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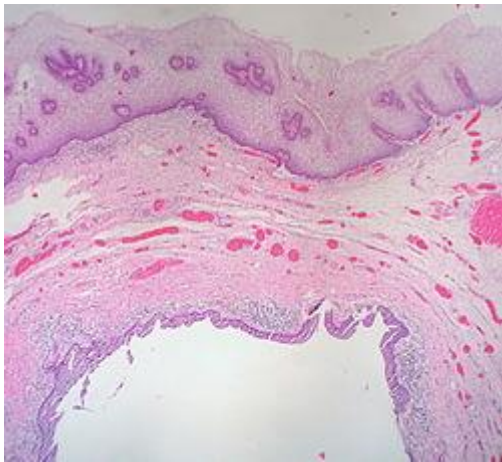
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VAGINA:

In the course of the reproductive cycle, the vaginal epithelium is subject to normal, cyclic changes, that are influenced by estrogen: with increasing circulating levels of the hormone, there is proliferation of epithelial cells along with an increase in the number of cell layers. As cells proliferate and mature, they undergo partial cornification. Although hormone induced changes occur in the other tissues and organs of the female reproductive system, the vaginal epithelium is more sensitive and its structure is an indicator of estrogen levels.



Some Langerhans cells and melanocytes are also present in the epithelium. The epithelium of the ectocervix is contiguous with that of the vagina, possessing the same properties and function. The vaginal epithelium is divided into layers of cells, including the basal cells, the parabasal cells, the superficial squamous flat cells, and the intermediate cells.

Basal cells

The basal layer of the epithelium is the most mitotically active and reproduces new cells. This layer is composed of one layer of cuboidal cells lying on top of the basal membrane.

Parabasal cells

The parabasal cells include the stratum granulosum and the stratum spinosum. In these two layers, cells from the lower basal layer transition from active metabolic activity to death (apoptosis). In these mid-layers of the epithelia, the cells begin to lose their mitochondria and other cell organelles. The multiple layers of parabasal cells are polyhedral in shape with prominent nuclei.

Intermediate cells

Intermediate cells make abundant glycogen and store it. Estrogen induces the intermediate and superficial cells to fill with glycogen. The intermediate cells contain nuclei and are larger than the parabasal cells and more flattened. Some have identified a transitional layer of cells above intermediate layer.

Superficial cells

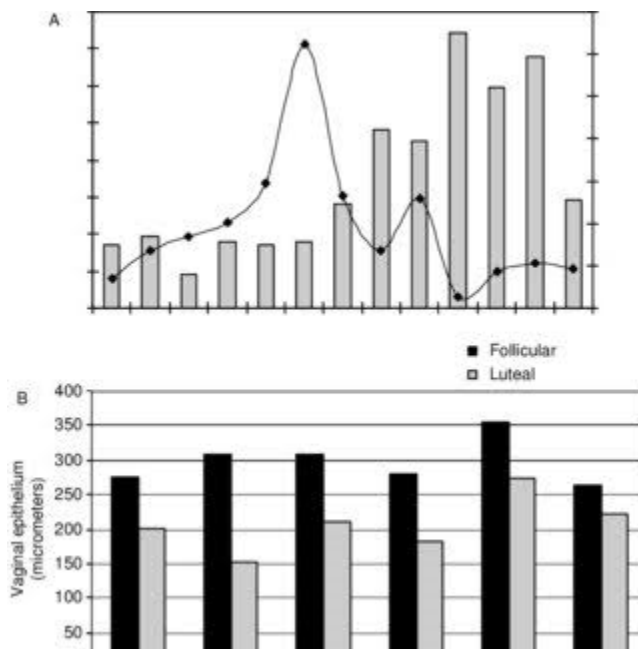
Estrogen induces the intermediate and superficial cells to fill with glycogen. Several layers of superficial cells exist that consist of large, flattened cells with indistinct nuclei. The superficial cells are exfoliated continuously.

