

CHAPTER 22: THE REPRODUCTIVE SYSTEMS

OBJECTIVES:

1. Briefly explain why human reproduction is significant, and how sexual reproduction always results in a unique zygote.
2. List the functions of the reproductive systems.
3. Define the terms *meiosis*, *DNA*, *somatic cells*, *gametes*, *diploid*, *haploid* and *zygote*.
4. Name the common term for both the male and female gamete.
5. Distinguish between spermatogenesis and oogenesis.
6. Illustrate the steps involved in gamete formation (meiosis), explain the highlight(s) of each step, and explain any differences between male and female end-products.
7. Name the specific step of meiosis where homologous chromosomes are arranged together in tetrads (this is also called synapsis).
8. Compose a table comparing mitosis and meiosis in terms of time of DNA replication, number of divisions involved, number of daughter cells produced and their genetic composition, and the importance of each process.
9. Locate each of the following male reproductive organs on a diagram, discuss the structure of each organ, and name a major function for each organ:

testes, scrotum, epididymis, vas(ductus) deferens, seminal vesicle, ejaculatory duct, prostate gland, bulbourethral glands, urethra, and penis
10. Describe the microscopic structure of the testes and explain where spermatogenesis and androgen production occurs.
11. List and describe the sequence of events involved in spermatogenesis, beginning with a spermatogonium and ending with mature sperm cells. Be sure to keep track of chromosome number ($2n = 46$, or $1n = 23$) and the number (i.e. 1, 2, or 4) of each cell type produced.
12. Name the location where sperm is stored.

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OBJECTIVES (CONTINUED)

13. Fully describe the structure of a mature sperm cell.
14. Explain why a sperm cell contains so many mitochondria and name the portion of the spermatocyte that houses these mitochondria.
15. Explain how the functions of the testes are hormonally controlled. Be sure to include the overall scheme from the hypothalamus all the way to the final target organs (2^o sexual organs).
16. Name the components of the spermatic cord and name the "canal" that houses these organs and passes them into the abdominopelvic cavity.
17. Name the site where the seminal vesicle and vas deferens unite within the prostate gland.
18. List the components of semen, name the organ (or gland) that secretes each of these components, and name the function of each semen component.
19. Explain the function of the cremaster muscle.
20. Sketch a cross-sectional view of the penis and include the following structures: corpora cavernosa, corpus spongiosum, glans penis, prepuce, tunica albuginea, and urethra.
21. Explain what portion of the penis is surgically removed during a circumcision.
22. Distinguish between erection, emission, ejaculation and orgasm in males.
23. Locate each of the following female reproductive organs on a diagram, describe the structure of each organ, and discuss the major function of each organ:

ovaries, fallopian tubes, uterus, cervix, vagina, labia, and clitoris
24. Describe the internal structure of an ovary and locate where oogenesis occurs.
25. Discuss the sequence of events involved in oogenesis. Be sure to include chromosome # and number of each cell produced.

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OBJECTIVES (continued)

26. Explain why a secondary oocyte does not always undergo Meiosis II.
27. Describe the events involved in maturation of an ovarian follicle each month. Draw a sketch to illustrate the components of the follicle.
28. Distinguish between a primary and secondary follicle.
29. Define the term *ovulation* and name the gonadotropin responsible for its occurrence.
30. Name the female reproductive organ containing fimbriae and cilia.
31. Discuss the structure (3 layers) of the uterus, and provide the name for the lower one-third where the uterus narrows.
32. Distinguish between a pap smear and colposcopy.
33. Name the female reproductive organ that houses the erect penis during intercourse, the organ(s) that protect the internal organs, and the organ that corresponds to the male penis.
34. Describe the structure of the mammary glands and track the flow of milk from the alveoli to the nipple.
35. Outline how ovarian function is hormonally controlled, starting with the hypothalamus to the final target organs (i.e. uterus, and 2^o sex organs). Then discuss the hormones named above in terms of the female reproductive cycle that occurs each month (i.e. list each hormone, name the (specific) organ or gland that secretes that hormone, list the corresponding day(s) of the cycle when that hormone is secreted, and name the response that occurs at each target organ.
36. Define the term *fertilization* and name the site where fertilization typically occurs.
37. Explain what is meant by capacitation of a sperm.
38. Describe the structure of a secondary oocyte when it is ovulated from the ovary.
39. Define syngamy and explain how and why it occurs.
40. List the components of a zygote.
41. Define the term *cleavage* and explain why the cells (blastomeres) are unable to grow between divisions.

