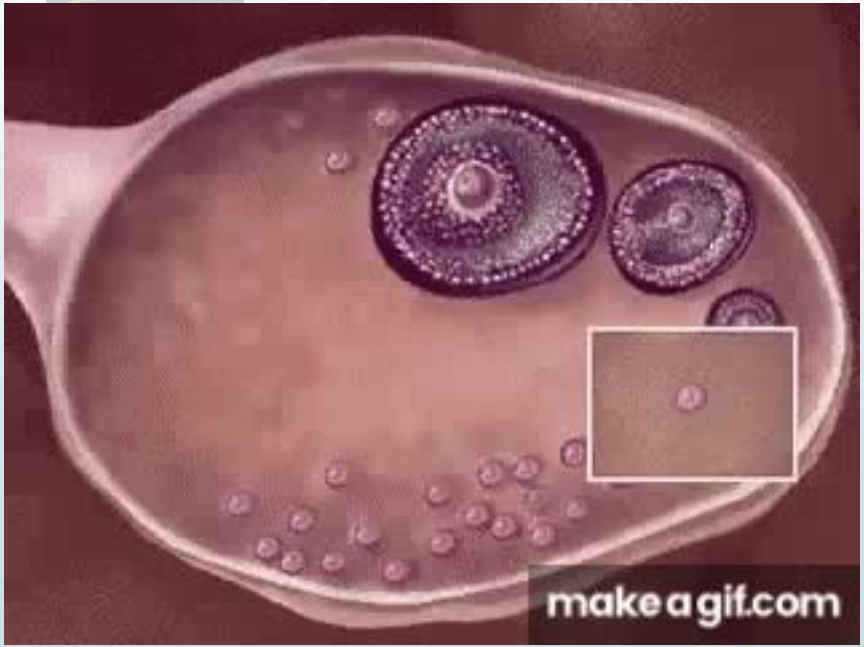
Chapter 1

Basic Mechanisms of Sexual Reproduction

- Document 1: Male and Female Reproductive Systems
- Document 2: Diploid and Haploid Cells
- Document 3: Meiosis
- Document 4: Spermatogenesis
- Document 5: Oogenesis
- Document 6: Fertilization

Document 5:

Oogenesis

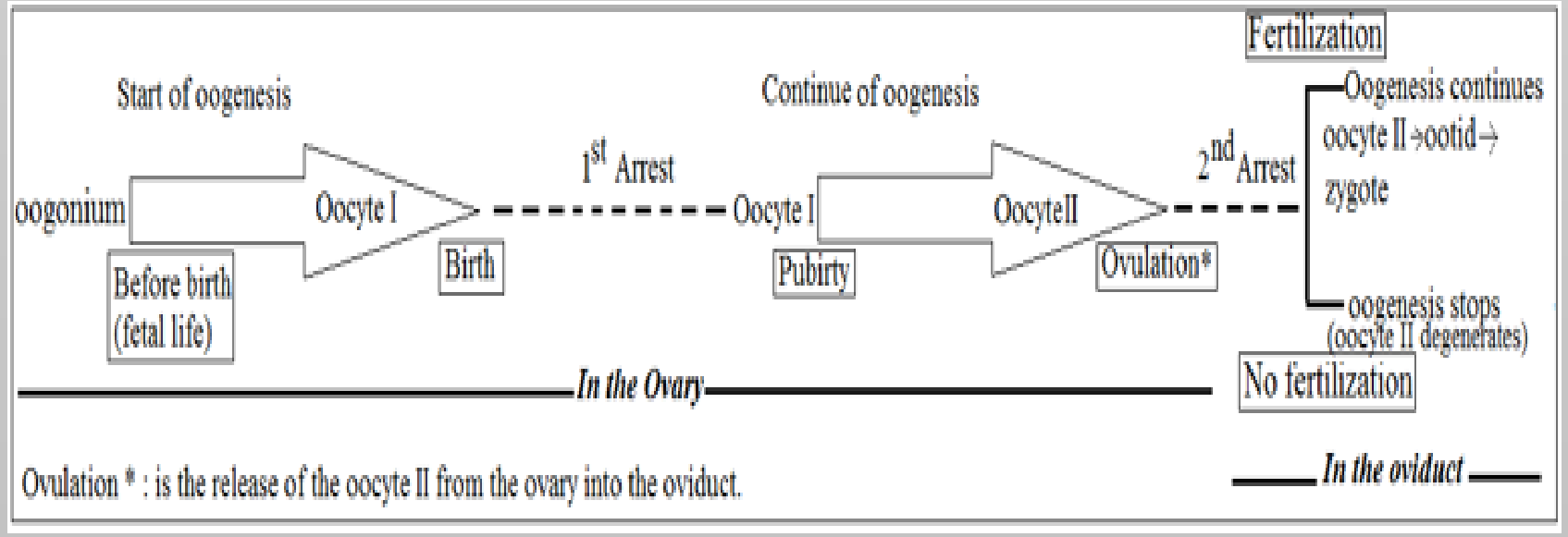


I. Oogenesis:

- **Definition:** is the process of production of haploid female gametes (oocytes) starting from a diploid mother cell (oogonium).
- **Location:** It occurs in the ovaries.
- ***When does it start?***

-It is a discontinuous process in females where:

- It starts in the ovaries before birth and then it is arrested at birth (1st arrest), and it continues at puberty, and then it is arrested at the day of ovulation (2nd arrest).



- Oogenesis starts in the ovaries and continues in the oviduct if there is fertilization.
- Oogenesis will stop completely at menopause age where all the oocytes are depleted.

- Oogenesis has 4 stages:

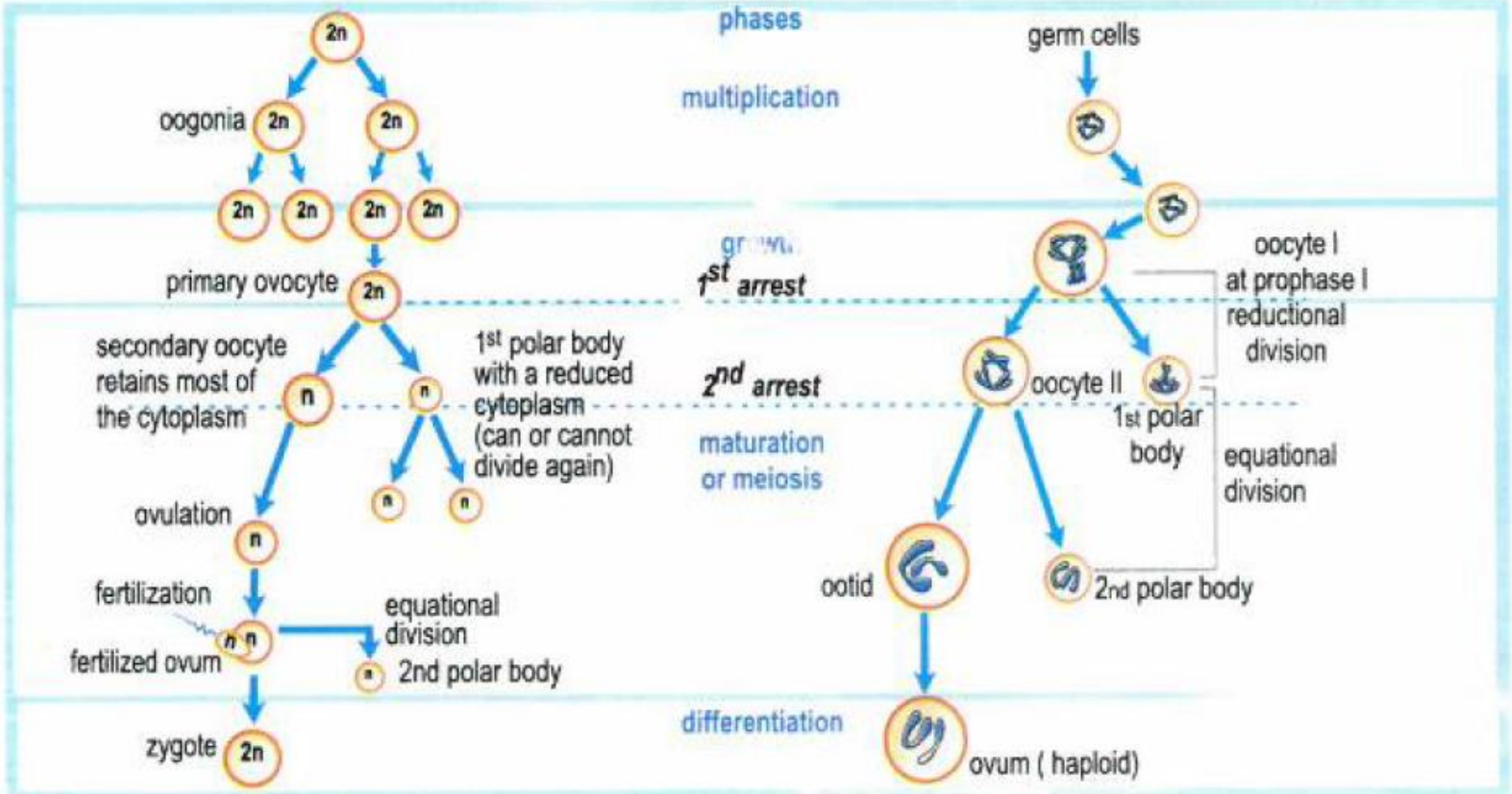
1- Multiplication

2- Growth

3- Maturation

4- Differentiation

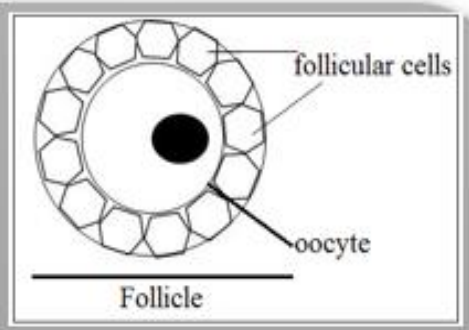
➢ Stages of Oogenesis: Doc. d p.28



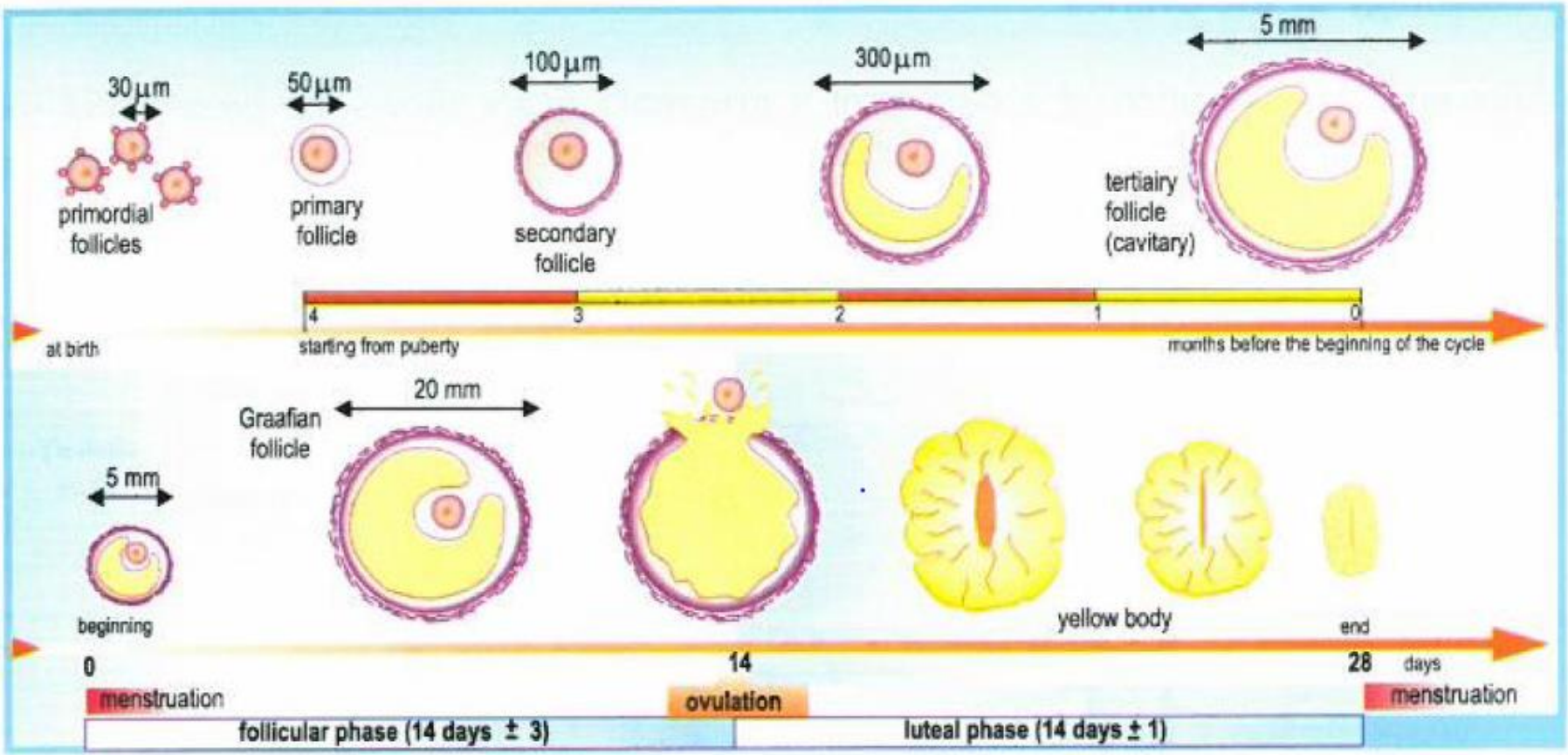
Doc.d *Phases of oogenesis and the corresponding chromosomal behaviour.*

II. Folliculogenesis:

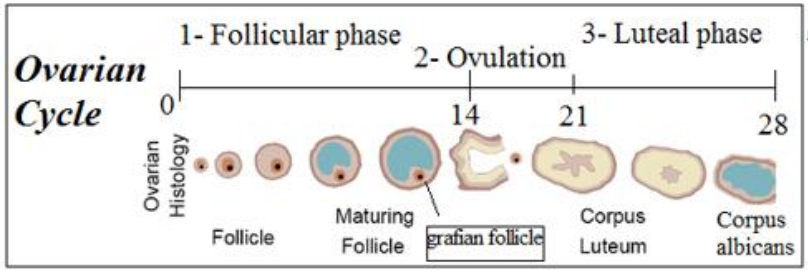
- Each oocyte found in the ovary is surrounded by a group of cells called follicular cells.
- Follicular cells + Oocyte = follicle.
- Role of Follicle:
  - It surrounds the oocyte and supports it.
  - Some follicular cells secrete estrogen and progesterone hormones.