Cell junctions

The junctions between epithelial cells regulate the passage of molecules, bacteria and viruses by functioning as a physical barrier. The three types of structural adhesions between epithelial cells are: tight junctions, adherent junctions, and desmosomes. "Tight junctions (zonula occludens) are composed of transmembrane proteins that make contact across the intercellular space and create a seal to restrict transmembrane proteins diffusion of molecules across the epithelial sheet. Tight junctions also have an organizing role in epithelial polarization by limiting the mobility of membrane-bound molecules between the apical and basolateral domains of the plasma membrane of each epithelial cell.

Mucus

The vagina itself does not contain mucous glands. Though mucus is not produced by the vaginal epithelium, mucus originates from the cervix. The cervical mucus that is located inside the vagina can be used to assess fertility in ovulating women. The Bartholin's glands and Skene's glands located at the entrance of the vagina do produce mucus.



Cyclic variations

During the luteal and follicular phases of the estrous cycle the structure of the vaginal epithelium varies. The number of cell layers vary during the days of the estrous cycle:

Day 10, 22 layers

Days 12-14, 46 layers

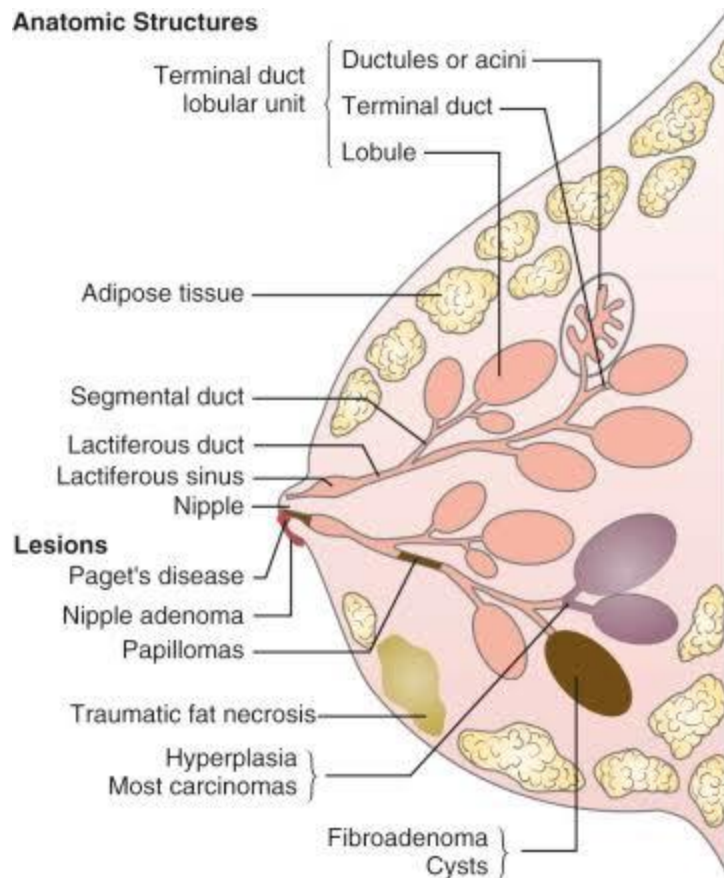
Day 19, 32 layers

Day 24, 24 layers

The glycogen levels in the cells is at its highest immediately before ovulation.

BREASTS:

Breast development is a vital part of a woman's reproduction. Breast development happens in certain stages during a woman's life: first before birth, again at puberty, and later during the childbearing years. Changes also happen to the breasts during the menstrual cycle and when a woman reaches menopause.



Breasts begin to form while the unborn baby is still growing in the mother's uterus. This starts with a thickening in the chest area called the mammary ridge or milk line. By the time a baby girl is born, nipples and the beginnings of the milk-duct system have formed.

