

Embryogenesis first week, ovulation, fertilization, implantation

Oogenesis and follicular development

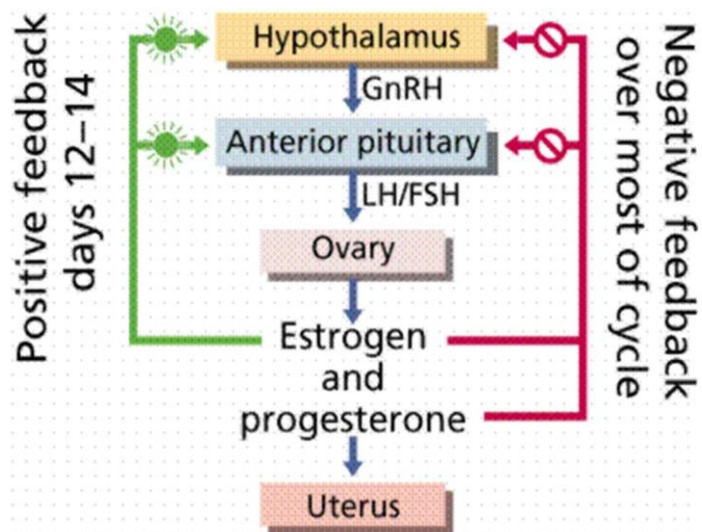
The 2 cycles in the female include

1. *The “ovarian” cycle* = (changes in ovary)
2. *The “uterine” cycle* = (changes in the mucosa of the uterus)
concurrent series of changes in the endometrium of the uterus
to prepare it for the arrival of a fertilized ovum.

The cycles control by Gonadotropin-releasing hormone (GnRH) is synthesized by neurosecretory cells in the hypothalamus Carried to the anterior pituitary gland by hypophyseal portal system Stimulates the release of 2 hormones produced by this gland that act on ovaries

A. Follicle-Stimulating Hormone(FSH) stimulates the development of ovarian follicles, stimulates Production of Estrogen by the follicular cells.

B. Luteinizing Hormone(LH) serves as the trigger for ovulation ,Stimulates the follicular cells and corpus luteum to produce progesterone.



Phases Of The Female Reproductive Cycle

Name of phase	Days
menstrual phase	1-4
follicular phase (also known as proliferative phase)	5-13
ovulation (not a phase, but an event dividing phases)	14
luteal phase (also known as secretory phase)	15-28

1. Menstrual phase

- Menstruation is also called menstrual bleeding, menses, a period. The flow of menses normally serves as a sign that a woman has not become pregnant.
- A woman's first menstruation is termed menarche, and is one of the later stages of puberty in girls. The average age of menarche in humans is 12 years, but is normal anywhere between ages 8 and 16. Factors such as heredity, diet and overall health can accelerate or delay menarche .

2. Follicular phase

About 200,000 to 2,000,000 of primary follicles present at birth, 40,000 remain at puberty, and around 400 will mature during a lifetime.

At the beginning of each ovarian cycle, 15 to 20 **primary (preantral) stage follicles** are stimulated to grow under the influence of FSH.

Under normal conditions, only one of these follicles reaches full maturity, and only one oocyte is discharged; the others degenerate and become atretic. In the next cycle, another group of primary follicles is recruited, and again, only one follicle reaches maturity. Consequently, most follicles degenerate without ever reaching full maturity. When a follicle becomes atretic, the oocyte and surrounding follicular cells degenerate and are replaced by connective tissue, forming a **corpus atreticum**. FSH also stimulates maturation of follicular (granulosa) cells that surrounding the oocyte and begin to grow and develop into **secondary (preantral) follicles**. Then, as the cycle progresses, FSH secretion recruits primary follicles to begin development into **secondary (antral, Graafian) follicles**.