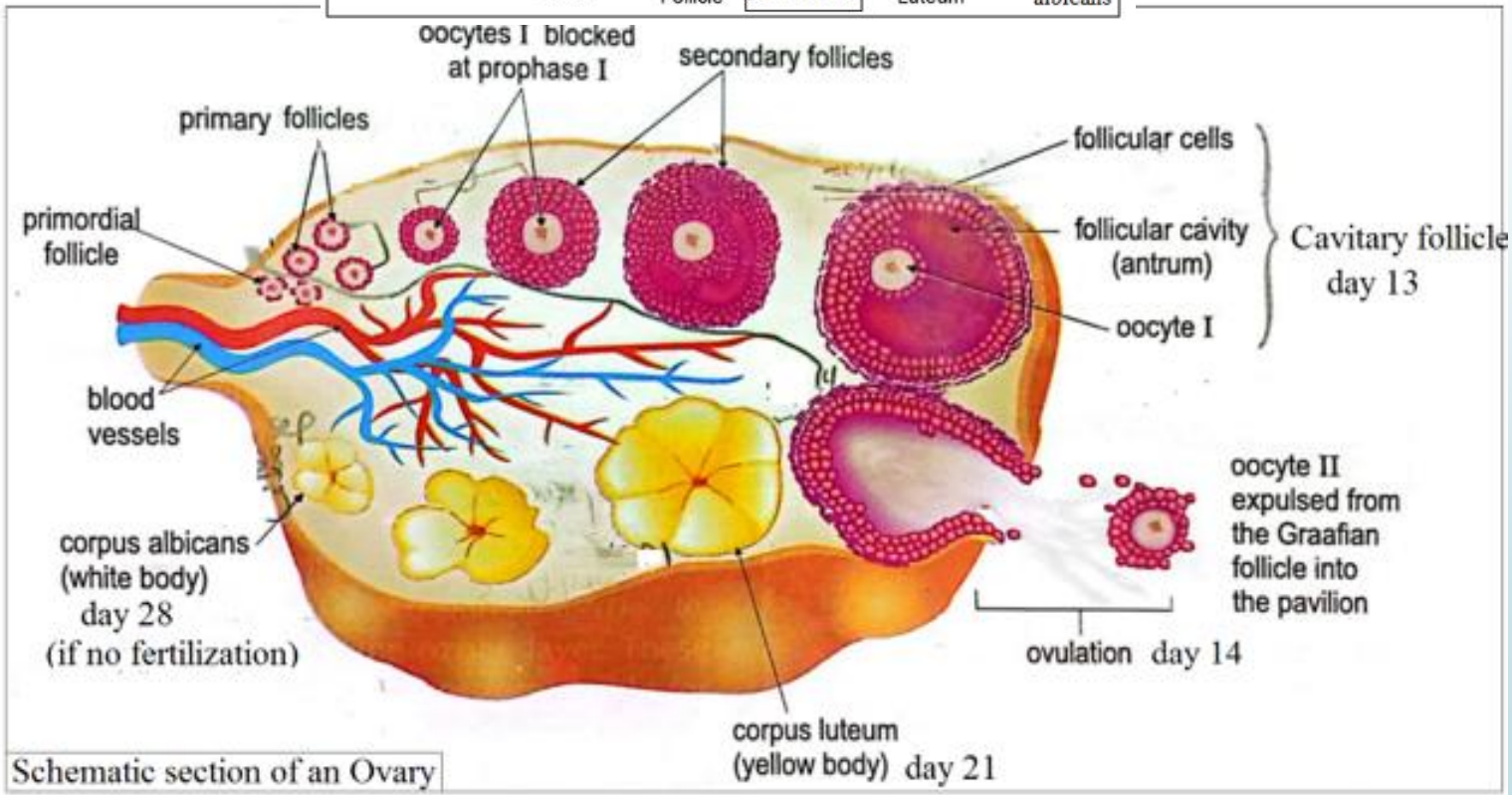


- ***Definition of folliculogenesis:*** Is the development of follicles inside the ovaries. It starts during the fetal life, continues at puberty as a cycle called ovarian cycle, and stops at menopause.
- Folliculogenesis undergoes many stages(Doc.c p.28) : primordial follicle → primary follicle → secondary follicle → tertairy follicle (cavitary follicle) → Grafian follicle → yellow body.
- Structure of Graphian follicle: Doc. b, p.27



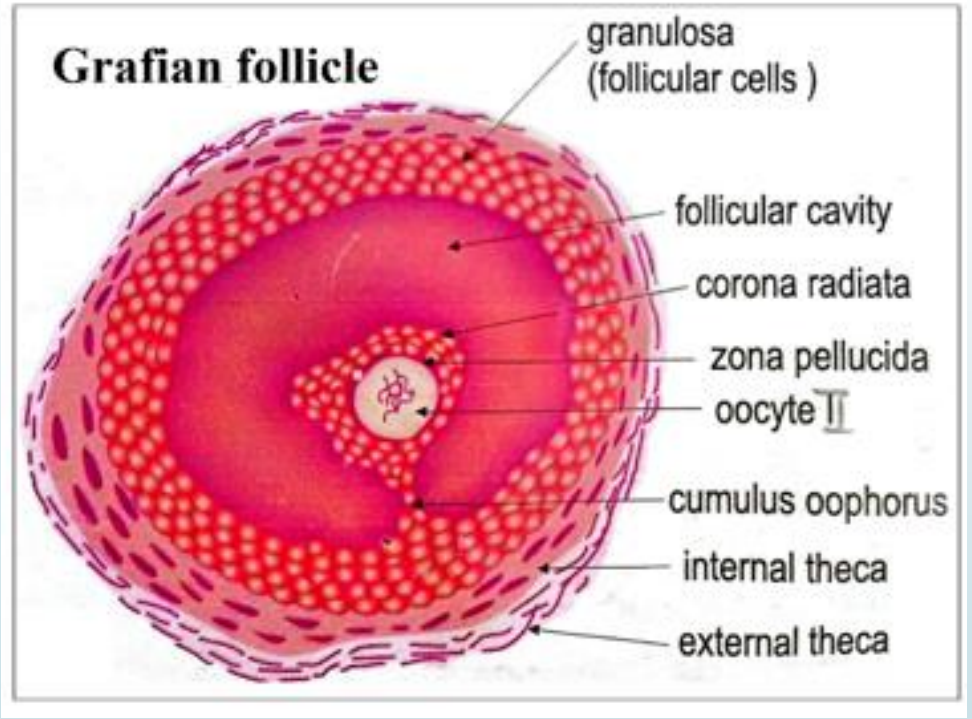
Doc.c *Schematic representation of folliculogenesis.*





