Introduction to the Reproductive System

The major function of the reproductive system is to ensure survival of the species. Other systems in the body, such as the endocrine and urinary systems, work continuously to maintain homeostasis for survival of the individual. An individual may live a long, healthy, and happy life without producing offspring, but if the species is to continue, at least some individuals must produce offspring.

Within the context of producing offspring, the reproductive system has four functions:

- To produce egg and sperm cells
- To transport and sustain these cells
- To nurture the developing offspring
- To produce hormones

These functions are divided between the primary and secondary, or accessory, reproductive organs. The primary reproductive organs, or gonads, consist of the ovaries and testes. These organs are responsible for producing the egg and sperm cells (gametes), and hormones. These hormones function in the maturation of the reproductive system, the development of sexual characteristics, and regulation of the normal physiology of the reproductive system. All other organs, ducts, and glands in the reproductive system are considered secondary, or accessory, reproductive organs. These structures transport and sustain the gametes and nurture the developing offspring.

Male Reproductive System

The male reproductive system, like that of the female, consists of those organs whose function is to produce a new individual, i.e., to accomplish reproduction. This system consists of a pair of testes and a network of excretory ducts (epididymis, ductus deferens (vas deferens), and ejaculatory ducts), seminal vesicles, the prostate, the bulbourethral glands, and the penis.

Testes

The male gonads, testes or testicles, begin their development high in the abdominal cavity, near the kidneys. During the last two months before birth, or shortly after birth, they descend through the inguinal canal into the scrotum, a pouch that extends below the abdomen, posterior to the penis. Although this location of the testes, outside the abdominal cavity, may seem to make them vulnerable to injury, it provides a temperature about 3° C below normal body temperature. This lower temperature is necessary for the production of viable sperm.

The scrotum consists of skin and subcutaneous tissue. A vertical septum, or partition, of subcutaneous tissue in the center divides it into two parts, each containing one testis. Smooth muscle fibers, called the dartos muscle, in the subcutaneous tissue contract to give the scrotum its wrinkled appearance. When these fibers are relaxed, the scrotum is smooth. Another muscle, the cremaster muscle, consists of skeletal muscle fibers and controls the position of the scrotum and testes. When it is cold or a man is sexually aroused, this muscle contracts to pull the testes closer to the body for warmth.

Structure

Each testis is an oval structure about 5 cm long and 3 cm in diameter. A tough, white fibrous connective tissue capsule, the tunica albuginea, surrounds each testis and extends inward to form septa that partition the organ into lobules. There are about 250 lobules in each testis. Each lobule contains 1 to 4 highly coiled seminiferous tubules that converge to form a single straight tubule, which leads into the rete testis. Short
efferent ducts exit the testes. Interstitial cells (cells of Leydig), which produce male sex hormones, are located between the seminiferous tubules within a lobule.

**Spermatogenesis**

Sperm are produced by spermatogenesis within the seminiferous tubules. A transverse section of a seminiferous tubule shows that it is packed with cells in various stages of development. Interspersed with these cells, there are large cells that extend from the periphery of the tubule to the lumen. These large cells are the supporting, or sustentacular cells (Sertoli's cells), which support and nourish the other cells.

Early in embryonic development, primordial germ cells enter the testes and differentiate into spermatagonia, immature cells that remain dormant until puberty. Spermatogonia are diploid cells, each with 46 chromosomes (23 pairs) located around the periphery of the seminiferous tubules. At puberty, hormones stimulate these cells to begin dividing by mitosis. Some of the daughter cells produced by mitosis remain at the periphery as spermatogonia. Others are pushed toward the lumen, undergo some changes, and become primary spermatocytes. Because they are produced by mitosis, primary spermatocytes, like spermatogonia, are diploid and have 46 chromosomes.

