Anatomy of the Reproductive System

**Gross Anatomy of the Human Male Reproductive System**

1. List the two principal functions of the testis. *Sperm production, testosterone production*

2. Identify all indicated structures or portions of structures on the diagrammatic view of the male reproductive system below.

   - Seminal vesicle
   - Urinary bladder
   - Ejaculatory duct
   - Ductus (vas) deferens
   - Prostate gland
   - Penile urethra
   - Corpus cavernosum
   - Penis
   - Corpus spongiosum
   - Glans penis
   - Epididymis
   - Bulbourethral (Cowper’s) gland
   - Seminiferous tubule (of the testis)
   - Tunica albuginea

3. A common part of any physical examination of the male is palpation of the prostate gland. How is this accomplished?

   (**Think!**) *Through the anterior wall of the rectum.*

4. How might enlargement of the prostate gland interfere with urination or the reproductive ability of the male?

   *Constriction of the urethra at that point may lead to nonpassage of urine or semen.*
5. Match the terms in column B to the descriptive statements in column A.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>f: penis</td>
<td>a. bulbourethral glands</td>
</tr>
<tr>
<td>m: testes</td>
<td>b. ductus deferens</td>
</tr>
<tr>
<td>b: ductus deferens</td>
<td>c. epididymis</td>
</tr>
<tr>
<td>l: spongy urethra</td>
<td>d. glans penis</td>
</tr>
<tr>
<td>c: epididymis</td>
<td>e. membranous urethra</td>
</tr>
<tr>
<td>k: scrotum</td>
<td>f. penis</td>
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<tr>
<td>g: prepuce</td>
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</tr>
<tr>
<td>e: membranous urethra</td>
<td>h. prostate gland</td>
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6. Why are the testes located in the scrotum? *Viable sperm production requires a temperature slightly lower (94–95°F) than body temperature.*

7. Describe the composition of semen and name all structures contributing to its formation. *Sperm and the alkaline secretions of the prostate, seminal vesicles (also containing fructose), and the bulbourethral glands.*

8. Of what importance is the fact that seminal fluid is alkaline? *Buffers the sperm against the acid environment of the female reproductive tract.*

9. What structures compose the spermatic cord? *Connective tissue sheath (extension of abdominal fascia), ductus deferens, blood vessels.*

Where is it located? *Passes from the scrotal sac through the inguinal canal into the abdominal cavity.*

10. Using the following terms, trace the pathway of sperm from the testes to the urethra: rete testis, epididymis, seminiferous tubule, ductus deferens.

    seminiferous tubule → rete testis → epididymis → ductus deferens
11. Using an appropriate reference, define cryptorchidism and discuss its significance.

Failure of the testes to descend into the scrotum from the abdominal cavity, resulting in sterility if uncorrected.

12. On the diagram below of a frontal section of a portion of the female reproductive system, identify all indicated structures.

13. Identify the female reproductive system structures described below:

   - uterus 1. site of fetal development
   - vagina 2. copulatory canal
   - uterine tube 3. “fertilized egg” typically formed here
   - clitoris 4. becomes erectile during sexual excitement
   - uterine tube 5. duct extending superolaterally from the uterus
   - hymen 6. partially closes the vaginal canal; a membrane
   - ovary 7. produces oocytes, estrogens, and progesterone
   - fimbriae 8. fingerlike ends of the fallopian tube

14. Do any sperm enter the pelvic cavity of the female? Why or why not? Yes. There is no anatomic continuity between the ovary and the first part of the duct system (i.e. uterine tube).
15. What is an ectopic pregnancy, and how can it happen? *Implantation of the embryo in a site other than the uterus. May occur when the uterine tubes are blocked (prevents passage) or when the egg is “lost” in the peritoneal cavity and fertilization occurs there.*

16. Name the structures composing the external genitalia, or vulva, of the female. *Mons pubis, labia majora and minora, clitoris, vaginal and urethral openings, hymen, and greater vestibular glands.*

17. Put the following vestibular-perineal structures in their proper order from the anterior to the posterior aspect: vaginal orifice, anus, urethral opening, and clitoris.

   Anterior limit: clitoris → urethral opening → vaginal orifice → anus

18. Name the male structure that is homologous to the female structures named below.

   labia majora → scrotum → clitoris → penis

19. Assume a couple has just consummated the sex act and the male’s sperm have been deposited in the woman’s vagina. Trace the pathway of the sperm through the female reproductive tract.

   vagina → cervix → uterus → uterine tube → peritoneal cavity

20. Define ovulation: *Ejection of an egg (actually an oocyte) from the ovary.*

Microscopic Anatomy of Selected Male and Female Reproductive Organs

21. The testis is divided into a number of lobes by connective tissue. Each of these lobes contains one to four *seminiferous tubules*, which converge on a tubular region at the testis hilus called the *rete testis*.

22. What is the function of the cavernous bodies seen in the male penis? *This tissue can become engorged with blood, thus making the penis stiff and more effective as a penetrating device.*

23. Name the three layers of the uterine wall from the inside out.

   endometrium → myometrium → serosa (perimetrium)

   Which of these is sloughed during menses? *Endometrium*

   Which contracts during childbirth? *Myometrium*
24. What is the function of the stereocilia exhibited by the epithelial cells of the mucosa of the epididymis? Absorb excess fluid and provide nutrients to the maturing sperm.

