



Oogenesis:

- It is the process that leads to the formation of female haploid gametes from diploid germ cells. (Germ cells are cells that are not ready for fertilization).
- It is a discontinuous process. It starts at embryonic stage (before birth), blocked and then resumes at puberty.
- It starts in the follicles of the female's ovary and ends in the fallopian tubes.

Phases of oogenesis (doc.d)

- **During embryonic life (fetal stage):**

1. Multiplication phase : Oogonium ($2n=46$) undergoes (successive mitosis) to increase the number of cells.

2. Growth phase : Oogonium undergoes growth phase to produce **primary oocyte (oocyte I)** ($2n=46$ with two chromatids each). During growth phase, Duplication of DNA occurs, and the size of nucleus and cytoplasm increases.

3. Meiosis 1(maturation): Primary oocyte starts meiosis 1 and stops at prophase I.

The female is born with oocyte I blocked at prophase I of meiosis 1. These oocytes stay during childhood.

- **Starting puberty and every month**

- At puberty, few hours before ovulation, one of oocyte I resumes meiosis 1(maturation) and continues metaphase I, anaphase I and telophase I to produce 2 unequal daughter cells **secondary oocyte (oocyte II)** ($n=23$ with 2 chromatids each) and 1st polar body.
- Secondary oocyte (oocyte II) starts meiosis 2, it undergoes Prophase II and stops at metaphase II. Oocyte II is released to the fallopian tube during ovulation.

If fertilization occurs, secondary oocyte resumes meiosis 2 and continues anaphase II and telophase II to produce 2 unequal daughter cells, ootid ($n=23$ with 1 chromatid) and 2nd polar body. Then ootid differentiates into an ovum then a zygote is formed.

If fertilization does not occur within 24 hours, secondary oocyte degenerates and its components: protein, lipids and sugar are reabsorbed by blood.

Notes:

- The first block or arrest is at prophase I of meiosis 1. It resumes at puberty few hours before ovulation.
- The second block or arrest is at metaphase II of meiosis 2. It resumes if fertilization occurs.
- Unequal division of cytoplasm at the end of meiosis produces polar bodies. Polar bodies are non functional cells which have reduced cytoplasm. Polar bodies may or may not divide.

Folliculogenesis

- Folliculogenesis is the development of the follicular cells that surround oogonia.
- Oogonia are surrounded by sacs called follicles.
- Oogenesis occurs inside follicles which are found in the ovary.

Folliculogenesis phases (doc.c)

- Before birth and during childhood:
The female has primordial follicles whose size is 30 μm and has few cells.
- At puberty, few months before the cycle (about 4 months before the cycle)
 1. Primordial follicles start to mature and become primary follicle whose size is 50 μm and has a complete layer of cells.
 2. Then primary follicle matures and becomes secondary follicle whose size is 100 μm .
 3. The secondary follicle matures and becomes tertiary follicle (cavitary follicle) whose size is 5 mm.
- Every month (cycle) (from first day of bleeding till the day before new bleeding)
 1. One cavitary follicle matures to become Graafian follicle whose size is 20 mm. This takes around 14 days and it is called follicular phase.
 2. At day 14(middle of the cycle), Graafian follicle ruptures and the oocyte found inside it is released to the fallopian tube to be fertilized. This is called ovulation
 3. The ruptured follicle changes into yellow body called corpus luteum which stays and develops during 14 days. This is called luteal phase.

If fertilization does not occur, corpus luteum degenerates by the end of the cycle and changes to white body called corpus albican.

If fertilization occurs, corpus luteum stays for the 1st three months of pregnancy.

Note : If fertilization does not occur, another cycle starts again.

Phases of folliculogenesis and oogenesis (doc.d)

➤ Before birth (embryonic stage)

- The female fetus has follicles which are called primordial follicles. The size of each primordial follicle is 30 μm and has few cells.
- Many primordial follicles degenerate before birth. This is called follicular atresia.
- Primordial follicles surround oogonia that undergo multiplication and growth phase of oogenesis to produce oocyte I which starts meiosis I and stops at prophase I.

