

Sexual reproduction – process by which organisms produce offspring from the union of germ cells called gametes.

- After male gamete (sperm cell) unites with female gamete (oocyte) – an event called fertilization – the resulting cell contains one set of chromosomes from each parent
- Males and females have distinct reproductive organs that are adapted for producing gametes; facilitating fertilization; and, in females, sustaining growth of embryo and fetus during pregnancy.

The organs of the male and female reproductive systems can be grouped by function.

- The gonads—testes in males and ovaries in females—produce gametes and secrete sex hormones. Various ducts then store and transport the gametes, and accessory sex glands produce substances that protect the gametes and facilitate their movement.
- Finally, supporting structures, such as the penis in males and the vagina and uterus in females, assist the delivery of gametes. The uterus is also the site for the development of the embryo and fetus.

I. Reproductive Cell Division

A. Somatic cells and gametes have different numbers of chromosomes

1. Somatic – include any cell in the body other than a gamete
 - a. 23 pairs (46 total)
 - b. Diploid (2n)
2. Gametes
 - a. 23 only
 - b. Haploid (1n)

B. There are two stages of meiosis

1. Meiosis I – begins once chromosomal replication is complete
 - a. Consists of 4 phases
 - I. Prophase I
 - extended phase in which the chromosomes shorten and thicken
 - nuclear envelope and nucleoli disappear
 - meiotic spindle forms
 - in addition, the sister chromatids of each pair of homologous chromosomes pair off, an event called synapsis
 - The resulting four chromatids form a structure called a tetrad.

II. Metaphase I

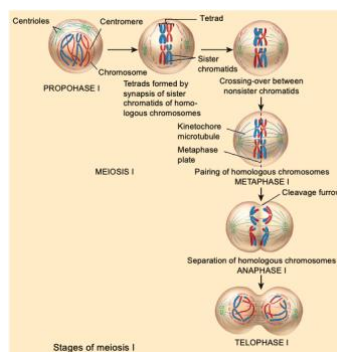
- tetrads formed by the homologous pairs of chromosomes line up along the metaphase plate of the cell, with homologous chromosomes side by side

III. Anaphase I

- members of each homologous pair of chromosomes separate as they are pulled to opposite poles of the cell by the microtubules attached to the centromeres.
- Paired sister chromatids, held by a centromere, remain together.

IV. Telophase I and cytokinesis of meiosis are similar to telophase and cytokinesis of mitosis.

- The net effect of meiosis I is that each resulting cell contains the haploid number of chromosomes because it contains only one member of each pair of the homologous chromosomes present in the starting cell.



2. Meiosis II – similar to those that occur during mitosis; the centromeres split, and the sister chromatids separate and move toward opposite poles of the cell.

a. Also 4 phases

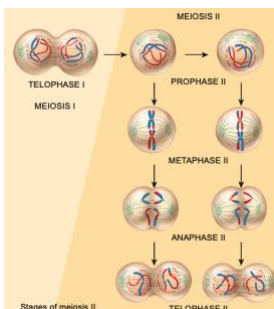
I. Prophase II

II. Metaphase II

III. Anaphase II

IV. Telophase II

*In summary, meiosis I begins with a diploid starting cell and ends with two cells, each with the haploid number of chromosomes. During meiosis II, each of the two haploid cells formed during meiosis I divides; the net result is four haploid gametes that are genetically different from the original diploid starting cell.



II. Male Reproductive System

A. The scrotum – protects the testes and regulates their temperature

B. The testes – produce sperm and secrete hormones

C. Seminiferous tubules of testes

1. Contain two cell types:

a. Sertoli (also known as sustentacular cells)

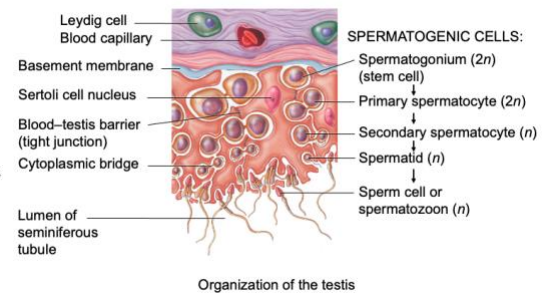
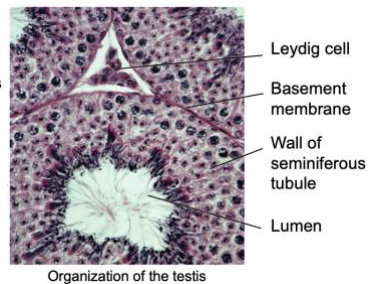
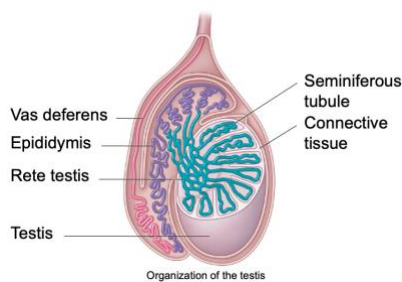
I. Support spermatogenesis

II. Tight junctions join neighboring Sertoli cells to one another, forming an obstruction known as blood–testis barrier – substances must first pass through Sertoli cells before they can reach the developing sperm

b. Leydig (also known as interstitial cells)

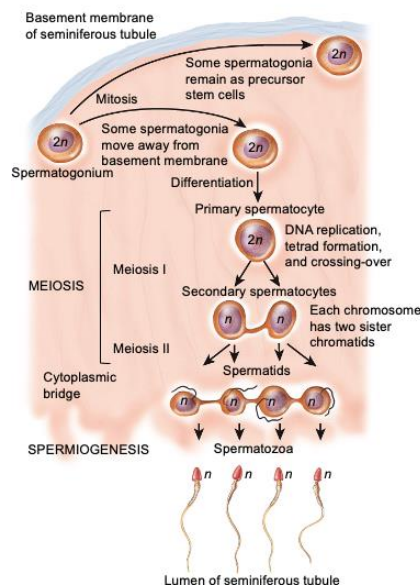
I. Secrete testosterone

- most prevalent androgen – promotes development of masculine characteristics
- promotes a man's libido (sexual drive)



D. Spermatogenesis

1. The process of multiplication and maturation of sperm



E. Sperm – each day about 300 million sperm complete the process of spermatogenesis

Once ejaculated, most sperm do not survive more than three to five days within the female reproductive tract.

1. Head

a. Nucleus

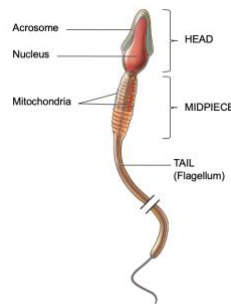
I. Haploid content of DNA

b. Acrosome

I. Cap-like vesicle filled with enzymes to help sperm penetrate egg

c. Tail

I. Flagella for locomotion



F. The male duct system aids in the maturation, storage, and transport of sperm

1. Duct system includes

a. Epididymis

- I. tightly coiled tube that connects the testis to the vas deferens
- II. site of sperm maturation, the process by which sperm acquire motility and the ability to fertilize an egg
- III. occurs over a period of about 14 days
- IV. helps propel sperm into the vas deferens during sexual arousal by peristaltic contraction of its smooth muscle
- V. stores sperm, which remain viable here for up to several months

b. Vas deferens (or ductus deferens)