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OBJECTIVES (continued)

42. Define the term *morula*, describe its structure, and state the approximate time-table for its appearance.
43. Define the term *blastocyst*, describe its structure, and state the approximate time-table for its appearance.
44. List the hormones of pregnancy, name the organ(s) that secrete each hormone, the time-table during pregnancy when each hormone is secreted and reaches peak levels, and the effect(s) of each hormone.
45. Define the term *gestation*, name the approximate time of human gestation, and name the special branch of medicine involved with gestation and birth.
46. Describe the anatomical changes that occur within a woman's body during pregnancy, and discuss the physiological changes that they result in.
47. Fully describe the three types of prenatal testing currently performed.
48. Define the term *karyotype* and discuss the type of information that may be obtained by one.
49. Name and discuss the major hormones involved with the onset of labor and birth.
50. List the three stages of birth and describe the events that occur within each.
51. Discuss the "fight-or-flight" response of a newborn.
52. Define the term *puerperium* and discuss the major events that occur during this time.

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I. INTRODUCTION

All living organisms must reproduce in order to continue their species. Humans reproduce by sexual reproduction with internal fertilization, where a flagellated sperm (from the male father) fertilizes an ovum (from the female mother) producing a zygote. In sexual reproduction, the genetic information is contributed by both parents, and therefore a unique combination of genetic information results in each zygote.

II. THE FUNCTIONS OF THE REPRODUCTIVE SYSTEMS

The various reproductive organs work together to:

- A. produce gametes;
- B. transport gametes;
- C. maintain gametes;
- D. maintain developing zygote/fetus(female);
- E. produce sex hormones:
 1. male = testosterone;
 2. female = estrogen and progesterone.

III. MEIOSIS

- A. The genetic information of living organisms is DNA (deoxyribonucleic acid) that is carried on the genes of chromosomes.
- B. In humans, each **somatic (body) cell is diploid**, which means the cell contains **46 chromosomes** or 23 pairs.
- C. Human sex cells or **gametes**, however, **are haploid**, which means the cell contains only **23 chromosomes**.
- D. **Meiosis** is the type of cell division that results in gametes that possess half the chromosome number of the parent cell (i.e. meiosis reduces the chromosome number by one-half).
 1. Male sperm (haploid) = 23 chromosomes (1 set)
 2. Female egg (haploid) = 23 chromosomes (1 set)

 3. Fertilization
(zygote; diploid) = 46 chromosome (2 sets).

* *What happens to this diploid zygote now?*

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III. Meiosis (continued)

E. Meiosis Overview:

1. **One Parent Cell**
(Two sets of duplicated chromosomes)
[23 pairs duplicated chromosomes]

2. **Two Daughter Cells**
(one set of duplicated chromosomes)
[23 duplicated chromosomes]

3. **Four Gametes**
(one set of chromosomes)
[23 chromosomes]

* Meiosis is called **spermatogenesis** in the male (testes).

** Meiosis is called **oogenesis** in the female (ovaries).

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III. Meiosis (continued)

F. **The (Specific) Stages of Meiosis:** See Fig 24.4, page 935.

1. Introduction:

Meiosis is similar to mitosis in that the chromosomes (DNA) are duplicated prior to the process, however this single replication is followed by two consecutive cell divisions called Meiosis I and Meiosis II.

2. **Interphase I:**

- a. Chromosomes replicate in parent cell;
- b. 23 pairs of duplicated chromosomes.

3. **Meiosis I:**

- a. reduction division:
- b. 4 stages:

m **Prophase I:**

1. Chromosomes shorten & thicken;
2. Nuclear envelope/nucleoli disappear;
3. Mitotic spindle appears;
4. **Chromosomes form tetrads (synapsis);** (i.e Homologous pairs are arranged together).

m **Metaphase I:**

1. Homologous chromosome pairs line up along metaphase plate.

m **Anaphase I:**

1. Homologous pairs separate;
2. One member of each pair moves to opposite pole;
3. Cleavage furrow starts to form.

m **Telophase I and cytokinesis:**

1. Cleavage furrow complete;
2. 2 daughter cells containing half the chromosome number of parent cell (23 duplicated chromosomes).