Each primary spermatocyte goes through the first meiotic division, meiosis I, to produce two secondary spermatocytes, each with 23 chromosomes (haploid). Just prior to this division, the genetic material is replicated so that each chromosome consists of two strands, called chromatids, that are joined by a centromere. During meiosis I, one chromosome, consisting of two chromatids, goes to each secondary spermatocyte. In the second meiotic division, meiosis II, each secondary spermatocyte divides to produce two spermatids. There is no replication of genetic material in this division, but the centromere divides so that a single-stranded chromatid goes to each cell. As a result of the two meiotic divisions, each primary spermatocyte produces four spermatids. During spermatogenesis there are two cellular divisions, but only one replication of DNA so that each spermatid has 23 chromosomes (haploid), one from each pair in the original primary spermatocyte. Each successive stage in spermatogenesis is pushed toward the center of the tubule so that the more immature cells are at the periphery and the more differentiated cells are nearer the center.

Spermatogenesis (and oogenesis in the female) differs from mitosis because the resulting cells have only half the number of chromosomes as the original cell. When the sperm cell nucleus unites with an egg cell nucleus, the full number of chromosomes is restored. If sperm and egg cells were produced by mitosis, then each successive generation would have twice the number of chromosomes as the preceding one.

The final step in the development of sperm is called spermiogenesis. In this process, the spermatids formed from spermatogenesis become mature spermatozoa, or sperm. The mature sperm cell has a head, midpiece, and tail. The head, also called the nuclear region, contains the 23 chromosomes surrounded by a nuclear membrane. The tip of the head is covered by an acrosome, which contains enzymes that help the sperm penetrate the female gamete. The midpiece, metabolic region, contains mitochondria that provide adenosine triphosphate (ATP). The tail or locomotor region, uses a typical flagellum for locomotion. The sperm are released into the lumen of the seminiferous tubule and leave the testes. They then enter the epididymis where they undergo final maturation and become capable of fertilizing a female gamete.

Sperm production begins at puberty and continues throughout the life of a male. The entire process, beginning with a primary spermatocyte, takes about 74 days. After ejaculation, the sperm can live for about 48 hours in the female reproductive tract.

**Duct System**

Sperm cells pass through a series of ducts to reach the outside of the body. After they leave the testes, the sperm passes through the epididymis, ductus deferens, ejaculatory duct, and urethra.
**Epididymis**

Sperm leave the testes through a series of efferent ducts that enter the epididymis. Each epididymis is a long (about 6 meters) tube that is tightly coiled to form a comma-shaped organ located along the superior and posterior margins of the testes. When the sperm leave the testes, they are immature and incapable of fertilizing ova. They complete their maturation process and become fertile as they move through the epididymis. Mature sperm are stored in the lower portion, or tail, of the epididymis.

**Ductus Deferens**

The ductus deferens, also called vas deferens, is a fibromuscular tube that is continuous (or contiguous) with the epididymis. It begins at the bottom (tail) of the epididymis then turns sharply upward along the posterior margin of the testes. The ductus deferens enters the abdominopelvic cavity through the inguinal canal and passes along the lateral pelvic wall. It crosses over the ureter and posterior portion of the urinary bladder, and then descends along the posterior wall of the bladder toward the prostate gland. Just before it reaches the prostate gland, each ductus deferens enlarges to form an ampulla. Sperm are stored in the proximal portion of the ductus deferens, near the epididymis, and peristaltic movements propel the sperm through the tube.

The proximal portion of the ductus deferens is a component of the spermatic cord, which contains vascular and neural structures that supply the testes. The spermatic cord contains the ductus deferens, testicular artery and veins, lymph vessels, testicular nerve, cremaster muscle that elevates the testes for warmth and at times of sexual stimulation, and a connective tissue covering.

**Ejaculatory Duct**

Each ductus deferens, at the ampulla, joins the duct from the adjacent seminal vesicle (one of the accessory glands) to form a short ejaculatory duct. Each ejaculatory duct passes through the prostate gland and empties into the urethra.

**Urethra**

The urethra extends from the urinary bladder to the external urethral orifice at the tip of the penis. It is a passageway for sperm and fluids from the reproductive system and urine from the urinary system. While reproductive fluids are passing through the urethra, sphincters contract tightly to keep urine from entering the urethra.

The male urethra is divided into three regions. The prostatic urethra is the proximal portion that passes through the prostate gland. It receives the ejaculatory duct, which contains sperm and secretions from the seminal vesicles, and numerous ducts from the prostate glands. The next portion, the membranous urethra, is a short region that passes through the pelvic floor. The longest portion is the penile urethra (also called spongy urethra or cavernous urethra), which extends the length of the penis and opens to the outside at the external urethral orifice. The ducts from the bulbourethral glands open into the penile urethra.