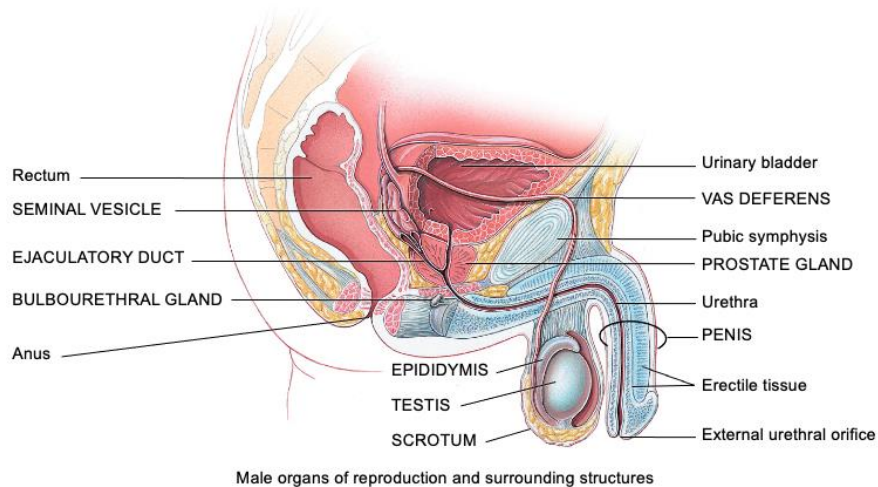
- I. From the epididymis, the vas deferens ascends out of the scrotum and enters the pelvic cavity, where it loops over the side and down the back surface of the urinary bladder
- II. conveys sperm during sexual arousal from the epididymis toward the urethra by peristaltic contractions of its smooth muscle
- III. Like the epididymis, the vas deferens can also store sperm for several months

c. Ejaculatory duct

- I. formed by the union of the vas deferens and the duct from the seminal vesicle
- II. enter the prostate gland and terminate in the urethra, where they eject sperm and seminal vesicle secretions just before the release of semen from the urethra to the exterior

d. Urethra

- I. In males – shared terminal duct of reproductive and urinary systems
 - serves as a passageway for both semen and urine



G. Accessory sex glands add secretions to sperm to form semen

1. Accessory glands

a. Seminal vesicle

- I. pouch-like structures located behind urinary bladder and in front of rectum
- II. Secrete alkaline, viscous fluid that helps neutralize the acidic environment of the male urethra and female reproductive tract that would otherwise inactivate and kill sperm. Fluid secreted by the seminal vesicles constitutes about 60% of the volume of semen. It contains:
 - Fructose – used for ATP production by sperm
 - Clotting protein fibrinogen – helps semen coagulate (clot) after ejaculation.
 - Prostaglandins – stimulate smooth muscle contractions within the female reproductive tract, facilitating movement of sperm cells up the tract.

b. Prostate gland

- I. roughly the size and shape of a golf ball, is below the urinary bladder and surrounds the upper portion of the urethra.
- II. Prostatic secretions make up about 25% of the volume of semen and contribute to sperm motility and viability.
- III. It secretes a milky, slightly acidic fluid (pH about 6.5) that contains several substances:
 - Citric acid – used by sperm for ATP production via the Krebs cycle
 - Clotting enzymes – act on fibrinogen from the seminal vesicles to clot semen after ejaculation
 - Proteolytic enzymes – such as prostate-specific antigen (PSA), fibrinolysin, and pepsinogen, eventually break down the clot
 - Seminalplasmin (antibiotic) – antibiotic that destroys bacteria that may be present in semen or in the female reproductive tract
 - Acid phosphatase – function is unknown

c. Bulbourethral glands (Also called Cowper's glands)

- I. Located below the prostate gland on either side of the urethra
- II. Secrete an alkaline fluid into the urethra that protects the passing sperm by neutralizing acids from urine in the urethra.
- III. They also secrete mucus that lubricates the end of the penis and the lining of the urethra, decreasing the number of sperm damaged during ejaculation.
- IV. Secretions from the bulbourethral glands constitute about 5% of the volume of semen.

* Semen is a mixture of sperm and the secretions of the seminal vesicles, prostate gland, and bulbourethral glands. Despite the slight acidity of prostatic fluid, semen has a slightly alkaline pH of 7.2–7.7 due to the higher pH and larger volume of fluid from the seminal vesicles. Prostatic secretion gives semen a milky appearance, and fluids from the seminal vesicles and bulbourethral glands give it a sticky consistency. Seminal fluid provides sperm with a transportation medium, nutrients, and protection from the hostile acidic environment of the male's urethra and the female's vagina.

*Once ejaculated, liquid semen coagulates within 5 minutes due to the presence of the clotting protein fibrinogen from the seminal vesicles and clotting enzymes from the prostate gland. Coagulation of semen occurs in the following way: The clotting enzymes act on fibrinogen to form the protein fibrin, which clots the semen, trapping mobile sperm cells within the fibrin meshwork. It is

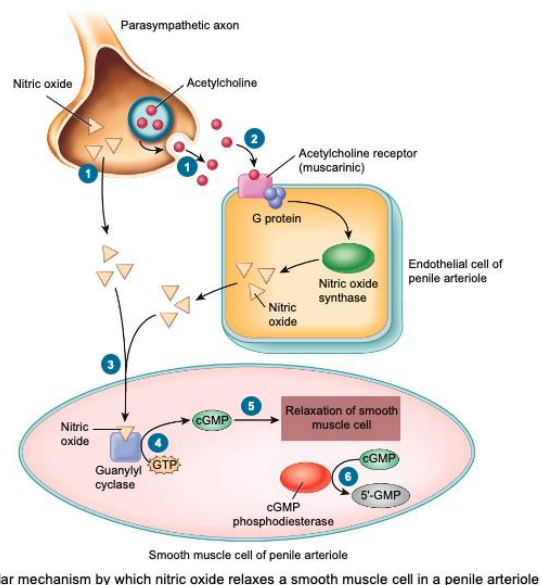
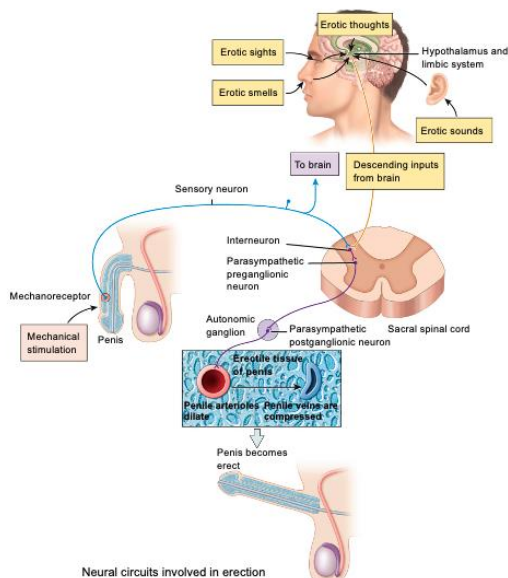
thought that semen coagulation occurs to help keep sperm cells from leaking out of the vagina. After about 10 to 20 minutes, semen liquefies because prostate-specific antigen (PSA) and other proteolytic enzymes produced by the prostate break down the clot. As the clot dissolves, sperm cells are released and begin their journey to the egg. Abnormal or delayed liquefaction of clotted semen may cause complete or partial immobilization of sperm, thereby inhibiting their movement through the female reproductive tract.