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F. **The (Specific) Stages of Meiosis:** See Fig 24.6, page 936.

4. **Meiosis II:**

- a. equatorial division;
 - b. 4 stages similar to those of mitosis, with
 - m centromere splitting (between duplicated chromosomes) and
 - m sister chromatids migrating to opposite poles during Anaphase II.
 - m Stages include:
 - 1. Prophase II,
 - 2. Metaphase II,
 - 3. Anaphase II,
 - 4. Telophase II and cytokinesis.
 - c. Result is **4 gametes with 23 chromosomes.**
- * **During spermatogenesis, 4 sperm** result.
 * **During oogenesis, only 1 ovum** results due to unequal cytokinesis (i.e. polar bodies result; discussed later).

G. **Comparison of Mitosis and Meiosis:** (Keyed on page 438 of this outline)

Event	Mitosis	Meiosis
DNA Replication		
Number of Divisions		
Number of daughter cells & genetic composition		
Importance		

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IV. ORGANS OF THE MALE REPRODUCTIVE SYSTEM

See Fig 22.1, page 837.

A. **TESTES**= The primary male sex organs which produce sperm and male sex hormones.

1. ovoid structures held within the **scrotum** (outside the male body);
2. Internal Structure of testis:

See Fig 22.3, page 839.

- a. Each testis is divided into **lobules**;
- b. Each lobule contains:
 - m **seminiferous tubules** (production of sperm cells under the influence of what hormone?) which are separated by
 - m **interstitial cells** (production of male sex hormones under the influence of what hormone?)
- c. The seminiferous tubules unite and give rise to the **epididymis** on the outer surface of the testis.

3. **Germinal Epithelium:**

See Fig 22.5, page 840.

- a. The **seminiferous tubules** are lined by stratified **epithelium**;
- b. This germinal epithelium consists of **two types of cells**:
 1. **Spermatogenic cells** which give rise to sperm cells;
 2. **Supporting (nurse) cells** which support and nourish the spermatogenic cells.

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IV. ORGANS OF THE MALE REPRODUCTIVE SYSTEM

A. Testes (continued):

4. Spermatogenesis:

See Fig 22.5b, page 840.

- a. Males produce sperm from puberty and then throughout life:
- b. The sperm is produced in the germinal epithelium of the seminiferous tubules;
- c. Sperm cells are produced from **spermatogonia cells which contain 46 chromosomes**;
- d. Meiosis reduces this number by one-half, so that the number of chromosomes in mature sperm cells is **23 chromosomes**;
- e. Overall sequence:
 - m **One spermatogonium (46)** gives rise to
 - m **one primary spermatocyte (46)** which gives rise to
 - m **two secondary spermatocytes (23)** following Meiosis I, which give rise to
 - m **four spermatids (23)** following Meiosis II, which mature into
 - m **four sperm cells (23)** which collect in the lumen of the seminiferous tubule.
- f. The sperm travel to and mature in the epididymis.

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IV. ORGANS OF THE MALE REPRODUCTIVE SYSTEM

A. Testes (continued):

5. **Sperm Structure:** See Fig 22.6, page 841.

The structure of a mature sperm cell consists of a head, a body, and a tail:

- a. The **head**
 - m contains 23 chromosomes and
 - m is covered by a helmet like structure called an **acrosome**.
 1. contains enzymes to help penetrate the oocyte.
- b. The **body** (mid-piece)
 - m contains many **mitochondria** needed to produce ATP for energy for the sperm cell to complete its long journey;
- c. The **tail**
 - m is a **flagellum**
 - m provides locomotion for the sperm cell.
 - m See green box on page 842 concerning toxic chemicals that affect a sperm's ability to swim.

6. **Hormonal Control of the Testes:** Fig 22.14, page 849.

- a. At puberty, the **hypothalamus** secretes a "releasing hormones" that target the males anterior pituitary gland;
- b. The **anterior pituitary gland** then secretes two gonadotropins:
 - m **Follicle stimulating hormone (FSH)**, which stimulates spermatogenesis in the germinal epithelium of Seminiferous tubules (ST's); and
 - m **Luteinizing hormone (LH)** which stimulates the interstitial cells between the ST's to produce male sex hormones.
- c. Male Sex Hormones = **Androgens**
 - m **Testosterone** is the major androgen whose production begins at puberty:
 - m Actions include development of male sex organs and development and maintenance of male **secondary sexual characteristics**:
 1. increased growth of body hair;
 2. lower-pitched voice;
 3. increased muscular growth;
 4. strengthening of bones.

