The Menstrual Cycle: Day by Day & Hormone by Hormone

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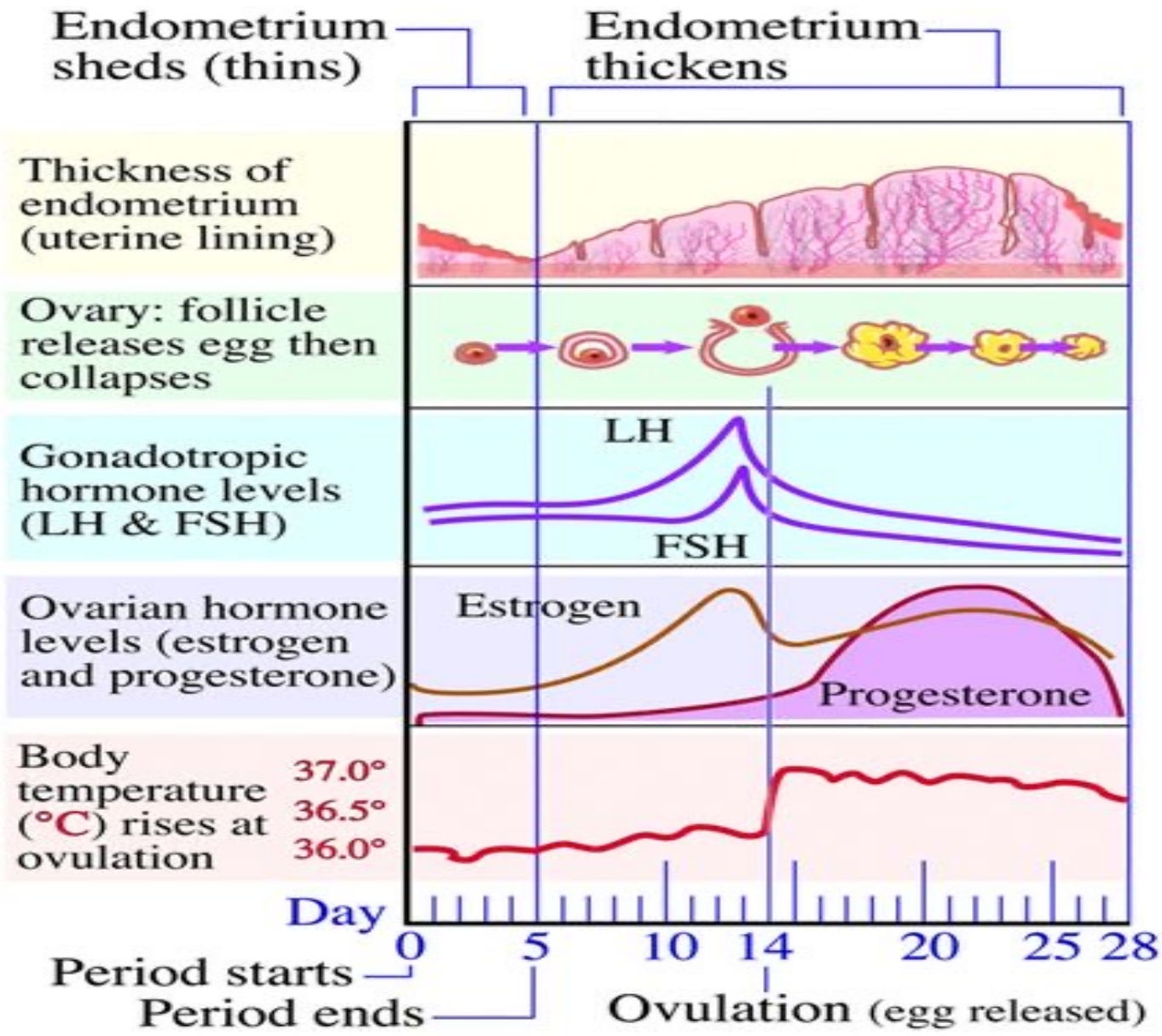