H. The penis is the male organ of copulation

1. Deposits semen into the female reproductive tract
2. Consists of two main regions: shaft and glans of penis
3. Two different erectile tissue types: corpus cavernosum and corpus spongiosum

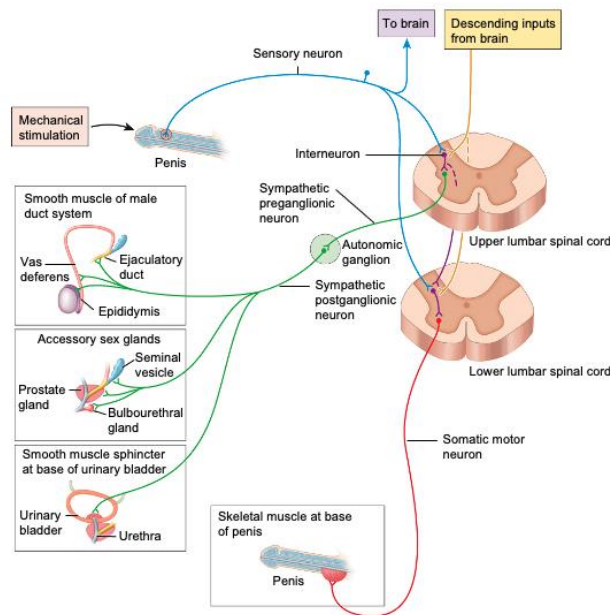
I. Erection reflex

1. Sexual stimulation causes parasympathetic axons extending to smooth muscle in penile arterioles to release nitric oxide and acetylcholine (ACh).
2. ACh binds to muscarinic receptors on endothelial cells in the penile arterioles activating nitric oxide synthase to produce nitric oxide.
3. Nitric oxide (NO) released from parasympathetic axons or from nearby endothelial cells diffuses through the membrane of the vascular smooth muscle cell to bind to the enzyme guanylyl cyclase.
4. Binding of NO to guanylyl cyclase activates the enzyme, which produces cGMP from GTP.
5. The cGMP, in turn, activates a pathway that results in relaxation of the smooth muscle cell. Relaxation of smooth muscle causes the penile arteriole to dilate, which ultimately causes erection to occur.



J. Ejaculation

1. Powerful smooth muscle contractions that result in release of semen



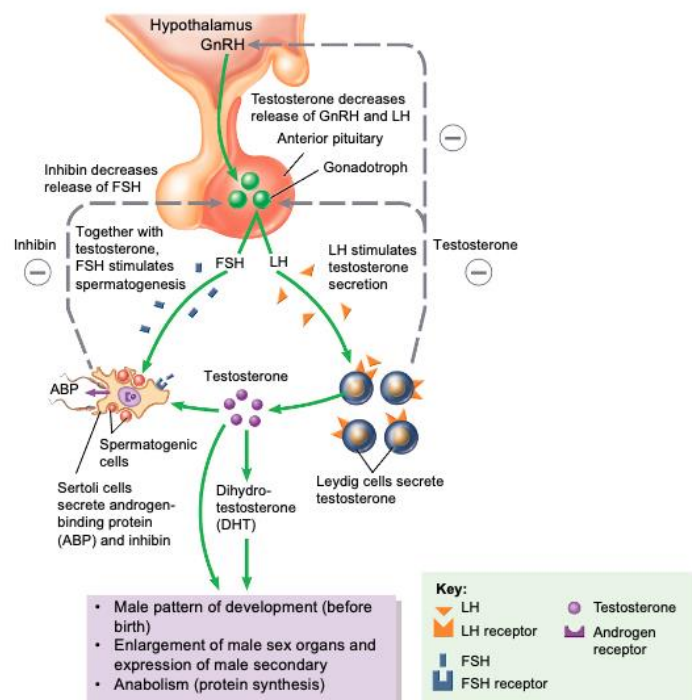
K. Male reproductive function is regulated by many different hormones

1. Main hormones

- Gonadotropin releasing hormone (GnRH)
- Luteinizing hormone (LH)
- Follicle stimulating hormone (FSH)
- Testosterone
- Dihydrotestosterone
- Inhibin

2. Major role hormones play

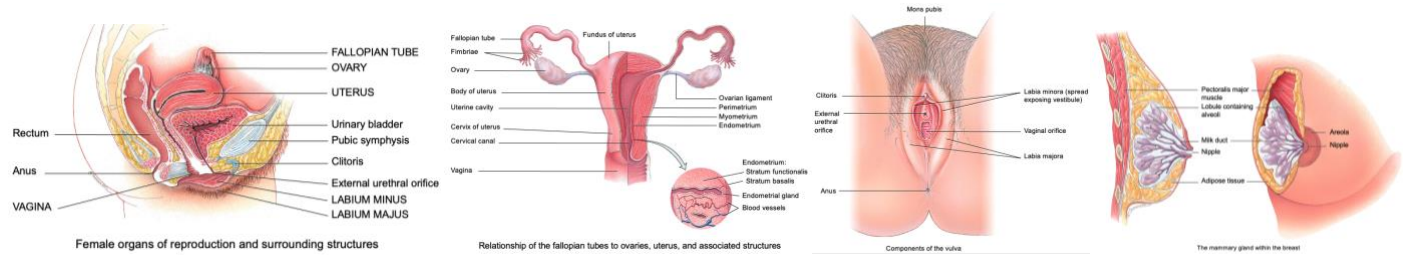
- Prenatal development
- Development of male sex characteristics
- Development of sexual function
- Stimulation of anabolism
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III. Female Reproductive System

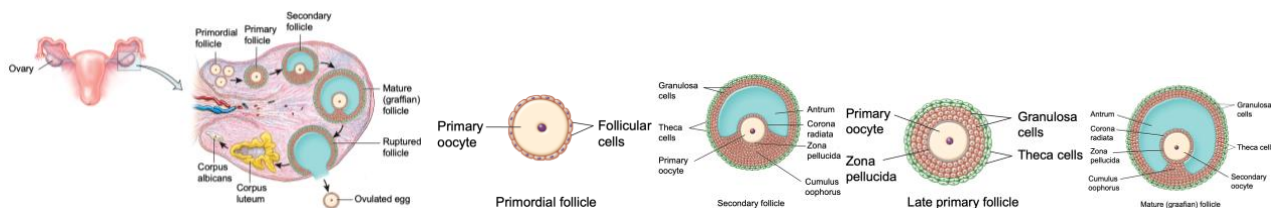
A. Female reproductive organs

1. Ovaries
2. Fallopian tubes (also known as uterine tubes)
3. Uterus
4. Vagina
5. Vulva
6. Mammary glands



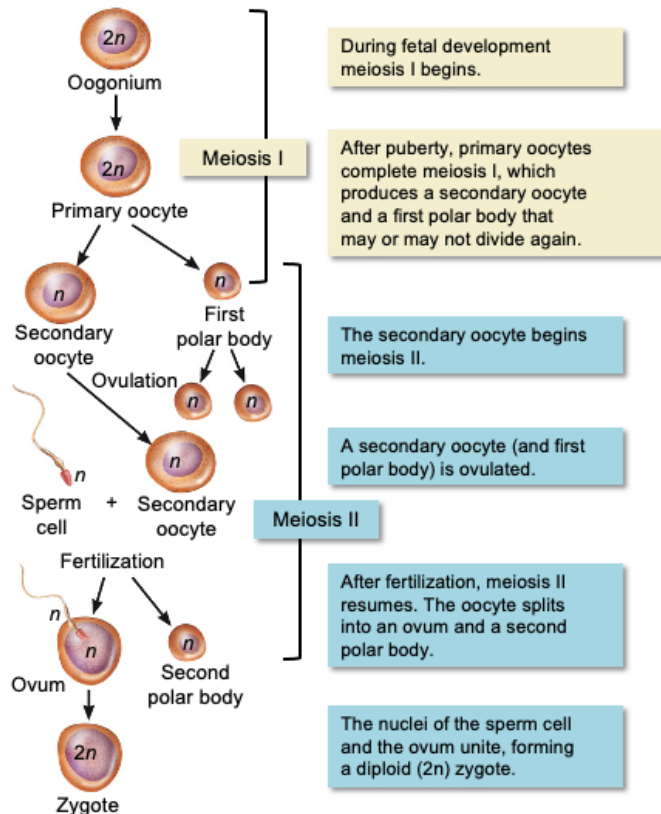
B. The ovaries produce eggs (oocytes) and secrete hormones

