

Reproductive System

Physiology



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Reproduction

- Reproduction can be defined as the process by which an organism continues its species.
- In the human reproductive process, two kinds of sex cells (gametes), are involved: the male gamete (sperm), and the female gamete (egg or ovum).
- These two gametes meet within the female's uterine tubes located one on each side of the upper pelvic cavity, and begin to create a new individual. The female needs a male to fertilize her egg; she then carries offspring through pregnancy and childbirth.

Differences between male and female reproductive systems

- A male who is healthy, and sexually mature, continuously produces sperm.
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- The woman is born with a predetermined immature number of oocytes and cannot produce new ones.
- After puberty, during each menstrual cycle, one oocyte matures during ovulation.
- The ovaries of a newborn baby girl contain about one million oocytes.
- This number declines to 400,000 to 500,000 by the time puberty is reached.
- On average, 500-1000 oocytes are ovulated during a woman's reproductive lifetime.
- When a young woman reaches puberty, a primary oocyte is discharged from one of the ovaries every 28 days.
- This continues until the woman reaches menopause, usually around the age of 50 years.
- Oocytes are present at birth, and age as a woman ages.

Functions of the Female Reproductive System

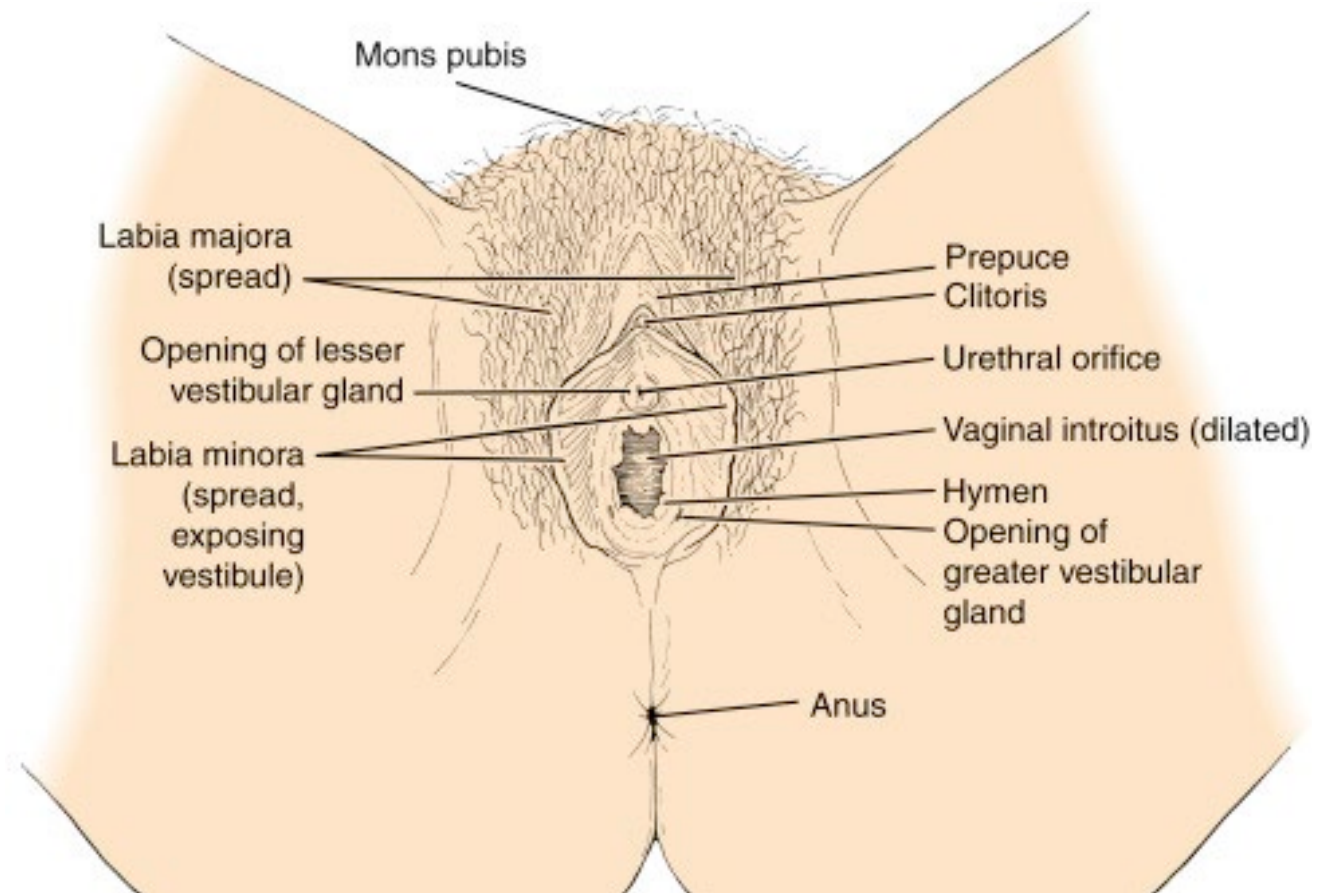
Functions of the Female Reproductive System

- Produces eggs (ova)
- Secretes sex hormones
- Receives the male spermatazoa during intercourse
- Protects and nourishes the fertilized egg until it is fully developed
- Delivers fetus through birth canal
- Provides nourishment to the baby through milk secreted by mammary glands in the breast



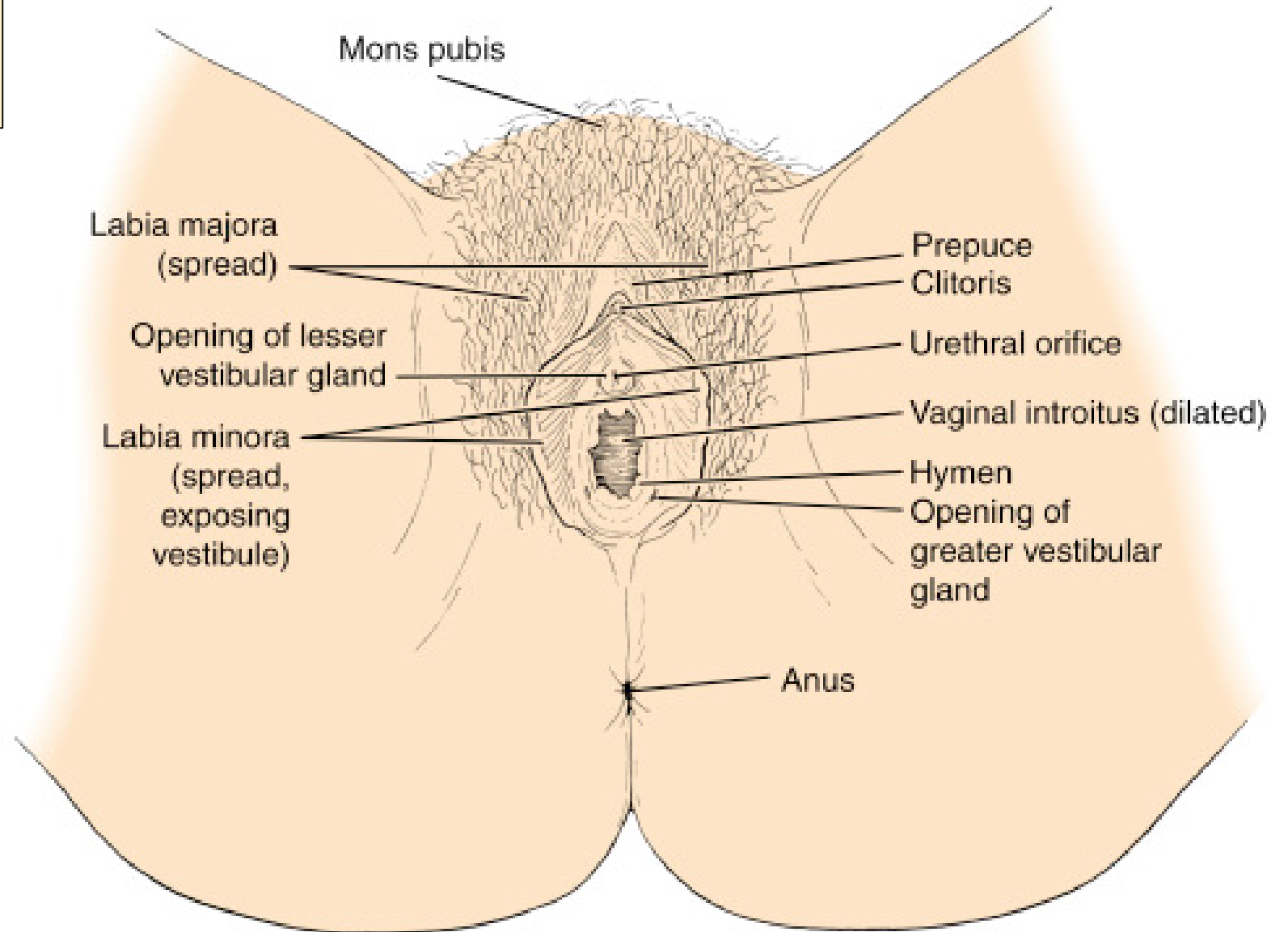
External Genitals; Vulva

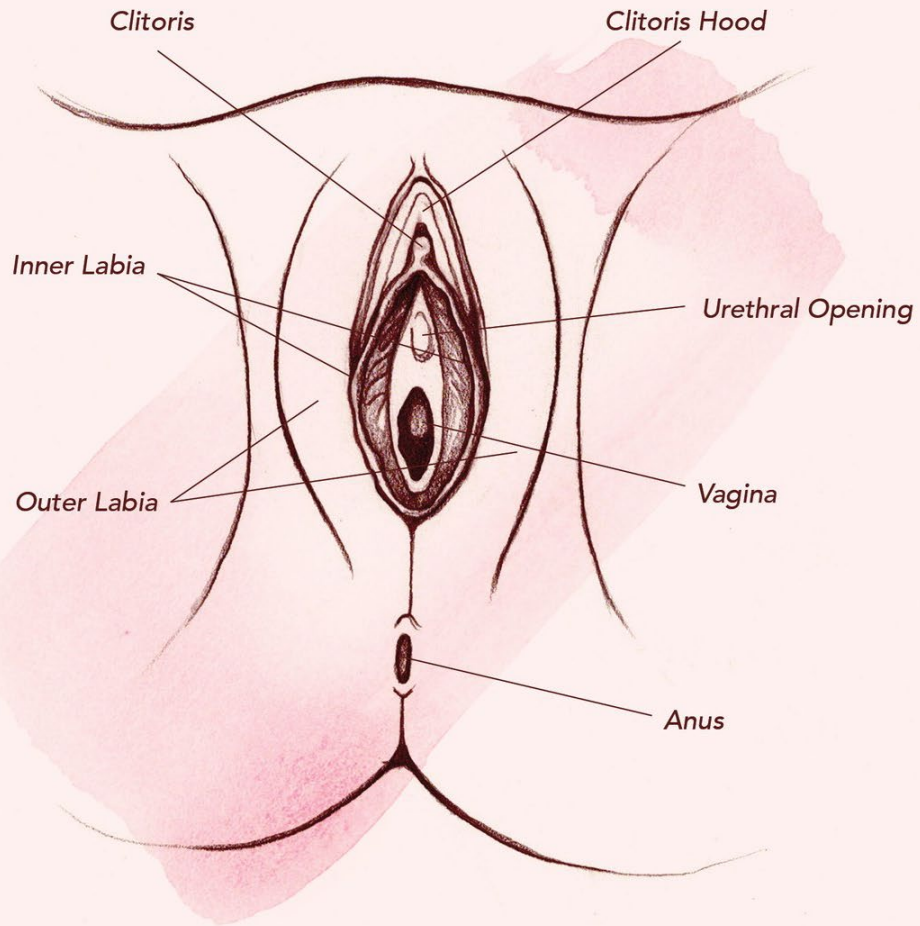
- The external female genitalia is referred to as vulva. It consists of
 - the labia majora (translates as “large lips”)
 - The labia minora (translates as “small lips”)
 - The mons pubis
 - The clitoris
 - The urethral opening (meatus)
 - The vaginal opening