Breast changes continue to happen over a woman's life. The first thing to develop are lobes, or small subdivisions of breast tissue. Mammary glands develop next and consist of 15 to 24 lobes. Mammary glands are influenced by hormones activated in puberty. Shrinkage (involution) of the milk ducts is the final major change that happens in the breast tissue. The mammary glands slowly start to shrink. This often starts around age 35.

As a girl approaches her teen years, the first visible signs of breast development begin. When the ovaries start to produce and release (secrete) estrogen, fat in the connective tissue starts to collect. This causes the breasts to enlarge. The duct system also starts to grow. Often these breast changes happen at the same that pubic hair and armpit hair appear.

Once ovulation and menstruation begin, the maturing of the breasts begins with the formation of secretory glands at the end of the milk ducts. The breasts and duct system continue to grow and mature, with the development of many glands and lobules. The rate at which breasts grow is different for each young woman.

| Female breast developmental stages | Description |
|------------------------------------|--|
| Stage 1 | Preteen. Only the tip of the nipple is raised. |
| Stage 2 | Buds appear, and breast and nipple are raised. The dark area of skin around the nipple (the areola) gets larger. |
| Stage 3 | Breasts are slightly larger, with glandular breast tissue present. |
| Stage 4 | The areola and nipple become raised and form a second mound above the rest of the breast. |
| Stage 5 | Mature adult breast. The breast becomes rounded and only the nipple is raised. |

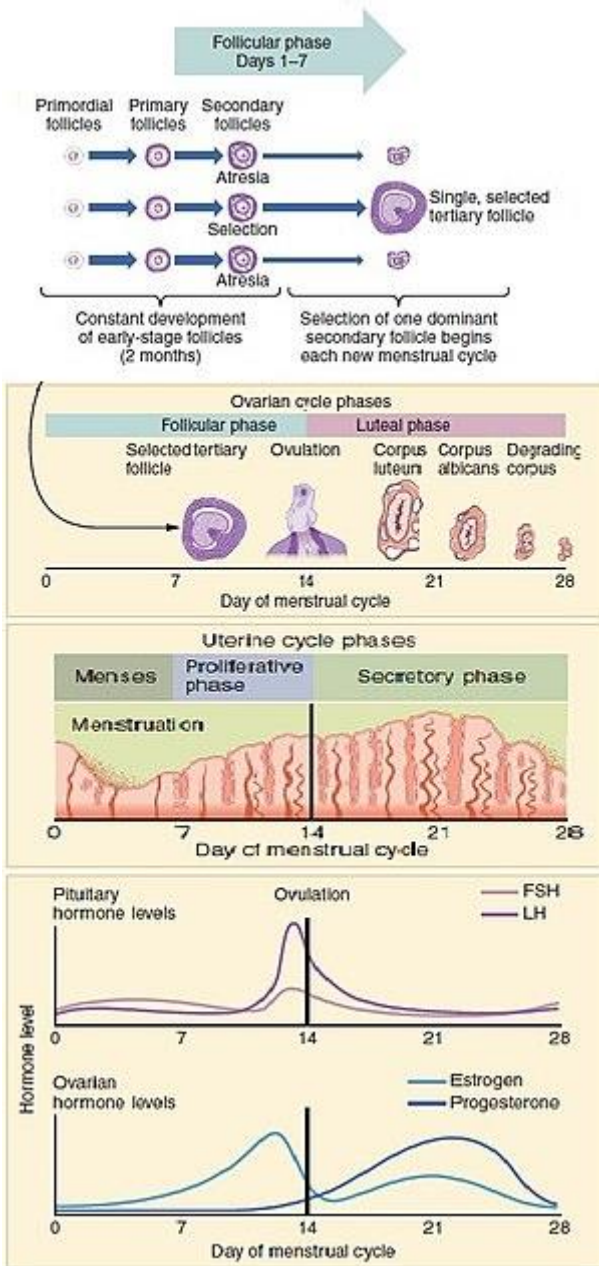
By the fifth or sixth month of pregnancy, the breasts are fully capable of producing milk. As in puberty, estrogen controls the growth of the ducts, and progesterone controls the growth of the glandular buds. Many other hormones also play vital roles in milk production. These include follicle-stimulating hormone (FSH), luteinizing hormone (LH), prolactin, oxytocin, and human placental lactogen (HPL).