1. Paired glands located in the pelvic cavity
2. Homologous to the testes
 - a. Within ovaries are ovarian follicles – each ovarian follicle consists of one oocyte and variable number of surrounding cells that nourish developing oocyte
 - b. It also secretes hormones as the follicle grows larger
 - I. The ovarian follicle initially begins as a primordial follicle
 - II. sequentially develops into a primary follicle, a secondary follicle, and a mature (graafian) follicle.
 - III. ovulation occurs when mature follicle ruptures, releasing oocyte into pelvic cavity.
 - IV. From pelvic cavity, the oocyte is normally swept into the fallopian tube.
 - V. Within the ovary, the remnants of the ruptured follicle develop into a structure called the corpus luteum (= yellow body).
 - VI. If released oocyte is not fertilized, corpus luteum eventually degenerates into fibrous scar tissue called corpus albicans (=white body)

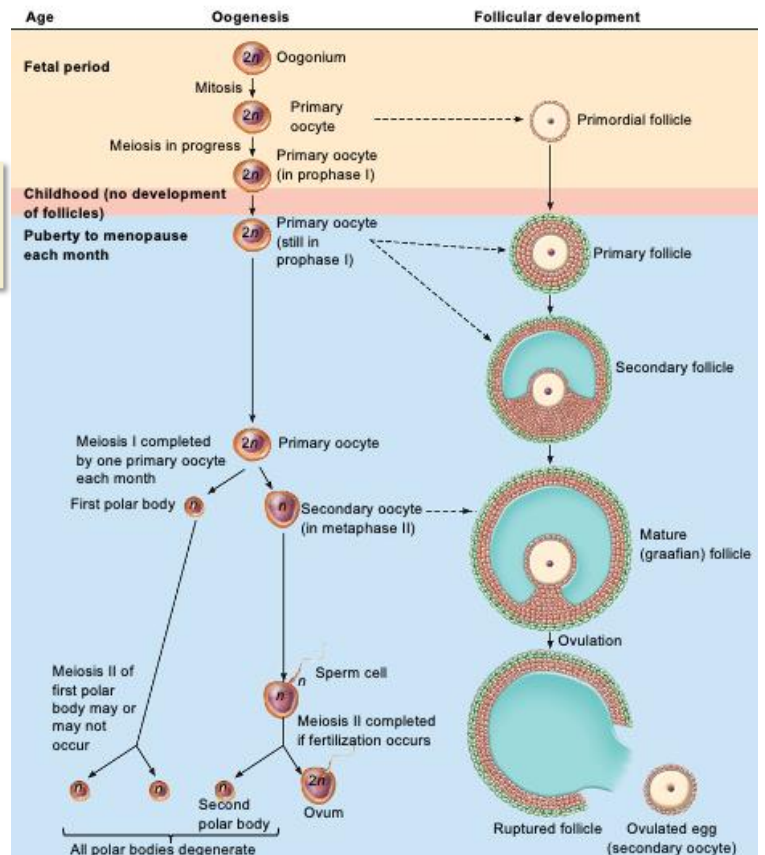


C. Oogenesis

1. Formation of gametes in the ovaries
2. During fetal development meiosis I begins
3. After puberty, meiosis I is completed, and meiosis II is initiated
4. Ovulation
5. Only after fertilization, meiosis II completed



Summary of Oogenesis and Follicular Development



D. The fallopian tube transports an egg from the ovary to the uterus.

1. Females have two fallopian tubes, also known as uterine tubes or oviducts, that extend from the upper part of the uterus
2. The funnel-shaped end of each tube is close to an ovary and contains fingerlike projections called fimbriae
3. Functionally, the fallopian tube transports an egg (oocyte) from the ovary to the uterus. This occurs in the following way:
 - a. After ovulation, local currents produced by movements of the fimbriae sweep the egg into the fallopian tube.
 - b. The egg is then moved along the tube by cilia in the tube's lining and peristaltic contractions of the tube's smooth muscle layer.

4. The fallopian tube also serves as the site where fertilization normally takes place.
 - a. After semen is deposited into the vagina by the penis during sexual intercourse, sperm move into the uterus and then into the fallopian tubes. If an egg is present in one of the tubes, it may be fertilized by a sperm cell.
 - b. The cilia and peristaltic contractions of the fallopian tube move the fertilized egg into the uterus, where it implants.
 - c. Fertilization can occur at any time up to about 24 hours after ovulation. If an egg is not fertilized by that time, it degenerates.
- E. The uterus has many reproductive functions
 1. Hollow pear-shaped organ between rectum and urinary bladder
 2. Made up of
 - a. Fundus
 - b. Body
 - c. Cervix
 - I. Sperm cells deposited in the vagina during intercourse reach the fallopian tubes by passing through the cervix and the body of the uterus.
 - II. The lining of the cervix contains glands that secrete cervical mucus. Most of the time, the mucous is viscous, forming a cervical plug that impedes the spread of bacteria and the passage of sperm cells.
 - III. However, at or near the time of ovulation, cervical mucus is less viscous, making it easier for sperm cells to pass through.
 3. The wall of the uterus is composed of three layers:
 - a. Endometrium – contains large numbers of blood vessels and consists of epithelial tissue, connective tissue, and endometrial glands. The endometrium is further divided into two layers:
 - I. Stratum functionalis – (functional layer)
 - lines the uterine cavity.
 - In a nonpregnant woman of reproductive age, this layer sloughs off every month, a process known as menstruation.
 - subsequent release of blood and tissue from the body is referred to as menstrual flow.
 - In a pregnant woman, this layer remains attached to the rest of the uterus and serves as the site where the fertilized egg has implanted and develops into a fetus.

II. Stratum basalis (basal layer) is the deeper part of the endometrium.

- It is a permanent layer that gives rise to a new stratum functionalis after each menstruation.

b. Myometrium – middle layer of the uterus

- consists of smooth muscle and forms the bulk of the uterine wall.
- During labor and childbirth, coordinated contractions of the myometrium in response to oxytocin from the posterior pituitary help expel the fetus from the uterus.

c. Perimetrium – outer layer of the uterus

- It consists of epithelium and connective tissue and provides support to uterus.

*In summary, the uterus performs several functions. It serves as part of pathway for sperm deposited in vagina to reach fallopian tubes. Also, site of implantation of a fertilized egg, development of fetus during pregnancy, and contractions that push the fetus out of a woman's body during childbirth. In addition, the uterus is the source of menstrual flow.