Schematic section of an Ovary

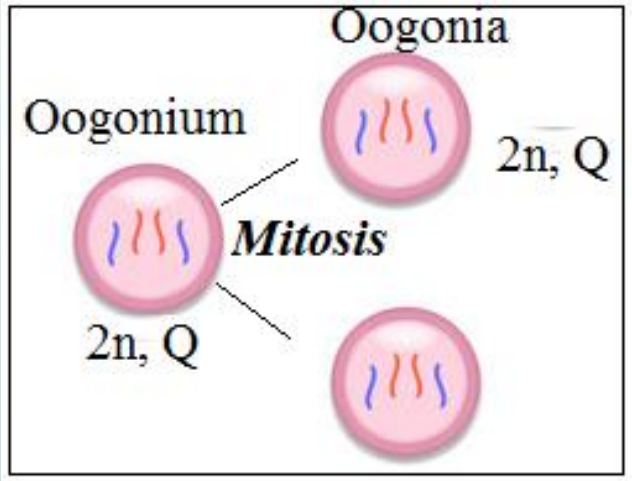
- **Document b p.27 shows a schematic representation of a mature Grafian follicle.**



➢ Stages of Oogenesis:

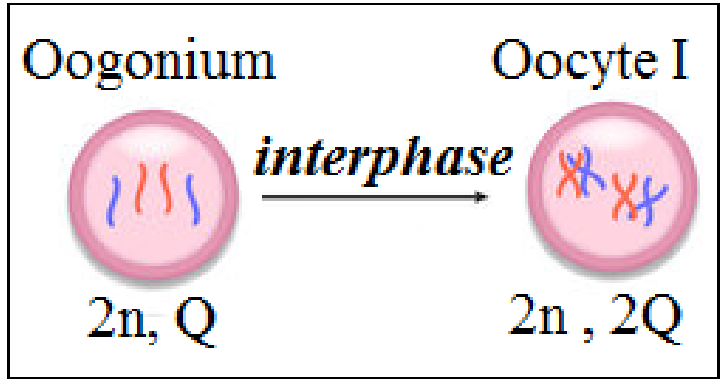
1- Multiplication: (Before birth)

- It happens during embryonic and fetal life.
- Female germ cell or oogonia divide by mitosis to produce ≈ 700 million oogonia



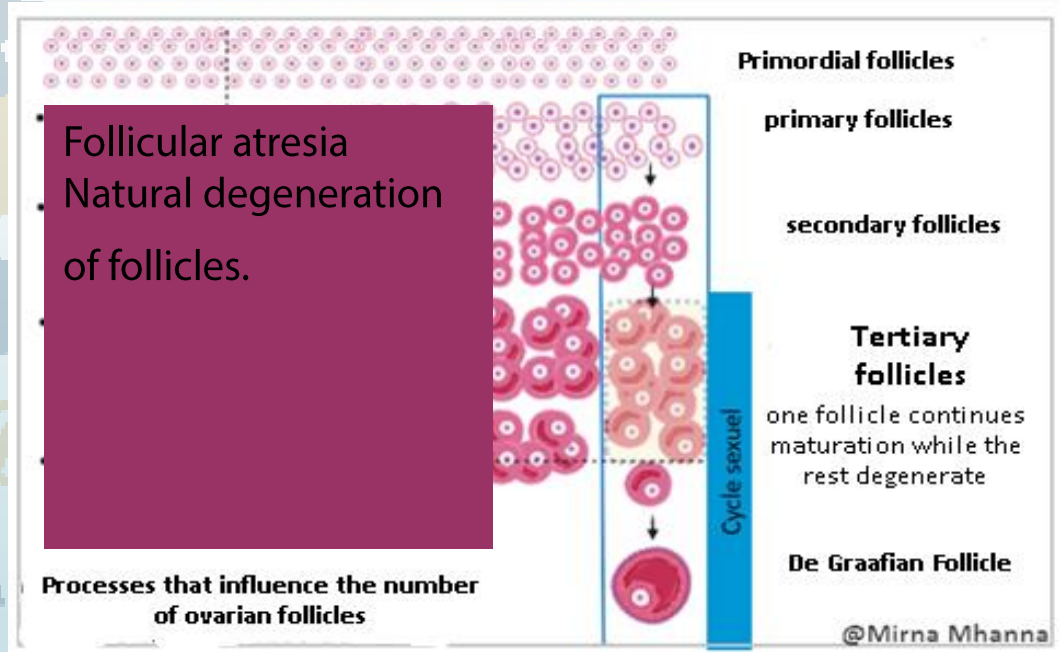
2- Growth : (Before birth)

- Happens during embryonic and fetal life.
- Oogonia undergo interphase and change into primary oocyte (oocyte I).
- Each oocyte is surrounded by few follicular cells to form primordial follicles.

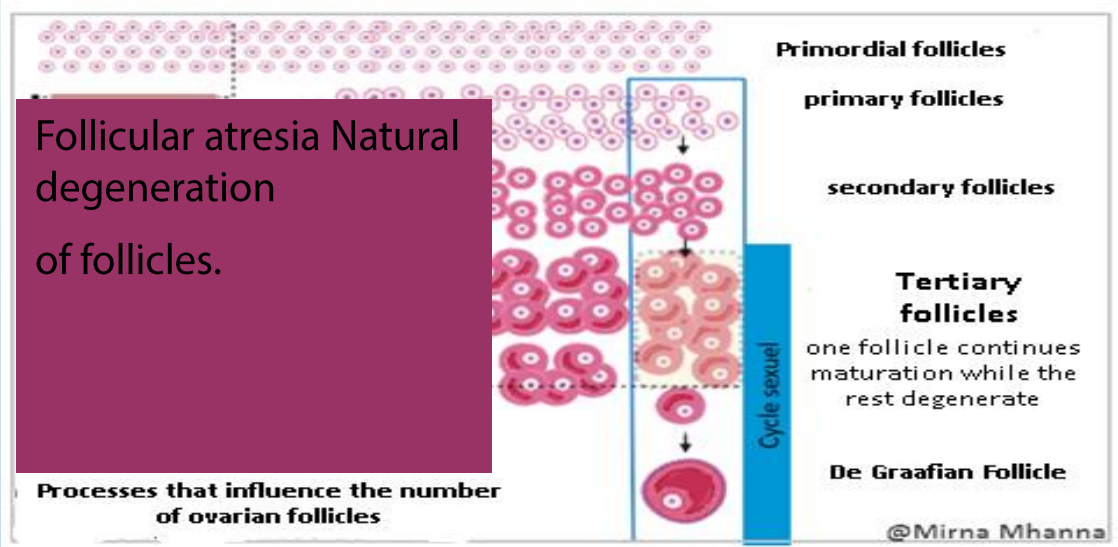


3- Maturation phase: (Meiosis before birth)