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IV. Male Reproductive Organs (continued): See Fig 22.1, page 837.

B. **Epididymis:** Also see Fig 22.8, page 842.

1. tightly coiled tube leading to vas deferens;
2. site of storage of sperm cells.

C. **Vas (Ductus) Deferens:** Also see Fig 22.9, page 843.

1. muscular tube which passes upward from testis, passes through parietal peritoneum (**inguinal canal**) and into abdominal cavity;

* The vas deferens, along with a testicular artery, autonomic nerves, testicular veins, lymphatic vessels, and the cremaster muscle pass upward within the inguinal canal and compose the **spermatic cord; Fig 22.2, page 838.**

2. fuses with duct from seminal vesicle to form **ejaculatory duct** (within prostate gland).
3. **Vasectomy.**

D. **Seminal Vesicle:**

1. sac-like structure attached to vas deferens;
2. secretes an alkaline fluid that is rich in nutrients (**fructose** for energy).

E. **Prostate Gland:** Also see Fig 22.10, page 843.

1. surrounds urethra below bladder;
2. secretes a milky, **alkaline fluid** which enhances **sperm motility.**

F. **Bulbourethral Glands:**

1. two small structures beneath prostate;
2. secrete **lubricant** for penis.

* **Semen** = sperm cells (from testes), alkaline fluids (from prostate), fructose (from seminal vesicle) and lubricant (from bulbourethral).

G. **Scrotum:**

1. pouch of skin and subcutaneous tissue that encloses the testes;
2. The **cremaster muscle** is an extension of the internal oblique muscle that elevates the scrotum during sexual arousal and on exposure to cold.

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IV. Male Reproductive Organs (continued)

H. **Penis:** See Fig 22.11, page 845.

1. male excitatory organ;
 2. specialized to become erect for insertion into vagina during sexual intercourse;
 3. cylindrical body composed of three columns of erectile tissue.
 4. completely surrounds urethra.
 5. Structure:
 - a. pair of dorsally located **corpora cavernosa**;
 - b. single **corpus spongiosum** which extends at its distal end to form the enlarged **glans penis**;
 - c. Each column is surrounded by a tough capsule of white fibrous CT called **tunica albuginea**;
 - d. A loose fold of skin called the **prepuce** covers the glans as a sheath.
 - m The prepuce is sometimes removed by a surgical procedure called a **circumcision**;
- * **Erection** = vascular spaces within erectile tissue become engorged with blood when male becomes sexually stimulated.
See Fig 22.12, page 848.
- * **Emission** = movement of semen from epididymis into urethra.
- * **Ejaculation** = forceful movement of semen from urethra to outside.
See Fig 22.13, page 848.
- * **Orgasm** = culmination of sexual stimulation accompanied by involuntary rhythmic contractions of the epididymis causing emission and ejaculation of semen, resulting in a sense of psychological and physiological release.

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V. THE FEMALE REPRODUCTIVE SYSTEM

A. Organs (See Fig 22.15, page 851)

1. **OVARIES** = the primary female sex organs which produce ova (eggs) and female sex hormones.

a. solid ovoid structures located (one on each side) on the posterior wall of the pelvic cavity.

b. Internal Structure (Fig 22.22, page 856).

m Each ovary is subdivided into a :

1. **medulla** = CT, blood & lymph vessels and nerves;
= nourishment and support.

2. **cortex** = ovarian follicles covered by germinal epithelium.

c. **Oogenesis:** (See Fig 22.17a, page 853).

m Mitosis of primordial germ cells within female embryos produces diploid **oogonia** which give rise to (by replication)

m **primary oocytes (46 chromosomes)**

1. Note that human females are born with all their potential ova as primary oocytes (46 chromosomes);

m At puberty, once each month, one primary oocyte (46) is stimulated to undergo Meiosis I, which gives rise to one

m **secondary oocyte (23)** [and a polar body due to unequal cytokinesis] which is ovulated from the ovary (...LH)

1. Note that only if the secondary oocyte is penetrated by a sperm cell is Meiosis II initiated.

m. When and if Meiosis II is complete,

1. a second polar body is separated from the large ovum,
2. the haploid nuclei of the sperm and the now-matured ovum fuse.