25. On the diagram showing the sagittal section of the human testis, correctly identify all structures provided with leader lines.

26. Match the term with the correct description.

- a; alveoli ________ glands that produce milk during lactation
- e; lobule ________ subdivisions of mammary lobes that contain alveoli
- d; lactiferous sinus ________ enlarged storage chambers for milk
- c; lactiferous duct ________ ducts connecting alveoli to the lactiferous sinus
- b; areola ________ pigmented area surrounding the nipple
- f; nipple ________ releases milk to the outside

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27. Using the key terms, correctly identify breast structures.

Key:
- a. adipose tissue
- b. lobule containing alveoli
- c. areola
- d. lactiferous duct
- e. lactiferous sinus
- f. nipple

28. Describe the procedure for self-examination of the breasts. (Men are not exempt from breast cancer, you know!)

1. Stand in front of a mirror, arms relaxed at sides; examine breasts for changes in size, shape, dimpling, etc.
2. Lie in supine position, pillow under one shoulder, arm raised. Examine the breast on that raised side by pressing the breast tissue with flattened fingers in small circular motions, moving from the periphery of the breast toward the nipple. Continue 360 degrees around the breast. Repeat for opposite side.
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<td>a. bulbourethral glands</td>
</tr>
<tr>
<td>2. site of sperm/androgen production</td>
<td>b. ductus deferens</td>
</tr>
<tr>
<td>3. muscular passageway conveying sperm to the ejaculatory duct; in the spermatic cord</td>
<td>c. epididymis</td>
</tr>
<tr>
<td>4. transports both sperm and urine</td>
<td>d. glans penis</td>
</tr>
<tr>
<td>5. sperm maturation site</td>
<td>e. membranous urethra</td>
</tr>
<tr>
<td>6. location of the testis in adult males</td>
<td>f. penis</td>
</tr>
<tr>
<td>7. loose fold of skin encircling the glans penis</td>
<td>g. prepuce</td>
</tr>
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<td>8. portion of the urethra between the prostate gland and the penis</td>
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![Diagram of female reproductive system]

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   - uterus
   - vagina
   - uterine tube
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   - ovary

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![Diagram of testis with labeled structures]

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Physiology of Reproduction: Gametogenesis and the Female Cycles

Meiosis

1. The following statements refer to events occurring during mitosis and/or meiosis. For each statement, decide if the event occurs in (a) mitosis only, (b) meiosis only, or (c) both mitosis and meiosis.

   - a. dyads are visible
   - b. tetrads are visible
   - c. product is two diploid daughter cells
   - d. product is four haploid daughter cells
   - e. involves the phases prophase, metaphase, anaphase, and telophase
   - f. occurs throughout the body
   - g. occurs only in the ovaries and testes
   - h. provides cells for growth and repair
   - i. homologues synapse and chiasmata are seen
   - j. daughter cells are genetically identical to the mother cell
   - k. chromosomes are replicated before the division process begins
   - l. provides cells for replication of the species
   - m. consists of two consecutive nuclear divisions, without chromosomal replication occurring before the second division

2. Describe the process of synapsis. *The homologous chromosomes become closely aligned along their entire length.*

3. How does crossover introduce variability in the daughter cells? *Where crossovers occur, chromosome breakage occurs and parts are exchanged. This results in chromosomes with different parental contributions.*

4. Define homologous chromosomes. *Chromosomes that carry genes for the same traits. (One = paternal chromosome, the other = maternal chromosome.)*
Spermatogenesis

5. The cell types seen in the seminiferous tubules are listed in the key. Match the correct cell type(s) with the descriptions given below.

Key:  a. primary spermatocyte  b. secondary spermatocyte  c. spermatogonium  d. sustentacular cell  e. spermatid  f. sperm

1. primitive stem cell  
2. haploid  
3. provides nutrients to developing sperm  
4. products of meiosis II  
5. product of spermiogenesis  
6. product of meiosis I

6. Why are spermatids not considered functional gametes? Too much superfluous cytoplasm; nonmotile.

7. Differentiate between spermatogenesis and spermiogenesis. Formation of haploid gametes by the male. Slauging off excessive spermatid cytoplasm to form a motile functional sperm.

8. Draw a sperm below and identify the acrosome, head, midpiece, and tail. Then beside each label, note the composition and function of each of these sperm structures.

```
Acrosome (penetrating device containing digestive enzymes)  Tail (contractile filaments)

Head (genetic region, nucleus)  Midpiece (contains mitochondria which provide ATP)
```

9. The life span of a sperm is very short. What anatomical characteristics might lead you to suspect this even if you didn’t know its life span? No cytoplasm (to speak of) in which to store nutrients.

Oogenesis, the Ovarian Cycle, and the Menstrual Cycle

10. The sequence of events leading to germ cell formation in the female begins during fetal development. By the time the child is born, all viable oogonia have been converted to primary oocytes.

In view of this fact, how does the total germ cell potential of the female compare to that of the male? Much smaller, and the total number is predetermined.