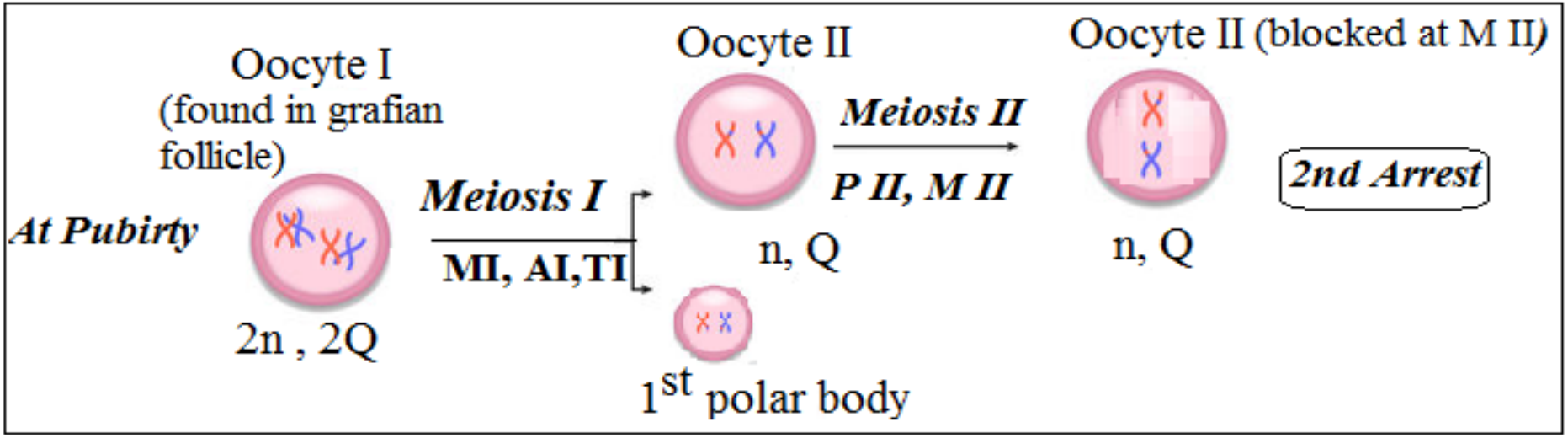
- During fetal life, large number of primordial follicles degenarate, this is called follicular atresia.
- The remaining oocytes I start meiosis I during fetal life. But at birth, Meiosis I is arrested and all oocytes I remain blocked at prophase I until puberty.
- Follicular degeneration (atresia) continues during childhood, so that at puberty both ovaries contain about 400,000 primordial follicles containing oocyte I blocked at prophase I.



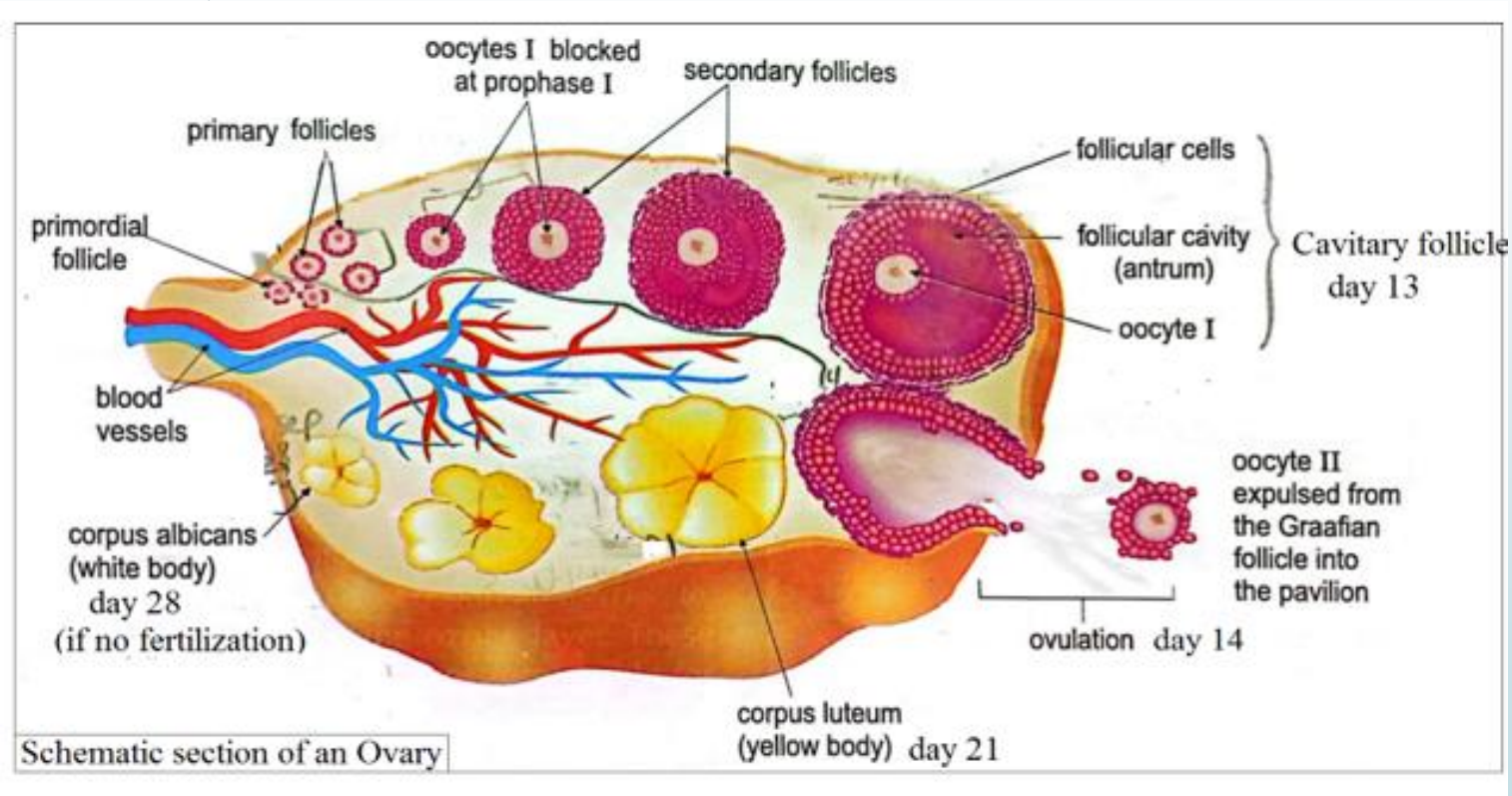
- Starting from puberty, and periodically 4 months before each cycle , a group of primordial follicles develop into primary follicle → secondary follicle → tertiary (cavitary) follicle. Only 1 cavitary (tertiary) follicle develops into mature Grafian follicle from day 1 to day 14 of the cycle, where oocyte I (found in the Grafian follicle) completes meiosis I (continues metaphase I, anaphase I and telophase I) to produce 2 unequal daughter cells: one small cell called 1st polar body and one oocyte II. Oocyte II enters meiosis II and continues prophase II and metaphase II to be blocked again at metaphase II (2nd arrest).