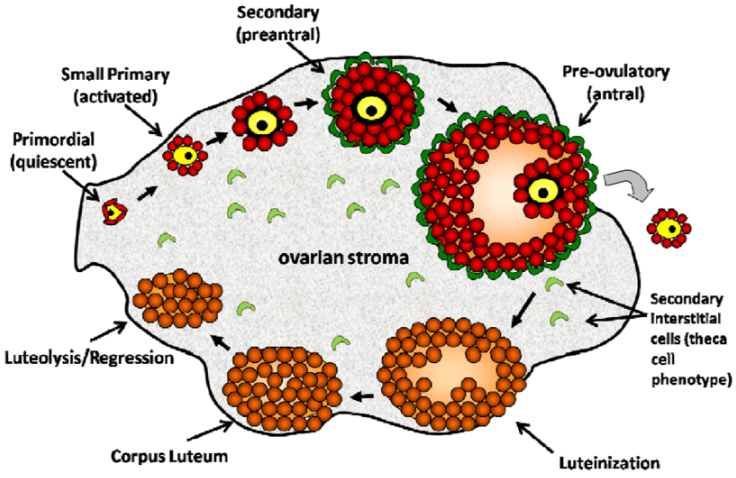
The graph above one page 1 has been used for decades to describe the complicated roller coaster ride of hormones and physiological changes occurring in females during their reproductive years. Thank God for my Y chromosome.

Looking at the page 1 graph, you will see that it is divided into a menstrual phase from day 1-5 when the endometrium is shedding and bleeding. Most women will lose less than 16 teaspoons of blood (80ml) during their period, with the average being around 6 to 8 teaspoons. Heavy menstrual bleeding is defined as losing 80ml or more in each period, having periods that last longer than 7 days, or both. When the blood loss goes higher than a female's normal loss (over 5 ounces), **EPO** hormone is stimulated from low oxygen levels flowing through the kidney. This is adaptive because it facilitates the production of more red blood cells to transport more oxygen around the body, thus raising oxygen levels in the tissues.

The above graph also shows that the time after the menstrual phase is when the endometrium is thickening. The graph below better demonstrates the four phases of the cycle. The **Menstrual Phase** is followed by the **Follicular Phase**, which is also called the **Pre-Ovulatory Phase**. Next is the shortest phase, the **Ovulatory Phase**. This is followed by the final stage called the **Luteal Phase**, which is often called the **Post-Ovulatory Phase.**

The Follicle

The follicle is in the ovary and it surrounds an oocyte. Women begin puberty with about 400,000 follicles, each with the potential to release an egg cell (ovum) at ovulation for fertilization. For the first 14 days of the cycle the follicle is growing under the influence of **FSH** (hence the name **Follicle Stimulating Hormone**). During the last two weeks of the cycle, the follicle is now stimulated by **LH**, **Lutenizing Hormone**, which stimulates the thecal cells on the outer ring of the follicle to make estrogen.



This process is called **Folliculogenesis.** Folliculogenesis describes the progression of a number of small *primordial follicles* into large *preovulatory follicles* that occurs in part during the menstrual cycle.

The primary role of the follicle is oocyte support. From birth, the ovaries of the human female contain a number of immature, primordial follicles. These follicles each contain a similarly immature primary oocytes. At puberty, bunches of follicles begin folliculogenesis, entering a growth pattern that ends in death (apoptosis) or in ovulation (the process where the oocyte leaves the follicle). During follicular development,

primordial follicles undergo a three series of critical changes histologically and hormonally.

Folliculogenesis is continuous, meaning that at any time the ovary contains follicles in many stages of development. The majority of follicles die and never complete development. A few develop fully to produce a secondary oocyte which is released by rupture of the follicle in a process called **ovulation.**

As you analyze the chart below on page 5, you will see the rise and fall of the various hormone levels. As you look to the left on Day 1 and then to the right on Day 28, the hormone levels should be very close to equal as you see the rise and fall throughout the month.

Estrogen
Estrogen levels are very low at the start of the cycle, but the **Thecal Cells** (under the influence of LH) produce massive amounts of estrogen just before ovulation to prepare for pregnancy. During the first few weeks of the cycle, the estrogen works on negative feedback with FSH & LH to prevent to many follicles from developing. Estrogen is preparing the uterus to be fertile.

When estrogen levels are low, the cervical mucus is a normally very tough and hard and it is tightly held together tightly, making spermatozoa penetration challenging. When estrogen levels peak, it makes the cervical mucus soft and sugary. It opens up the tight bonds making penetration easy. It makes the spermatozoa slippery to go faster and the sugar provides energy for the journey.