Note: Multiplication phase, growth phase and prophase I of meiosis I of oogenesis occur inside primordial follicles.

Oogonium and oocyte I are surrounded by primordial follicles.

➤ After birth and during childhood

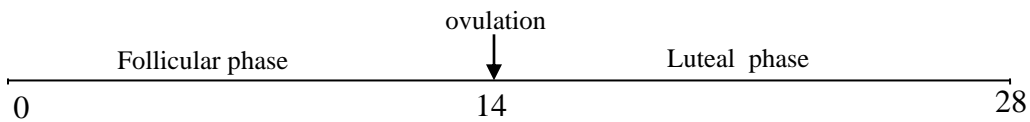
- The female is born having primordial follicles surrounding oocyte I blocked at prophase I.
- More primordial follicles degenerate (follicular atresia).
- The female continues her childhood having primordial follicles surrounding oocyte I blocked at prophase I.

➤ At puberty, few months before the cycle (about 4 months before the cycle)

- More primordial follicles degenerate
 1. Primordial follicles start to mature and become primary follicle whose size is 50 μm and has a complete layer of cells. Primary follicle surrounds oocyte I blocked at prophase I.
 2. Then primary follicle matures and becomes secondary follicle whose size is 100 μm and also surrounding oocyte I blocked at prophase I.
 3. The secondary follicle matures and becomes tertiary follicle (cavitary follicle) whose size is 5 mm and still surrounding oocyte I blocked at prophase I.

➤ Cycle (ovarian cycle) every month

- It includes 3 phases; Follicular phase, ovulation , luteal phase



Follicular phase:

- Tertiary follicle (Cavitary follicle) matures into Graafian follicle whose size is 20 mm.
- Meiosis 1 continues inside Graafian follicle at day 12 of the cycle. Oocyte I ($2n=46$ with 2 chromatids each) resumes meiosis I and produces Oocyte II ($n=23$ with 2 chromatids each) and first polar body.
- Also inside Graafian follicle, Oocyte II undergoes meiosis 2 and stops at metaphase II.

Ovulation:

Graafian follicle ruptures and oocyte II which is blocked at metaphase II is released to the fallopian tube ready to be fertilized.