Maturation Phase

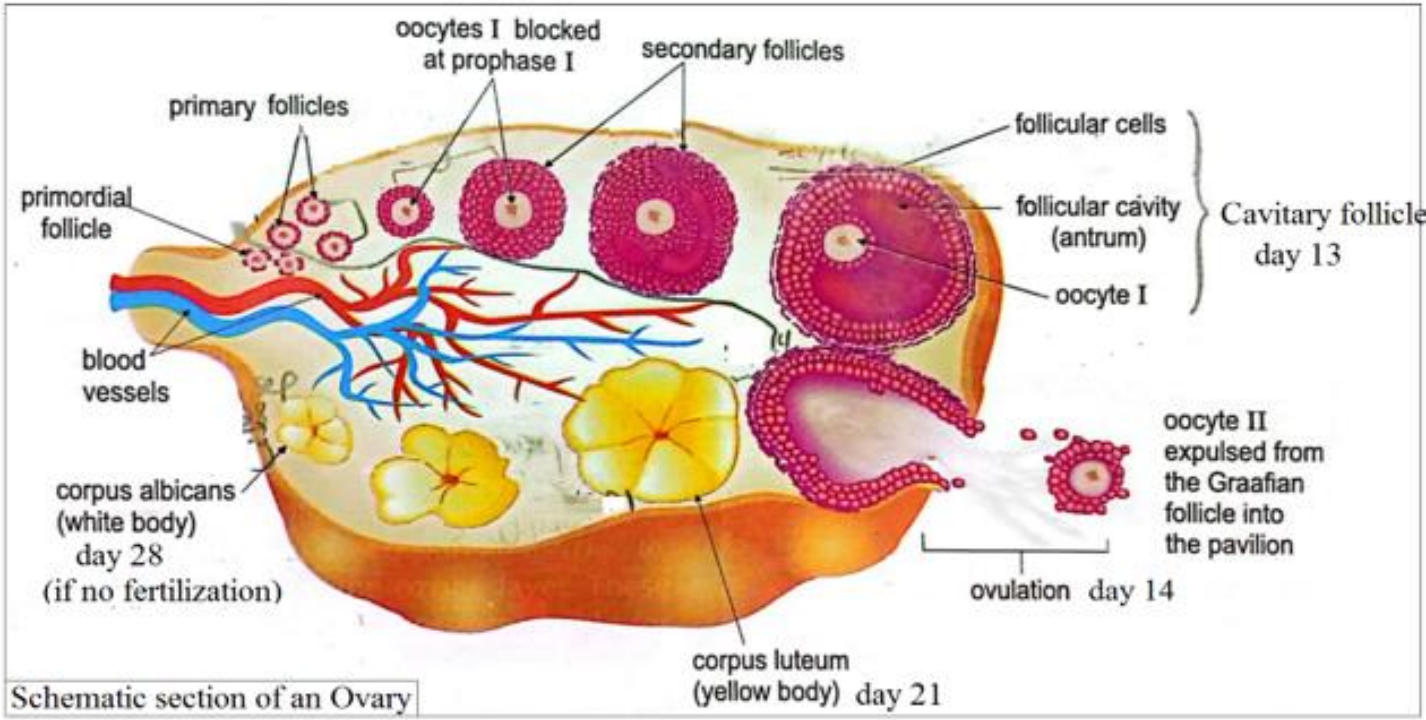


*At day 14 of the cycle, day of ovulation, Grafian follicle (mature follicle) ruptures, and oocyte II blocked at metaphase II will be released from the ovary into the oviduct.



Fate of the released oocyte II (in the oviduct) and the ruptured follicle (in the ovary) :

- *If fertilization does not occur: Oocyte II blocked at metaphase II remains for 24 hours in the oviduct and then degenerates without completing Meiosis II. While, the ruptured Grafian changes to corpus luteum (yellow body) at day 21, then to corpus albicans (white body) at day 28; this marks the end of the cycle.*

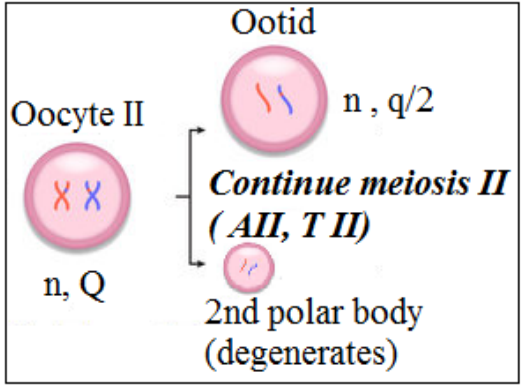


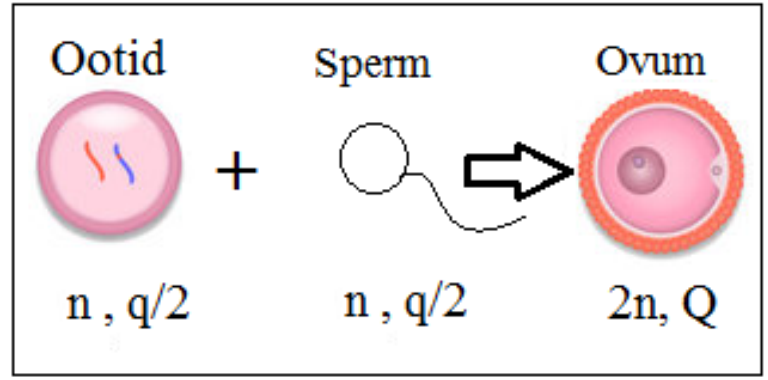
Schematic section of an Ovary

- If fertilization occurs, oogenesis stage 4 continues ⇒

4- Differentation:

- It happens only in case of fertilization.
- Oocyte II continues anaphase II and telophase II of meiosis II to produce a second polar body (which degenerates) and an ootid.





- **Fate of the corpus luteum :**

After fertilization, corpus luteum (yellow body) persists (remains) for 3 months in the ovaries releasing hormones to support pregnancy.

☞ Oocytes are subjected to 2 arrests:

1- First arrest is at birth (At prophase I of Meiosis I). It is activated at puberty.

2- Second arrest is at ovulation (At metaphase II of Meiosis II). It is activated by fertilization.

Probing the documents

1. Compare a sperm cell and a secondary oocyte.
2. What is the outcome of the oocyte II and the ruptured follicle:
   - if fertilization does not take place.
   - if fertilization takes place.
3. Construct a comparative table of spermatogenesis and oogenesis.
4. Compare the age of an oocyte I in a woman to that of a spermatocyte I in a man.
5. Summarize, in a few lines, folliculogenesis and oogenesis during an ovarian cycle.

1- The sperm cell and the secondary oocyte have some similarities and some differences.

- **Similarities:**

  Both have the main structures of a cell: cell membrane, cytoplasm and nucleus. Moreover, both gametes are haploid.