Mons Pubis

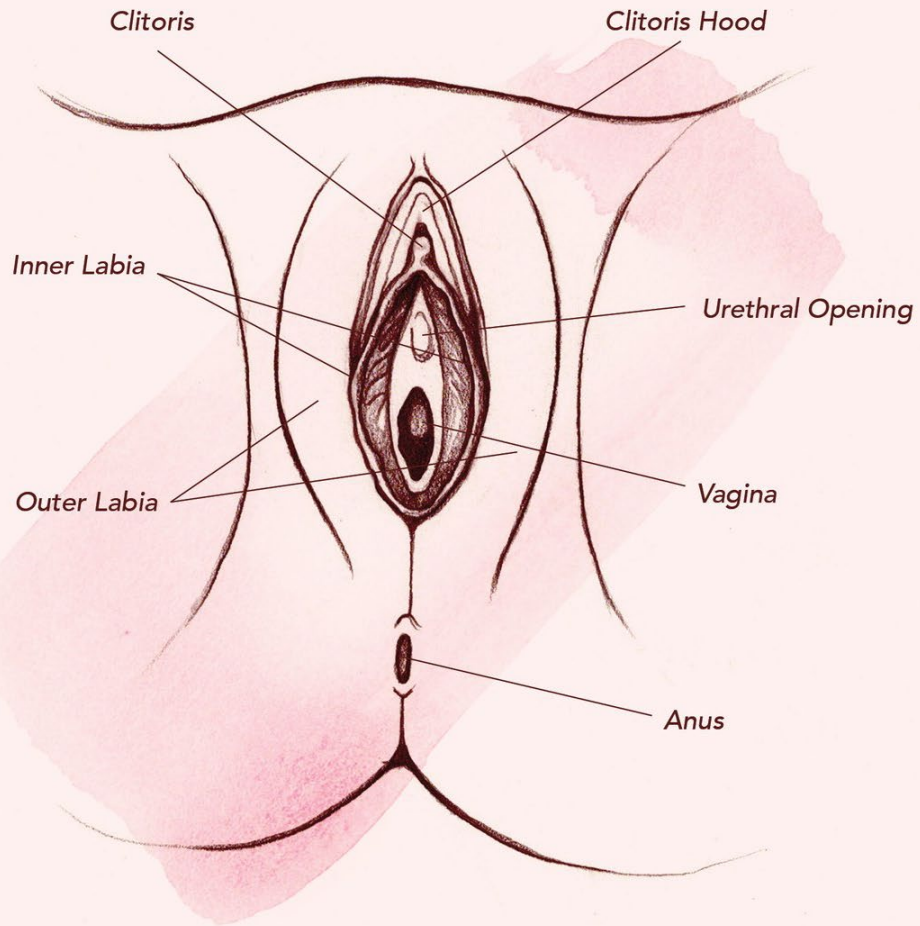
- The mons pubis refers to the fatty pad of tissue covering the pubic bone, where pubic hair grows.
- The mons pubis assists to protect the pubic bone and vulva from the impact of sexual intercourse.





Labia Majora

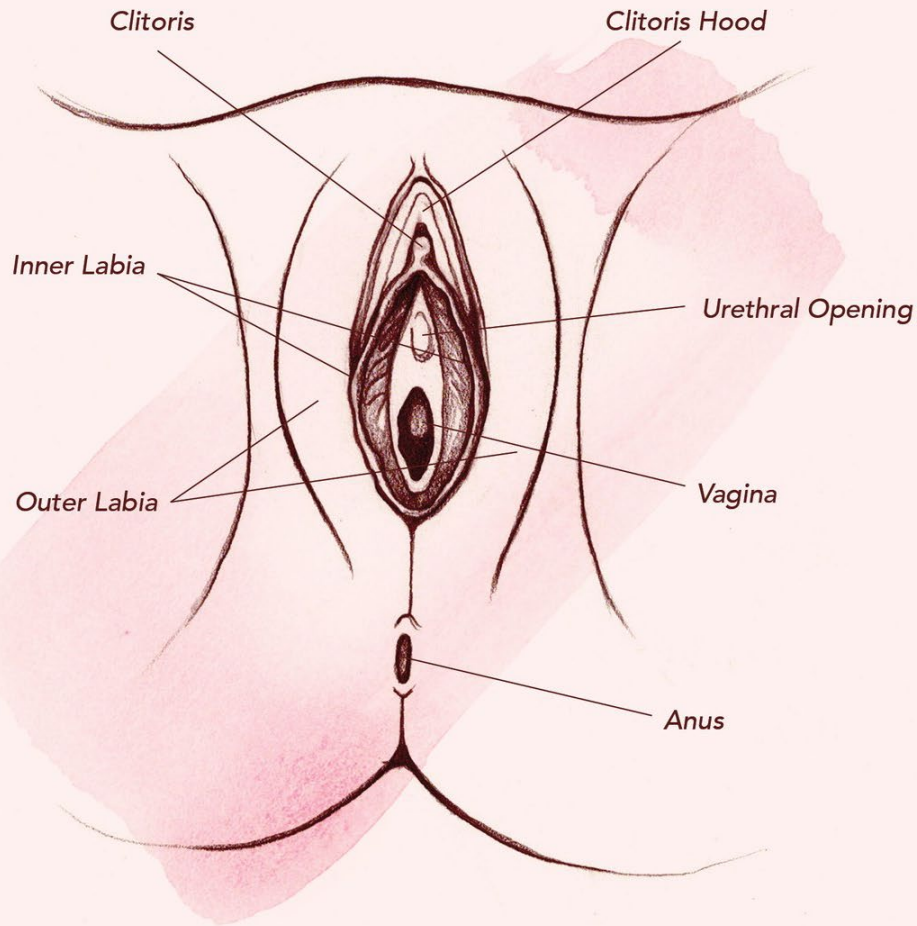
- The labia majora are the outer "lips" of the vulva. They are pads of loose connective and adipose tissue, as well as some smooth muscle. The labia majora wrap around the vulva from the mons pubis to the perineum. The labia majora generally hides, partially or entirely, the other parts of the vulva. These labia are usually covered with pubic hair.



Labia Minora

- Medial to the labia majora are the labia minora. The labia minora are the inner lips of the vulva. They are thin stretches of tissue within the labia majora that fold and protect the vagina, urethra, and clitoris.
- There is no pubic hair on the labia minora, but there are sebaceous glands.
- The labia minora protect the vaginal and urethral openings.

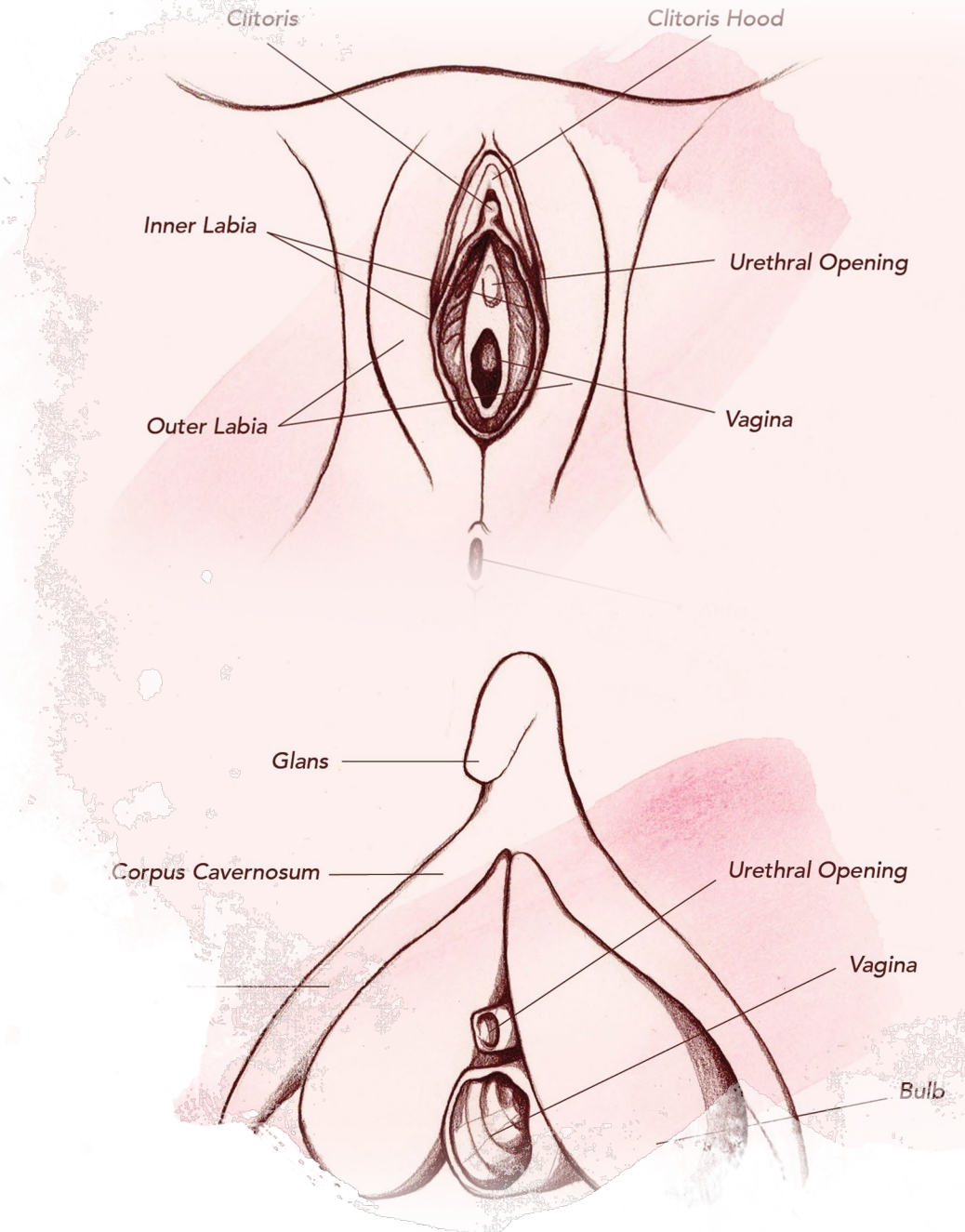
Clitoris



- The clitoris is a small oval structure located at the top of the labia minora.
- It is believed that it functions solely for sexual pleasure.
- During sexual excitement, the clitoris erects and extends, the hood retracts, making the clitoral glans more accessible.
- The size of the clitoris is variable between women.

Clitoris

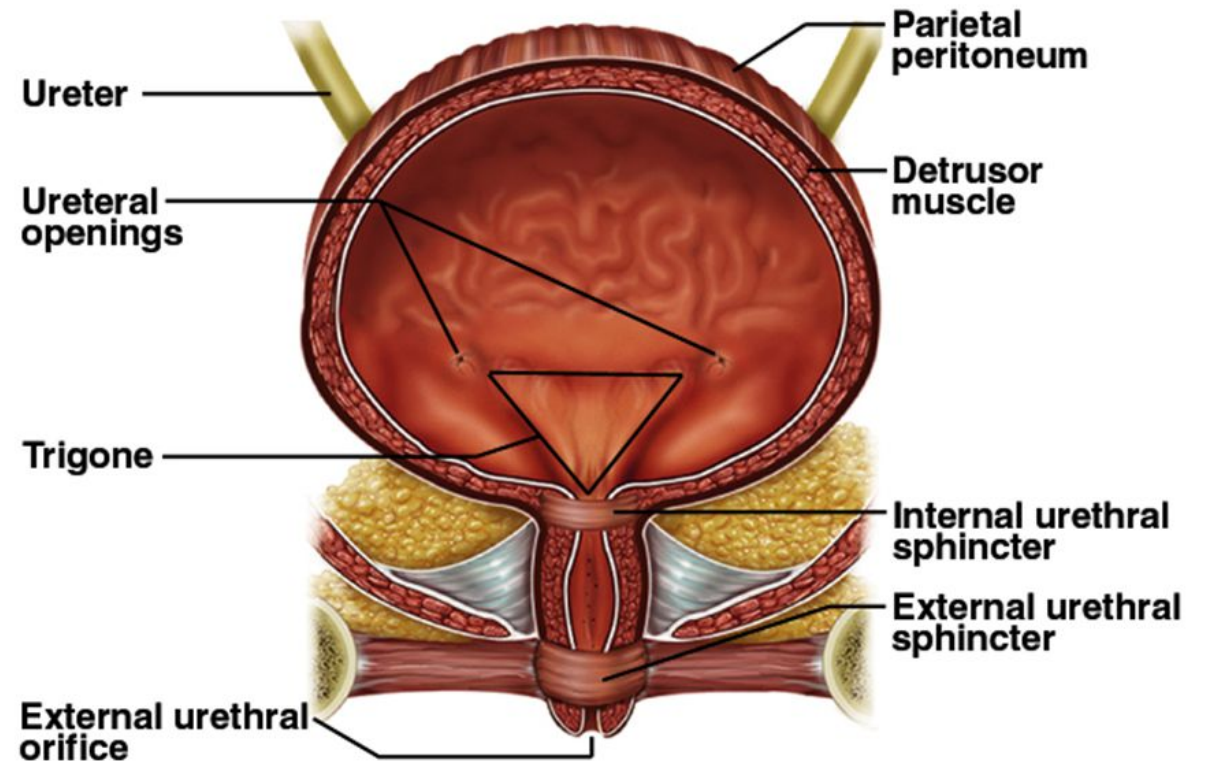
- The clitoris is a small oval structure located at the top of the labia minora.
- It is believed that it functions solely for sexual pleasure.
- Only the tip or glans of the clitoris shows externally, but the organ itself is elongated and branched into two forks, the crura, which extend downward along the rim of the vaginal opening toward the perineum.
- Thus the clitoris is much larger than most people think it is, about 4" long on average.