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V. THE FEMALE REPRODUCTIVE SYSTEM

A. Organs (continued)

1. Ovary (continued)

d. **Maturation of Follicle:** See Fig 22.19, pg 872 & Fig 22.22, pg 856.

m During child bearing years, each month **FSH** stimulates one primordial follicle to mature:

1. The oocyte enlarges;
2. The follicular cells multiply and give rise to stratified epithelium composed of **granulosa cells**;
3. A layer called the **zona pellucida** appears and separates the oocyte from the granulosa cells = a **primary follicle**;
4. A fluid-filled cavity appears (**antrum**) = a **secondary follicle**.

e. **Ovulation**

m Oogenesis is complete as the follicle matures (approximately **14 days**);

m Upon maturation, the follicle bursts (LH), **releasing an secondary oocyte** (ovum, egg);

m After ovulation, the oocyte is drawn into the fallopian tube (via fimbriae).

2. **Fallopian Tubes** (Uterine Tubes, Oviduct):

See Fig 22.23, page 857.

- a. Tubes which pass medially from ovaries to uterus;
- b. Distal ends are expanded over ovary and form extensions called **fimbriae**; .
- c. Inner lining is covered with **cilia** to aid oocyte movement; See Fig 22.24, page 857.
- d. Fertilization typically occurs in fallopian tube.

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V. THE FEMALE REPRODUCTIVE SYSTEM

A. Organs (continued)

3. **Uterus:** See Fig 22.23, page 874.

a. A **muscular organ** that receives embryo and sustains its life during development;

b. The uterine wall has **three layers**:

m **Endometrium** = inner lining;

See Fig 22.25, page 858 to study the histology of the inner lining of wall.

* **Endometriosis** = endometrial tissue in locations other than uterus; tissue bleeds, but does not shed, resulting in scars or adhesions; painful and possibly infertile condition.

m **Myometrium** = bundles of smooth muscle; bulk of uterus;

m **Perimetrium** = visceral covering.

c. Lower one-third of uterus narrows to form **cervix**:

m internal os;

m cervical canal;

m external os;

m posterior/anterior fornix.

* **Pap smears are taken from cervical tissue.**

4. **Vagina:** Fig 22.15a, page 851.

a. passageway from cervix to outside;

b. serves to **receive erect penis**, to convey uterine secretions, and to transport offspring during birth.

c. The **hymen** is membrane composed of epithelium and CT which partially closes the vaginal orifice.

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V. THE FEMALE REPRODUCTIVE SYSTEM

A. Organs (continued)

5. **Labia:** See Fig 22.15a, page 851 and Fig 22.26, page 859.
 - a. external organs;
 - b. enclose and protect underlying organs and tissues;
 - c. composed of labia majora and labia minora.
 - d. The space enclosed by the labia minora = **vestibule of vulva.**

6. **Clitoris:** See Fig 22.15a, page 851 and Fig 22.26, page 859.
 - a. external excitatory organ;
 - b. small projection at the anterior end of the labia which corresponds to the male penis;
 - c. composed of two columns of erectile tissue.

- * **Erection** = erectile tissues of clitoris become engorged with blood and swell during sexual stimulation.

- * * **Orgasm** = rhythmic contraction of muscles of perineum, uterine wall and fallopian tubes, which result in a feeling of psychological and physiological release.

See Fig 22.27, page 860.

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V. THE FEMALE REPRODUCTIVE SYSTEM

A. Organs (continued)

7. Summary Table: See Table 22.2, page 860 & page 440 of this outline.

Name of Organ	Structure	Function

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B. Hormonal Control of Female Reproductive Functions

1. Secretion of Gonadotropins:

The female body remains reproductively immature until about eight years of age when **gonadotropin (FSH and LH)** secretion from the anterior pituitary gland (under the influence of the hypothalamus) increases:

- a. **FSH causes maturation of a follicle** and within each follicle, an primary oocyte matures also (Day 0-14);
- b. **LH causes ovulation** (Day 14); a secondary oocyte is released into a fallopian tube and the follicle becomes the corpus luteum.

* There are two important female sex hormones secreted by the structures named above.

