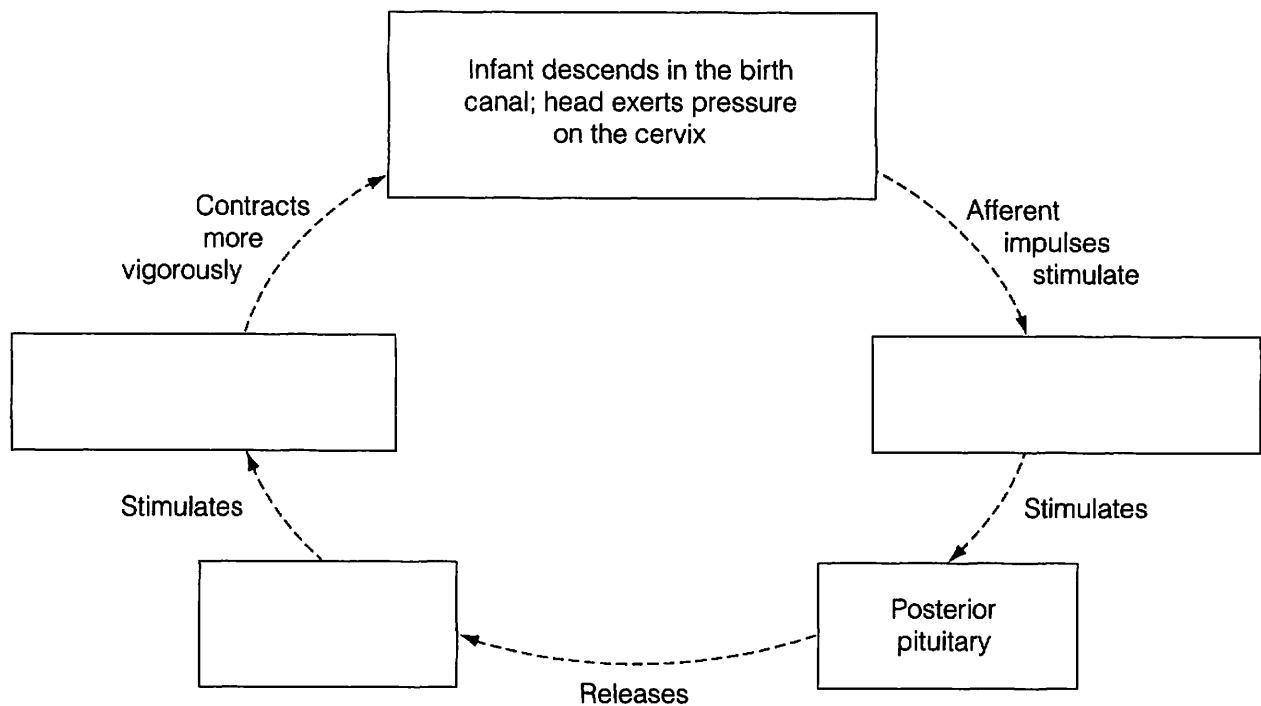


Figure 16–11

- 32.** How long will the cycle illustrated in Figure 16–11 continue to occur?

- 33.** Labor is an example of a positive feedback mechanism. What does that mean?

DEVELOPMENTAL ASPECTS OF THE REPRODUCTIVE SYSTEM

34. Complete the following statements by inserting your responses in the answer blanks.

- _____ 1. A male embryo has (1) sex chromosomes, whereas a female has (2). During early development, the reproductive structures of both sexes are identical, but by the eighth week, _____ 2. (3) begin to form if testosterone is present. In the absence of testosterone, (4) form. The testes of a male fetus _____ 3. descend to the scrotum shortly before birth. If this does not occur, the resulting condition is called (5). _____ 4.
- _____ 5. The most common problem affecting the reproductive organs of women are infections, particularly (6), (7), and (8). _____ 6. When the entire pelvis is inflamed, the condition is called (9). Most male problems involve inflammations, resulting from (10). A leading cause of cancer death in adult women _____ 7. is cancer of the (11); the second most common female reproductive system cancer is cancer of the (12). Thus a _____ 8. yearly (13) is a very important preventive measure for early detection of this latter cancer type. The cessation of ovulation in an aging woman is called (14). Intense vasodilation of _____ 9. blood vessels in the skin lead to uncomfortable (15). Additionally, bone mass (16) and blood levels of cholesterol _____ 10. (17) when levels of the hormone (18) wane. In contrast, healthy men are able to father children well into their eighth _____ 11. decade of life. Postmenopausal women are particularly susceptible to (19) inflammations. The single most common _____ 12. problem of elderly men involves the enlargement of the (20), which interferes with the functioning of both the _____ 13. (21) and (22) systems. _____ 14.
- _____ 15.
- _____ 16.
- _____ 17.
- _____ 18.
- _____ 19.
- _____ 20.
- _____ 21.
- _____ 22.



INCREDIBLE JOURNEY

A Visualization Exercise for the Reproductive System

*... you hear a piercing sound coming
from the almond-shaped organ as its wall ruptures.*

35. Where necessary, complete statements by inserting the missing word(s) in the answer blanks.

- _____ 1. This is your final journey. You are introduced to a hostess this time, who has agreed to have her cycles speeded up by
- _____ 2. megahormone therapy so that all of your observations can be completed in less than a day. Your instructions are to
- _____ 3. observe and document as many events of the two female cycles as possible.
- _____ 4.
- _____ 5. You are miniaturized to enter your hostess through a tiny incision in her abdominal wall (this procedure is called a laparotomy, or, more commonly, "belly button surgery") and
- _____ 6. end up in her peritoneal cavity. You land on a large and pear-shaped organ in the abdominal cavity midline, the (1).
- _____ 7. You survey the surroundings and begin to make organ identifications and notes of your observations. Laterally and way
- _____ 8. above you on each side is an almond-shaped (2), which is suspended by a ligament and almost touched by "feather-duster-like" projections of a tube snaking across the abdomi-