- **Differences:**
  - The secondary oocyte is a big cell, spherical in shape, not flagellated and immobile.
  - The sperm cell is small, elongated in shape, flagellated and mobile.
  - The sperm cell survives 48 hours in the female reproductive tract while the secondary oocyte lives only 24 hours if there is no fertilization

Probing the documents

1. Compare a sperm cell and a secondary oocyte.
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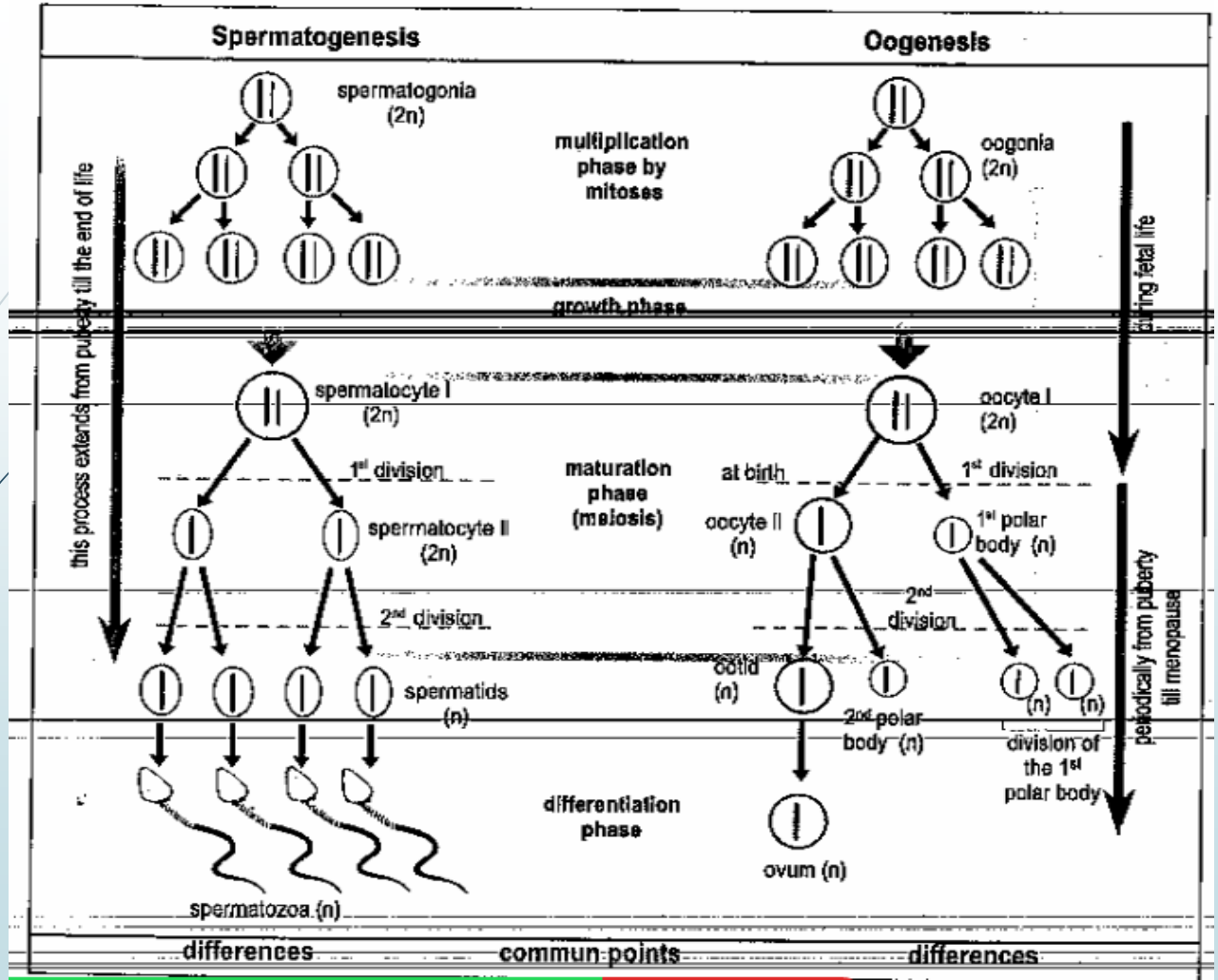
2- - If fertilization does not take place, the oocyte II degenerates about 24hours after ovulation, and the ruptured follicle becomes a corpus luteum which degenerates by the end of the cycle.

- After fertilization, the haploid oocyte II (n) resumes meiosis (equational division), release the second polar body and becomes an egg-cell or diploid zygote (2n). The ruptured follicle will form the corpus luteum which remains till the third month of pregnancy.

3.


Spermatogenesis
Oogenesis
spermatogonia (2n)
multiplication phase by mitoses
oogonia (2n)
growth phase
during fetal life
this process extends from puberty till the end of life
spermatocyte I (2n)
oocyte I (2n)
1st division
maturation phase (meiosis)
at birth
1st division
spermatocyte II (2n)
oocyte II (n)
1st polar body (n)
periodically from puberty till menopause
2nd division
2nd division
spermatids (n)
ootid (n)
2nd polar body (n)
(n) (n)
division of the 1st polar body
differentiation phase
ovum (n)
spermatozoa (n)
differences
commun points
differences

Probing the documents

1. Compare a sperm cell and a secondary oocyte.
2. What is the outcome of the oocyte II and the ruptured follicle:
   - if fertilization does not take place.
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5. Summarize, in a few lines, folliculogenesis and oogenesis during an ovarian cycle.

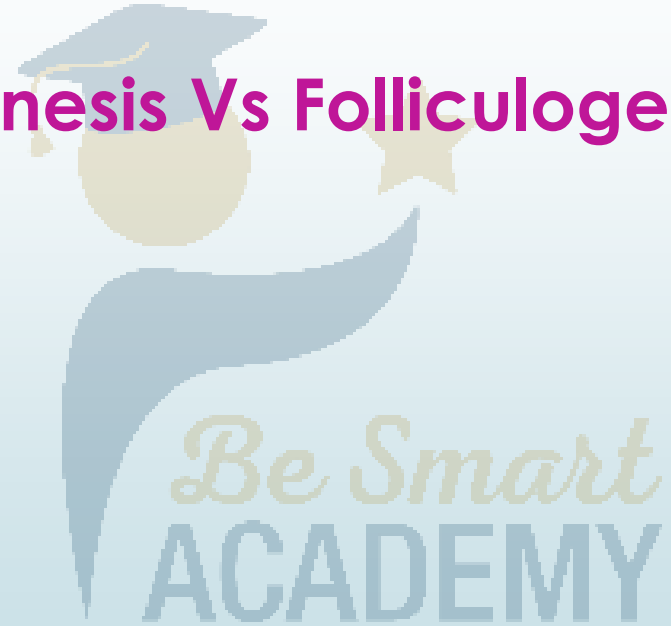
5- During the follicular phase, the cavitary follicle develops and becomes 14 days later a mature follicle or Graafian follicle.

