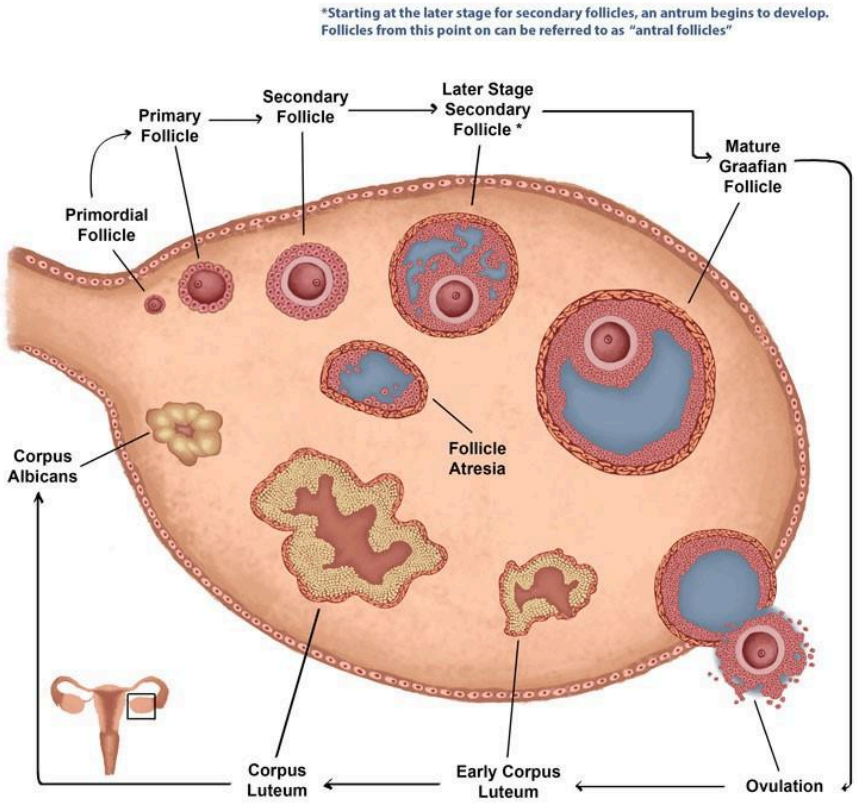
10.3.2

Folliculogenesis



Stages of Folliculogenesis.*Image drawn by BYU-Idaho student Fall 2013*

Primordial Follicle

Refer to the images above as you read the explanation of this process. The process of follicular development (**folliculogenesis**) begins even before the birth of the woman. In the fetal ovary, primary oocytes become surrounded by flat, squamous shaped cells that will later become granulosa cells. Granulosa cells are analogous to the Sertoli cells that surround and support the spermatogonia. Once the primary oocyte becomes surrounded by these pre-granulosa" cells, we call the group of cells, along with the basement membrane that surrounds it, a **primordial follicle.** Even though there are millions of primordial follicles in the fetus, by the onset of puberty, a female will have only about 400,000 primordial follicles. This is due to the continual process of **atresia** (apoptosis, or programmed cell death). It is not fully understood what regulates atresia and why some primordial follicles die and others do not. Beginning at puberty, primordial follicles may be recruited to develop further. It is also not known what regulates or determines which

primordial follicles will begin further development, but it is known that several hormones are required for the process: the gonadotropins of the anterior pituitary, FSH and LH, as well as the ovarian hormone estrogen. The process is ongoing and during the female reproductive years there are always follicles in various stages of maturation and growth. Approximately 400 of the primary follicles will actually be released during a woman's reproductively active life.