11. The female gametes develop in structures called follicles. What is a follicle? A structure consisting of a capsule of follicle (or granulosa) cells that encloses a developing gamete (oocyte).
How are primary and vesicular follicles anatomically different? *The primary follicle has one or a small number of layers of follicle cells surrounding the oocyte; the vesicular follicle has a large antrum containing fluid produced by the granulosa cells, and the developing oocyte, surrounded by several layers of granulosa cells, is pushed to one side.*

What is a corpus luteum? *Glandular ovarian structure that produces progesterone. The ruptured vesicular follicle is converted to a corpus luteum.*

12. What is the major hormone produced by the vesicular follicle? *Estrogen*

By the corpus luteum? *Progesterone (and some estrogen)*

13. Use the key to identify the cell type you would expect to find in the following structures.

Key: a. oogonium b. primary oocyte c. secondary oocyte d. ovum

1. forming part of the primary follicle in the ovary  (b)
2. in the uterine tube before fertilization  (c)
3. in the mature vesicular follicle of the ovary  (c)
4. in the uterine tube shortly after sperm penetration  (d)

14. The cellular product of spermatogenesis is four *spermatids*; the final product of oogenesis is one *ovum* and three *polar bodies*. What is the function of this unequal cytoplasmic division seen during oogenesis in the female? *To provide the ovum or functional gamete with adequate nutritional reserves so that it can survive during its journey to the uterus.*

What is the fate of the three tiny cells produced during oogenesis? *They deteriorate.*

Why? *They lack sustaining cytoplasm with nutrient reserves.*

15. The following statements deal with anterior pituitary, ovarian hormones, and hormonal interrelationships. Name the hormone(s) described in each statement.

*FSH (follicle-stimulating hormone)* 1. produced by primary follicles in the ovary

* LH (luteinizing hormone)* 2. ovulation occurs after its burstlike release

*estrogen* and *progesterone* 3. exert negative feedback on the anterior pituitary relative to FSH secretion

*estrogen* 4. stimulates LH release by the anterior pituitary

*LH* 5. stimulates the corpus luteum to produce progesterone and estrogen

*LH* 6. maintains the hormonal production of the corpus luteum in a nonpregnant woman

16. Why does the corpus luteum deteriorate toward the end of the ovarian cycle? *Because blood levels of the anterior pituitary hormone LH are extremely low.*
17. For each statement below dealing with hormonal blood levels during the female ovarian and menstrual cycles, decide whether the condition in column A is usually (a) greater than, (b) less than, or (c) essentially equal to the condition in column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. amount of estrogen in the blood during menses</td>
<td>amount of estrogen in the blood at ovulation</td>
</tr>
<tr>
<td>2. amount of progesterone in the blood on day 14</td>
<td>amount of progesterone in the blood on day 23</td>
</tr>
<tr>
<td>3. amount of LH in the blood during menses</td>
<td>amount of LH in the blood at ovulation</td>
</tr>
<tr>
<td>4. amount of FSH in the blood on day 6 of the cycle</td>
<td>amount of FSH in the blood on day 20 of the cycle</td>
</tr>
<tr>
<td>5. amount of estrogen in the blood on day 10</td>
<td>amount of progesterone in the blood on day 10</td>
</tr>
</tbody>
</table>

18. Ovulation and menstruation usually cease by the age of _________.

19. What uterine tissue undergoes dramatic changes during the menstrual cycle? **Endometrium**

20. When during the female menstrual cycle would fertilization be unlikely? Explain why. **Any time but the three-day interval (days 14–16) around ovulation. (Twenty-eight day cycle is assumed.)**

21. Assume that a woman could be an “on demand” ovulator like the rabbit, in which copulation stimulates the hypothalamic-anterior pituitary axis and causes LH release, and an oocyte was ovulated and fertilized on day 26 of her 28-day cycle. Why would a successful pregnancy be unlikely at this time? **The hormonal production of the ovary has ceased; the endometrium is beyond the receptive stage and is ready to slough off in menses.**

22. The menstrual cycle depends on events within the female ovary. The stages of the menstrual cycle are listed below. For each, note its approximate time span and the related events in the uterus; and then to the right, record the ovarian events occurring simultaneously. Pay particular attention to hormonal events.

<table>
<thead>
<tr>
<th>Menstrual cycle stage</th>
<th>Uterine events</th>
<th>Ovarian events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menstruation</td>
<td>Days 1–5. Endometrium is sloughing off.</td>
<td>Primary follicle begins to grow.</td>
</tr>
<tr>
<td>Secretory</td>
<td>Days 15–28. Vascular supply increases and glands begin secretory activity.</td>
<td>Ruptured follicle is converted to a corpus luteum, which begins to produce progesterone (and some estrogen). Peaks at day 23 and then begins to decline.</td>
</tr>
</tbody>
</table>
Survey of Embryonic Development

Developmental Stages of Sea Urchins and Humans

1. Define zygote. _Fertilized egg._

2. Describe how you were able to tell by observation when a sea urchin egg was fertilized. _A fertilization membrane is present beneath the outer jelly coat._

3. Use the key choices to identify the embryonic stage or process described below.

- **Key:**
  - a. cleavage
  - b. morula
  - c. zygote
  - d. fertilization
  - e. blastula
  - f. gastrulation

- **Identified Stages:**
  - d 1. fusion of male and female pronuclei
  - b 2. solid ball of embryonic cells
  - a 3. process of rapid mitotic cell division without intervening growth periods
  - c 4. combination of egg and sperm
  - f 5. process involving cell rearrangements to form the three primary germ layers
  - e 6. embryonic stage in which the embryo consists of a hollow ball of cells

4. What is the importance of cleavage in embryonic development? _It provides a large number of smaller cells for morphogenesis._

How is cleavage different from mitotic cell division, which occurs later in life? _During cleavage there are no intervening growth periods between the successive divisions. Therefore the cells get smaller and smaller, but the embryonic mass remains essentially the same size._

5. The cells of the human blastula (blastocyst) have various fates. Which blastocyst structures have the following fates?