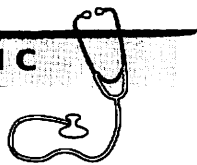
nal cavity toward the almond-shaped organs. The projections appear to be almost still, which is puzzling because you thought that they were the (3), or fingerlike projections of the uterine tubes, which are supposed to be in motion. You walk toward the end of one of the uterine tubes to take a better look. As you study the ends of the uterine tube more closely, you discover that the featherlike projections are now moving more rapidly, as if they are trying to coax something into the uterine tube. Then you spot a reddened area on the almond-shaped organ, which seems to be enlarging even as you watch. As you continue to observe the area, you waft gently up and down in the peritoneal fluid. Suddenly you feel a gentle but insistent sucking current, drawing you slowly toward the uterine tube. You look upward and see that the reddened area now looks like an angry boil, and the uterine tube projections are gyrating and waving frantically. You realize that you are about to witness (4). You try to get still closer to the opening of the uterine tube, when you hear a piercing sound coming from the almond-shaped organ as its wall ruptures. Then you see a ball-like structure, with a "halo" of tiny cells enclosing it, being drawn into the uterine tube. You have just seen the (5), surrounded by its capsule of (6) cells, entering the uterine tube. You hurry into the uterine tube behind it and, holding onto one of the tiny cells, follow it to the uterus. The cell mass that you have attached to has no way of propelling itself, yet you are being squeezed along toward the uterus by a process called (7). You also notice that there are (8), or tiny hair-like projections of the tubule cells, that are all waving in the same direction as you are moving.

- _____ 9. Nothing seems to change as you are carried along until finally you are startled by a deafening noise. Suddenly there are
- _____ 10. thousands of tadpole-like (9) swarming all around you and the sphere of cells. Their heads seem to explode as their
- _____ 11. (10) break and liberate digestive enzymes. The cell mass now has hundreds of openings in it, and some of the small
- _____ 12. cells are beginning to fall away. As you peer through the rather transparent cell "halo" you see that one of the tadpole-like structures has penetrated the large central cell.
- _____ 13. Chromosomes then appear, and that cell begins to divide.
- _____ 14. You have just witnessed the second (11) division. The products of this division are one large cell, the (12), and one
- _____ 15. very tiny cell, a (13), which is now being ejected. This cell will soon be (14) because it has essentially no cytoplasm or
- _____ 16. food reserves. As you continue to watch, the sperm nucleus and that of the large central cell fuse, an event called (15).
- _____ 17. You note that the new cell just formed by this fusion is called a (16), the first cell of the embryonic body.
- _____ 18.
- _____ 19. As you continue to move along the uterine tube, the central cell divides so fast that no cell growth occurs between the divisions. Thus the number of cells forming the embryonic
- _____ 20. body increases, but the cells become smaller and smaller. This embryonic division process is called (17).

Finally, the uterine chamber looms before you. As you drift into its cavity, you scrutinize its lining, the (18). You notice that it is thick and velvety in appearance and that the fluids you are drifting in are slightly sweet. The embryo makes its first contact with the lining, detaches, and then makes a second contact at a slightly more inferior location. This time it sticks, and as you watch, the lining of the organ begins to erode away. The embryo is obviously beginning to burrow into the rich cushiony lining, and you realize that (19) is occurring.

You now leave the embryo and propel yourself well away from it. As you float in the cavity fluids, you watch the embryo disappear from sight beneath the lining. Then you continue to travel downward through your hostess's reproductive tract, exiting her body at the external opening of the (20).

AT THE CLINIC



36. A 28-year-old primagravida (in first pregnancy) has been in the first stage of labor for several hours. Her uterine contractions are weak, and her labor is not progressing normally. Since the woman insists upon a vaginal delivery, the physician orders that Pitocin (a synthetic oxytocin) be infused. What will the effect of Pitocin be? What is the normal mechanism by which oxytocin acts to promote birth?

- 37.** A 38-year-old male is upset about his low sperm count and visits a “practitioner” who commonly advertises his miracle cures for sterility. In fact, the practitioner is a quack who treats conditions of low sperm count with megadoses of testosterone. Although his patients experience a huge surge in libido, their sperm count is even lower after hormone treatment. Explain why.
- 38.** Mr. and Mrs. John Cary, a young couple who had been trying unsuccessfully to have a family for years, underwent a series of tests with a fertility clinic to try to determine the problem. Mr. Cary was found to have a normal sperm count and the sperm morphology and motility are normal.
- Mrs. Cary's history sheet revealed that she had two episodes of PID during her early 20s, and the time span between successive menses ranged from 21 to 30 days. She claimed that her family was “badgering” her about not giving them grandchildren and that she was frequently despondent. A battery of hormonal tests was ordered, and Mrs. Cary was asked to perform cervical mucus testing and daily basal temperature recordings. Additionally, gas was blown through her uterine tubes to determine their patency. Her tubes proved to be closed and she was determined to be anovulatory. What do you suggest might have caused the closing of her tubes? Which of the tests done or ordered would have revealed her anovulatory condition?
- 39.** A man swam in a cold lake for an hour and then noticed that his scrotum was shrunken and wrinkled. His first thought was that he had lost his testicles. What had really happened?
- 40.** Mary is a heavy smoker and has ignored a friend's advice to stop smoking during her pregnancy. On the basis of what you know about the effect of smoking on physiology, describe how Mary's smoking might affect her fetus.
- 41.** Mrs. Ginko's Pap smear shows some abnormal cells. What possibility should be investigated?