**Accessory Glands**

The accessory glands of the male reproductive system are the seminal vesicles, prostate gland, and the bulbourethral glands. These glands secrete fluids that enter the urethra.

**Seminal Vesicles**

The paired seminal vesicles are saccular glands posterior to the urinary bladder. Each gland has a short duct that joins with the ductus deferens at the ampulla to form an ejaculatory duct, which then empties into the urethra. The fluid from the seminal vesicles is viscous and contains fructose, which provides an energy source for the sperm; prostaglandins, which contribute to the mobility and viability of the sperm; and proteins that cause slight coagulation reactions in the semen after ejaculation.

**Prostate**

The prostate gland is a firm, dense structure that is located just inferior to the urinary bladder. It is about the size of a walnut and encircles the
urethra as it leaves the urinary bladder. Numerous short ducts from the substance of the prostate gland empty into the prostatic urethra. The secretions of the prostate are thin, milky colored, and alkaline. They function to enhance the motility of the sperm.

Three hormones are the principle regulators of the male reproductive system: follicle-stimulating hormone (FSH) stimulates spermatogenesis; luteinizing hormone (LH) stimulates the production of testosterone; and testosterone stimulates the development of male secondary sex characteristics and spermatogenesis.

### Female Reproductive System

#### Ovaries

The primary female reproductive organs, or gonads, are the two ovaries. Each ovary is a solid, ovoid structure about the size and shape of an almond, about 3.5 cm in length, 2 cm wide, and 1 cm thick. The ovaries are located in shallow depressions, called ovarian fossae, one on each side of the uterus, in the lateral walls of the pelvic cavity. They are held loosely in place by peritoneal ligaments.

#### Structure

The ovaries are covered on the outside by a layer of simple cuboidal epithelium called germinal (ovarian) epithelium. This is actually the visceral peritoneum that envelops the ovaries. Underneath this layer is a dense connective tissue capsule, the tunica albuginea. The substance of the ovaries is distinctly divided into an outer cortex and an inner medulla. The cortex appears more dense and granular due to the presence of numerous ovarian follicles in various stages of development. Each of the follicles contains an oocyte, a female germ cell. The medulla is a loose connective tissue with abundant blood vessels, lymphatic vessels, and nerve fibers.

#### Oogenesis

Female sex cells, or gametes, develop in the ovaries by a form of meiosis called oogenesis. The sequence of events in oogenesis is similar to the sequence in spermatogenesis, but the timing and final result are different. Early in fetal development, primitive germ cells in the ovaries differentiate into oogonia. These divide rapidly to form thousands of cells, still called oogonia, which have a full complement of 46 (23 pairs) chromosomes. Oogonia then enter a growth phase, enlarge, and become primary oocytes. The diploid (46 chromosomes) primary oocytes replicate their DNA and begin the first meiotic division, but the process stops in prophase and the cells remain in this suspended state until puberty. Many of the primary oocytes degenerate before birth, but even with this decline, the two ovaries together contain approximately 700,000 oocytes at birth. This is the lifetime supply, and no more will develop. This is quite different than the male in which spermatogonia and primary spermatocytes continue to be produced.
throughout the reproductive lifetime. By puberty the number of primary oocytes has further declined to about 400,000.

Beginning at puberty, under the influence of follicle-stimulating hormone, several primary oocytes start to grow again each month. One of the primary oocytes seems to outgrow the others and it resumes meiosis I. The other cells degenerate. The large cell undergoes an unequal division so that nearly all the cytoplasm, organelles, and half the chromosomes go to one cell, which becomes a secondary oocyte. The remaining half of the chromosomes go to a smaller cell called the first polar body. The secondary oocyte begins the second meiotic division, but the process stops in metaphase. At this point ovulation occurs. If fertilization occurs, meiosis II continues. Again this is an unequal division with all of the cytoplasm going to the ovum, which has 23 single-stranded chromosome. The smaller cell from this division is a second polar body. The first polar body also usually divides in meiosis I to produce two even smaller polar bodies. If fertilization does not occur, the second meiotic division is never completed and the secondary oocyte degenerates. Here again there are obvious differences between the male and female. In spermatogenesis, four functional sperm develop from each primary spermatocyte. In oogenesis, only one functional fertilizable cell develops from a primary oocyte. The other three cells are polar bodies and they degenerate.