- **inner cell mass**
  - 1. produces the embryonic body
- **trophoblast**
  - 2. becomes the chorion and cooperates with uterine tissues to form the placenta
- **inner cell mass**
  - 3. produces the amnion, yolk sac, and allantois
- **yolk sac**
  - 4. produces the primordial germ cells (an embryonic membrane)
- **allantois**
  - 5. an embryonic membrane that provides the structural basis for the body stalk or umbilical cord
6. Using the letters on the diagram, correctly identify each of the following maternal or embryonic structures.

- **j** amnion
- **g** chorion
- **b** decidua basalis
- **f** endoderm
- **i** body stalk
- **h** chorionic villi
- **a** decidua capsularis
- **e** mesoderm
- **d** ectoderm
- **c** uterine cavity

![Diagram of theEmbryo](image)

7. Explain the importance of gastrulation. It involves the migration, movement, and rearrangement of embryonic cells, so that a three-layer embryo (three primary germ layers) is formed.

8. What is the function of the amnion and the amniotic fluid? The amnion is a protective, fluid-filled sac that surrounds the embryo. The fluid “buffer” protects the embryo from physical trauma and prevents adhesion formation.

9. Describe the process of implantation, noting the role of the trophoblast cells. The trophoblast cells overlying the inner cell mass adhere to the endometrium. The trophoblast cells then secrete enzymes that erode the endometrial lining to reach the vascular supply beneath it.

10. How many days after fertilization is implantation generally completed? **7**. What event in the female menstrual cycle ordinarily occurs just about this time if implantation does not occur? Menses, because this is usually the 14th day after ovulation.
11. What name is given to the part of the uterine wall directly under the implanting embryo? Decidua basalis

That surrounding the rest of the embryonic structure? Decidua capsularis

12. Using an appropriate reference, find out what decidua means and state the definition. That which “falls off” or is subject to periodic shedding.

How is this terminology applicable to the deciduas of pregnancy? After birth they slough off and are flushed out of the uterus.

13. Referring to the illustrations and text of A Colour Atlas of Life Before Birth: Normal Fetal Development, answer the following:

Which two organ systems are extensively developed in the very young embryo?

nervous system and circulatory system

Describe the direction of development by circling the correct descriptions below:

(proximal-distal) distal-proximal caudal-rostral rostral-caudal

Does bodily control during infancy develop in the same directions? Think! Can an infant pick up a common pin (pincer grasp) or wave his arms earlier? Is arm-hand or leg-foot control achieved earlier?

Yes. Arm-hand control occurs before leg-foot control is achieved.

14. Note whether each of the following organs or organ systems develops from the (a) ectoderm, (b) endoderm, or (c) mesoderm. Use an appropriate reference as necessary.

<table>
<thead>
<tr>
<th>Organ/System</th>
<th>Ectoderm</th>
<th>Endoderm</th>
<th>Mesoderm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. skeletal muscle</td>
<td>c</td>
<td></td>
<td>b</td>
</tr>
<tr>
<td>2. skeleton</td>
<td>c</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. lining of gut</td>
<td></td>
<td>a</td>
<td></td>
</tr>
<tr>
<td>4. respiratory mucosa</td>
<td></td>
<td></td>
<td>a</td>
</tr>
<tr>
<td>5. circulatory system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. epidermis of skin</td>
<td></td>
<td>a</td>
<td>b</td>
</tr>
<tr>
<td>7. nervous system</td>
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</tr>
<tr>
<td>8. serosa membrane</td>
<td></td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>9. liver, pancreas</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In Utero Development

15. Make the following comparisons between a human and the pregnant dissected animal structures.

<table>
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<tr>
<th>Comparison object</th>
<th>Human</th>
<th>Dissected animal</th>
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<tr>
<td>Shape of the placenta</td>
<td>Disc-shaped</td>
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<td>Pear-shaped</td>
<td>Y-shaped</td>
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17. Describe the function(s) of the placenta. Provides nutrients and oxygen to the fetus, removes fetal wastes, and produces the hormones of pregnancy.
What embryonic membranes has the placenta more or less “put out of business”? *Yolk sac and allantois.*

18. When does the human embryo come to be called a fetus? *Ninth week of development.*

19. What is the usual and most desirable fetal position in utero? *Head down.*

   Why is this the most desirable position? *The largest fetal dimension is the skull. Therefore, if the skull is used as a wedge, the rest of the body is delivered easily. Also, if difficulties are encountered, the baby can be suctioned and given oxygen even before delivery is completed.*

**Gross and Microscopic Anatomy of the Placenta**

20. Describe fully the gross structure of the human placenta as observed in the laboratory. *Smooth on the side from which the umbilical cord issues. Torn, rough, and bloody on the side that was united with maternal tissues. Blood-rich.*

21. What is the tissue origin of the placenta: fetal, maternal, or both? *Both*

22. What are the placental barriers that must be crossed to exchange materials? *The membranes of the villi and capillary walls of the fetal vascular supply.*
**Gross Anatomy of the Human Male Reproductive System**

1. List the two principal functions of the testis. *Sperm production, testosterone production*

2. Identify all indicated structures or portions of structures on the diagrammatic view of the male reproductive system below.