2. Female Sex hormones:

- a. **Estrogen** which is produced by the maturing follicle (of the ovary); Day 1-14.
 - m is responsible for the development and maintenance of most **female secondary sexual characteristics**:
 1. development of breasts and mammary glands;
 2. increased fat deposition in breasts, thighs, and buttocks;
 3. increased hair growth.
- b. **Progesterone** which is produced by the corpus luteum (of the ovary); Day 14-24;
 - m functions to cause changes in the endometrium of the uterus; prepares the uterus for implantation of the zygote.

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V. THE FEMALE REPRODUCTIVE SYSTEM

- C. **Female Reproductive Cycles:** See Fig 22.29, page 863 and Table 22.3, page 862.
1. The menstrual cycle is **initiated by FSH**, which stimulates the maturation of a follicle;
 - a. The **maturing follicle secretes estrogen**, which is responsible for maintaining secondary sexual traits and causing a slight thickening of the uterus wall;
 2. **Ovulation is triggered by a burst of LH;**
 - a. Following ovulation, the follicular cells give rise to the **corpus luteum**;
 - b. The **corpus luteum secretes progesterone** which causes the uterine lining to become vascular and glandular;
 3. If the oocyte is not fertilized, the corpus luteum begins to degenerate.
 - a. As the concentration of estrogen and progesterone decline, the uterine lining is shed causing menstruation.
 4. During this cycle, estrogen and progesterone inhibit the release of LH and FSH.
 - a. As the anterior pituitary senses the fall in the concentrations of these hormones, it secretes them again (negative feedback), initiating a new menstrual cycle.
 5. If fertilization and implantation of the zygote does occur, the corpus luteum continues to produce progesterone to maintain the embryo/fetus within the uterus (Chapter 23).

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V. THE FEMALE REPRODUCTIVE SYSTEM

C. Summary of **Female Reproductive Cycles**: Keyed on page 441 of this outline.

HORMONE				
secreted by what organ or gland?				
days of secretion				
target(s) of hormone				
response				

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VI. DEVELOPMENT DURING PREGNANCY

Pregnancy includes a sequence of events including fertilization, implantation, embryonic growth, and fetal growth that finally results in birth.

A. Fertilization = fusion of genetic material from sperm and ovum into a single nucleus; See Fig 22.32, page 866 and Fig 22.31, page 865.

1. Sperm become fully **capacitated** within female reproductive tract (i.e. acrosome secretes digestive enzymes to break through corona radiata).
2. Secondary oocyte is ovulated from ovary surrounded by a **zona pellucida** and **corona radiata** (nutritive granulosa cells).
3. Usually in the **fallopian tube**, sperm bind to the zona pellucida, but only one sperm penetrates and enters the secondary oocyte (i.e. **syngamy**):
 - a. depolarization of oocyte cell membrane;
 - b. calcium ions rush in (and from within);
 - c. granules are released from oocyte;
 - d. causing oocyte cell membrane to become impermeable to other sperm.
 - e. Prevents polyspermy.
4. Once the sperm has entered a secondary oocyte:
 - a. Meiosis II occurs (forming **female pronucleus** = 23 chromosomes [i.e. haploid; 1n]);
 - b. Sperm's tail is shed (forming **male pronucleus** = 23 chromosomes [i.e. haploid; 1n]);
 - c. Pronuclei fuse forming a **segmentation nucleus** (= 46 chromosomes; 2n);
 - d. **Zygote** = segmentation nucleus, cytoplasm, and the zona pellucida.

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VI. DEVELOPMENT DURING PREGNANCY

B. Formation of the Morula

See Fig 22.33, page 867.

1. **Cleavage** = the early series of mitotic divisions of the zygote.
 - a. These divisions occur so rapidly, that the cells are unable to grow between divisions.
 - b. The mass of successively smaller and smaller cells is still contained within the zona pellucida.
 - c. These small cells are called **blastomeres**.
2. First division = 36 hours = 2 cells.
3. Second division = 48 hours = 4 cells.
4. **Morula** = solid ball of 32 cells (resembles a raspberry); about 96 hours.

C. Formation of the Blastocyst:

See Fig 22.33, page 867.

1. **Blastocyst** = a hollow ball of cells surrounding a central cavity; about 5 days.