F. The vagina is the female organ of copulation

1. Serves as receptacle for the penis during intercourse
2. Tubular canal that extends from the cervix of the uterus to body exterior
3. Opening of the vagina to the exterior is known as the vaginal orifice
4. Secretions from vaginal walls is acidic preventing microbial growth
 - a. Damaging to sperm
 - I. Alkaline secretions in semen help to neutralize

G. The vulva (also called pudendum) refers to the female external genitalia

1. Includes:
 - a. Mons pubis – rounded, fatty area that covers joint between pubic bones
 - b. Labia majora – Extends down and back from the mons pubis
 - I. prominent folds of skin – homologous to the scrotum of the male.
 - c. Labia minora – The labia majora enclose the labia minora
 - I. two smaller folds of skin that are homologous to the shaft of the penis
 - d. Clitoris – small cylindrical mass of erectile tissue located at the front end of the vulva. It is homologous to the glans penis. Like its male counterpart, the clitoris fills with blood and enlarges during sexual arousal.

- e. Vestibule – space between the labia minora. Within the vestibule are the external urethral orifice (the opening of the urethra to the exterior) and the vaginal orifice (the opening of the vagina to the exterior).
- f. Paraurethral (Skene's) glands – located near the external urethral orifice, which secrete mucus into the urethra. These glands are homologous to the male prostate gland.
- g. Greater vestibular (Bartholin's) glands – located on either side of the vaginal orifice, which secrete a lubricating mucus into the vestibule during sexual arousal. The greater vestibular glands are homologous to the bulbourethral glands in males.

H. The mammary glands function in lactation

- 1. Consists of 15–20 lobes separated by variable amounts of adipose tissue
 - a. Smaller lobules called alveoli
 - I. Milk secreting structures
 - b. Lactation
 - I. The release of milk through the nipples

I. Female reproductive function is regulated by many hormones

- 1. Gonadotropin releasing hormone – Beginning at puberty, the hypothalamus increases secretion of gonadotropin-releasing hormone (GnRH). GnRH in turn stimulates the release of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) from the anterior pituitary.
- 2. Follicle stimulating hormone – initiates follicular growth
- 3. Luteinizing hormone – stimulates further development of the ovarian follicles
 - a. stimulates the theca cells of a developing follicle to produce androgens (the main thecal androgen is androstenedione).
 - b. In addition, both FSH and LH stimulate the ovarian follicles to secrete estrogens.
 - c. Under the influence of FSH, the androgens are taken up by the granulosa cells of the follicle and are then converted into estrogens. The enzyme aromatase catalyzes this reaction.
 - d. LH also triggers ovulation and then promotes formation of the corpus luteum, the reason for the name luteinizing hormone.
 - e. Stimulated by LH, the corpus luteum produces and secretes estrogens, progesterone, relaxin, and inhibin.

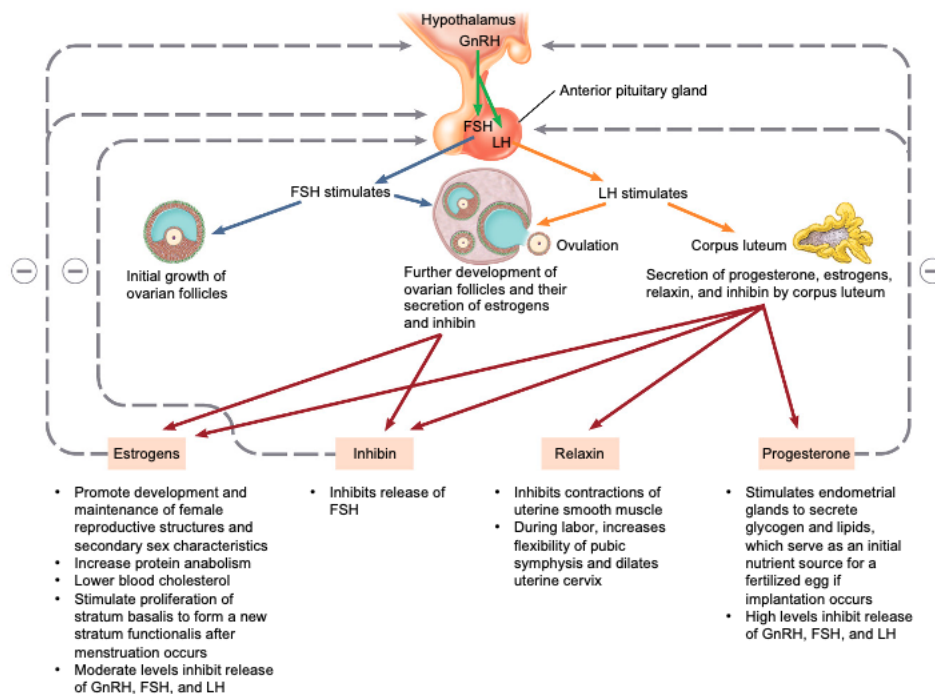
4. Estrogens – secreted by ovarian follicles and the corpus luteum have several important functions:
 - a. promotes development and maintenance of female reproductive structures and secondary sex characteristics, which include:
 - I. distribution of adipose tissue in breasts, abdomen, mons pubis, and hips
 - II. a higher voice pitches
 - III. a broad pelvis
 - IV. female pattern of hair growth on head and body
 - b. increases protein anabolism, including the building of strong bones.
 - c. lowers blood cholesterol level, which is probably the reason that women under age 50 have a much lower risk of coronary artery disease than do men of comparable age.
 - d. Every month, after menstruation occurs, estrogens stimulate proliferation of the stratum basalis to form a new stratum functionalis that replaces the one that has sloughed off.
 - e. Moderate levels of estrogens in the blood inhibit both the release of GnRH by the hypothalamus and secretion of LH and FSH by the anterior pituitary.
 - f. At least six different estrogens have been isolated from the plasma of human females, but only three are present in significant quantities:
 - I. beta (β)-estradiol – most abundant estrogen in nonpregnant woman, which is synthesized from cholesterol in ovaries
 - II. estrone
 - III. estriol
5. Progesterone – produced by cells of the corpus luteum
 - a. prepares the endometrium of the uterus for the possible implantation of a fertilized egg by stimulating the endometrial glands to secrete glycogen and lipids. These secretions serve as a nutrient source for the embryo during the early stages of pregnancy until the placenta develops.
 - b. High levels of progesterone also inhibit secretion of GnRH, FSH, and LH.
6. Relaxin
 - a. Small quantity:
 - I. produced by the corpus luteum during each monthly cycle relaxes the uterus by inhibiting contractions of the myometrium. Presumably, implantation of a fertilized egg occurs more readily in a “quiet” uterus.

b. Large quantity:

- I. during pregnancy, the placenta produces much more relaxin, and it continues to relax uterine smooth muscle.
- II. at the end of pregnancy, relaxin also increases the flexibility of the pubic symphysis and may help dilate the uterine cervix, both of which ease delivery of the baby.

7. Inhibin – secreted by granulosa cells of growing follicles and by the corpus luteum after ovulation.

a. It inhibits secretion of FSH.



J. Female reproductive cycles – encompasses the ovarian and uterine cycles, the hormonal changes that regulate them, and the related cyclical changes in the breasts and cervix.