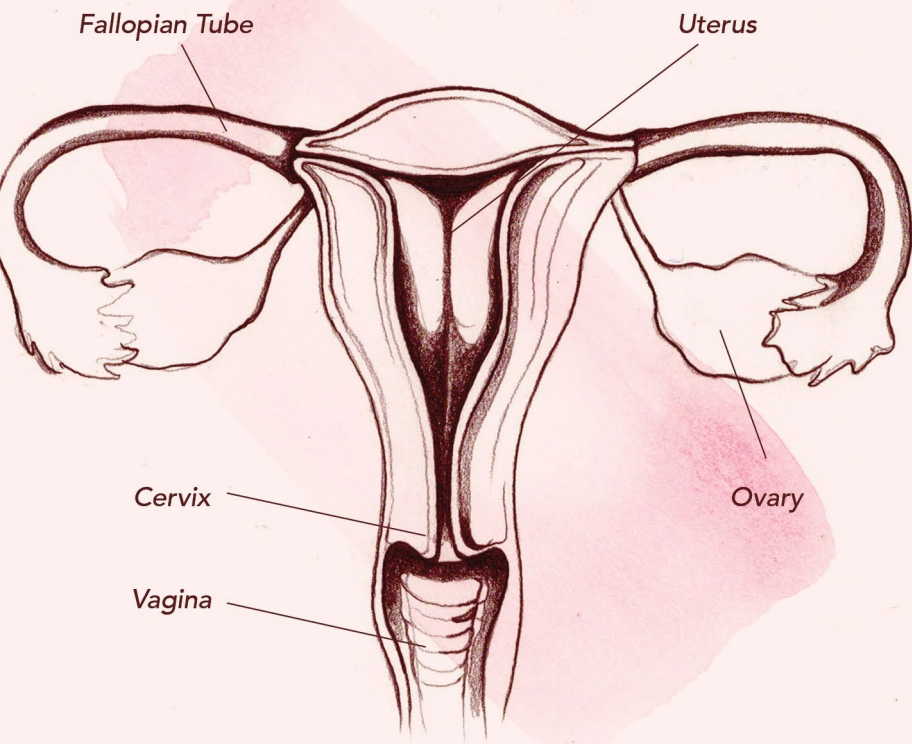


Urethra

- The opening to the urethra is just below the clitoris.
- The urethra is used for the passage of urine.
- The urethra is connected to the bladder.
- In females the urethra is 1.5 inches long, compared to males whose urethra is 8 inches long.
- Because the urethra is so close to the anus, women should always wipe themselves from front to back to avoid infecting the vagina and urethra with bacteria.
- This location issue is the reason for bladder infections being more common among females.

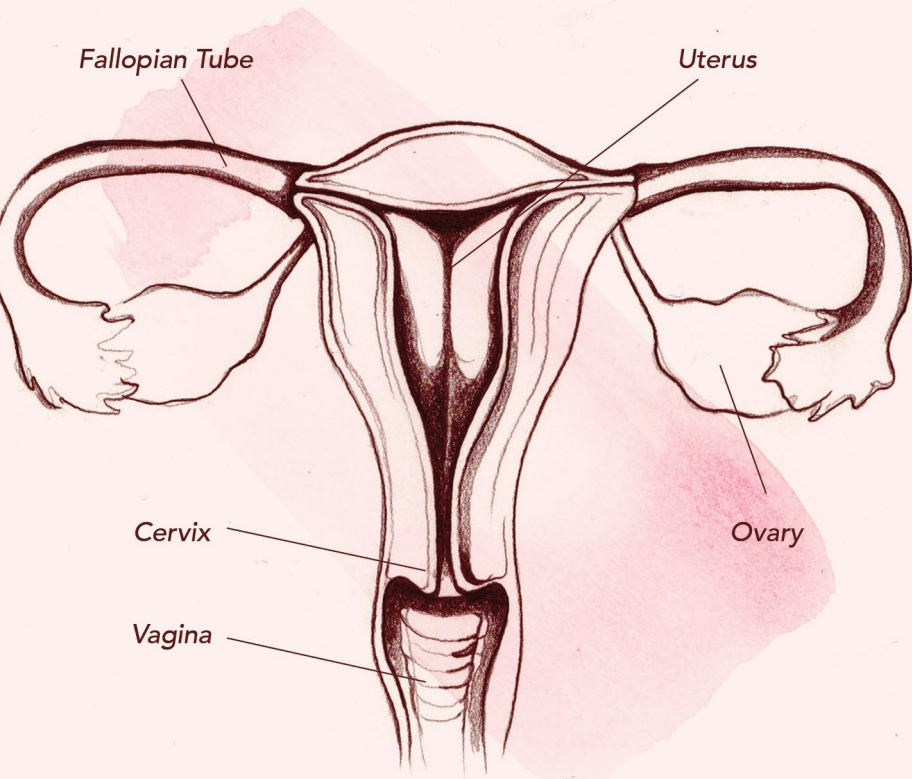
Urinary Bladder and Urethra - Female





Vagina

- The vagina is a muscular, hollow tube that extends from the vaginal opening to the cervix of the uterus.
- The vagina functions as a passageway for sperm to gain access to the fallopian tubes where fertilization may occur.
- The vagina is made up of three layers
 - an inner mucosal layer
 - a middle muscularis layer
 - an outer fibrous layer.



Vagina

- The vagina is made up of three layers
 - an inner mucosal layer
 - a middle muscularis layer
 - an outer fibrous layer
- The inner layer is made of vaginal rugae that stretch and allow penetration to occur.
- the vaginal rugae have glands that secrete an acidic mucus (pH of around 4.0.) that keeps bacterial growth down.
- The outer muscular layer is especially important with delivery of a fetus and placenta.

Cervix



The cervix (from Latin "neck") is the lower, narrow portion of the uterus where it joins with the top end of the vagina.



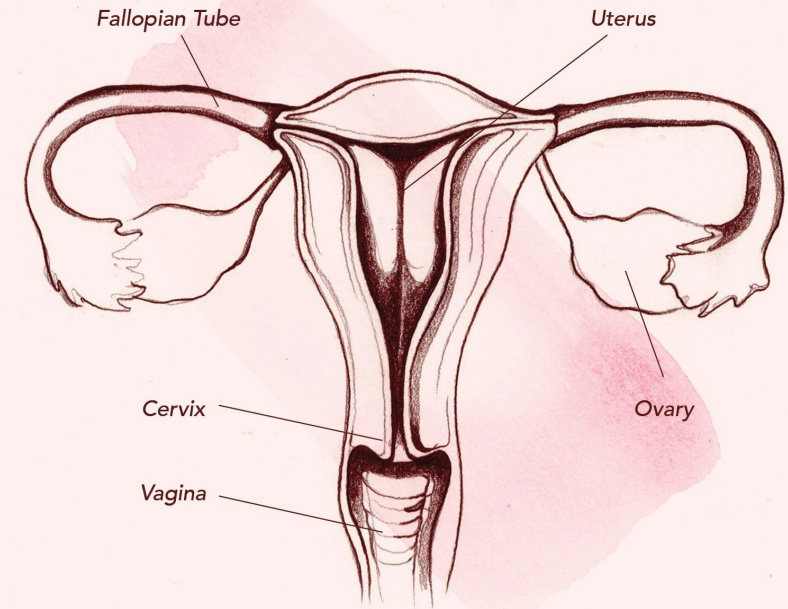
During menstruation, the cervix stretches open slightly to allow the endometrium to be shed.



During childbirth, contractions of the uterus will dilate the cervix up to 10 cm in diameter to allow the child to pass through.

Uterus

- The uterus is shaped like an upside-down pear, with a thick lining and muscular walls. Located near the floor of the pelvic cavity, it is hollow to allow a blastocyte, or fertilized egg, to implant and grow.
- It also allows for the inner lining of the uterus to build up until a fertilized egg is implanted, or it is sloughed off during menses.
- The uterus contains some of the strongest muscles in the female body.
- These muscles are able to expand and contract to accommodate a growing fetus and then help push the baby out during labor.

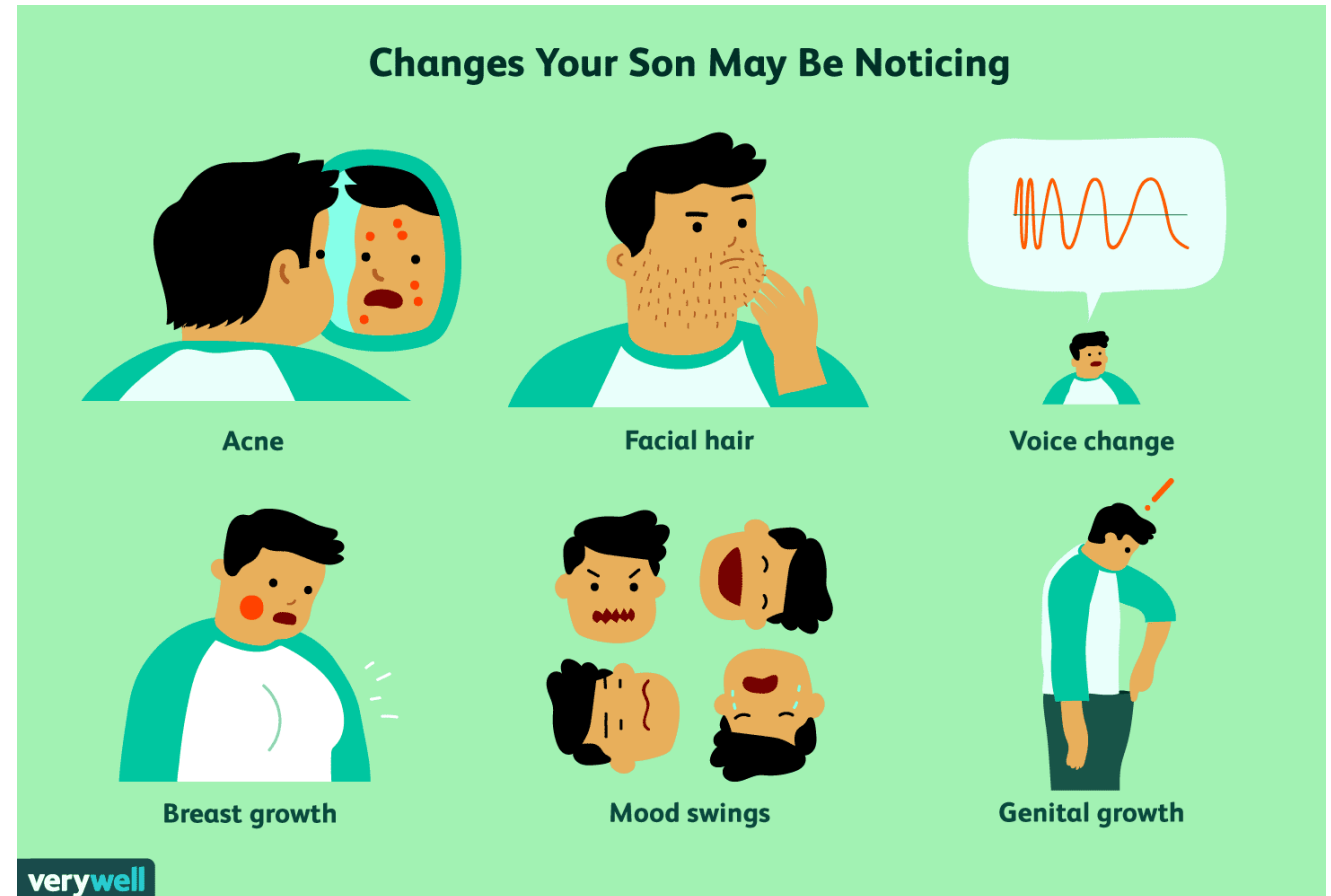


Reproductive Biology

- Reproductive physical maturity and the capacity for human reproduction begin during puberty, a period of rapid growth and change experienced by both males and females.
 - Puberty is not an isolated event, but a process which takes place over several years.
 - During puberty, the hypothalamus produces hormones.
 - These hormones stimulate the gonads (the testes in males and the ovaries in females) to produce either testosterone (in males) or estrogen and progesterone (in females).