**Ovarian Follicle Development**

An ovarian follicle consists of a developing oocyte surrounded by one or more layers of cells called follicular cells. At the same time that the oocyte is progressing through meiosis, corresponding changes are taking place in the follicular cells. Primordial follicles, which consist of a primary oocyte surrounded by a single layer of flattened cells, develop in the fetus and are the stage that is present in the ovaries at birth and throughout childhood.

![Structure of an Ovary](image)

Beginning at puberty, follicle-stimulating hormone stimulates changes in the primordial follicles. The follicular cells become cuboidal, the primary oocyte enlarges, and it is now a primary follicle. The follicles continue to grow under the influence of follicle-stimulating hormone, and the follicular cells proliferate to form several layers of granulose cells around the primary oocyte. Most of these primary follicles degenerate along with the primary oocytes within them, but usually one continues to develop each month. The granulosa cells start secreting estrogen and a cavity, or antrum, forms within the follicle. When the antrum starts to develop, the follicle becomes a secondary follicle. The granulose cells also secrete a glycoprotein substance that forms a clear membrane, the zona pellucida, around the oocyte. After about 10 days of growth the follicle is a mature vesicular (graafian) follicle, which forms a "blister" on the surface of the ovary and contains a secondary oocyte ready for ovulation.

**Ovulation**

Ovulation, prompted by luteinizing hormone from the anterior pituitary, occurs when the mature follicle at the surface of the ovary ruptures and releases the secondary oocyte into the peritoneal cavity. The ovulated secondary oocyte, ready for fertilization is still surrounded by the zona pellucida and a few layers of cells called the corona radiata. If it is not fertilized, the secondary oocyte degenerates in a couple of days. If a sperm passes through the corona radiata and zona pellucida and enters the cytoplasm of the secondary oocyte, the second meiotic division resumes to form a polar body and a mature ovum.

After ovulation and in response to luteinizing hormone, the portion of the follicle that remains
in the ovary enlarges and is transformed into a corpus luteum. The corpus luteum is a glandular structure that secretes progesterone and some estrogen. Its fate depends on whether fertilization occurs. If fertilization does not take place, the corpus luteum remains functional for about 10 days; then it begins to degenerate into a corpus albicans, which is primarily scar tissue, and its hormone output ceases. If fertilization occurs, the corpus luteum persists and continues its hormone functions until the placenta develops sufficiently to secrete the necessary hormones. Again, the corpus luteum ultimately degenerates into corpus albicans, but it remains functional for a longer period of time.

Genital Tract

Fallopian Tubes

There are two uterine tubes, also called Fallopian tubes or oviducts. There is one tube associated with each ovary. The end of the tube near the ovary expands to form a funnel-shaped infundibulum, which is surrounded by fingerlike extensions called fimbriae. Because there is no direct connection between the infundibulum and the ovary, the oocyte enters the peritoneal cavity before it enters the Fallopian tube. At the time of ovulation, the fimbriae increase their activity and create currents in the peritoneal fluid that help propel the oocyte into the Fallopian tube. Once inside the Fallopian tube, the oocyte is moved along by the rhythmic beating of cilia on the epithelial lining and by peristaltic action of the smooth muscle in the wall of the tube. The journey through the Fallopian tube takes about 7 days. Because the oocyte is fertile for only 24 to 48 hours, fertilization usually occurs in the Fallopian tube.

Uterus

The uterus is a muscular organ that receives the fertilized oocyte and provides an appropriate environment for the developing fetus. Before the first pregnancy, the uterus is about the size and shape of a pear, with the narrow portion directed inferiorly. After childbirth, the uterus is usually larger, then regresses after menopause.

The uterus is lined with the endometrium. The stratum functionale of the endometrium sloughs off during menstruation. The deeper stratum basale provides the foundation for rebuilding the stratum functionale.