3. A common part of any physical examination of the male is palpation of the prostate gland. How is this accomplished?

   (Think!) *Through the anterior wall of the rectum.*

4. How might enlargement of the prostate gland interfere with urination or the reproductive ability of the male?

   *Constriction of the urethra at that point may lead to nonpassage of urine or semen.*
5. Match the terms in column B to the descriptive statements in column A.

**Column A**

- penis
- testes
- ductus deferens
- spongy urethra
- epididymis
- scrotum
- prepuce
- membranous urethra
- prostate gland
- bulbourethral glands

**Column B**

1. copulatory organ/penetrating device
2. site of sperm/androgen production
3. muscular passageway conveying sperm to the ejaculatory duct; in the spermatic cord
4. transports both sperm and urine
5. sperm maturation site
6. location of the testis in adult males
7. loose fold of skin encircling the glans penis
8. portion of the urethra between the prostate gland and the penis
9. empties a secretion into the prostatic urethra
10. empties a secretion into the membranous urethra

6. Why are the testes located in the scrotum? 

Viable sperm production requires a temperature slightly lower (94–95°F) than body temperature.

7. Describe the composition of semen and name all structures contributing to its formation. 

Sperm and the alkaline secretions of the prostate, seminal vesicles (also containing fructose), and the bulbourethral glands.

8. Of what importance is the fact that seminal fluid is alkaline? 

Buffers the sperm against the acid environment of the female reproductive tract.

9. What structures compose the spermatic cord? 

Connective tissue sheath (extension of abdominal fascia), ductus deferens, blood vessels.

Where is it located? 

Passes from the scrotal sac through the inguinal canal into the abdominal cavity.

10. Using the following terms, trace the pathway of sperm from the testes to the urethra: rete testis, epididymis, seminiferous tubule, ductus deferens.

- seminiferous tubule → rete testis → epididymis → ductus deferens
11. Using an appropriate reference, define *cryptorchidism* and discuss its significance.

*Failure of the testes to descend into the scrotum from the abdominal cavity, resulting in sterility if uncorrected.*

---

**Gross Anatomy of the Human Female Reproductive System**

12. On the diagram below of a frontal section of a portion of the female reproductive system, identify all indicated structures.

13. Identify the female reproductive system structures described below:

<table>
<thead>
<tr>
<th>Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>uterus</td>
<td>1. site of fetal development</td>
</tr>
<tr>
<td>vagina</td>
<td>2. copulatory canal</td>
</tr>
<tr>
<td>uterine tube</td>
<td>3. “fertilized egg” typically formed here</td>
</tr>
<tr>
<td>clitoris</td>
<td>4. becomes erectile during sexual excitement</td>
</tr>
<tr>
<td>uterine tube</td>
<td>5. duct extending superolaterally from the uterus</td>
</tr>
<tr>
<td>hymen</td>
<td>6. partially closes the vaginal canal; a membrane</td>
</tr>
<tr>
<td>ovary</td>
<td>7. produces oocytes, estrogens, and progesterone</td>
</tr>
<tr>
<td>fimbriae</td>
<td>8. fingerlike ends of the fallopian tube</td>
</tr>
</tbody>
</table>

14. Do any sperm enter the pelvic cavity of the female? Why or why not? *Yes. There is no anatomic continuity between the ovary and the first part of the duct system (i.e. uterine tube).*
15. What is an ectopic pregnancy, and how can it happen? *Implantation of the embryo in a site other than the uterus. May occur when the uterine tubes are blocked (prevents passage) or when the egg is “lost” in the peritoneal cavity and fertilization occurs there.*

16. Name the structures composing the external genitalia, or vulva, of the female. *Mons pubis, labia majora and minora, clitoris, vaginal and urethral openings, hymen, and greater vestibular glands.*

17. Put the following vestibular-perineal structures in their proper order from the anterior to the posterior aspect: vaginal orifice, anus, urethral opening, and clitoris.

   Anterior limit: clitoris → urethral opening → vaginal orifice → anus

18. Name the male structure that is homologous to the female structures named below.

   labia majora: *scrotum*  
   clitoris: *penis*

19. Assume a couple has just consummated the sex act and the male’s sperm have been deposited in the woman’s vagina. Trace the pathway of the sperm through the female reproductive tract.

   vagina → cervix → uterus → uterine tube → peritoneal cavity

20. Define *ovulation*: *Ejection of an egg (actually an oocyte) from the ovary.*

**Microscopic Anatomy of Selected Male and Female Reproductive Organs**

21. The testis is divided into a number of lobes by connective tissue. Each of these lobes contains one to four *seminiferous tubules*, which converge on a tubular region at the testis hilus called the *rete testis*.