During the last few days of maturation of secondary follicles, estrogens will be produced by follicular and thecal cells, stimulate and increase production of LH by the pituitary and this hormone causes the follicle to enter the **preovulatory stage**, to complete meiosis I, and to enter meiosis II where it **arrests in metaphase approximately 3 hours before ovulation**.

Granulosa and thecal cells produce estrogens that

(a) cause the uterine endometrium to enter the follicular or proliferative phase;

(b) cause thinning of the cervical mucus to allow passage of sperm; and

(c) stimulate the pituitary gland to secrete LH.

3. Ovulation phase

- ☐ **When the egg has matured, it secretes enough estradiol to trigger the acute release of luteinizing hormone (LH).**
- ☐ **In the average cycle this LH surge starts around cycle day 12 and may last 48 hours. The release of LH matures the egg and weakens the wall of the follicle in the ovary.**
- ☐ **Ovulation occurs around mid cycle about 14 days in a 28 day menstrual cycle, Ovarian follicle undergoes sudden growth spurt (burst) under the influence of FSH & LH.**

4. Luteal phase (CORPUS LUTEUM)

- ☐ **After ovulation, granulosa cells remaining in the wall of the ruptured follicle, together with cells from the theca interna, are vascularized by surrounding vessels.**

- Under the influence of LH, these cells develop a yellowish pigment and change into lutean cells, which form the corpus luteum and secrete the hormone progesterone. Progesterone, together with estrogenic hormones, causes the uterine mucosa to enter the progestational or secretory stage in preparation for implantation of the embryo. The surface of the ovary begins to bulge locally, and at the apex, an avascular spot, (the **stigma**), appears. The high concentration of LH increases collagenase activity, resulting in digestion of collagen fibers surrounding the follicle. **Prostaglandin levels also increase** in response to the LH surge and **cause local muscular contractions in the ovarian wall. Those contractions extrude the oocyte**, which together with its surrounding granulosa cells from the region of the cumulus oophorus, breaks free (ovulation) and floats out of the ovary. Some of the cumulus oophorus cells then rearrange themselves around the zona pellucida to form the corona radiata.
- **The expelled secondary oocyte is surrounded by Zona Pellucida and layers of follicular cells called Corona Radiata .Zona Pellucida is composed of 3 glycoproteins ZPA, ZPB & ZPC. The egg is swept into the fallopian tube by the fimbria - a fringe of tissue at the end of each fallopian tube. If fertilization occurs, it will happen in the fallopian tube.**

CORPUS ALBICANS

If fertilization does not occur, the corpus luteum reaches maximum development approximately **9 days after ovulation**. It can easily be recognized as a yellowish projection on the surface

of the ovary. Subsequently, the corpus luteum shrinks because of degeneration of luteal cells and forms a mass of fibrotic scar tissue, the **corpus albicans**. Simultaneously, **progesterone production decreases, precipitating menstrual bleeding**. If the oocyte is fertilized, degeneration of the corpus luteum is prevented by **human chorionic gonadotropin (hCG)**, a hormone secreted by the syncytiotrophoblast of the developing embryo.

If Fertilization Doesn't Occur

- **No HCG**
- **Corpus luteum degenerates**
- **Estrogen and progesterone levels fall**
- **Secretory endometrium enters an ischemic phase**