Vagina

The vagina is a fibromuscular tube, about 10 cm long, that extends from the cervix of the uterus to the outside. It is located between the rectum and the urinary bladder. Because the vagina is tilted posteriorly as it ascends and the cervix is tilted anteriorly, the cervix projects into the vagina at nearly a right angle. The vagina serves as a passageway for menstrual flow, receives the erect penis during intercourse, and is the birth canal during childbirth.

External Genitalia

The external genitalia are the accessory structures of the female reproductive system that are external to the vagina. They are also referred to as the vulva or pudendum. The external genitalia include the labia majora, mons pubis, labia minora, clitoris, and glands within the vestibule.

The clitoris is an erectile organ, similar to the male penis, that responds to sexual stimulation. Posterior to the clitoris, the urethra, vagina, paraurethral glands and greater vestibular glands open into the vestibule.

Female Sexual Response & Hormone Control

The female sexual response includes arousal and orgasm, but there is no ejaculation. A woman may become pregnant without having an orgasm.
Follicle-stimulating hormone, luteinizing hormone, estrogen, and progesterone have major roles in regulating the functions of the female reproductive system.

At puberty, when the ovaries and uterus are mature enough to respond to hormonal stimulation, certain stimuli cause the hypothalamus to start secreting gonadotropin-releasing hormone. This hormone enters the blood and goes to the anterior pituitary gland where it stimulates the secretion of follicle-stimulating hormone and luteinizing hormone. These hormones, in turn, affect the ovaries and uterus and the monthly cycles begin. A woman's reproductive cycles last from menarche to menopause.

The monthly ovarian cycle begins with the follicle development during the follicular phase, continues with ovulation during the ovulatory phase, and concludes with the development and regression of the corpus luteum during the luteal phase.

The uterine cycle takes place simultaneously with the ovarian cycle. The uterine cycle begins with menstruation during the menstrual phase, continues with repair of the endometrium during the proliferative phase, and ends with the growth of glands and blood vessels during the secretory phase.

Menopause occurs when a woman's reproductive cycles stop. This period is marked by decreased levels of ovarian hormones and increased levels of pituitary follicle-stimulating hormone and luteinizing hormone. The changing hormone levels are responsible for the symptoms associated with menopause.

**Mammary Glands**

Functionally, the mammary glands produce milk; structurally, they are modified sweat glands. Mammary glands, which are located in the breast overlying the pectoralis major muscles, are present in both sexes, but usually are functional only in the female.

Externally, each breast has a raised nipple, which is surrounded by a circular pigmented area called the areola. The nipples are sensitive to touch, due to the fact that they contain smooth muscle that contracts and causes them to become erect in response to stimulation.

Internally, the adult female breast contains 15 to 20 lobes of glandular tissue that radiate around the nipple. The lobes are separated by connective tissue and adipose. The connective tissue helps support the breast. Some bands of connective tissue, called suspensory (Cooper's) ligaments, extend through the breast from the skin to the underlying muscles. The amount and distribution of the adipose tissue determines the size and shape of the breast. Each lobe consists of lobules that contain the glandular units. A lactiferous duct collects the milk from the lobules within each lobe and carries it to the nipple. Just before the nipple, the lactiferous duct enlarges to form a lactiferous sinus (ampulla), which serves as a reservoir for milk. After the sinus, the duct again narrows and each duct opens independently on the surface of the nipple.

Mammary gland function is regulated by hormones. At puberty, increasing levels of estrogen stimulate the development of glandular tissue in the female breast. Estrogen also causes the breast to increase in size through the accumulation of adipose tissue. Progesterone stimulates the development of the duct system. During pregnancy, these hormones enhance further development of the mammary glands. Prolactin from the anterior pituitary stimulates the production of milk within the glandular tissue, and oxytocin causes the ejection of milk from the glands.

**Review: Introduction to the Reproductive System**

Here is what we have learned from *Introduction to the Reproductive System*:

- The four functions of the reproductive system are:
  - To produce egg and sperm cells
  - To transport and sustain these cells
  - To nurture the developing fetus
  - To produce hormones
- The primary reproductive organs are the gonads, which produce the gametes and hormones. The secondary, or accessory, structures transport and sustain the
gametes and nurture the developing offspring.