Male puberty

- Male puberty generally occurs between the ages of 13-15.
 - It is characterized by the secretion of the male hormone testosterone
 - Testosterone stimulates spermatogenesis (sperm production)
 - Testosterone causes the development of secondary sexual characteristics including:
 - increased height and weight
 - broadening of the shoulders
 - growth of the testes and penis
 - pubic and facial hair growth
 - voice deepening
 - muscle development



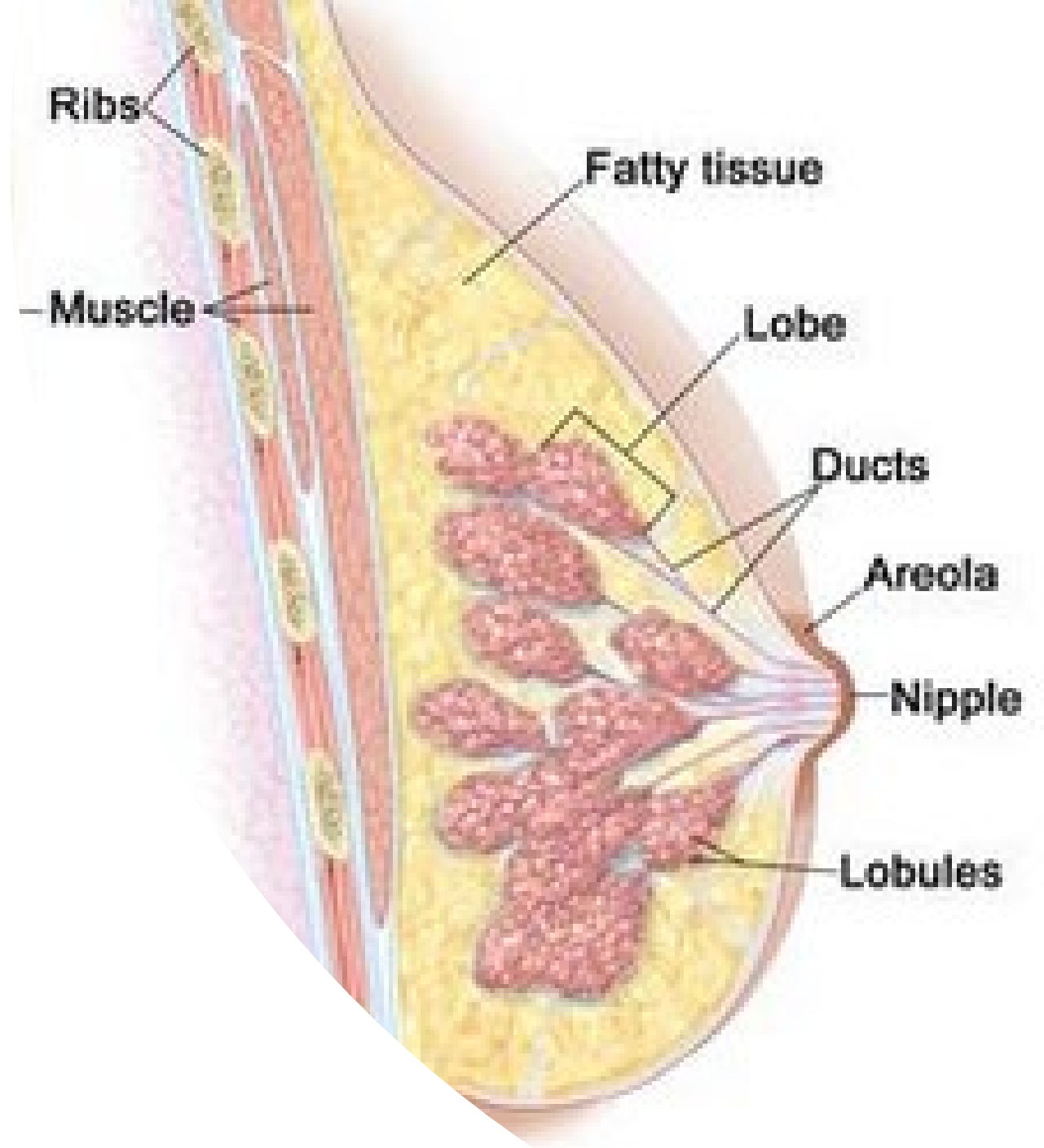
Female puberty

- Female puberty generally occurs between the ages of 9-13.
 - The menstrual cycle begins:
 - ovulation and menstruation and cyclic hormonal changes in estrogen and progesterone.
 - Secondary sexual characteristics develop:
 - growth of pubic and underarm hair
 - breast enlargement
 - vaginal and uterine growth
 - widening hips
 - increased height, weight and fat distribution



Mammary Glands

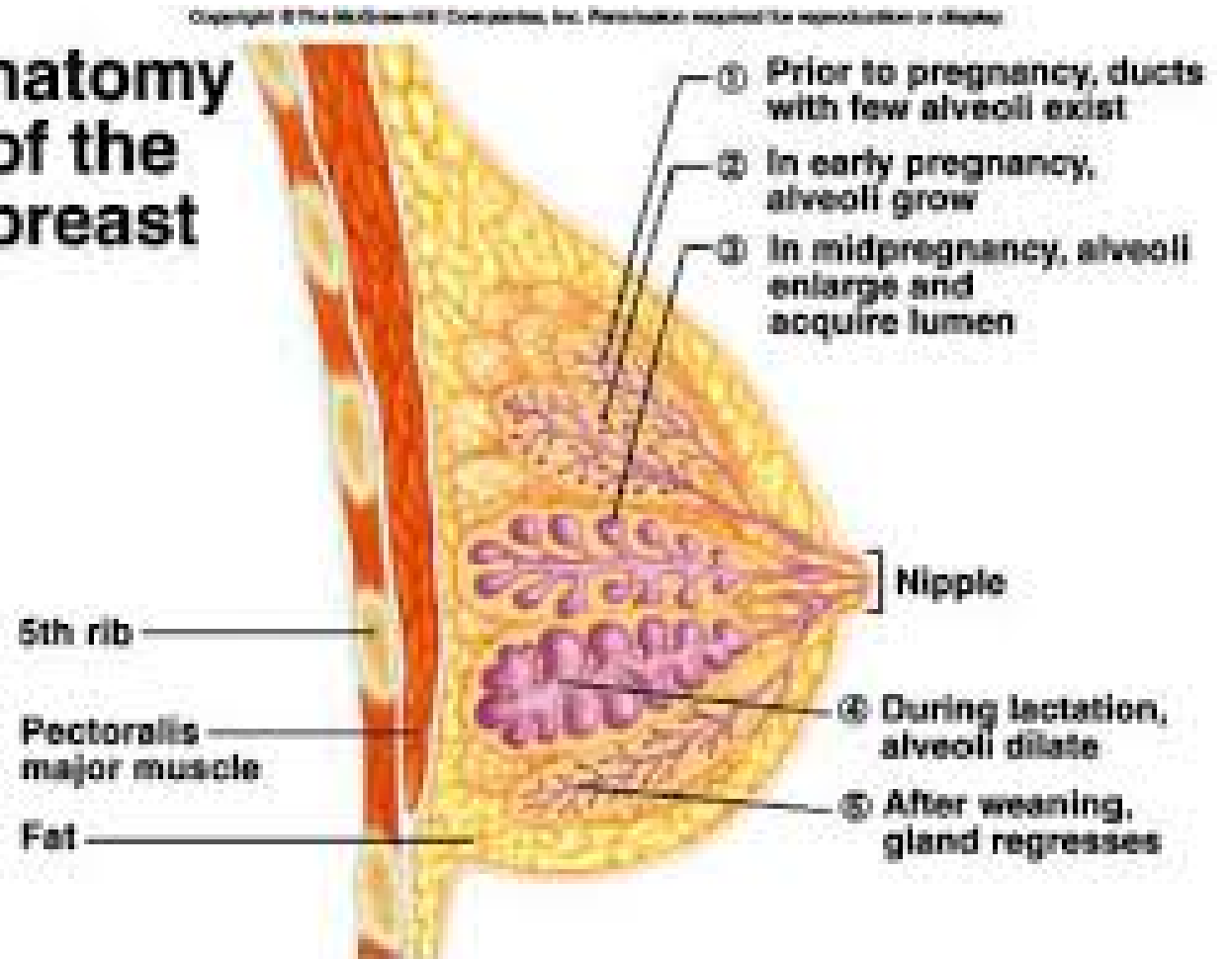
- Mammary glands are the organs that produce milk for the sustenance of a baby.
- These exocrine glands are enlarged and modified sweat glands.



Mammary Glands

- The basic components of the mammary gland are the alveoli.
 - Small, hollow cavities
 - lined with milk-secreting epithelial cells
 - surrounded by myoepithelial cells.

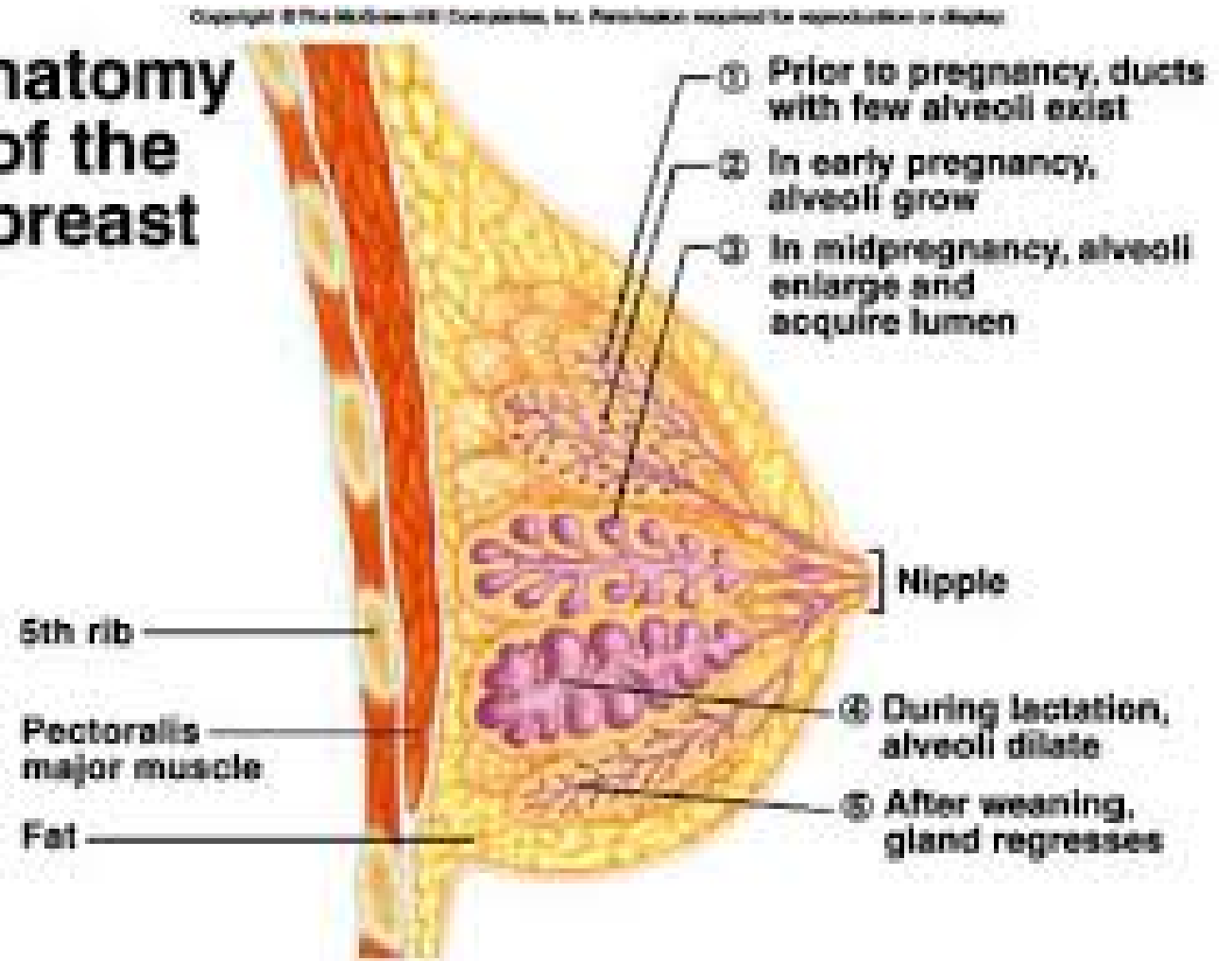
Anatomy of the breast



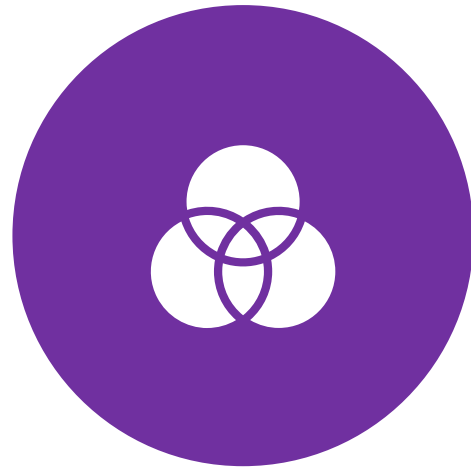
lobules

- These alveoli join up to form groups known as lobules, and each lobule has a lactiferous duct that drains into openings in the nipple.
- The myoepithelial cells can contract, similar to muscle cells, and thereby push the milk from the alveoli through the lactiferous ducts towards the nipple, where it collects in widenings (sinuses) of the ducts.
- A suckling baby essentially squeezes the milk out of these sinuses.