22. What is the function of the cavernous bodies seen in the male penis? *This tissue can become engorged with blood, thus making the penis stiff and more effective as a penetrating device.*

23. Name the three layers of the uterine wall from the inside out.

   endometrium, myometrium, serosa (perimetrium)

   Which of these is sloughed during menses? *Endometrium*

   Which contracts during childbirth? *Myometrium*
24. What is the function of the stereocilia exhibited by the epithelial cells of the mucosa of the epididymis? 

**Absorb excess fluid and provide nutrients to the maturing sperm.**

25. On the diagram showing the sagittal section of the human testis, correctly identify all structures provided with leader lines.

![Diagram of the Sagittal Section of the Human Testis](image)

**The Mammary Glands**

26. Match the term with the correct description.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a; alveoli</td>
<td>Glands that produce milk during lactation</td>
</tr>
<tr>
<td>b; areola</td>
<td>Pigmented area surrounding the nipple</td>
</tr>
<tr>
<td>c; lactiferous duct</td>
<td>Ducts connecting alveoli to the lactiferous sinus</td>
</tr>
<tr>
<td>d; lactiferous sinus</td>
<td>Enlarged storage chambers for milk</td>
</tr>
<tr>
<td>e; lobule</td>
<td>Subdivisions of mammary lobes that contain alveoli</td>
</tr>
<tr>
<td>f; nipple</td>
<td>Releases milk to the outside</td>
</tr>
</tbody>
</table>

a. alveoli  
b. areola  
c. lactiferous duct  
d. lactiferous sinus  
e. lobule  
f. nipple
27. Using the key terms, correctly identify breast structures.

Key:  
- a. adipose tissue
- b. lobule containing alveoli
- c. areola
- d. lactiferous duct
- e. lactiferous sinus
- f. nipple

28. Describe the procedure for self-examination of the breasts. (Men are not exempt from breast cancer, you know!)

1. Stand in front of a mirror, arms relaxed at sides; examine breasts for changes in size, shape, dimpling, etc.  
2. Lie in supine position, pillow under one shoulder, arm raised. Examine the breast on that raised side by pressing the breast tissue with flattened fingers in small circular motions, moving from the periphery of the breast toward the nipple. Continue 360 degrees around the breast. Repeat for opposite side.
Physiology of Reproduction: Gametogenesis and the Female Cycles

Meiosis

1. The following statements refer to events occurring during mitosis and/or meiosis. For each statement, decide if the event occurs in (a) mitosis only, (b) meiosis only, or (c) both mitosis and meiosis.

   1. dyads are visible  
      a  
   2. tetrads are visible  
      b  
   3. product is two diploid daughter cells  
      a  
   4. product is four haploid daughter cells  
      b  
   5. involves the phases prophase, metaphase, anaphase, and telophase  
      a  
   6. occurs throughout the body  
      a  
   7. occurs only in the ovaries and testes  
      b  
   8. provides cells for growth and repair  
      a  
   9. homologues synapse and chiasmata are seen  
      b  
  10. daughter cells are quantitatively and qualitatively different from the mother cell  
      a  
  11. daughter cells are genetically identical to the mother cell  
      a  
  12. chromosomes are replicated before the division process begins  
      c  
  13. provides cells for replication of the species  
      b  
  14. consists of two consecutive nuclear divisions, without chromosomal replication occurring before the second division  
      b  

2. Describe the process of synapsis. The homologous chromosomes become closely aligned along their entire length.

3. How does crossover introduce variability in the daughter cells? Where crossovers occur, chromosome breakage occurs and parts are exchanged. This results in chromosomes with different parental contributions.

4. Define homologous chromosomes. Chromosomes that carry genes for the same traits. (One = paternal chromosome, the other = maternal chromosome.)
Spermatogenesis

5. The cell types seen in the seminiferous tubules are listed in the key. Match the correct cell type(s) with the descriptions given below.

Key:  
- a. primary spermatocyte  
- b. secondary spermatocyte  
- c. spermatogonium  
- d. sustentacular cell  
- e. spermatid  
- f. sperm

1. primitive stem cell  
2. haploid  
3. provides nutrients to developing sperm  
4. products of meiosis II  
5. product of spermiogenesis

6. Why are spermatids not considered functional gametes? Too much superfluous cytoplasm; nonmotile.

7. Differentiate between spermatogenesis and spermiogenesis.  

- Spermatogenesis: Formation of haploid gametes by the male.  
- Spermiogenesis: Sloughing off excessive spermatid cytoplasm to form a motile functional sperm.

8. Draw a sperm below and identify the acrosome, head, midpiece, and tail. Then beside each label, note the composition and function of each of these sperm structures.

9. The life span of a sperm is very short. What anatomical characteristics might lead you to suspect this even if you didn’t know its life span? No cytoplasm (to speak of) in which to store nutrients.

Oogenesis, the Ovarian Cycle, and the Menstrual Cycle

10. The sequence of events leading to germ cell formation in the female begins during fetal development. By the time the child is born, all viable oogonia have been converted to primary oocytes.

In view of this fact, how does the total germ cell potential of the female compare to that of the male? Much smaller, and the total number is predetermined.

11. The female gametes develop in structures called follicles. What is a follicle? A structure consisting of a capsule of follicle (or granulosa) cells that encloses a developing gamete (oocyte).
How are primary and vesicular follicles anatomically different? The primary follicle has one or a small number of layers of follicle cells surrounding the oocyte; the vesicular follicle has a large antrum containing fluid produced by the granulosa cells, and the developing oocyte, surrounded by several layers of granulosa cells, is pushed to one side.