- The male reproductive system consists of the testes, duct system, accessory glands, and penis.
- The male gonads are the testes. Their location within the scrotum is necessary for the production of viable sperm.
- The female reproductive system includes the ovaries, uterine tubes, uterus, vagina, accessory glands, and external genital organs.
- The female gonads are the ovaries, which are located on each side of the uterus in the pelvic cavity.
- Estrogen and progesterone stimulate the development of glandular tissue and ducts in the breast. Prolactin stimulates the production of milk, and oxytocin causes the ejection of milk.

**Disorders and Diseases of the Digestive System**

**Endometriosis**

Endometriosis is an often painful disorder in which tissue that normally lines the inside of your uterus — the endometrium — grows outside your uterus. Endometriosis most commonly involves your ovaries, bowel or the tissue lining your pelvis. Rarely, endometrial tissue may spread beyond your pelvic region.

In endometriosis, displaced endometrial tissue continues to act as it normally would: It thickens, breaks down and bleeds with each menstrual cycle. And because this displaced tissue has no way to exit your body, it becomes trapped. Surrounding tissue can become irritated, eventually developing scar tissue and adhesions — abnormal tissue that binds organs together.

The primary symptom of endometriosis is pelvic pain, often associated with your menstrual period. Although many women experience cramping during their menstrual period, women with endometriosis typically describe menstrual pain that's far worse than usual. They also tend to report that the pain has increased over time.

Common signs and symptoms of endometriosis may include:

- **Painful periods (dysmenorrhea).** Pelvic pain and cramping may begin before and extend several days into your period and may include lower back and abdominal pain.
- **Pain with intercourse.** Pain during or after sex is common with endometriosis.
- **Pain with bowel movements or urination.** You're most likely to experience these symptoms during your period.
- **Excessive bleeding.** You may experience occasional heavy periods (menorrhagia) or bleeding between periods (menometrorrhagia).
- **Infertility.** Endometriosis is first diagnosed in some women who are seeking treatment for infertility.
- **Other symptoms.** You may also experience fatigue, diarrhea, constipation, bloating or nausea, especially during menstrual periods.

The severity of your pain isn't necessarily a reliable indicator of the extent of the condition. Some women with mild endometriosis have extensive pain, while others with advanced endometriosis may have little pain or even no pain at all.

Endometriosis is sometimes mistaken for other conditions that can cause pelvic pain, such as pelvic inflammatory disease (PID) or ovarian cysts. It may be confused with irritable bowel syndrome (IBS), a condition that causes bouts of diarrhea, constipation and abdominal cramping. IBS can accompany endometriosis, which can complicate the diagnosis.

**Polycystic ovary syndrome (POC)**

Polycystic ovary syndrome (PCOS) is the most common hormonal disorder among women of reproductive age. The name of the condition comes from the appearance of the ovaries in most, but not all, women with the disorder — enlarged and containing numerous small cysts located along the outer edge of each ovary (polycystic appearance).
Infrequent or prolonged menstrual periods, excess hair growth, acne and obesity can all occur in women with polycystic ovary syndrome. Menstrual abnormality may signal the condition in adolescence, or PCOS may become apparent later following weight gain or difficulty becoming pregnant.

Polycystic ovary syndrome signs and symptoms often begin soon after you first begin having periods (menarche). In some cases, PCOS develops later on during your reproductive years, for instance, in response to substantial weight gain.

Signs and symptoms vary from person to person, in both type and severity. To be diagnosed with the condition, your doctor looks for at least two of the following:

- **Menstrual abnormality.** This is the most common characteristic. Examples of menstrual abnormality include menstrual intervals longer than 35 days; fewer than eight menstrual cycles a year; failure to menstruate for four months or longer; and prolonged periods that may be scant or heavy.

- **Excess androgen.** Elevated levels of male hormones (androgens) may result in physical signs, such as excess facial and body hair (hirsutism); adult acne or severe adolescent acne; and male-pattern baldness (androgenic alopecia). However, the physical signs of androgen excess vary with ethnicity, so depending on your ethnic background you may or may not show signs of excess androgen. For instance, women of Northern European or Asian descent may not be affected.

- **Polycystic ovaries.** Enlarged ovaries containing numerous small cysts can be detected by ultrasound. Despite the condition's name, polycystic ovaries alone do not confirm the diagnosis. To be diagnosed with PCOS, you must also have abnormal menstrual cycles or signs of androgen excess. Some women with polycystic ovaries may not have PCOS, while a few women with the condition have ovaries that appear normal.