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VII. HORMONES OF PREGNANCY(See Fig 22.35, page 868 & Table 22.5, page 869)

A. Estrogens and Progesterones:

1. from corpus luteum through month 3:
 - a. relatively low levels;
 - b. maintain uterine lining during pregnancy (i.e essentially needed for the continued attachment of the embryo/fetus.)
 - c. prepare mammary glands to secrete milk.
2. from placenta (chorion) from month 3 until birth:
 - a. extremely high levels;
 - b. maintain pregnancy;
 - c. develop mammary glands for lactation.

2. Human Chorionic Gonadotropin (hCG) from chorion of placenta:

1. stimulates continued secretion of estrogens and progesterones by the corpus luteum (mimics LH);
2. can be detected by Day 8;
3. peaks at about Week 9;
4. decreases sharply during fourth and fifth month;
5. may be the cause of "morning sickness".

C. Human Chorionic Somatomammotropin (hCS) or Human Placental Lactogen (hPL) from chorion:

1. secretion starts about Day 8;
2. Levels increase as size of placenta increases;
3. peaks at Week 32 and remains at that level;
4. Effects include:
 - a. development of breast tissue for lactation;
 - b. deposition of protein in tissues;
 - c. regulation of metabolism:
 - m decreases use of glucose by mother, leaving more available to fetus;
 - m releases fatty acids from fat deposits, providing an alternative source of energy for the mother's metabolism.

D. Relaxin from the placenta and ovaries assists in delivery.

1. relaxes pubic symphysis and ligaments;
2. dilates uterine cervix.

E. Inhibin from the ovaries:

1. inhibits secretion of FSH.

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VIII. GESTATION

A. Introduction

1. Definition = the time a zygote, embryo, and fetus is carried in the female reproductive tract;
2. Time period = 266 days from fertilization;
3. **Obstetrics** = the specialized branch of medicine that deals with pregnancy, labor, and the period immediately following birth.

B. Anatomical Changes of Uterus:

1. occupies most of pelvic cavity by end of month 3;
2. At full-term, occupies most of the abdominal cavity.
 - a. Liver, intestines and stomach are pushed upward;
 - b. elevates diaphragm;
 - c. widens thoracic cavity;
 - d. Ureters and urinary bladder are compressed.

C. Physiological Changes:

1. General:

- a. weight gain (from fetus, amniotic fluid, placenta, uterus, and water);
- b. increased storage of proteins, triglycerides, and minerals;
- c. marked breast enlargement in prep of lactation;
- d. lower back pain due to lordosis.

2. Cardiovascular Changes:

- a. increase in SV & CO by 30%;
- b. increase in HR by 10/15%;
- c. increase in blood volume by 30/50%;
- d. compression of IVC decreases venous blood return and results in edema in lower limbs.

3. Pulmonary Changes:

- a. TV & ERV increase 30/40%;
- b. functional residual capacity may decrease to 25%;
- c. Total oxygen consumption increases 10/20%.

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VIII. GESTATION

C. Physiological Changes:

4. GI Changes:

- a. increased appetite;
- b. decreased motility (constipation);
- c. nausea, vomiting, heartburn,

5. Urinary Changes:

- a. urinary frequency, urgency, & incontinence;
- b. increased GFR by 40.

6. Skin Changes:

- a. increased pigmentation;
- b. striae.

7. Reproductive Changes:

- a. edema & vascularity of vulva & vagina;
- b. uterus weight increases from 60-80g to 900-1200g at term (from hyperplasia/hypertrophy).

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IX. Mammary Glands (within breast tissue):

See Fig 22.39, page 873.

- A. modified sudoriferous (apocrine) glands that produce milk;
 - B. consist of 15-20 lobes separated by adipose tissue;
 - C. Each lobe is composed of lobules composed of CT and milk-secreting glands called alveoli;
 - D. Production/Flow of milk:
 - 1. Milk is produced by alveoli & passes into
 - 2. secondary tubules then into
 - 3. mammary ducts then into
 - 4. lactiferous sinuses (near nipple) then into
 - 5. lactiferous ducts and exits through the
 - 6. nipple.
- * See CA 22.4, page 874-875 concerning breast cancer.
- * See CA 22.5, pages 878-879 concerning Human Milk and Breast Feeding.

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10. Sexually Transmitted Diseases

See Table 22.10, page 882 for more information.

