I. The functions of the female reproductive system include:
   - Production of female gametes (ova).
   - Production of female sex hormones (estrogens and progesterone).
   - Reception and maintenance of a developing embryo and fetus.

II. Ovaries
   a. Flank the uterus laterally and are held in place by several ligaments.
   b. Ovarian ligament anchors the ovary medially to the uterus.
   c. Suspensory ligament anchors it laterally to the pelvic wall.
   d. Mesovarium anchors the ovary to the uterus and abdominal wall and runs between the ovarian ligament and fallopian tube.
   e. Suspensory ligament and mesovarium are part of the broad ligament, a fold of peritoneum that supports the uterus, uterine tubes, and ovaries.
   f. Ovarian arteries and ovarian veins are the major blood vessels of the ovaries.
   g. Each ovary is surrounded by a fibrous tunica albuginea. The tunica albuginea is surrounded by a layer of simple cuboidal epithelium called germinal epithelium.
   h. Ovarian cortex contains ovarian follicles, which house the developing gametes.
   i. Ovarian medulla primarily contains blood vessels and nerves.
   j. Each ovarian follicle consists of a developing egg (an oocyte) surrounded by one or more layers of supporting cells.
   k. There are 4 basic stages of follicular development.
   l. A primordial follicle is of a layer of squamous follicle cells surrounding an oocyte.
   m. A primary follicle has 1≤ layers of cuboidal follicle cells surrounding an oocyte.
   n. A secondary follicle is similar to a primary follicle except that fluid-filled spaces exist between the surrounding cells.
   o. A graafian follicle (vesicular follicle) has a huge fluid-filled cavity called an antrum.
   p. Each month, one graafian follicle (on average) will undergo ovulation and the oocyte will be ejected from the ovary into the peritoneal cavity.
   q. The follicle then transforms into a short-lived endocrine tissue, the corpus luteum.

III. Uterine or fallopian tubes
   a. Initial part of the female duct system.
   b. Receive the ovulated oocyte and transport it to the uterus. Each is 4” long and extends medially from the ovary to the uterus.
   c. Primarily supported by a portion of the broad ligament known as the mesosalpinx.
   d. The uterine tube has 4 regions.
   e. At the end are the fimbriae, ciliated fingerlike extensions that drape over the ovary.
   f. The infundibulum is an open funnel-shaped structure with extending fimbriae.
   g. The ampulla is the portion that curves around the ovary.
   h. The isthmus is the constricted region where the tube joins the uterus.
   i. When an ovulated oocyte is cast into the peritoneal cavity, the cilia on the fimbriae beat creating a current of fluid that draws the oocyte into the infundibulum.
   j. The uterine tube contains a smooth muscle layer and a ciliated epithelium. These both assist in moving an oocyte towards the uterus.
   k. Fertilization usually occurs in the ampulla. The developing blastocyst is then propelled towards the uterus.
IV. Uterus
a. Hollow, thick-walled organ that receives, retains, and nourishes a developing embryo and fetus.
b. Anterior to the rectum and posterosuperior to the bladder.
c. Continuous with the vagina.
d. Flexes anteriorly where it joins the vagina and is thus anteverted. In older women, it may flex posteriorly instead and be retroverted.
e. 3 major regions. The body is the large midportion. The fundus is the rounded portion just superior to the entrances of the uterine tubes. The cervix is the neck that projects into the vagina inferiorly.
f. The cavity of the cervix is the cervical canal. It communicates with the uterine cavity (w/i the body of the uterus) via the internal os. It communicates with the vaginal cavity via the external os.
g. The cervical mucosa contains mucus-secreting cervical glands. Cervical mucus plays an important role in the timing of fertilization as well as preventing pathogens from accessing the uterus.
h. The uterus is supported laterally by the broad ligament, anteriorly by the round ligament, the cervical ligaments laterally and the uterosacral ligaments posteriorly.
i. Another important source of uterine support is the muscles of the pelvic floor – i.e., the muscles of the urogenital and pelvic diaphragms.
j. The wall of the uterus has 3 layers. The perimetrium is the outermost layer and is serosa/adventitia (depending on the location). The myometrium is the middle layer and is made of smooth muscle bundles. The endometrium is the inner layer and is lined by a simple columnar epithelium underlain by a thick lamina propria.
k. The endometrium is divided into 2 sublayers. The stratum functionalis is superficial and undergoes cyclic changes in response to ovarian hormones and is shed during menstruation. The stratum basalis is the thinner and deeper layer and is unresponsive to ovarian hormones and forms a new stratum functionalis after menstruation ends.