Menstruation occurs

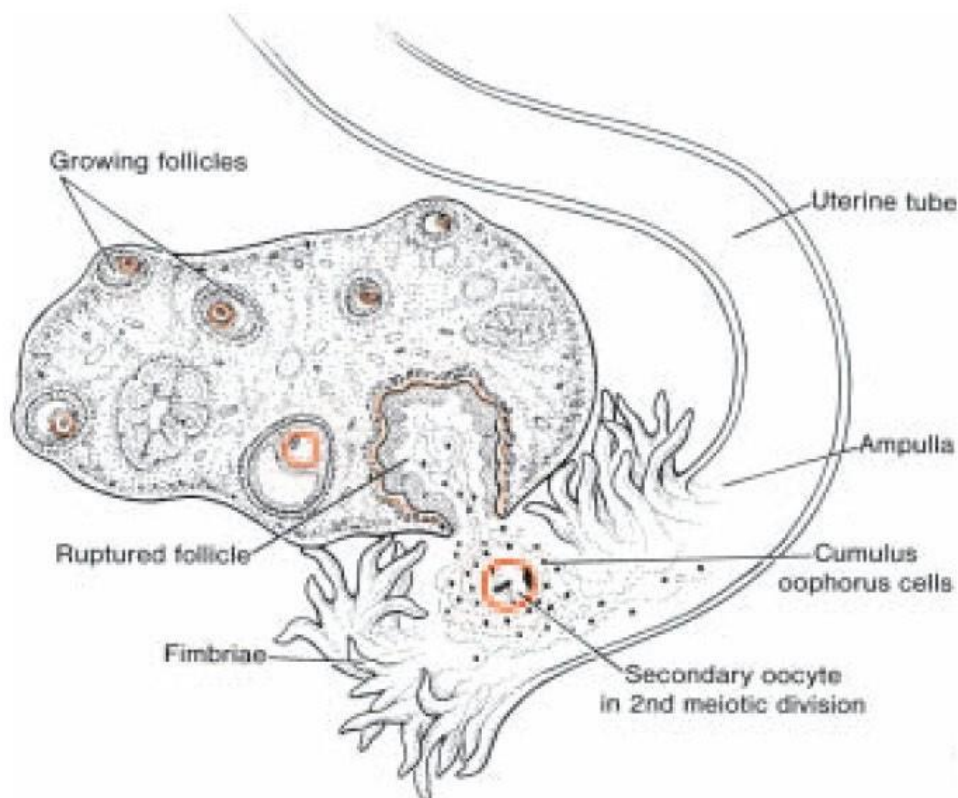


Figure 2.4 Relation of fimbriae and ovary. Fimbriae collect the oocyte and sweep it into the uterine tube.

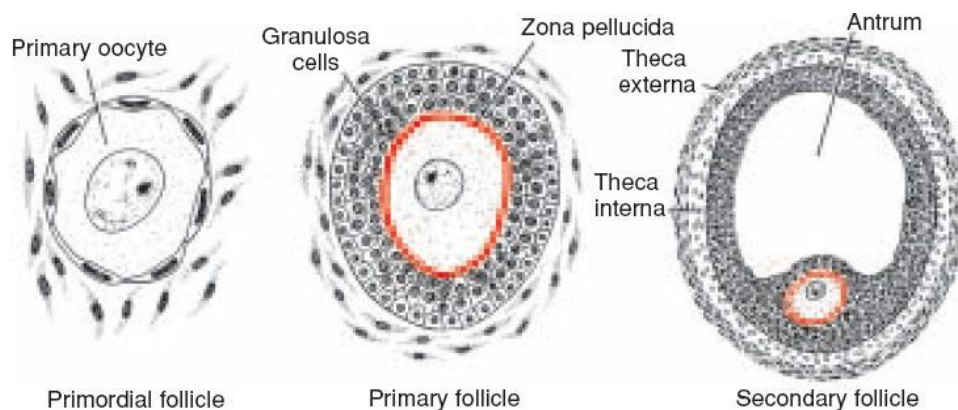


Figure 2.1 From the pool of primordial follicles, every day some begin to grow and develop into secondary (preantral) follicles, and this growth is independent of FSH. Then, as the cycle progresses, FSH secretion recruits primary follicles to begin development into secondary (antral, Graafian) follicles. During the last few days of maturation of secondary follicles, estrogens, produced by follicular and thecal cells, stimulate increased production of LH by the pituitary (Fig. 2.13), and this hormone causes the follicle to enter the preovulatory stage, to complete meiosis I, and to enter meiosis II where it arrests in metaphase approximately 3 hours before ovulation.