1. Uterine – concurrent series of changes in the endometrium of the uterus to prepare it for the arrival of a fertilized egg that will develop there until birth
 - a. Menses
 - b. Proliferative
 - c. Secretory
2. Ovarian – series of events in the ovaries that occur during and after the maturation of an egg.
 - a. Follicular
 - b. Ovulation
 - c. Luteal

3. The duration of the female reproductive cycle typically ranges from 24 to 35 days. For this discussion, it is assumed that the cycle has a duration of 28 days and is divided into four phases:
- a. menstrual phase (menstruation) – lasts for roughly the first 5 days of the cycle. By convention, the first day of menstruation is day 1 of a new cycle.
 - I. Events in the Ovaries
 - Under the influence of FSH, several primordial follicles develop into primary follicles and then into secondary follicles. This developmental process may take several months to occur. Therefore, a follicle that begins to develop at the beginning of a particular menstrual cycle may not reach maturity and ovulate until several menstrual cycles later.
 - II. Events in the Uterus
 - Menstrual flow from the uterus consists of 50–150 mL of blood, tissue fluid, mucus, and epithelial cells shed from the stratum functionalis of the endometrium. This discharge occurs because the declining levels of estrogens and progesterone stimulate release of prostaglandins that cause the uterine arteries to constrict. As a result, the cells they supply become oxygen-deprived and start to die. Eventually, the entire stratum functionalis sloughs off. At this time the endometrium is very thin, about 2–5 mm, because only the stratum basalis remains. The menstrual flow passes from the uterine cavity through the cervix and vagina to the exterior.
 - b. preovulatory phase – time between the end of menstruation and the beginning of ovulation. The preovulatory phase of the cycle is more variable in length than the other phases and accounts for most of the differences in length of the cycle. It lasts from day 6 to day 13 in a 28-day cycle.
 - I. Events in the Ovaries
 - Some of the secondary follicles in the ovaries begin to secrete estrogens and inhibin. By about day 6, a single secondary follicle in one of the two ovaries has outgrown all of the others to become the dominant follicle. Estrogens and inhibin secreted by the dominant follicle decrease the secretion of FSH, which causes other, less well-developed follicles to stop growing and undergo atresia. Fraternal (nonidentical) twins or triplets result when two or three secondary

follicles become codominant and later are ovulated and fertilized at about the same time.

- Normally, the one dominant secondary follicle becomes the mature (graafian) follicle, which continues to enlarge until it is more than 20 mm in diameter and ready for ovulation. This follicle forms a blister-like bulge on the surface of the ovary due to the swelling antrum. During the final maturation process, the mature follicle continues to increase its production of estrogens.
- With reference to the ovarian cycle, the menstrual and preovulatory phases together are termed the follicular phase because ovarian follicles are growing and developing.

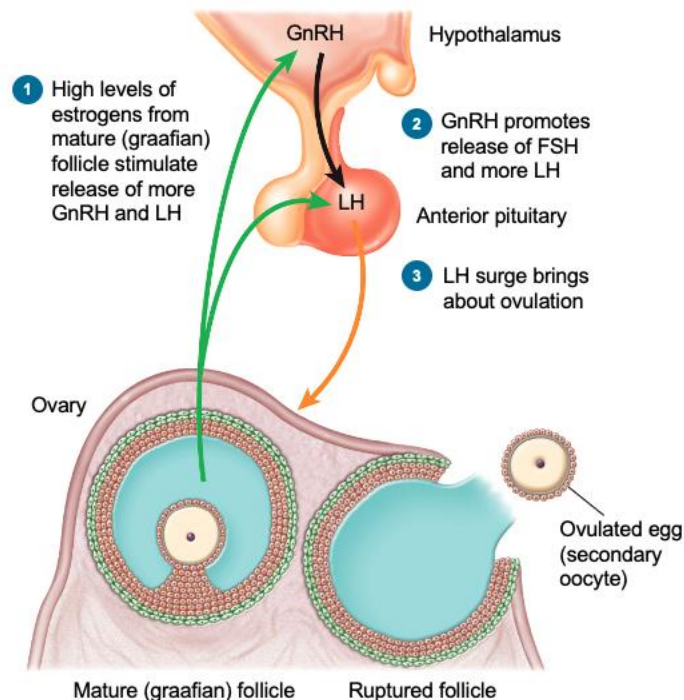
II. Events in the Uterus

- Estrogens liberated into the blood by growing ovarian follicles stimulate the repair of the endometrium; cells of the stratum basalis undergo mitosis and produce a new stratum functionalis. As the endometrium thickens, the endometrial glands develop, and blood vessels coil and lengthen as they penetrate the stratum functionalis. The thickness of the endometrium approximately doubles, to about 4–10 mm. With reference to the uterine cycle, the preovulatory phase is also termed the proliferative phase because the endometrium is proliferating.

c. Ovulation – rupture of the mature (graafian) follicle and the release of the egg (secondary oocyte) into the pelvic cavity, usually occurs on day 14 in a 28-day cycle. During ovulation, the secondary oocyte remains surrounded by its zona pellucida and corona radiata.

- The high levels of estrogens during the last part of the preovulatory phase exert a positive feedback effect on the cells that secrete LH and gonadotropin-releasing hormone (GnRH) and cause ovulation, as follows:
 1. A high concentration of estrogens stimulates more frequent release of GnRH from the hypothalamus. It also directly stimulates gonadotrophs in the anterior pituitary to secrete LH.
 2. GnRH promotes the release of FSH and additional LH by the anterior pituitary.

3. LH causes rupture of the mature (graafian) follicle and expulsion of a secondary oocyte about 9 hours after the peak of the LH surge. The ovulated oocyte and its zona pellucida and corona radiata cells are usually swept into the fallopian tube.



- d. postovulatory phase – time between the end of ovulation and the onset of the next menses. In duration, it is the most constant part of the female reproductive cycle. It lasts for 14 days in a 28-day cycle, from day 15 to day 28

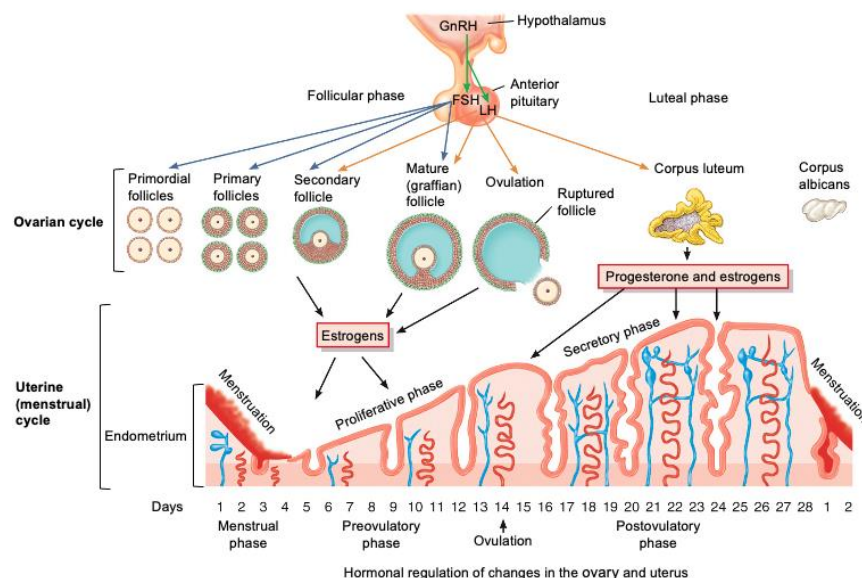
I. Events in One Ovary

- After ovulation, the ruptured follicle is transformed into the corpus luteum under the influence of LH. Stimulated by LH, the corpus luteum secretes progesterone, estrogen, relaxin, and inhibin. With reference to the ovarian cycle, this phase is also called the luteal phase.
- Later events in an ovary that has ovulated an oocyte depend on whether the oocyte is fertilized. If the oocyte is not fertilized, the corpus luteum has a lifespan of only 2 weeks. After that, its secretory activity declines, and it degenerates into a corpus albicans. As the levels of estrogens, progesterone, and inhibin decrease, release of GnRH, FSH, and LH rises due to loss of negative feedback suppression by the ovarian hormones. Follicular growth resumes and a new ovarian cycle begins.