What is a corpus luteum? Glandular ovarian structure that produces progesterone. The ruptured vesicular follicle is converted to a corpus luteum.

12. What is the major hormone produced by the vesicular follicle? Estrogen

By the corpus luteum? Progesterone (and some estrogen)

13. Use the key to identify the cell type you would expect to find in the following structures.

Key: a. oogonium b. primary oocyte c. secondary oocyte d. ovum

1. forming part of the primary follicle in the ovary
2. in the uterine tube before fertilization
3. in the mature vesicular follicle of the ovary
4. in the uterine tube shortly after sperm penetration

14. The cellular product of spermatogenesis is four spermatids; the final product of oogenesis is one ovum and three polar bodies. What is the function of this unequal cytoplasmic division seen during oogenesis in the female? To provide the ovum or functional gamete with adequate nutritional reserves so that it can survive during its journey to the uterus.

What is the fate of the three tiny cells produced during oogenesis? They deteriorate.

Why? They lack sustaining cytoplasm with nutrient reserves.

15. The following statements deal with anterior pituitary, ovarian hormones, and hormonal interrelationships. Name the hormone(s) described in each statement.

FSH (follicle-stimulating hormone) 1. produced by primary follicles in the ovary
LH (luteinizing hormone) 2. ovulation occurs after its burstlike release and progesterone 3. exert negative feedback on the anterior pituitary relative to FSH secretion
Estrogen 4. stimulates LH release by the anterior pituitary
Estrogen 5. stimulates the corpus luteum to produce progesterone and estrogen
LH 6. maintains the hormonal production of the corpus luteum in a nonpregnant woman

16. Why does the corpus luteum deteriorate toward the end of the ovarian cycle? Because blood levels of the anterior pituitary hormone LH are extremely low.
17. For each statement below dealing with hormonal blood levels during the female ovarian and menstrual cycles, decide whether the condition in column A is usually (a) greater than, (b) less than, or (c) essentially equal to the condition in column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>____________________________</td>
<td>____________________________</td>
</tr>
<tr>
<td>1. amount of estrogen in the blood during menses</td>
<td>amount of estrogen in the blood at ovulation</td>
</tr>
<tr>
<td>2. amount of progesterone in the blood on day 14</td>
<td>amount of progesterone in the blood on day 23</td>
</tr>
<tr>
<td>3. amount of LH in the blood during menses</td>
<td>amount of LH in the blood at ovulation</td>
</tr>
<tr>
<td>4. amount of FSH in the blood on day 6 of the cycle</td>
<td>amount of FSH in the blood on day 20 of the cycle</td>
</tr>
<tr>
<td>5. amount of estrogen in the blood on day 10</td>
<td>amount of progesterone in the blood on day 10</td>
</tr>
</tbody>
</table>

18. Ovulation and menstruation usually cease by the age of 55–60.

19. What uterine tissue undergoes dramatic changes during the menstrual cycle? **Endometrium**

20. When during the female menstrual cycle would fertilization be unlikely? Explain why. **Any time but the three-day interval (days 14–16) around ovulation. (Twenty-eight day cycle is assumed.)**

21. Assume that a woman could be an “on demand” ovulator like the rabbit, in which copulation stimulates the hypothalamic-anterior pituitary axis and causes LH release, and an oocyte was ovulated and fertilized on day 26 of her 28-day cycle. Why would a successful pregnancy be unlikely at this time? **The hormonal production of the ovary has ceased; the endometrium is beyond the receptive stage and is ready to slough off in menses.**

22. The menstrual cycle depends on events within the female ovary. The stages of the menstrual cycle are listed below. For each, note its approximate time span and the related events in the uterus; and then to the right, record the ovarian events occurring simultaneously. Pay particular attention to hormonal events.

<table>
<thead>
<tr>
<th>Menstrual cycle stage</th>
<th>Uterine events</th>
<th>Ovarian events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menstruation</td>
<td>Days 1–5. Endometrium is sloughing off.</td>
<td>Primary follicle begins to grow.</td>
</tr>
<tr>
<td>Secretory</td>
<td>Days 15–28. Vascular supply increases and glands begin secretory activity.</td>
<td>Ruptured follicle is converted to a corpus luteum, which begins to produce progesterone (and some estrogen). Peaks at day 23 and then begins to decline.</td>
</tr>
</tbody>
</table>
Survey of Embryonic Development

Developmental Stages of Sea Urchins and Humans

1. Define zygote. *Fertilized egg.*

2. Describe how you were able to tell by observation when a sea urchin egg was fertilized. *A fertilization membrane is present beneath the outer jelly coat.*

3. Use the key choices to identify the embryonic stage or process described below.

   Key:  
   a. cleavage  
   b. morula  
   c. zygote  
   d. fertilization  
   e. blastula  
   f. gastrulation

   d  1. fusion of male and female pronuclei  
   b  2. solid ball of embryonic cells  
   a  3. process of rapid mitotic cell division without intervening growth periods  
   c  4. combination of egg and sperm  
   f  5. process involving cell rearrangements to form the three primary germ layers  
   e  6. embryonic stage in which the embryo consists of a hollow ball of cells

4. What is the importance of cleavage in embryonic development? *It provides a large number of smaller cells for morphogenesis.*

   How is cleavage different from mitotic cell division, which occurs later in life? *During cleavage there are no intervening growth periods between the successive divisions. Therefore the cells get smaller and smaller, but the embryonic mass remains essentially the same size.*

5. The cells of the human blastula (blastocyst) have various fates. Which blastocyst structures have the following fates?