Anatomy of the breast



The development of mammary glands



THE DEVELOPMENT IS CONTROLLED BY HORMONES. ESTROGEN PROMOTES FORMATION, WHILE TESTOSTERONE INHIBITS IT.



TRUE SECRETORY ALVEOLI DEVELOP DURING PREGNANCY IN RESPONSE TO RISING LEVELS OF ESTROGEN AND PROGESTERONE.

The development of mammary glands



LACTATION BEGINS A FEW DAYS AFTER BIRTH AND IS DUE TO A REDUCTION IN CIRCULATING PROGESTERONE AND PROLACTIN.



COLOSTRUM IS SECRETED IN LATE PREGNANCY AND FOR THE FIRST FEW DAYS AFTER GIVING BIRTH.

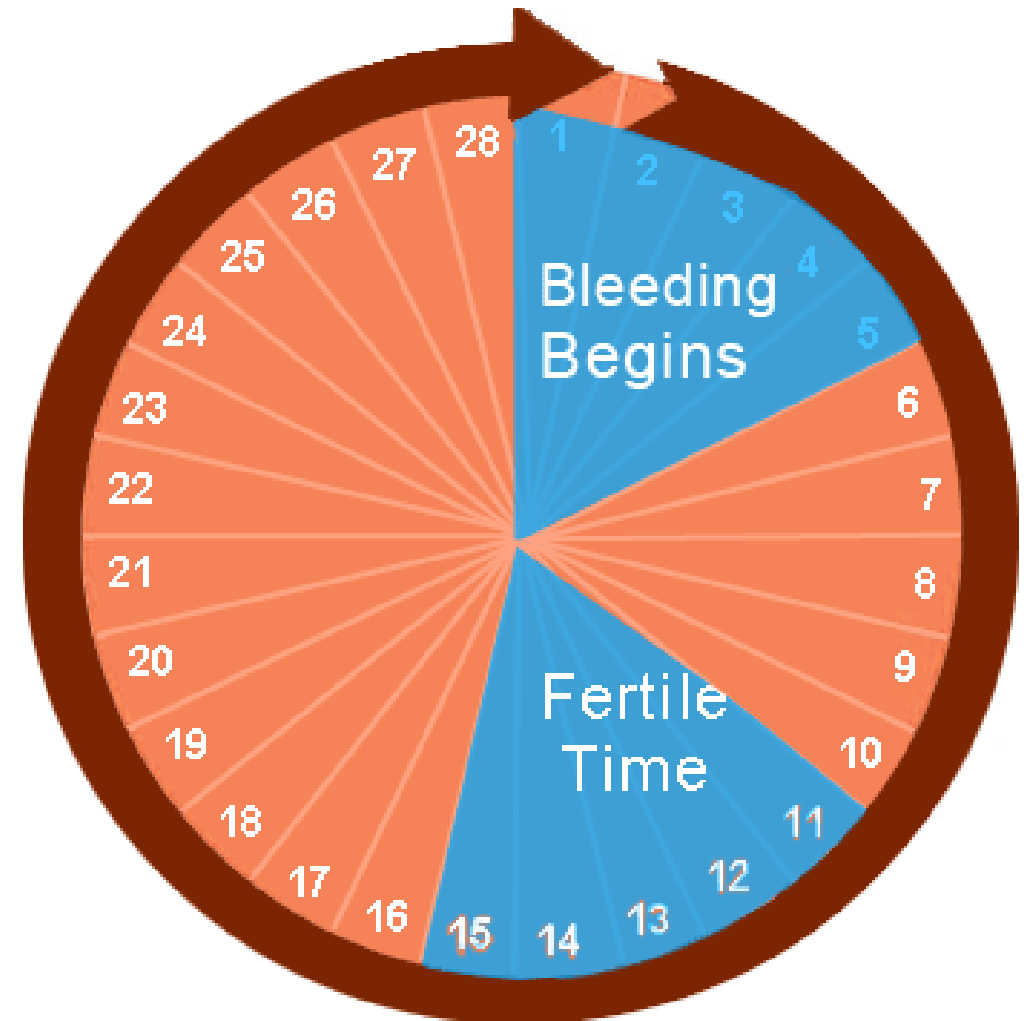


THE SUCKLING OF THE BABY CAUSES THE RELEASE OF THE HORMONE OXYTOCIN WHICH STIMULATES CONTRACTION OF THE MYOEPIHELIAL CELLS.

The Female Reproductive Cycle

- Towards the end of puberty, girls begin to release eggs as part of a monthly period called the female reproductive cycle, or menstrual cycle (menstrual referring to "monthly").
- Approximately every 28 days, during ovulation, an ovary sends a tiny egg into one of the fallopian tubes.

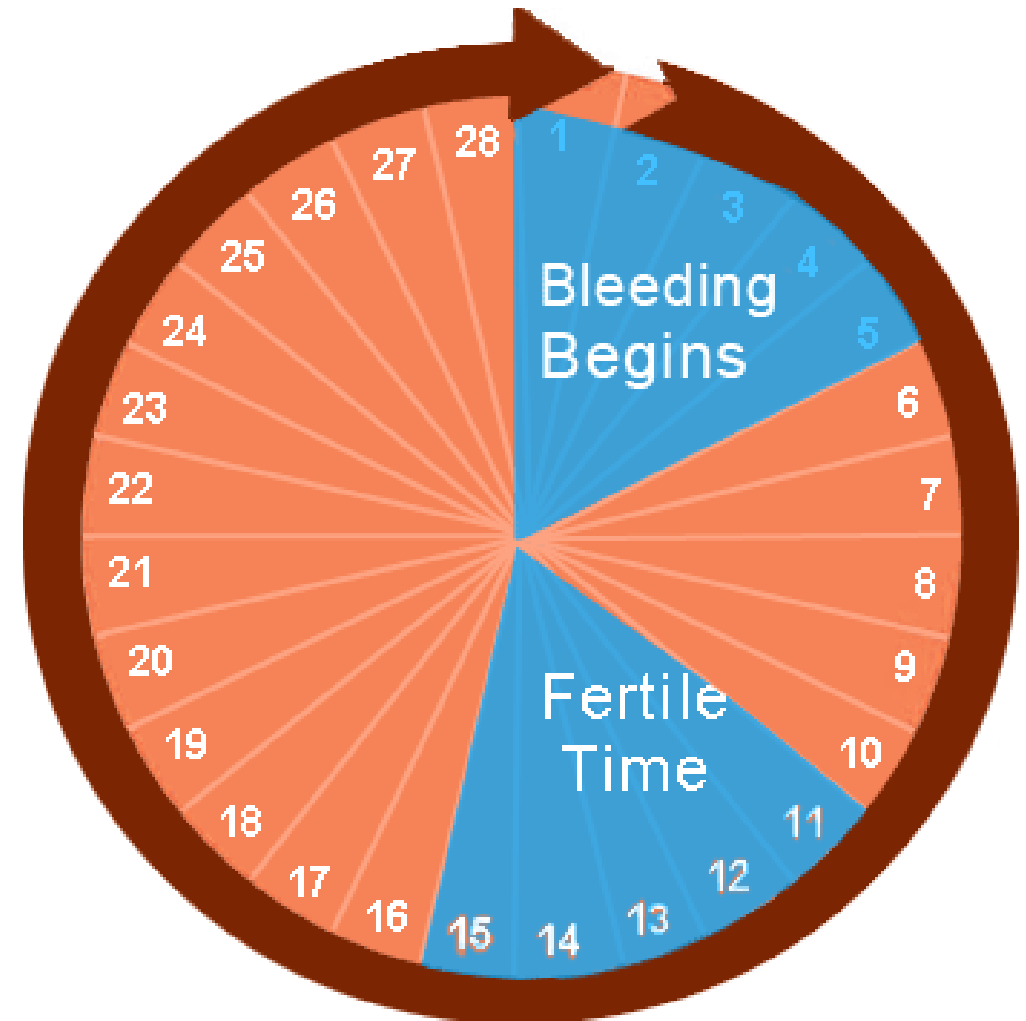
The Menstrual Cycle



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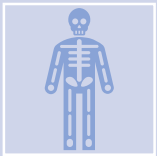
The Menstrual Cycle



Menstrual cycle



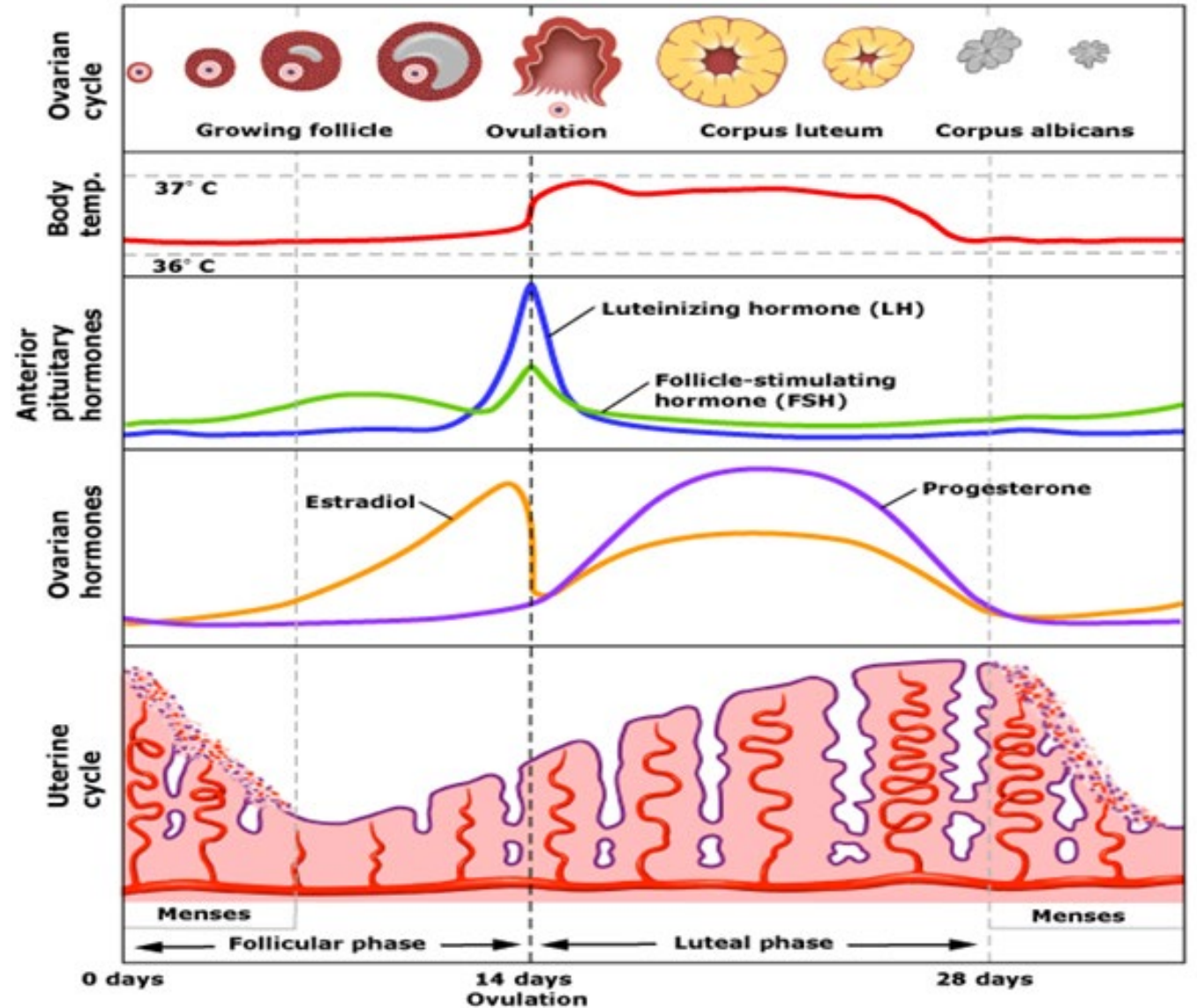
The reproductive cycle can be divided into an ovarian cycle and a uterine cycle