- A. AIDS
- B. Chlamydia
- C. Genital Herpes
- D. Genital Warts
- E. Gonorrhea
- F. Syphilis

VII. Other Disorders/Imbalances

- A. Male disorders:
 - 1. Testicular cancer: See green box and page 838.
 - 2. Prostate Disorders: See CA 22.1, page 844.
 - 3. Impotence
 - 4. Infertility: See CA 22.2, page 846.
 - 5. Sterility
- B. Female Disorders:
 - 1. Menstrual Abnormalities: See green boxes on pages 861.
 - 2. Adenosis: See green box on page 858.
 - 3. PMS: See green box on page 863.
 - 4. Ovarian Cysts
 - 5. Endometriosis
 - 6. Infertility: See CA 22.3, page 872.
 - 7. Cervical cancer (directly related to HPV; genital warts)

CHAPTER 22: THE REPRODUCTIVE SYSTEMS

Comparison of Mitosis and Meiosis: (outline page 416)

Event	Mitosis	Meiosis
DNA Replication	Occurs during inter-phase before nuclear division occurs.	Occurs during inter-phase before nuclear division occurs.
Number of Divisions	One (PMAT)	Two (2xPMAT); no replication between divisions; synapsis occurs during PI.
Number of daughter cells & genetic composition	Two, each diploid (2n) and genetically identical to parent cell.	Four, haploid cells (1n), genetically non-identical to parent cell.
Importance	Growth, repair, development of multicellular adult from zygote.	Production of gametes; reduces chromosome # by $\frac{1}{2}$; variation.

CHAPTER 22: THE REPRODUCTIVE SYSTEMS

Male Reproductive Organ Summary Table (outline page 422)

Name of Organ	Structure	Function
Testes	solid ovoid structure held in scrotum; lobules of seminiferous tubules separated by interstitial cells; See pages 854-857 in text	production of sperm (seminiferous tubules/FSH); secretion of testosterone (interstitial cells, LH)
Epididymis	tightly coiled tubule superior to testes; leads to vas deferens	storage of sperm
Vas Deferens	muscular tube leading from epid. into abdominal cavity	movement of sperm
Seminal Vesicle	sac-like structure attached to vas deferens	addition of fructose (energy source) to sperm/semen
Prostate Gland	sponge-like structure below bladder and surrounding urethra	addition of milky alkaline fluid to semen for sperm motility
Bulbourethral Glands	two pea-shaped structures below prostate	addition of penis lubricant to sperm
Urethra	tube leading from bladder/prostate to outside; held within penis	transport of sperm and urine to outside
Penis	male excitatory organ; vascular columns fill with blood causing erection	is held in female vagina during intercourse for transfer of sperm
Scrotum	pouch of skin and fat that holds testes	hold testes at cooler temperature to insure optimum sperm production

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FEMALE REPRODUCTIVE Organs Summary Table (outline page 427):

Name of Organ	Structure	Function
Ovary	solid, ovoid structures on posterior pelvic cavity; cortex of ovarian follicles	production of secondary oocytes for fertilization; production of estrogen for development of 2^o sex organs; production of progesterone to prepare endometrium for implantation
Fallopian Tube	tubes that pass medially from ovaries to uterus; lined with cilia, expanded ends (fimbriae) over ovary	site of fertilization; transportation of fertilized egg to uterus
Uterus	muscular (smooth) organ that houses developing embryo, fetus; 3 layers	houses developing embryo/fetus
Cervix	lower one-third of uterus	Pap smear location
Vagina	passageway from cervix to outside	birth canal; houses erect penis during intercourse
Labia	external reproductive organs	protect underlying organs
Clitoris	small projection at anterior end of labia; two columns of vascular tissue	female excitatory organ

CHAPTER 22: THE REPRODUCTIVE SYSTEMS

Summary of Female Reproductive Cycle (outline page 430) :

	FSH	LH	estrogen	progesterone
secreted by what organ or gland?	anterior pituitary gland	anterior pituitary gland	maturing ovarian follicle	corpus luteum
days of secretion	Days 0-14	day 14	days 1-14	days 14-24
target(s) of hormone	ovarian follicle	mature ovarian follicle	secondary sex organs (breasts, hair follicles in axillary and inguinal region, adipose tissue in buttocks and thigh region)	endometrium of uterus
response	maturation of ovarian follicle and ovum	bursting of ovarian follicle; ovulation	development at puberty; maintenance throughout life	causes endometrium to thicken, become vascular and glandular; preparation for implantation