Other physical changes happen as well. These include the blood vessels in the breast becoming more visible and the areola getting larger and darker. All of these changes are in preparation for breastfeeding the baby after birth.

MENSTRUAL CYCLE:

The menstrual cycle is the regular natural change that occurs in the female reproductive system that makes pregnancy possible. The cycle is required for the production of oocytes, and for the preparation of the uterus for pregnancy. The menstrual cycle occurs due to the rise and fall of oestrogen. This cycle results in the thickening of the lining of the uterus, and the growth of an egg. The egg is released from an ovary around day fourteen in the cycle; the thickened lining of the uterus provides nutrients to an embryo after implantation. If pregnancy does not occur, the lining is released in what is known as menstruation.

The first period usually begins between twelve and fifteen years of age, a point in time known as menarche. They may occasionally start as early as eight, and this onset may still be normal. The average age of the first period is generally later in the developing world and earlier in developed world. The typical length of time between the first day of one period and the first day of the next is 21 to 45 days in young women and 21 to 35 days in adults (an average of 28 days). Menstruation stops occurring after menopause which usually occurs between 45 and 55 year of age. Bleeding usually lasts around 3 to 7 days. The menstrual cycle is governed by hormonal changes. These changes can be altered by using hormonal birth control to prevent pregnancy. Each cycle can be divided into three phases based on events in the ovary (ovarian cycle) or in the uterus (uterine cycle). The ovarian cycle consists of the follicular phase, ovulation, and luteal phase whereas the uterine cycle is divided into menstruation, proliferative phase, and secretory phase.



Onset and frequency

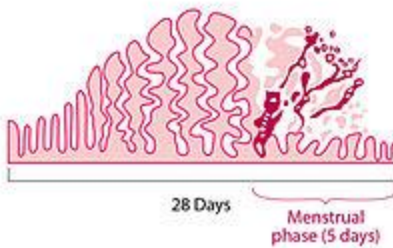


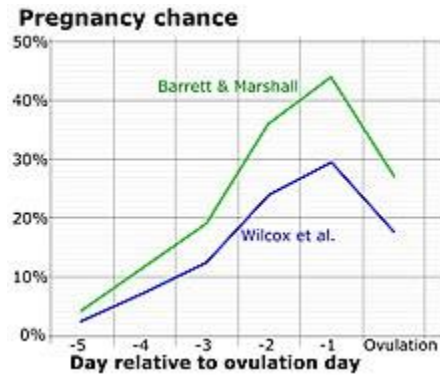
Diagram illustrating how the uterus lining builds up and breaks down during the menstrual cycle.

The average age of menarche is 12–15. They may occasionally start as early as eight, and this onset may still be normal. This first period often occurs later in the developing world than the developed world. The cessation of menstrual cycles at the end of a woman's reproductive period is termed menopause. The average age of menopause in women is 52 years, with anywhere between 45 and 55 being common. Menopause before age 45 is considered *premature* in industrialized countries. Like the age of menarche, the age of menopause is largely a result of cultural and biological factors; however, illnesses, certain surgeries, or medical treatments may cause menopause to occur earlier than it might have otherwise.

The length of a woman's menstrual cycle typically varies somewhat, with some shorter cycles and some longer cycles. A woman who experiences variations of less than eight days between her longest cycles and shortest cycles is considered to have regular menstrual cycles. It is unusual for a woman to experience cycle length variations of more than four days. Length variation between eight and 20 days is considered as moderately irregular cycles. Variation of 21 days or more between a woman's shortest and longest cycle lengths is considered very irregular.