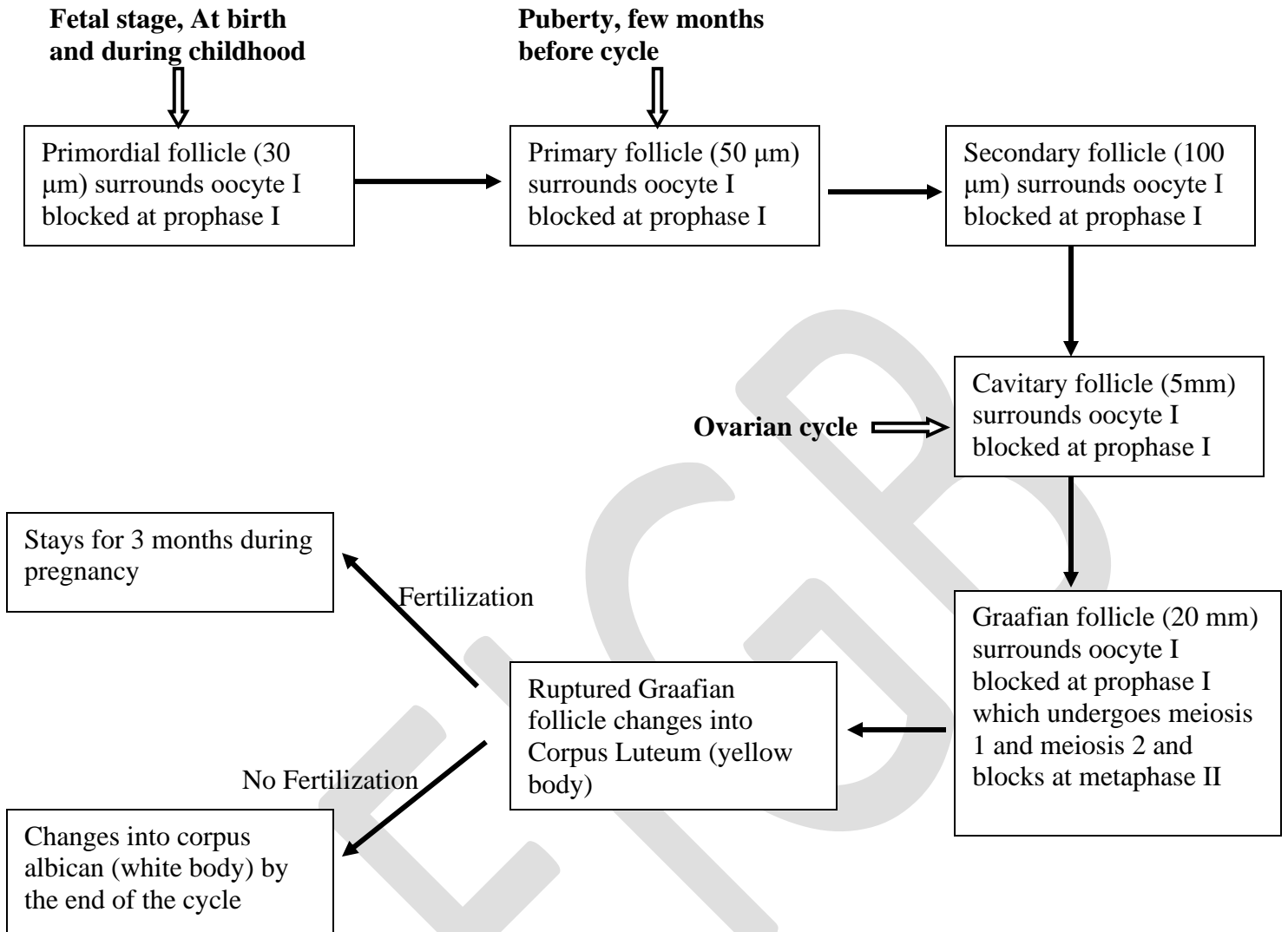
Luteal phase:

The ruptured follicle changes into a yellow body called corpus luteum.

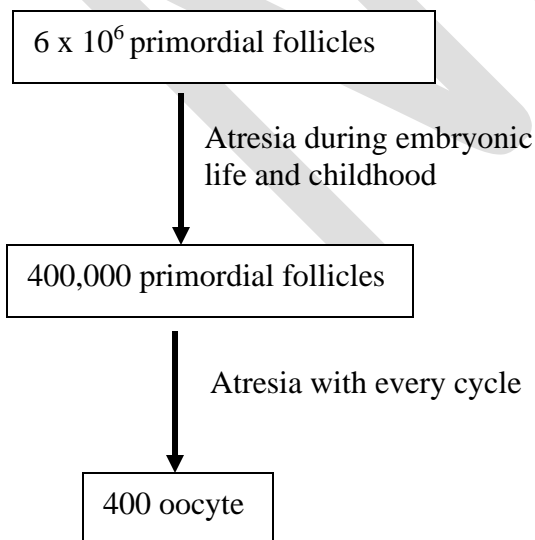
Corpus luteum continues to develop till the end of the cycle.

If fertilization does not occur, corpus luteum changes into a white body called corpus albicans by the end of the cycle.

If fertilization occurs, corpus luteum continues to develop during the first 3 months of pregnancy and then changes into corpus albicans and degenerates.



Follicular atresia:



Note: At menopause there is total depletion of oocytes