**Infertility.** Women with polycystic ovary syndrome may have trouble becoming pregnant because they experience infrequent ovulation or a lack of ovulation. PCOS is the most common cause of female infertility.

**Obesity.** About half the women with polycystic ovary syndrome are obese. Compared with women of a similar age who don't have polycystic ovary syndrome, women with PCOS are more likely to be overweight or obese.

**Prediabetes or type 2 diabetes.** Many women with polycystic ovary syndrome are insulin resistant, which impairs the body's ability to use insulin effectively to regulate blood sugar. This can result in high blood sugar and type 2 diabetes. Prediabetes is also called impaired glucose tolerance.

**Acanthosis nigricans.** This is the medical term for darkened, velvety skin on the nape of your neck, armpits, inner thighs, vulva or under your breasts. This skin condition is a sign of insulin resistance.

**Menopause**

Menopause is the permanent end of menstruation and fertility, defined as occurring 12 months after your last menstrual period.

Menopause is a natural biological process, not a medical illness. Even so, the physical and emotional symptoms of menopause can disrupt your sleep, sap your energy and — at least indirectly — trigger feelings of sadness and loss.

Hormonal changes cause the physical symptoms of menopause, but mistaken beliefs about the menopausal transition are partly to blame for the emotional ones. First, menopause doesn't mean the end is near — you've still got as much as half your life to go. Second, menopause will not snuff out your femininity and sexuality. In fact, you may be one of the many women who find it liberating to stop worrying about pregnancy and periods.

Most important, even though menopause is not an illness, you shouldn't hesitate to get treatment if you're having severe symptoms. Many
treatments are available, from lifestyle adjustments to hormone therapy.

Technically, you don't actually "hit" menopause until it's been one year since your final menstrual period. In the United States, that happens about age 51, on average.

The signs and symptoms of menopause, however, often appear long before the one-year anniversary of your final period. They include:

- Irregular periods
- Decreased fertility
- Vaginal dryness
- Hot flashes
- Sleep disturbances
- Mood swings
- Increased abdominal fat
- Thinning hair
- Loss of breast fullness

Menopause itself requires no medical treatment. Instead, treatments focus on relieving your signs and symptoms and on preventing or lessening chronic conditions that may occur with aging. Treatments include:

- **Hormone therapy.** Estrogen therapy remains, by far, the most effective treatment option for relieving menopausal hot flashes. Depending on your personal and family medical history, your doctor may recommend estrogen in the lowest dose needed to provide symptom relief for you.
- **Low-dose antidepressants.** Venlafaxine (Effexor), an antidepressant related to the class of drugs called selective serotonin reuptake inhibitors (SSRIs), has been shown to decrease menopausal hot flashes. Other SSRIs can be helpful, including fluoxetine (Prozac, Sarafem), paroxetine (Paxil, others), citalopram (Celexa) and sertraline (Zoloft).
- **Gabapentin (Neurontin).** This drug is approved to treat seizures, but it also has been shown to significantly reduce hot flashes.
- **Clonidine (Catapres, others).** Clonidine, a pill or patch typically used to treat high blood pressure, may significantly reduce the frequency of hot flashes, but unpleasant side effects are common.

- **Bisphosphonates.** Doctors may recommend these nonhormonal medications, which include alendronate (Fosamax), risedronate (Actonel) and ibandronate (Boniva), to prevent or treat osteoporosis. These medications effectively reduce both bone loss and your risk of fractures and have replaced estrogen as the main treatment for osteoporosis in women.
- **Selective estrogen receptor modulators (SERMs).** SERMs are a group of drugs that includes raloxifene (Evista). Raloxifene mimics estrogen's beneficial effects on bone density in postmenopausal women, without some of the risks associated with estrogen.
- **Vaginal estrogen.** To relieve vaginal dryness, estrogen can be administered locally using a vaginal tablet, ring or cream. This treatment releases just a small amount of estrogen, which is absorbed by the vaginal tissue. It can help relieve vaginal dryness, discomfort with intercourse and some urinary symptoms.