The estrogen also changes the vaginal pH to be more alkaline, which helps the spermatozoa to not be killed by a normally acidic environment. Estrogen is essentially getting the uterus ready to get ovulate by changing pH, changing the mucus and even providing nourishment.

Progesterone
At the start of the cycle, Progesterone is in smaller amounts than estrogen and increases slightly before ovulation and spikes during the third week. The progesterone is made by the **Granulosa Cells**. Remember, progesterone = pro gestation.

Ovulation
Because the estrogen has been rising for the first few weeks, it negative feedback loops with FSH & LH so it doesn't overproduce. A few days before ovulation, the estrogen levels cause a spike of **GnRH**, which is what causes the FSH & LH levels to rise before ovulation. When the surge of LH happens, it guarantees that ovulation will happen in 12-24 hours.

During ovulation, the mature follicle explodes. The fluid in the antruim ruptures and literally pops out the oocyte. The exploding oocyte is shot into the peritoneal cavity and the fimbria at the end of the fallopian tube engorges with blood and begins creating a

wave which helps to wash the egg into the fallopian tube. The oocyte only lives for 12-24 hours.

The cells that were left behind in the “explosion” were the Granulosa Cells and the Thecal Cells. These cells make a Corpus Luteum, which is a large granular structure. These cells now start making **Progesterone**. The Progesterone hormone causes changes in the uterus that make it more suitable for implantation of the fertilized ovum and the nourishment of the embryo. If the egg is not fertilized, the corpus luteum becomes inactive after 10–14 days, and menstruation occurs.

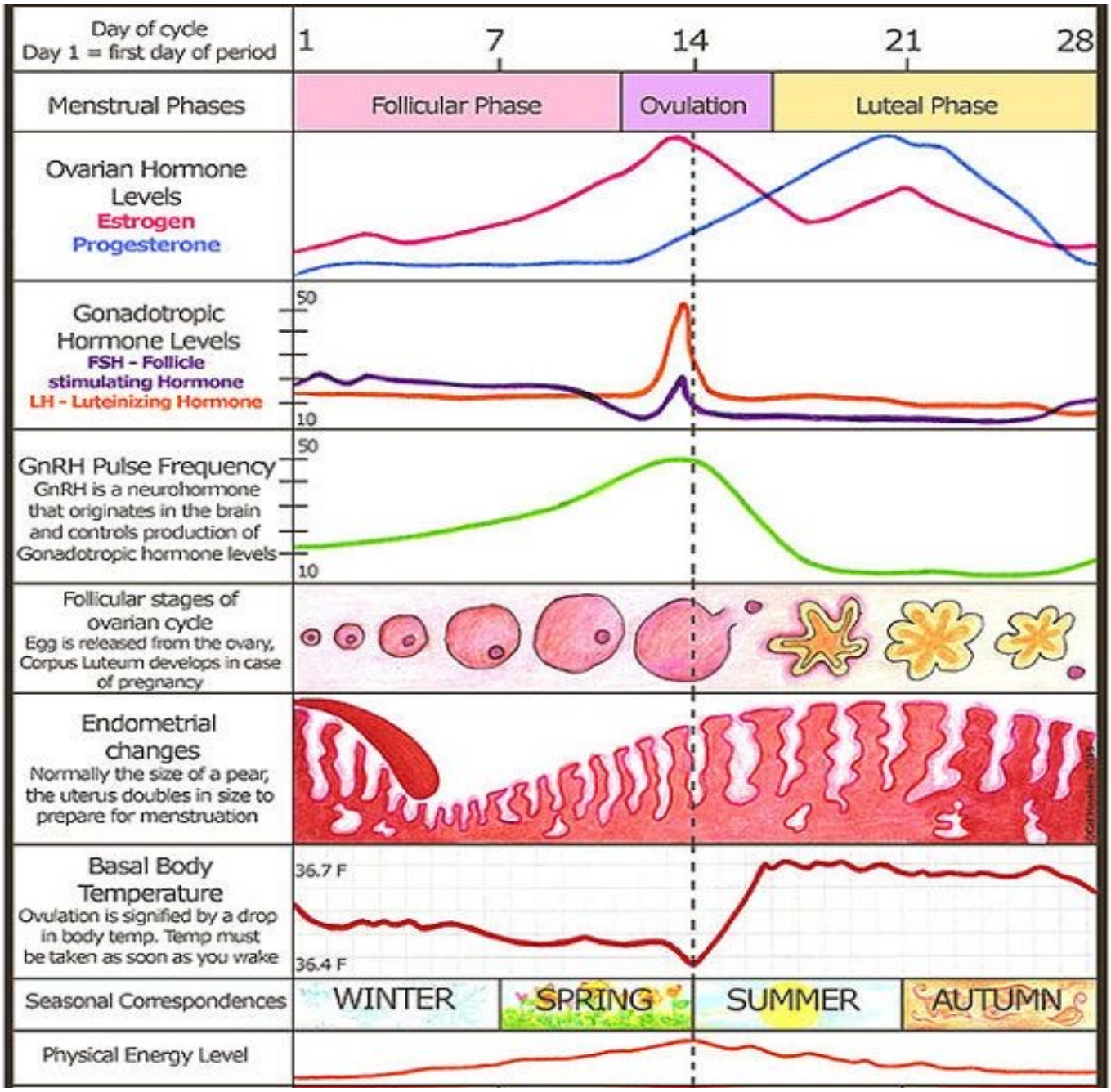
Progesterone
After ovulation, the Estrogen levels bottom out and Progesterone takes over and rises dramatically. The progesterone creates a very hostile protective environment so that no more spermatozoa can get through. It hardens the cervix, makes it fibrotic and dry. It makes it nearly impossible for more sperm to penetrate.