The average menstrual cycle lasts 28 days. The variability of menstrual cycle lengths is highest for women under 25 years of age and is lowest, that is, most regular, for ages 25 to 39. Subsequently, the variability increases slightly for women aged 40 to 44. The luteal phase of the menstrual cycle is about the same length in most individuals (mean 14.13 days, standard deviation 1.41 days) whereas the follicular phase tends to show much more variability (log-normally distributed with 95% of individuals having follicular phases between 10.3 and 16.3 days).¹² The follicular phase also seems to get significantly shorter with age (geometric mean

Fertility



Chance of fertilization by menstrual cycle day relative to ovulation.

The most fertile period (the time with the highest likelihood of pregnancy resulting from sexual intercourse) covers the time from some 5 days before until 1 to 2 days after ovulation. In a 28-day cycle with a 14-day luteal phase, this corresponds to the second and the beginning of the third week. A variety of methods have been developed to help individual women estimate the relatively fertile and the relatively infertile days in the cycle; these systems are called fertility awareness. There are many fertility testing methods, including urine test kits that detect the LH surge that occurs 24 to 36 hours before ovulation; these are known as ovulation predictor kits (OPKs). Computerized devices that interpret basal body temperatures, urinary test results, or changes in saliva are called fertility monitors. Fertility awareness methods that rely on cycle length records alone are called calendar-based methods.

A woman's fertility is also affected by her age. As a woman's total egg supply is formed in fetal life, to be ovulated decades later, it has been suggested that this long lifetime may make the chromatin of eggs more vulnerable to division problems, breakage, and mutation than the chromatin of sperm, which are produced continuously during a man's reproductive life. However, despite this hypothesis, a similar paternal age effect has also been observed.

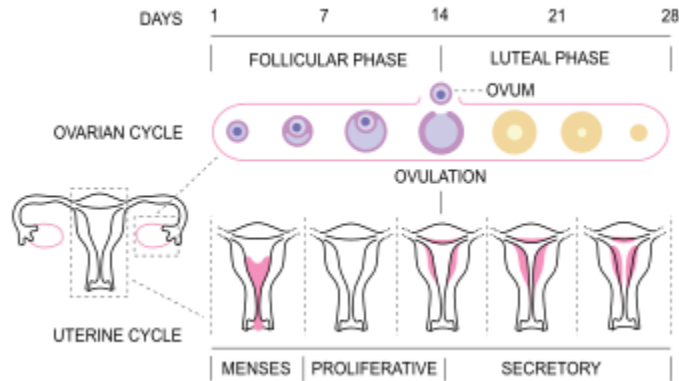
Mood and behavior

The different phases of the menstrual cycle correlate with women's moods. In some cases, hormones released during the menstrual cycle can cause behavioral changes in females; mild to severe mood changes can occur. The menstrual cycle phase and ovarian hormones may contribute to increased empathy in women.

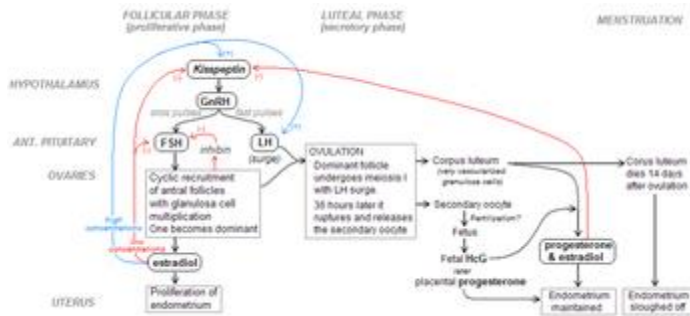
Eating behavior

Females have been found to experience different eating habits at different stages of their menstrual cycle, with food intake being higher during the luteal phase than the follicular phase. Food intake increases by approximately 10% during the luteal phase compared to the follicular phase.