V. Vagina
a. Thin walled tube that sits btwn the bladder and rectum and extends from the cervix to the body exterior. It receives the penis and semen during sexual intercourse and provides a delivery route for an infant and for menstrual flow.
b. The vaginal wall contains a mucosa, smooth muscle muscularis, and an adventitia.
c. The mucosa is lined by stratified squamous epithelium and contains rugae, but no glands. Cervical mucous glands provide lubrication for sexual intercourse.
d. The opening of the vagina is the external vaginal orifice. The opening between the vaginal canal and the cervical canal is the external os.
e. In virgins, the vaginal mucosa partially covers the external vaginal orifice. This partition is called the hymen.
f. B/c the cervix projects into the vagina, there is a recess around the neck of the cervix called the vaginal fornix. It has lateral, posterior, and anterior portions.

VI. External genital
a. The ovaries, uterine tubes, uterus, and vagina constitute the internal genitalia.
b. The external genitalia, or vulva, include the mons pubis, labia, clitoris, and structures associated with the vestibule.
c. The mons pubis is a fatty rounded area overlying the pubic symphysis.

d. Running posteriorly from the mons pubis are two skin folds, the labia majora.

e. The labia majora enclose the labia minora, two smaller folds of skin.

f. The labia minora enclose a recess called the vestibule, which contains the external urethral and vaginal orifices. Lateral to the vaginal opening are the greater vestibular glands. They release mucus for lubrication during intercourse.

g. Anterior to the vestibule is the clitoris. Similar to the penis, the clitoris is composed largely of erectile tissue and consists of crura, a body, and a glans. The glans of the clitoris is covered by a prepuce.

h. Adjacent to the vaginal and urethral orifices are a pair of erectile tissues known as the vestibular bulbs. Their engorgement with blood during sexual activity allows for stimulation of the penis as well as constriction of the urethra.

i. The female perineum is a diamond shaped area bounded laterally by the ischial tuberosities, posteriorly by the coccyx, and anteriorly by the pubic arch. It contains the anus and vulva.

VII. Mammary glands

a. Found in both sexes, but function only in females.

b. Produce milk to nourish a newborn.

c. Each mammary gland is contained within the superficial fascia of the breast anterior to the pectoral muscle.

d. Internally, each gland consists of 15-25 lobes that radiate around and open at the nipple. Surrounding the nipple is a ring of pigmented skin called the areola.

e. Within the breast, the lobes are separated by fibrous connective tissue and fat. This CT constitutes the suspensory ligament of the breast.

f. Within the lobes are smaller units called lobules, which contain glandular alveoli that contain milk when a woman is lactating. These alveolar glands pass milk into lactiferous ducts, which open to the outside at the nipple.

VIII. Oogenesis

a. Meiotic process in females in which diploid germ cells produce haploid gametes.

b. During the fetal period, oogonia (diploid germ cells) multiply by mitosis. The oogonia replicate their DNA and become primary oocytes. They are surrounded by a single layer of simple squamous follicle cells – yielding primordial follicles.

c. Primary oocytes begin meiosis I but become “stuck” and do no further division until they receive the appropriate hormonal signal during each menstrual cycle. By birth, there are approximately two million primordial follicles, each containing a single primary oocyte, present in the ovarian cortex. At puberty, about 80 percent of these follicles have degenerated and only about 250,000 remain. From then on during each cycle, one follicle will complete the long process of becoming a graafian follicle and its contained oocyte will complete meiosis I.

d. At the end of meiosis I, the single primary oocyte has divided into 2 dissimilar cells, a tiny haploid cell called the first polar body and a large haploid secondary oocyte.

e. The secondary oocyte is the cell that will actually be ovulated. The first polar body will die (although it may divide before dying).
f. The large size of the secondary oocyte makes it easier for the sperm cell to find it. If and only if a sperm fertilizes the secondary oocyte, will the secondary oocyte complete meiosis II? If fertilization does not occur, the secondary oocyte will die.

g. Meiosis II results in a large ovum and another tiny polar body – the second polar body. The large size of the ovum is advantageous b/c it allows for the retention of nutrients as well as proteins and other molecules involved in development. The ovum will contain 2 sets of haploid pronuclei – its own and that of the sperm that fertilized it. When these 2 pronuclei fuse, the cell is now diploid and is now known as a zygote. The second polar body will die.