   - *Inner cell mass*  
     1. produces the embryonic body  
   - *Trophoblast*  
     2. becomes the chorion and cooperates with uterine tissues to form the placenta  
   - *Inner cell mass*  
     3. produces the amnion, yolk sac, and allantois  
   - *Yolk sac*  
     4. produces the primordial germ cells (an embryonic membrane)  
   - *Allantois*  
     5. an embryonic membrane that provides the structural basis for the body stalk or umbilical cord
6. Using the letters on the diagram, correctly identify each of the following maternal or embryonic structures.

<p>| | | | | |</p>
<table>
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<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>j</td>
<td>amnion</td>
<td>g</td>
<td>chorion</td>
<td>b</td>
</tr>
<tr>
<td>i</td>
<td>body stalk</td>
<td>h</td>
<td>chorionic villi</td>
<td>a</td>
</tr>
<tr>
<td>d</td>
<td>ectoderm</td>
<td>c</td>
<td>uterine cavity</td>
<td></td>
</tr>
</tbody>
</table>

7. Explain the importance of gastrulation. *It involves the migration, movement, and rearrangement of embryonic cells, so that a three-layer embryo (three primary germ layers) is formed.*

8. What is the function of the amnion and the amniotic fluid? *The amnion is a protective, fluid-filled sac that surrounds the embryo.* The fluid “buffer” protects the embryo from physical trauma and prevents adhesion formation.

9. Describe the process of implantation, noting the role of the trophoblast cells. *The trophoblast cells overlying the inner cell mass adhere to the endometrium. The trophoblast cells then secrete enzymes that erode the endometrial lining to reach the vascular supply beneath it.*

10. How many days after fertilization is implantation generally completed? _______ What event in the female menstrual cycle ordinarily occurs just about this time if implantation does not occur? *Menses, because this is usually the 14th day after ovulation.*
11. What name is given to the part of the uterine wall directly under the implanting embryo? Decidua basalis

That surrounding the rest of the embryonic structure? Decidua capsularis

12. Using an appropriate reference, find out what decidua means and state the definition. That which “falls off” or is subject to periodic shedding.

How is this terminology applicable to the decidues of pregnancy? After birth they slough off and are flushed out of the uterus.

13. Referring to the illustrations and text of A Colour Atlas of Life Before Birth: Normal Fetal Development, answer the following:

Which two organ systems are extensively developed in the very young embryo? Nervous system and circulatory system

Describe the direction of development by circling the correct descriptions below:

(proximal-distal) distal-proximal caudal-rostral rostral-caudal

Does bodily control during infancy develop in the same directions? Think! Can an infant pick up a common pin (pincer grasp) or wave his arms earlier? Is arm-hand or leg-foot control achieved earlier? Yes. Arm-hand control occurs before leg-foot control is achieved.

14. Note whether each of the following organs or organ systems develops from the (a) ectoderm, (b) endoderm, or (c) mesoderm. Use an appropriate reference as necessary.

<table>
<thead>
<tr>
<th>Organ or System</th>
<th>Ectoderm</th>
<th>Endoderm</th>
<th>Mesoderm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. skeletal muscle</td>
<td></td>
<td></td>
<td>b</td>
</tr>
<tr>
<td>2. skeleton</td>
<td>c</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. lining of gut</td>
<td>b</td>
<td></td>
<td>a</td>
</tr>
<tr>
<td>4. respiratory mucosa</td>
<td></td>
<td></td>
<td>a</td>
</tr>
<tr>
<td>5. circulatory system</td>
<td>c</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. epidermis of skin</td>
<td>a</td>
<td></td>
<td>b</td>
</tr>
<tr>
<td>7. nervous system</td>
<td></td>
<td></td>
<td>c</td>
</tr>
<tr>
<td>8. serosa membrane</td>
<td></td>
<td></td>
<td>c</td>
</tr>
<tr>
<td>9. liver, pancreas</td>
<td></td>
<td></td>
<td>c</td>
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<td>(depends on animal)</td>
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17. Describe the function(s) of the placenta. Provides nutrients and oxygen to the fetus, removes fetal wastes, and produces the hormones of pregnancy.
What embryonic membranes has the placenta more or less “put out of business”? *Yolk sac and allantois.*

18. When does the human embryo come to be called a fetus? *Ninth week of development.*

19. What is the usual and most desirable fetal position in utero? *Head down.*

Why is this the most desirable position? *The largest fetal dimension is the skull. Therefore, if the skull is used as a wedge, the rest of the body is delivered easily. Also, if difficulties are encountered, the baby can be suctioned and given oxygen even before delivery is completed.*

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**Gross and Microscopic Anatomy of the Placenta**

20. Describe fully the gross structure of the human placenta as observed in the laboratory. *Smooth on the side from which the umbilical cord issues. Torn, rough, and bloody on the side that was united with maternal tissues. Blood-rich.*

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21. What is the tissue origin of the placenta: fetal, maternal, or both? *Both*

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