The oocyte will only live for one day, but the corpus luteum lives for 12 days and then dies, which will drop the progesterone levels. When the corpus luteum dies and there is no more Progesterone. If pregnancy does not occur, the next menstrual cycle is guaranteed to start in 12 days, because the corpus luteum has died. If a lucky sperm is able to fertilize and egg, then the corpus luteum stays and continues making Progesterone for the rest of the pregnancy.

Zygote
After fertilization, the zygote immediately goes through mitosis with the exact DNA of mom and dad. It takes the zygote 4-5 days to get through the fallopian tube. During this time, the fallopian tubes are secreting glucose to feed and nourish the hungry zygote. Once the zygote reaches the uterus, it takes another 4-5 days for it to implant into the wall. In the fallopian tubes, the zygote was getting nourishment from the tubes. In the uterus, the zygote eats the wall and lining of the uterus to stay alive. The wall has been building up with fats, proteins and glucose from the Progesterone.

The zygote is now a new embryo and it makes a hormone and sends it to the corpus luteum to keep it going. The hormone is **HCG, Human Chorionic Gonadotropin**, which is also the indicator hormone used in pregnancy testing. If the HCG doesn’t get to the corpus luteum, there will be another period and the uterus expels the zygote. If pregnancy continues, the corpus luteum will live for about two weeks before it becomes a placenta and the placenta will make Progesterone. Progesterone acts to maintain pregnancy by supporting the lining of the uterus (womb), which provides the environment for the fetus and the placenta to grow.

Seasonal Changes
Seasonal changes can affect metabolism, mood, and even cycles. Sunshine helps the body to increase its secretion of FHS.There may be less ovulation in the winter leading to longer cycles. Cold climates can also alter the BMR, which relates to hormonal imbalance.


Day of cycle
Day 1 = first day of period
1
7
14
21
28
Menstrual Phases
Follicular Phase
Ovulation
Luteal Phase
Ovarian Hormone Levels
Estrogen
Progesterone
Gonadotropic Hormone Levels
FSH - Follicle stimulating Hormone
LH - Luteinizing Hormone
50
10
GnRH Pulse Frequency
GnRH is a neurohormone that originates in the brain and controls production of Gonadotropic hormone levels
50
10
Follicular stages of ovarian cycle
Egg is released from the ovary, Corpus Luteum develops in case of pregnancy
Endometrial changes
Normally the size of a pear, the uterus doubles in size to prepare for menstruation
Basal Body Temperature
Ovulation is signified by a drop in body temp. Temp must be taken as soon as you wake
36.7 F
36.4 F
Seasonal Correspondences
WINTER
SPRING
SUMMER
AUTUMN
Physical Energy Level