During the uterine cycle, the endometrial lining of the uterus builds up under the influence of increasing levels of estrogen

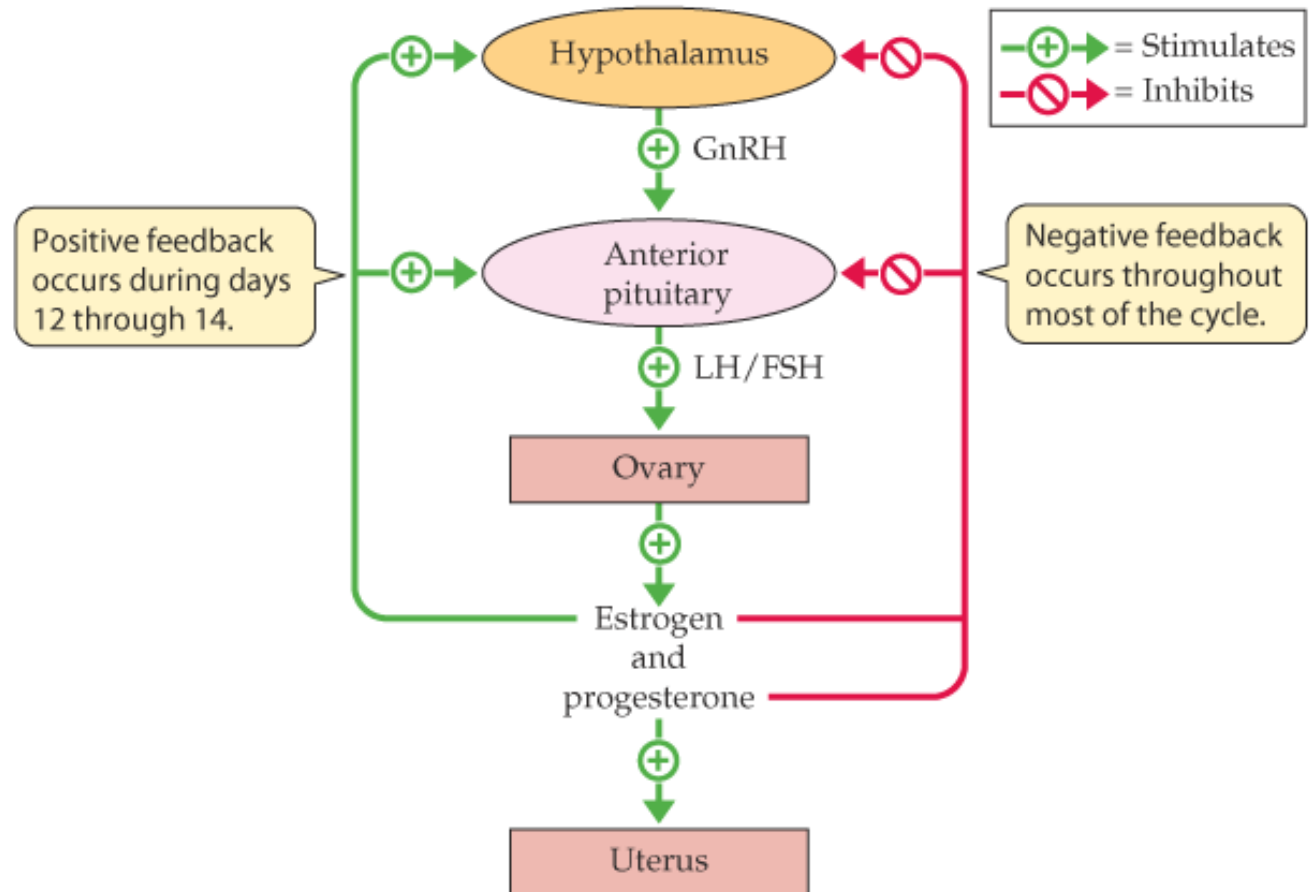
The Menstrual/Hormonal Cycle

- This cycle (**menstrual cycle**) is described below:
 - The first day of menstruation (referred to as Day 1).
 - Occurs when levels of estrogen and progesterone are low.
 - when levels of estrogen and progesterone are low, the hypothalamus secretes **gonadotrophin releasing hormone (GnRH)**.
 - **gonadotrophin releasing hormone (GnRH)** triggers the **anterior pituitary gland** to release two hormones: **follicle stimulating hormone (FSH)**, and **luteinizing hormone (LH)**.



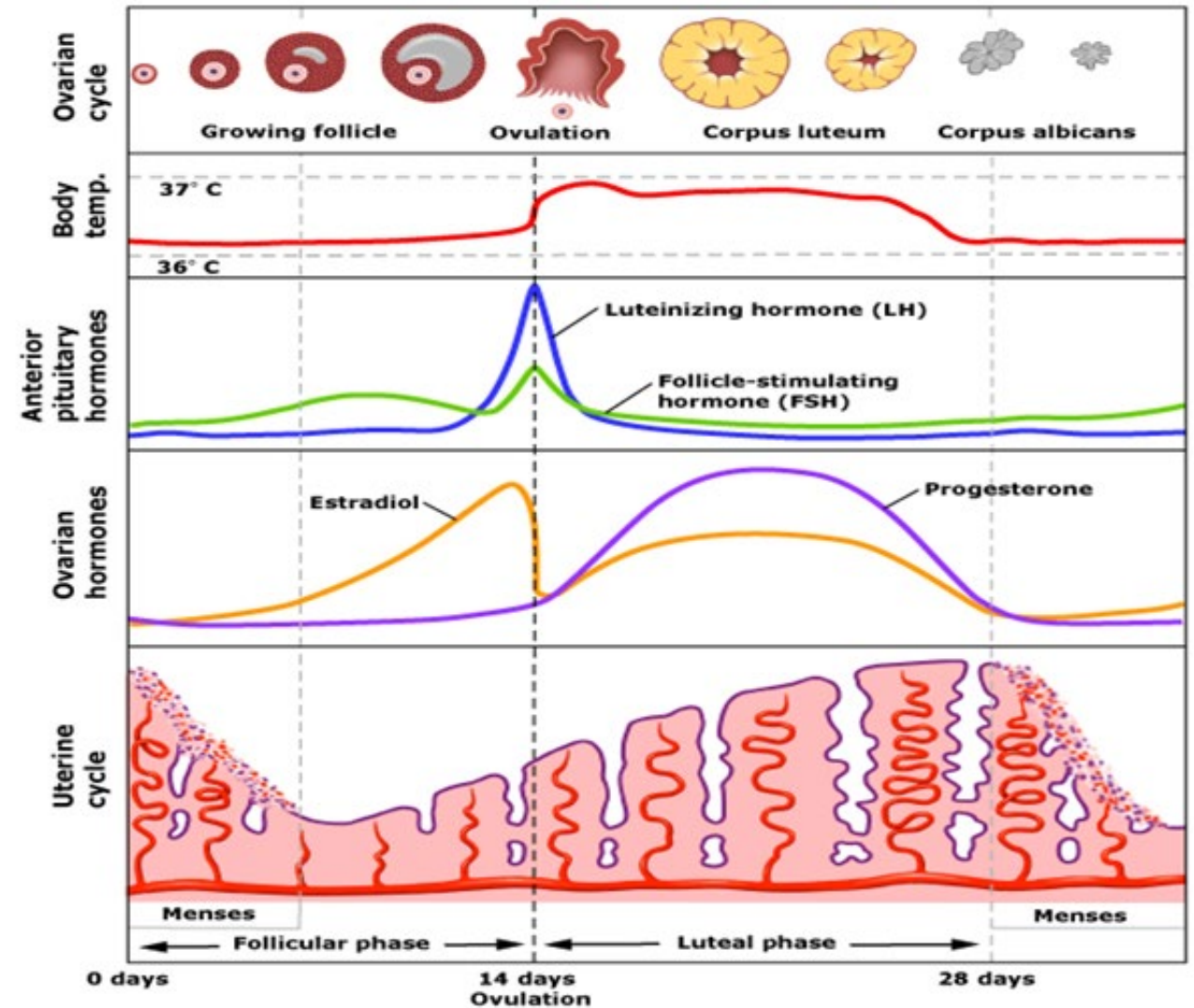
The Menstrual/Hormonal Cycle

- **Follicle stimulating hormone (FSH)** stimulates the development of follicles within the ovary.
- One dominant follicle continues to develop and produces increasing amounts of estrogen.
- This increase in estrogen stimulates the release of **luteinizing hormone (LH)**.
- **luteinizing hormone (LH)** then inhibits FSH, which suppresses further follicular development.



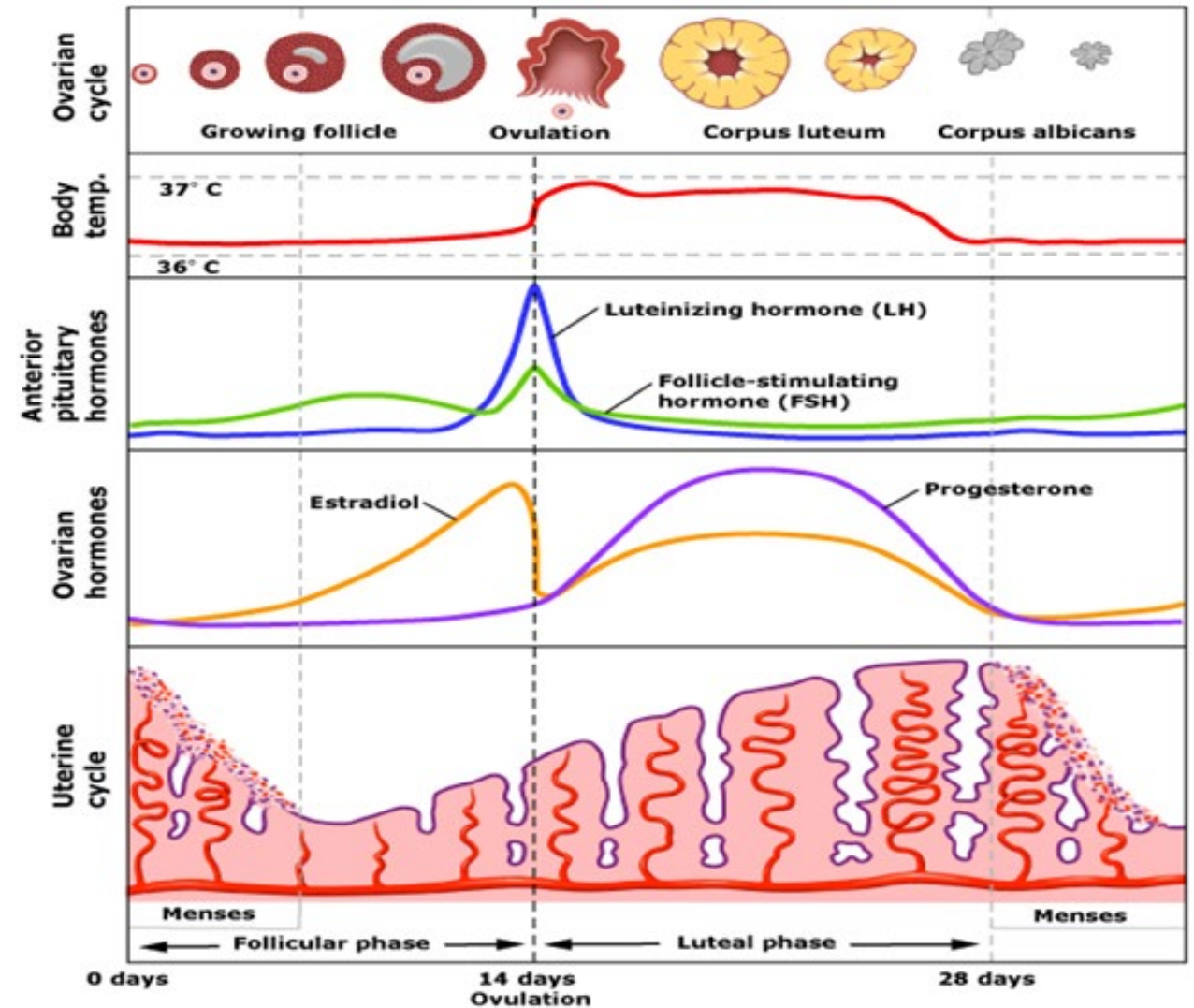
The Menstrual/Hormonal Cycle

- When LH levels are highest (LH surge), the ovarian follicle “ruptures” and releases one ovum, which is “swept” into the fallopian tube by hair-like projections called cilia that line the **fimbriae** (the fringe-like end of the fallopian tube that is closest to the ovary).
- This process is called ovulation.