IX. Ovarian cycle

b. Consists of 2 consecutive phases: the follicular phase is the period during which follicle growth is hormonally stimulated (typically days 1-14 of the cycle); the luteal phase is the period of corpus luteum activity, during which the uterus is prepared for pregnancy (typically days 15-28 of the cycle).

c. At the onset of the follicular phase, the hypothalamus secretes increasing amounts of gonadotropin releasing hormone (GnRH). GnRH acts on the anterior pituitary, making it secrete follicle stimulating hormone (FSH) and luteinizing hormone (LH).

d. FSH and LH stimulate follicle growth. (NOTE – a primordial follicle will not mature into a graafian follicle during the 2 weeks of the follicular phase. This takes months to occur but growth occurs during the follicular phase of each cycle.)

e. As follicles mature and grow during the follicular phase, they secrete estrogen.

f. Estrogen prepares the uterus for a possible pregnancy. Estrogen feeds back and prevents the release of FSH and LH from the anterior pituitary but at the same time causes the anterior pituitary to stockpile LH and FSH. As follicle growth continues and estrogen levels rise and FSH and LH levels decline.

g. Some primary follicles develop antra and become secondary follicles. A single layer of follicle cells (the corona radiata) still surrounds the oocyte. Eventually only one follicle becomes a mature graafian follicle and is ready for ovulation. Remember – it took months for the graafian follicle to develop.

h. On or around day 14, estrogen levels reach a threshold level and the anterior pituitary releases its stored FSH and more importantly its LH. A massive surge in plasma LH occurs. This LH surge causes:
   - the primary oocyte (w/i the graafian follicle) to complete Meiosis I forming a secondary oocyte and the first polar body.
   - ovulation. The secondary oocyte is cast into the peritoneal cavity where it will be swept into the uterine tube and towards the uterus, where along the way it may or may not get fertilized by a sperm.
   - the remaining follicle cells to turn into a corpus luteum.

i. Following ovulation, the luteal phase commences. The corpus luteum begins to secrete progesterone as well as a small amount of estrogen. Progesterone maintains the uterus in a state ready to receive and nourish an embryo (if fertilization has occurred). Progesterone also inhibits any further pituitary release of FSH or LH. This prevents any further follicle growth or ovulation during the next 2 weeks– in case pregnancy has occurred.
j. If pregnancy does not occur, then LH levels will become quite low due to the inhibitory effect of progesterone. LH is necessary for maintenance of the corpus luteum. As LH levels diminish past a threshold level, the corpus luteum begins to degenerate. It will gradually turn into a whitish mass of scar tissue known as a corpus albicans. As the corpus luteum degenerates, progesterone levels fall and the inhibition of pituitary FSH and LH is removed. LH and FSH levels begin to rise again and the cycle will begin anew.

k. However if pregnancy does occur, then the soon-to-be placenta will produce a hormone known as human chorionic gonadotropin (HCG). It will maintain the corpus luteum and prevent its degeneration even as LH levels plummet.

X. Uterine cycle
a. Cyclical changes that occur in the uterus in response to ovarian hormones.

b. Days 1-5 are the menstrual phase, during which plasma progesterone will plummet and the stimulus for maintaining the thick endometrium will disappear. In response to this, the stratum functionalis will be shed and detached tissue and blood (menses) will slough out the vagina.

c. Days 6-14 are the proliferative phase, during which plasma estrogen is rising. This causes the stratum functionalis to grow thicker and more vascular and glandular. This is in preparation for the possibility of fertilization and pregnancy. Estrogen also causes cervical mucus to become less viscous. This facilitates sperm entry.

d. Days 14-28 are the secretory phase, during which plasma progesterone rises to its peak during this period of corpus luteum activity. Progesterone causes even more vascularization of the stratum functionalis and causes the endometrial glands to twist, coil, and enlarge. Progesterone will cause cervical mucus to become more viscous (i.e., it creates a cervical plug). This helps prevent the embryo from being attacked by any pathogens that may migrate from the vagina.

XI. Extravaginal effects of estrogen and progesterone.

a. Estrogen:
- Promotes bone lengthening and epiphyseal plate closure in adolescents
- Inhibits bone resorption
- Promotes skin hydration
- Stimulates female pattern of fat deposit and growth of axillary and pubic hair
- Increases renal retention of sodium and consequently of water
- Enhances HDL cholesterol and reduces LDL cholesterol.

b. Progesterone increases body T° and promotes urination.

XII. Female sexual response
a. Somewhat similar to the male response. The vaginal mucosa, clitoris, and breasts engorge with blood – analogous to erection.

b. Orgasm is not typically accompanied by ejaculation, but muscular tension, BP, and HR all increase.

XIII. Other important terms and events
a. Puberty → period of life (typically btwn 10y and 15y) during which the reproductive organs grow to adult size and become functional.

b. Menarche → first menstrual period.

c. Menopause → normal cessation of menstrual function that typically occurs btwn ages 46 and 54.