- If the oocyte is fertilized and begins to divide, the corpus luteum persists past its normal 2-week lifespan. It is “rescued” from degeneration by human chorionic gonadotropin (hCG). This hormone is produced by the chorion of the embryo beginning about 8 days after fertilization. Like LH, hCG stimulates the secretory activity of the corpus luteum. The presence of hCG in maternal blood or urine is an indicator of pregnancy and is the hormone detected by home pregnancy tests.

II. Events in the Uterus

- Estrogens secreted by the corpus luteum cause continued growth of the stratum functionalis. As a result, the endometrium thickens to about 12–18 mm (0.48–0.72 in.). Progesterone produced by the corpus luteum promotes further growth and coiling of the endometrial glands and vascularization of the superficial endometrium. In addition, progesterone stimulates the endometrial glands to secrete glycogen and lipids, which serve as an initial nutrient source for a fertilized egg if implantation occurs. Because of the secretory activity of the endometrial glands, this period is called the secretory phase of the uterine cycle. These preparatory changes peak about 1 week after ovulation, at the time a fertilized egg might arrive in the uterus. If a woman is not pregnant, the levels of estrogens and progesterone decline due to degeneration of the corpus luteum. Withdrawal of estrogens and progesterone causes menstruation.



IV. The Human Sexual Response

A. Heterosexual intercourse

1. Also referred to as coitus or copulation
2. Penis is inserted into the vagina

B. A similar sequence of physiological and emotional changes that occur in both males and females is termed the human sexual response.

C. Consists of four phases

1. Excitement

a. Consists of

- I. Vasocongestion of genitals
 - Engorging with blood
- II. Results in erection for both males and females
- III. Allows for transudation
 - A lubrication of the vaginal walls that occurs once the When the connective tissue of the vagina becomes engorged with blood
 - Lubricating fluid oozes from the capillaries and seeps through the epithelial lining
- IV. Increased heart rate and blood pressure
- V. Increased skeletal muscle tone throughout the body
- VI. Hyperventilation

2. Plateau

- a. Sustained sensations and physiological changes obtained during excitement
- b. Lasts for only a few seconds to minutes
- c. Can display a sex flush (especially females)
 - I. Redness in the face
- d. Late plateau phase
 - I. Pronounced vasocongestion of the lower part of the vagina
 - Swells the tissue and narrows the opening of the vagina
 - Causes increased grip of the penis

3. Orgasm – also known as the climax

- a. Briefest phase
- b. Both sexes experience several rhythmic muscular contractions
- c. Intense pleasurable sensations
- d. Further increase in blood pressure, heart rate, breathing rate

- e. Sex flush more prominent
 - f. In males – orgasm usually accompanies ejaculation.
 - I. Emission
 - contraction of smooth muscle in the walls of the epididymis, vas deferens, and ejaculatory ducts as well as secretion of fluid by the accessory sex glands cause semen to move into the urethra
 - II. Ejaculation occurs
 - rhythmic contractions of skeletal muscles at the base of the penis propel semen out of the penis
 - III. Enter a refractory period
 - A second orgasm and ejaculation are physiologically impossible
 - g. In females – if effective sexual stimulation continues, orgasm may occur
 - I. associated with 3–12 rhythmic contractions of the skeletal muscles that underlie the vulva
 - II. reception of the ejaculate provides little stimulus for a female, especially if she is not already at the plateau phase
 - this is why a female partner does not automatically experience orgasm simultaneously with her partner
 - h. refractory period
 - I. In both males and females, orgasm is a total body response that may produce milder sensations on some occasions and more intense, explosive sensations at other times.
 - II. Whereas females may experience two or more orgasms in rapid succession, males enter a refractory period
 - a recovery time during which a second ejaculation and orgasm is physiologically impossible
 - In some males, the refractory period lasts only a few minutes; in others it lasts for several hours.
 - i. A female does not have to experience an orgasm for fertilization to occur
4. Resolution – final phase
- a. Begins with a sense of profound relaxation
 - b. All tissues and physiological parameters return to unaroused state
 - c. If sexual excitement has been intense but orgasm has not occurred, resolution takes place more slowly

V. Contraception

A. Various methods of contraception control fertility and prevent conception

- a. Refers to the avoidance of pregnancy
- b. Only method to be 100% effective is complete abstinence
- c. Other methods available:
- d. Sterilization
 - I. procedure that renders an individual incapable of further reproduction. The principal method for sterilization of males is a vasectomy, in which a portion of each vas deferens is removed. To gain access to the vas deferens, an incision is made with a scalpel (conventional procedure) or a puncture is made with special forceps (nonscalpel vasectomy). Then a small section of each vas deferens is cut out and the remaining free ends are tied off or cauterized. Although sperm production continues in the testes, sperm can no longer reach the exterior. The sperm degenerate and are destroyed by phagocytosis. Because blood vessels are not cut, testosterone levels in the blood remain normal, so vasectomy has no effect on sexual desire, sexual performance, or ejaculation.
 - II. Sterilization in females is achieved most often by performing a tubal ligation, in which both fallopian tubes are closed off. This can be achieved in a few different ways. "Clips" or "clamps" can be placed on the fallopian tubes, the tubes can be tied off and/or cut, and sometimes they are cauterized. In any case the result is that the egg cannot pass through the fallopian tube, and sperm cannot reach the egg.
 - III. An alternative to tubal ligation is a type of nonincisional sterilization known as Essure®. In the Essure® procedure, a soft, tiny coil made of polyester fibers and nickel-titanium alloy is inserted with a catheter into the vagina, through the uterus, and into each fallopian tube. Over a 3 month period, the coil stimulates growth of scar tissue in and around itself, blocking fallopian tubes. As with tubal ligation, the egg cannot pass through the fallopian tubes, and sperm cannot reach the egg.
- e. hormonal methods
 - I. Aside from complete abstinence or sterilization, hormonal methods are the most effective means of birth control. Oral contraceptives, or birth control pills, contain various mixtures of synthetic estrogens and

progestin (a chemical with actions similar to progesterone). They prevent pregnancy by negative feedback inhibition of GnRH release from the hypothalamus, and FSH and LH release from the anterior pituitary gland. The low levels of FSH and LH usually prevent the development of a dominant follicle in the ovary. As a result, levels of estrogens do not rise, the midcycle LH surge does not occur, and ovulation does not take place. Even if ovulation does occur, as it does in some cases, the progestin in oral contraceptives thickens cervical mucus, making it difficult for sperm to reach the egg, and it also blocks implantation in the uterus.