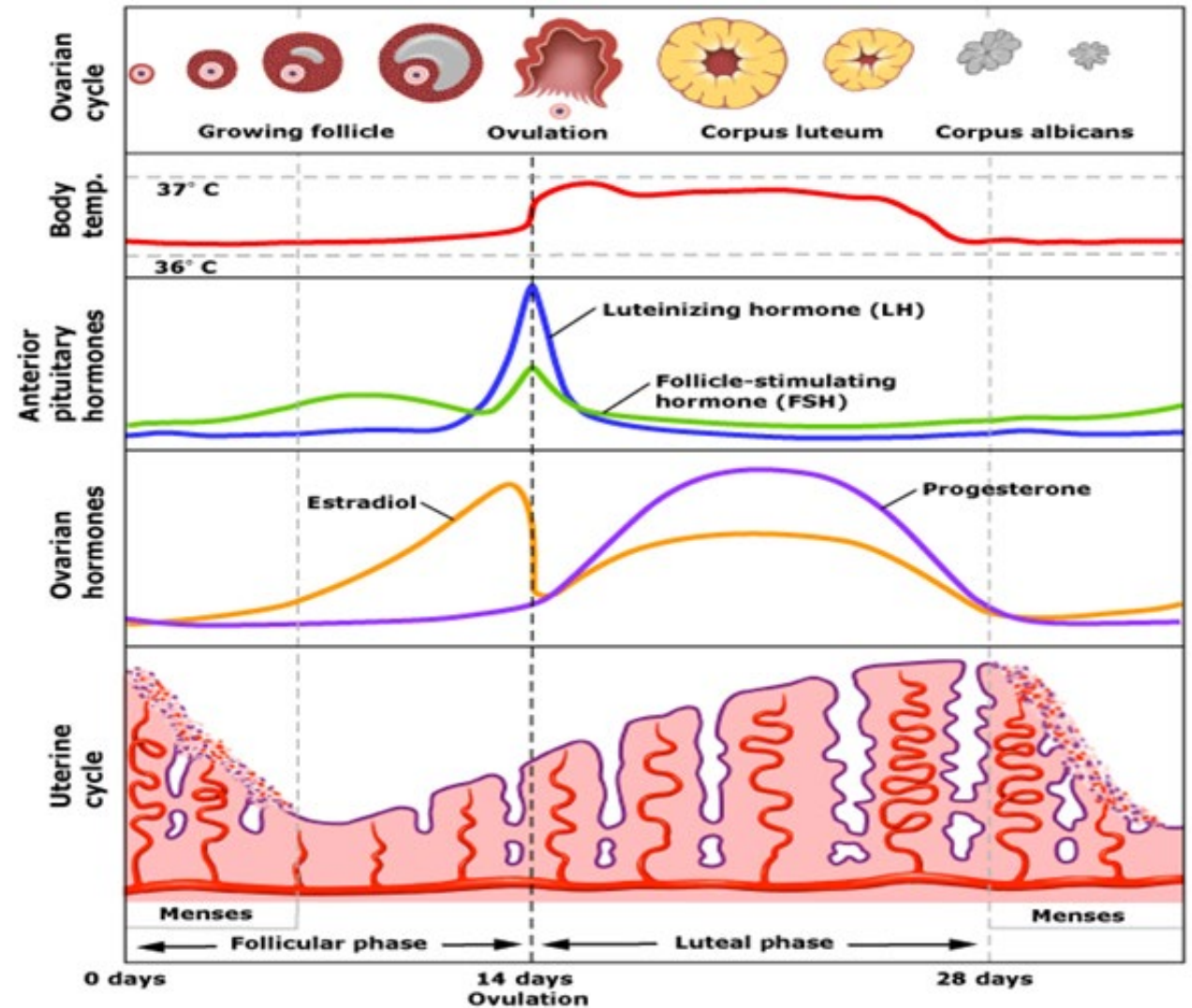
The Menstrual/Hormonal Cycle

- Following ovulation, the ruptured follicle is transformed into the **corpus luteum**, a glandular mass that continues to produce estrogen and high levels of **progesterone**.
- The progesterone causes the endometrium to thicken, preparing it for implantation of a fertilized egg.
- If fertilization takes place during ovulation, hormonal levels remain high, essential for the maintenance of the pregnancy.



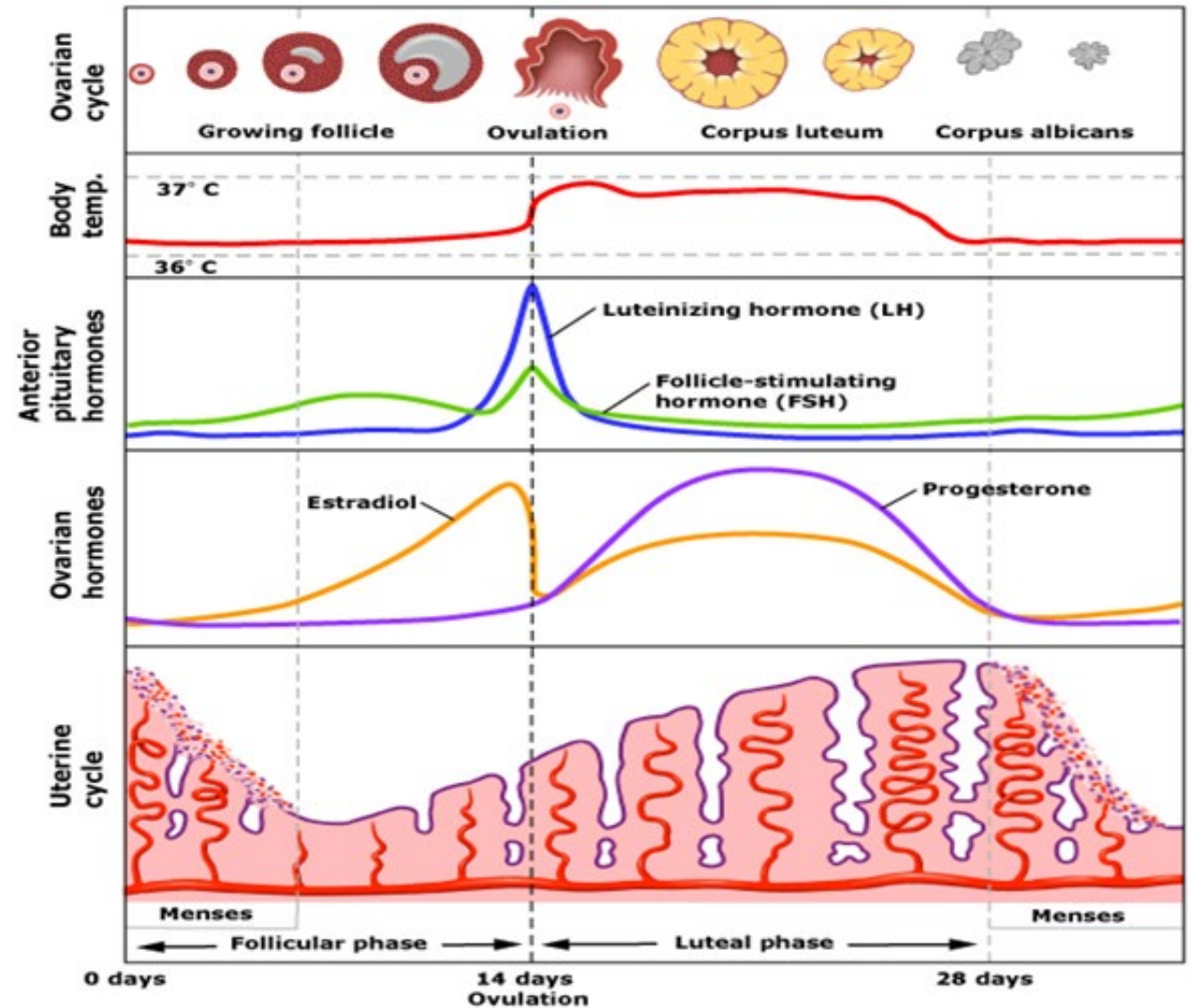
The Menstrual/Hormonal Cycle

- If fertilization does not occur, the corpus luteum shrinks and levels of both estrogen and progesterone decrease.
- The withdrawal of estrogen and progesterone cause the blood vessels of the endometrial (uterine) lining to “break” resulting in vaginal bleeding (**menstruation**).
- The average menstrual cycle is 28-35 days, and menstrual flow usually continues for three to seven days, although there are variations among women.



The Menstrual/Hormonal Cycle

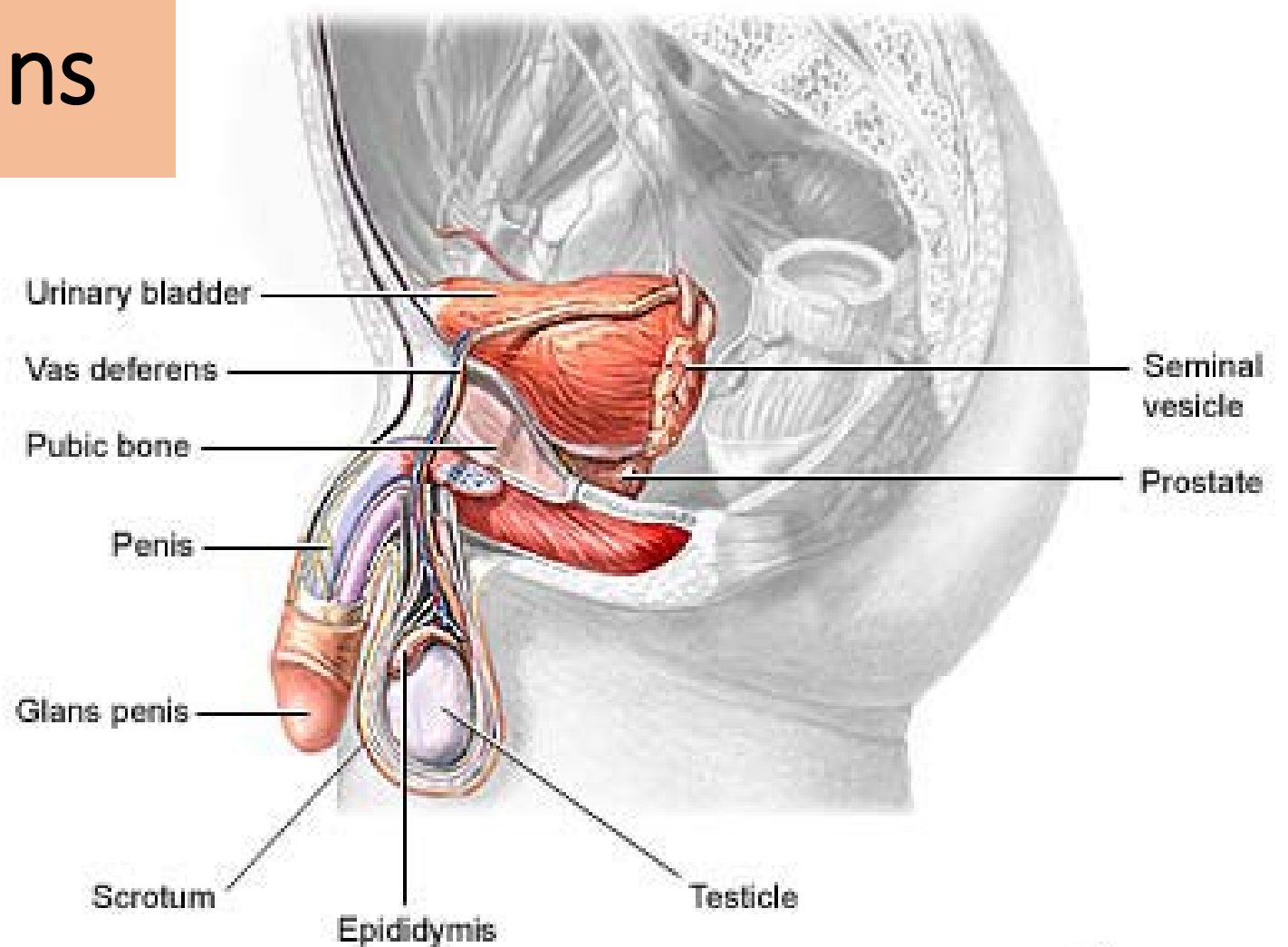
- Following menstruation, estrogen and progesterone levels are low, triggering the hypothalamus to once again release GnRH, starting the entire cycle again.
- If fertilization does take place, menstruation will not reoccur for the duration of the pregnancy