Cycles and phases



Menstrual cycle



Flowchart of the hormonal control of the menstrual cycle

The menstrual cycle can be described by the ovarian or uterine cycle. The ovarian cycle describes changes that occur in the follicles of the ovary whereas the uterine cycle describes changes in the endometrial lining of the uterus. Both cycles can be divided into three phases. The ovarian cycle consists of the follicular phase, ovulation, and the luteal phase, whereas the uterine cycle consists of menstruation, proliferative phase, and secretory phase.

Ovarian cycle

Follicular phase

The follicular phase is the first part of the ovarian cycle. During this phase, the ovarian follicles mature and get ready to release an egg. The latter part of this phase overlaps with the proliferative phase of the uterine cycle.

Through the influence of a rise in follicle stimulating hormone (FSH) during the first days of the cycle, a few ovarian follicles are stimulated. These follicles, which were present at birth and have been developing for the better part of a year in a process known as folliculogenesis, compete with each other for dominance. Under the influence of several hormones, all but one of these follicles will stop growing, while one dominant follicle in the ovary will continue to maturity. The follicle that reaches maturity is called a tertiary or Graafian follicle, and it contains the ovum.

Uterine cycle

The uterine cycle has three phases: menses, proliferative, secretory.

Menstruation

Menstruation (also called menstrual bleeding, menses, catamenia or a period) is the first phase of the uterine cycle. The flow of menses normally serves as a sign that a woman has not become pregnant. (However, this cannot be taken as certainty, as a number of factors can cause bleeding during pregnancy; some factors are specific to early pregnancy, and some can

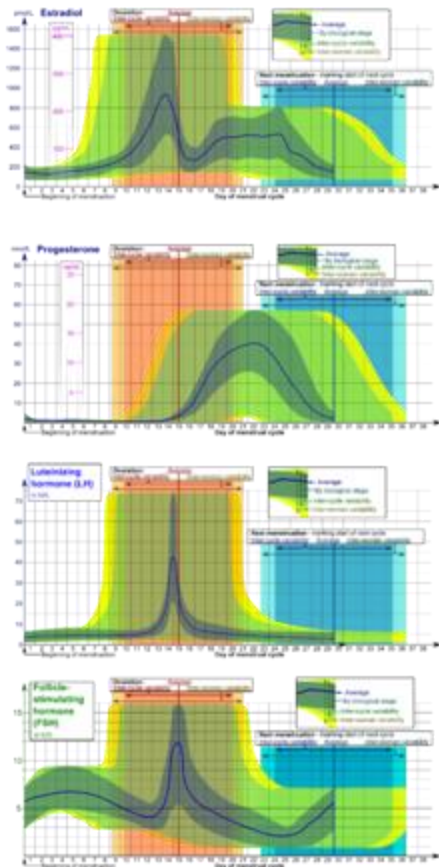
Proliferative phase

The proliferative phase is the second phase of the uterine cycle when estrogen causes the lining of the uterus to grow, or proliferate, during this time. As they mature, the ovarian follicles secrete increasing amounts of estradiol, and estrogen. The estrogens initiate the formation of a new layer of endometrium in the uterus, histologically identified as the proliferative endometrium. The estrogen also stimulates crypts in the cervix to produce cervical mucus, which causes vaginal discharge regardless of arousal, and can be tracked by women practicing fertility awareness.

Secretory phase

The secretory phase is the final phase of the uterine cycle and it corresponds to the luteal phase of the ovarian cycle. During the secretory phase, the corpus luteum produces progesterone, which plays a vital role in making the endometrium receptive to implantation of the blastocyst and supportive of the early pregnancy, by increasing blood flow and uterine

secretions and reducing the contractility of the smooth muscle in the uterus; it also has the side effect of raising the woman's basal body temperature.



Painful cramping in the abdomen, back, or upper thighs is common during the first few days of menstruation. Severe uterine pain during menstruation is known as dysmenorrhea, and it is most common among adolescents and younger women (affecting about 67.2% of adolescent females). When menstruation begins, symptoms of premenstrual syndrome (PMS) such as breast tenderness and irritability generally decrease. Sanitary products include pads and tampons, and are essential items for use during menstruation.