Primary Follicle

Beginning at puberty small groups (cohorts) of primordial follicles start developing. The pre-granulosa cells around the oocyte increase in size and become cuboidal in shape. At this point, we refer to these surrounding cells as **granulosa cells.** At the same time, the primary oocyte inside this layer of cells begins to increase in size and secrete proteins. Also, the granulosa cells nearest the oocyte secrete mucopolysaccharides. Together the proteins from the oocyte and the mucopolysaccharides from the granulosa cells form the **zona pellucida,** a clear layer between the oocyte and the granulosa cells. It is this barrier that the sperm will eventually have to penetrate in order to fertilize the ovum. The follicle is now a **primary follicle.**

Secondary Follicle

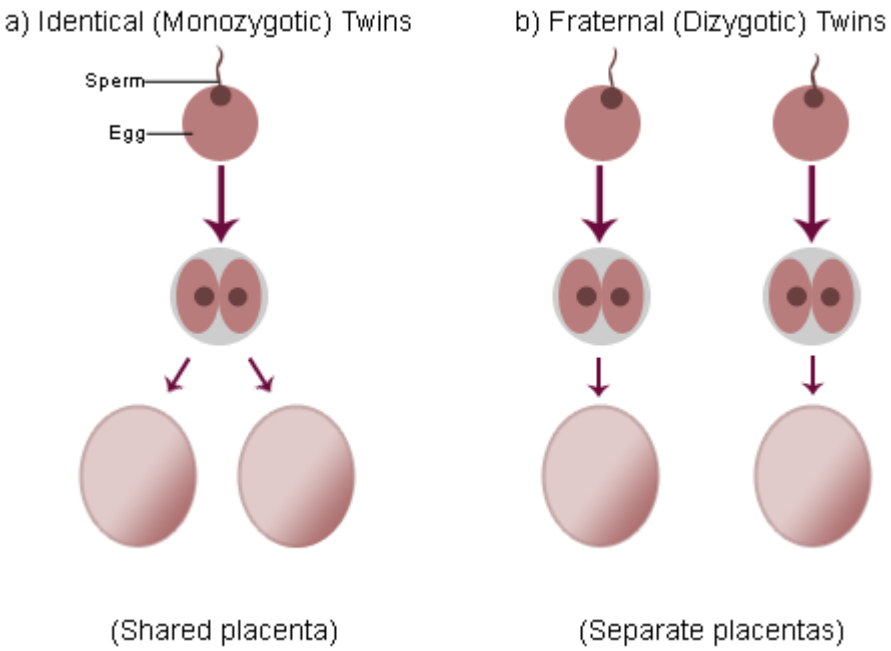
Next, the surrounding granulosa cells begin to divide by mitosis and form multiple layers. Simultaneously, stromal cells (connective tissue cells) are recruited by the follicle to form a layer of **"thecal" cells** just outside of the basement membrane. Once these processes are complete we call the follicle a **secondary follicle.**

Graafian follicle: As the follicle continues to develop, the thecal cells multiply forming several layers on the outside of the follicle. Additionally, the granulosa cells continue to increase in number and begin to secrete fluid (follicular fluid) resulting in the formation of fluid filled spaces among the granulosa cells. With the aid of the granulosa cells the primary oocyte continues to enlarge. Eventually all of the fluid filled spaces will coalesce into one large cavity called the antrum.

Graafian Follicle

The follicle is now called a mature **Graafian follicle.** Note that in the Graafian follicle the oocyte is located on one side of the antrum and is surrounded by several layers of granulosa cells, the **cumulus oophorus.** The Graafian follicle is now almost ready for ovulation. The final event, occurring several hours prior to ovulation, is completion of meiosis I to produce a secondary oocyte which immediately starts meiosis II. Once again however, the oocyte arrests, this time at the metaphase II stage where it will remain until it is fertilized by a sperm.

The exact timing of the sequence of events explained above is not completely understood and there are at least two opinions on how long it takes. After the cohort of primary follicles (9 -20) are recruited, one view indicates development 2-3 days prior to the onset of menses in the previous cycle and mature to Graafian follicles in the next cycle. The opposing view is that once recruited, it requires three or four monthly cycles before the follicles reach full maturity. Whichever model is correct, only one of the follicles will generally reach maturity and all of the others of that cohort will degenerate. The exact mechanism for how this dominant follicle is selected is unclear but it is thought to be a consequence of estrogen-induced actions within the follicle. Occasionally it is possible to have more than one follicle reach the final stage of development and ovulate (think fraternal twins or triplets), but it is relatively rare.



Identical vs Fraternal Twins.*Author: ChristinaT3 at English Wikipedia; License: [CC BY 3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons Link: https://books.byui.edu/-NJPS*