External Reproductive Organs

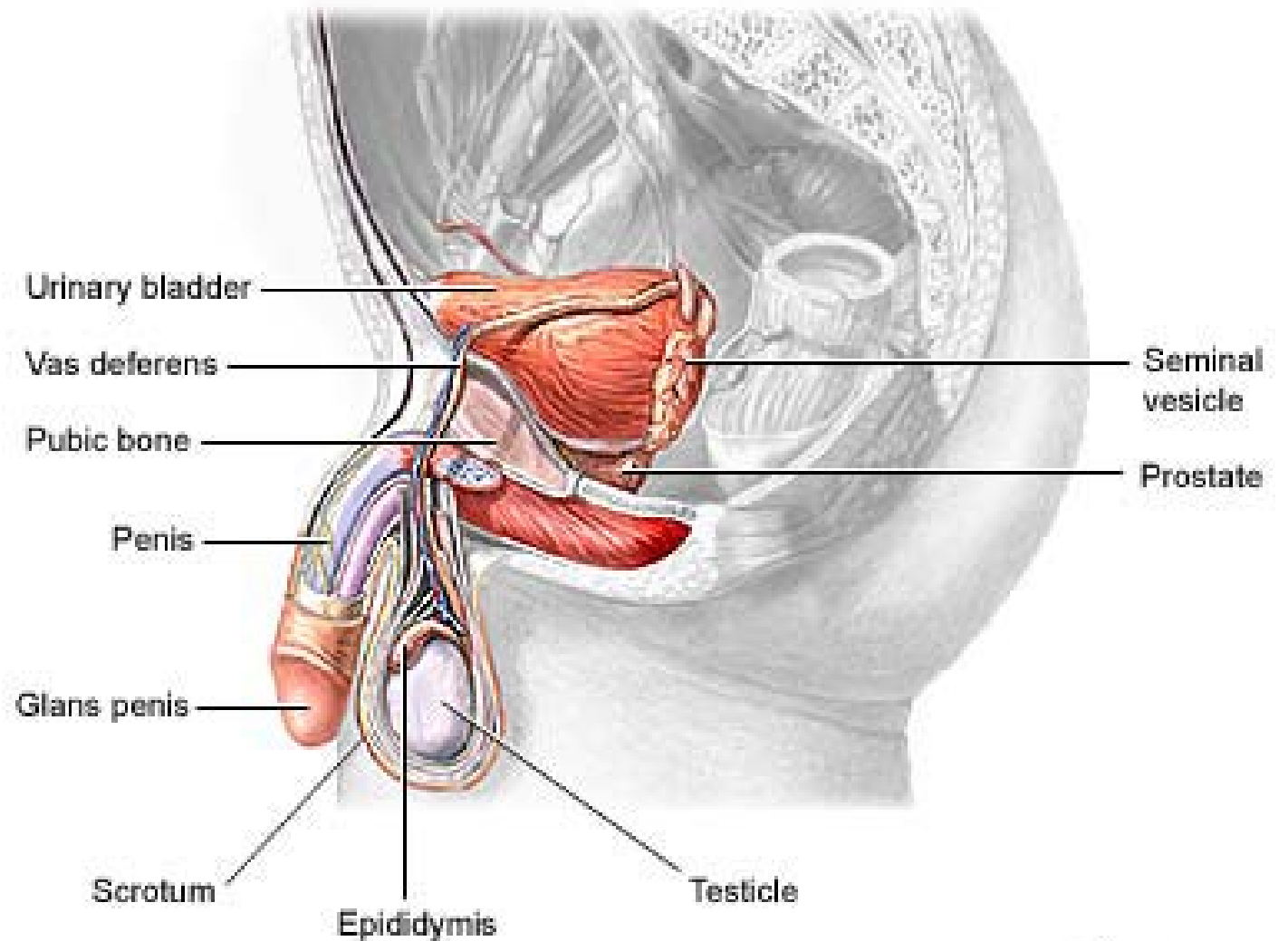
The male external structures are the **penis** and the **scrotum** (a pouch which protects the testes).

- The penis consists of the **glans** (the head), and the **shaft**(the body).
- The **glans** is covered by a fold of skin called the **foreskin**(circumcision removes the foreskin).
- The scrotum surrounds and protects the two **testes**, internal structures also referred to as testicles.
- The testes are the male gonads and contain hundreds of tiny **seminiferous tubules** where sperm cells are produced.



Internal Reproductive Organs

- The **epididymis** is a small oblong body which rests on the surface of the testes where sperm mature and are stored.
- The **epididymis** leads into the **vas deferens** (narrow tubes which carry sperm away from the testes).
- The vas deferens extends to join with the ducts of the two **seminal vesicles** (located on side of the prostate gland) to form the ejaculatory ducts which extend through the body of the **prostate gland** and empty into the urethra.
- The prostate gland surrounds the neck of the **bladder** (the structure that stores urine) and the **urethra**, (a thin tube which extends through the penis and carries **semen** and urine outside of the body, although not simultaneously).
- The **Cowper's glands** (also called the **bulbourethral glands**) are found on each side of the urethra, just below the prostate gland.



Process of Spermatogenesis

- Spermatogenesis begins in the **seminiferous tubules** of the testes.
- Sperm pass into the **epididymis** where they mature and become **motile** so they are able to move through the **vas deferens** and into the **seminal vesicles** where they mix with seminal fluids, rich in fructose and other nutrients.
- The prostate gland and the Cowper's glands secrete fluids which also help to nourish and transport the sperm. This mixture of fluids and sperm is called **semen**, the fluid which is expelled from a man's penis during **ejaculation**.
- Although men continue to produce sperm throughout their lives, testosterone production decreases at about 45-65 years of age.

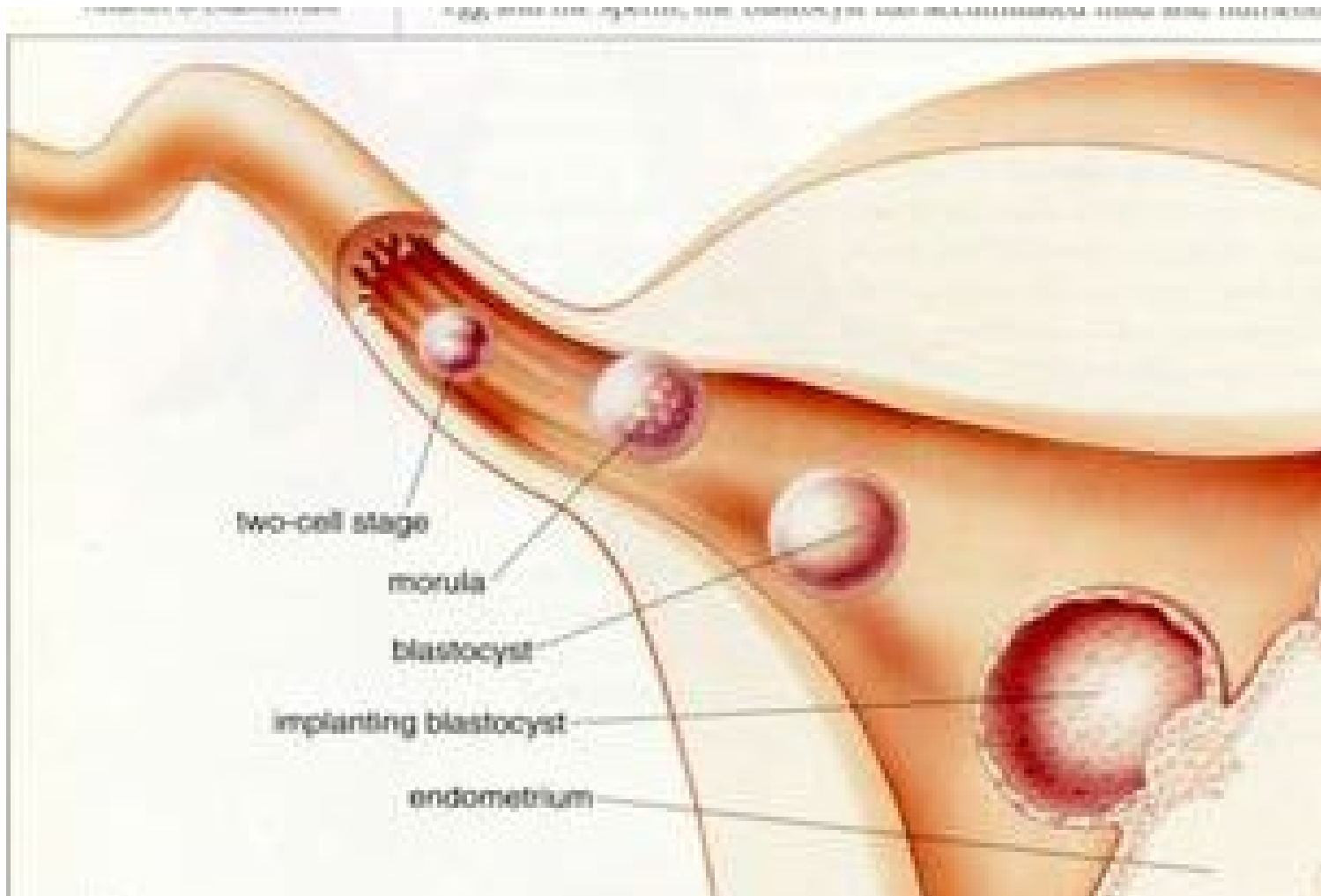


Fertilization

During **coitus** (sexual intercourse) between a male and a female, semen is released into the vagina and transported through the uterus into the fallopian tube.

- Although many factors contribute to whether or not a single act of intercourse will result in pregnancy, most important is whether or not a sperm cell will “meet” an ovum in the fallopian tube (**fertilization**).
- Fertilization can only occur if intercourse takes place before the time of **ovulation** that usually occurs “mid-cycle”, or about 14 days before the woman's next menstrual period.
- At the time of ovulation, the ovum is released from the ovary and transported in the fallopian tube where it remains for about 24-72 hours.
- Pregnancy is most likely to occur if fresh semen is present when ovulation occurs.





Sperm cells remain viable within the female reproductive tract for about 72 hours.

Only a single sperm cell is needed to fertilize the ovum.

During fertilization, the sperm donates its genetic material to the ovum at which time the egg becomes fertilized (becoming a ZYGOTE).

The zygote will remain in the fallopian tube for approximately three days before it travels to the uterus where it will remain for approximately four to five days before **implantation** into the uterine lining.



Sex Determination

Prior to fertilization, the sperm and egg cells have only half the number of **chromosomes** (the genetic determinants of heredity) of other body cells because they go through a process of cell division called **meiosis**, which reduces the number of chromosomes from 46 to 23.

The 23 chromosomes from the sperm cell combine with the 23 chromosomes from the ovum to form a single cell (zygote) consisting of 46 chromosomes.

Sex of the offspring is determined by whether the sperm contains an X or a Y sex chromosome.

Female ova always carry an X chromosome. If the sperm cell contains a Y chromosome, the offspring will be a male (XY pair).

If it contains an X chromosome, the offspring will be a female (XX pair).

Thus, the sperm biologically determines sex.