- II. Among the noncontraceptive benefits of oral contraceptives are regulation of the length of menstrual cycle and decreased menstrual flow. However, oral contraceptives may not be advised for women with a history of blood-clotting disorders, cerebral blood vessel damage, migraine headaches, hypertension, liver malfunction, or heart disease. Women who take the pill and smoke face far higher odds of having a heart attack or stroke than do nonsmoking pill users. Smokers should quit smoking or use an alternative method of contraception.
- III. There are several variations of oral hormonal methods of contraception:
 - Combined pill. Contains both estrogens and progestin and is typically taken once a day for 3 weeks. The pills taken during the fourth week are inactive (do not contain hormones) and permit menstruation to occur.
 - Seasonale®. Contains both estrogens and progestin and is taken once a day in 3-month cycles of 12 weeks of hormone-containing pills followed by 1 week of inactive pills. Menstruation occurs during the thirteenth week.
 - Minipill. Contains progestin only and is taken every day of the month.
 - Emergency contraception (EC) pill. Consists of one pill containing progestin that is used to prevent pregnancy following unprotected sexual intercourse. The relatively high level of progestin in an EC pill suppresses ovulation, thickens cervical mucus to prevent sperm from reaching the egg, and blocks implantation. An EC pill is also known as the morning after pill. An example is Plan B®, which is available

without a prescription. The pill should be taken as soon as possible but within 72 hours of unprotected intercourse.

IV. Non-oral hormonal methods of contraception

- Contraceptive skin patch (Ortho Evra®). Contains both estrogens and progestin delivered in a skin patch placed on the skin (upper outer arm, back, lower abdomen, or buttocks) once a week for 3 weeks. After 1 week, the patch is removed from one location and then a new one is placed elsewhere. During the fourth week no patch is used, allowing menstruation to occur.
- Vaginal contraceptive ring (NuvaRing®). A flexible doughnut-shaped ring about 5 cm (2 in.) in diameter that contains estrogens and progestin and is inserted by the female herself into the vagina. It is left in the vagina for three weeks to prevent conception and then removed for one week to permit menstruation.
- Hormone injections (Depo-provera®). An injectable progestin given intramuscularly by a health-care practitioner once every 3 months.
- Hormone implant (Implanon®). A matchstick-sized plastic rod containing progestin that is surgically implanted under the skin of the arm using local anesthesia. It slowly and continuously releases progestin, which inhibits ovulation and thickens cervical mucus. The effect lasts for 3 years and is even more reliable than sterilization. Removing the implant restores fertility.

f. intrauterine devices

- I. is a small, T-shaped object that is inserted by a health-care professional into the cavity of the uterus. Two types of IUDs are available in the United States: the copper IUD and the hormonal IUD. The copper IUD (ParaGard®) contains a plastic frame that is covered with a copper wire. The copper causes changes in the uterine lining that prevent implantation of the fertilized egg. ParaGard is approved for up to 10 years of use and has long-term effectiveness comparable to that of tubal ligation. The hormonal IUD (Mirena®) has a plastic frame that surrounds a reservoir containing progestin. The progestin is slowly released from the IUD and functions like the other progestin-containing contraceptives: It suppresses ovulation, thickens cervical mucus, and

blocks implantation. Mirena is effective for up to 5 years. Some women cannot use IUDs because of expulsion, bleeding, or discomfort.

g. Spermicides

- I. Various foams, creams, jellies, and suppositories that contain sperm-killing agents, or spermicides, make the vagina and cervix unfavorable for sperm survival and are available without prescription. They are placed in vagina before sexual intercourse. Most widely used spermicide is nonoxynol-9, which kills sperm by disrupting their plasma membrane. Spermicide is more effective when used with barrier method such as a male condom, vaginal pouch, diaphragm, or cervical cap.

h. Barrier methods

- I. use a physical barrier and are designed to prevent sperm from gaining access to the uterine cavity and fallopian tubes. In addition to preventing pregnancy, certain barrier methods (male condom and vaginal pouch) may also provide some protection against sexually transmitted diseases (STDs) such as AIDS. In contrast, oral contraceptives and IUDs confer no such protection. Among barrier methods are male condom, vaginal pouch, diaphragm, and cervical cap.
 - A male condom is a covering of latex, polyurethane, or animal membrane that is placed over the penis to prevent deposition of sperm in the female reproductive tract.
 - A vaginal pouch, sometimes called a female condom, is designed to prevent sperm from entering the uterus. It is made of two flexible rings connected by a polyurethane sheath. One ring lies inside the sheath and is inserted to fit over the cervix; the other ring remains outside the vagina and covers the female external genitalia.
 - A diaphragm is a rubber, dome-shaped structure that covers the cervix and must be fitted by a health-care professional. It is used in conjunction with a spermicide and can be inserted by the female up to 6 hours before intercourse. The diaphragm stops most sperm from passing into the cervix and the spermicide kills most sperm that do get by. Although diaphragm use does decrease the risk of some STDs, it does not fully protect against HIV infection because the vagina is still exposed.

- A cervical cap resembles a diaphragm but is smaller and more rigid. It fits snugly over the cervix and also must be fitted by a health-care professional. Spermicides should be used with the cervical cap.

i. Periodic abstinence

- I. A couple can use their knowledge of the physiological changes that occur during the female reproductive cycle to decide either to abstain from intercourse on those days when pregnancy is a likely result or to plan intercourse on those days if they wish to conceive a child. In females with normal and regular menstrual cycles, these physiological events help to predict the day on which ovulation is likely to occur.
- II. The first physiologically based method, developed in the 1930s, is known as the rhythm method. It takes advantage of the fact that the egg is only viable for up to 24 hours and that sperm can survive 3 to 5 days in the female reproductive tract. Thus, couples using this contraceptive method should avoid sexual intercourse for several days before ovulation, the day of ovulation, and several days after ovulation (just in case ovulation occurs a few days after day 14). The effectiveness of the rhythm method for birth control is poor in many women due to the irregularity of the female reproductive cycle.
- III. Another system is the symptothermal method, in which couples are instructed to know and understand certain signs of fertility. The signs of ovulation include a slight decrease in basal body temperature prior to ovulation and then a slight increase in basal body temperature just after ovulation; the production of abundant clear, stretchy cervical mucus; and pain associated with ovulation (mittelschmerz). If a couple abstains from sexual intercourse when the signs of ovulation are present, the chance of pregnancy is decreased. A big problem with this method is that fertilization can still occur if intercourse takes place a few days before ovulation.

j. Coitus interruptus

- I. is withdrawal of the penis from the vagina just before ejaculation. Failures with this method are due either to failure to withdraw before ejaculation or to pre-ejaculatory emission of sperm-containing fluid

from the urethra. In addition, this method offers no protection against transmission of STDs.

2. Table provides the failure rates for different types of contraceptive methods.

Method	Failure Rates (%) [*]	
	Perfect Use [†]	Typical Use
Complete abstinence	0.10	0
Sterilization		
Vasectomy	0.10	0.15
Tubal ligation	.5	0.5
Essure [®]	0.2	0.2
Hormonal Methods		
Oral contraceptives		
<i>Combined pill</i>	0.3	1–2
<i>Seasonale[®]</i>	0.3	1–2
<i>Minipill</i>	0.5	2
<i>Emergency contraception pill</i>	25	25
Nonoral contraceptives		
<i>Contraceptive skin patch</i>	0.1	1–2
<i>Vaginal contraceptive ring</i>	0.1	1–2
<i>Hormone injections</i>	0.3	1–2
<i>Hormone implant (Implanon[®])</i>	0.05	0.05
Intrauterine devices		
Copper IUD (Paragard [®])	0.6	0.8
Hormonal IUD (Mirena [®])	0.2	0.2
Spermicides (alone)	15	29
Barrier methods		
Male condom	2	15
Vaginal pouch	5	21
Diaphragm (with spermicide)	6	16
Cervical cap (with spermicide)	9	16
Periodic abstinence		
Rhythm	9	25
Sympto-thermal	2	20
Coitus interruptus	4	18
No method	85	85