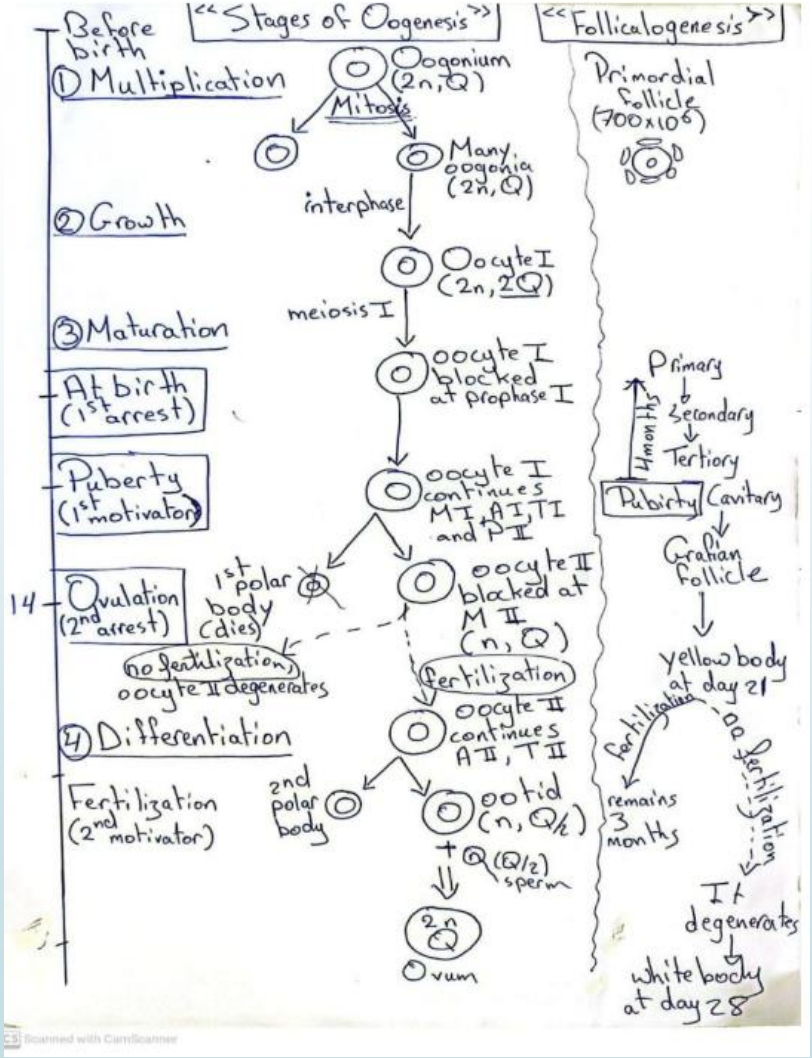
Just prior to ovulation, oocyte I, which is blocked at prophase I, resumes the first meiotic division and starts the second meiotic division which in turn will be blocked at metaphase II. Ovulation takes place at the 14^{th} day; Graafian follicle bursts and releases oocyte II.

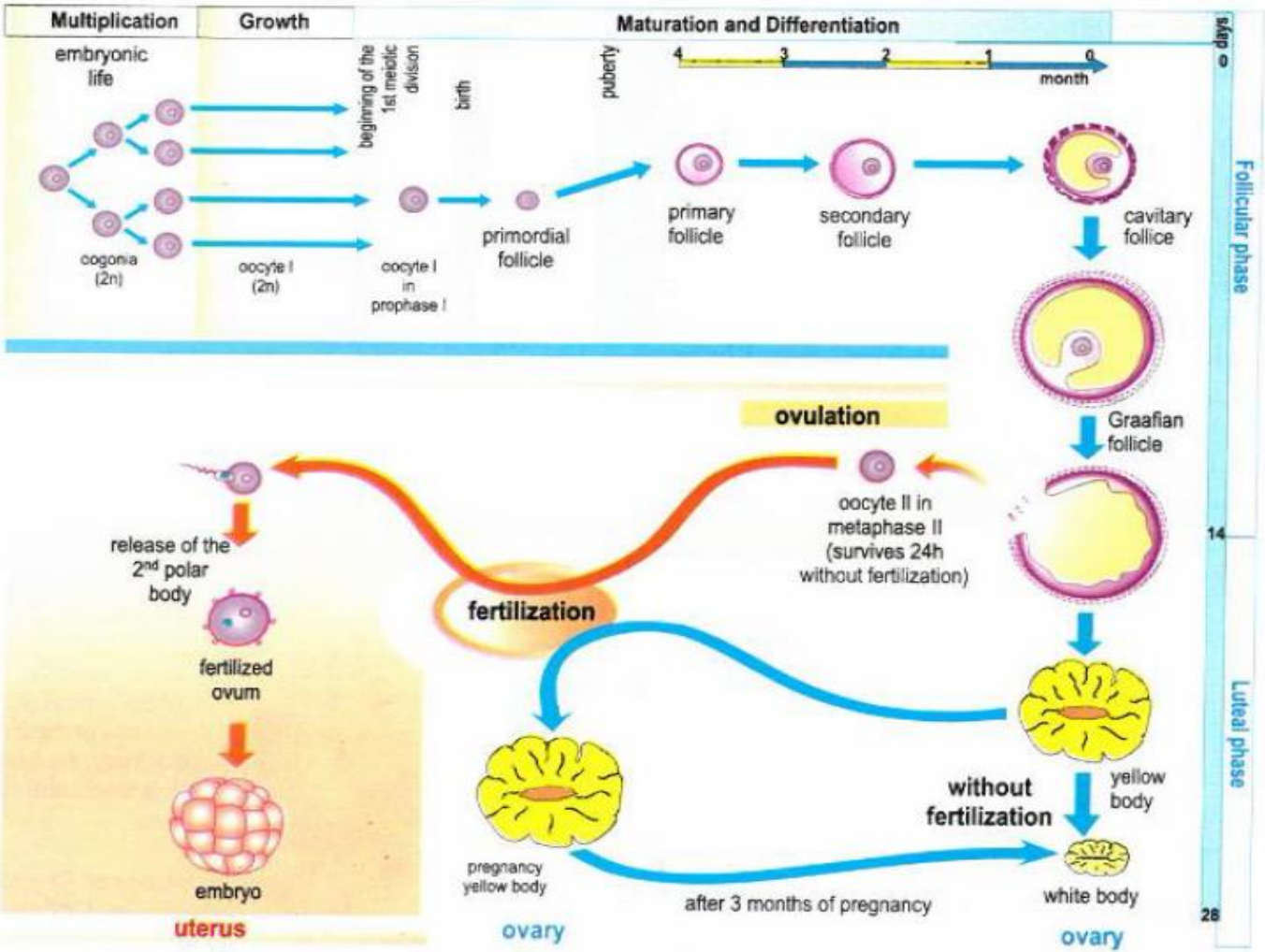
During the luteal phase, the raptured follicle becomes the corpus luteum which degenerates 14 days late and the oocyte II degenerates about 24 hours after ovulation, i there is no fertilization.

If fertilization does take place, the corpus leteum develops and is maintained during the first three months of pregnancy. Oocyte II resumes in the pavilion its second meiotic division, releases the second polar body and becomes a diploid egg-cell.

Oogenesis Vs Folliculogenesis




<<Stages of Oogenesis>>
<<Follicalogenesis>>
Before birth
① Multiplication
Oogonium (2n, Q)
Mitosis
Many oogonia (2n, Q)
② Growth
interphase
Oocyte I (2n, 2Q)
③ Maturation
meiosis I
oocyte I blocked at prophase I
At birth (1st arrest)
Puberty (1st motivator)
oocyte I continues MI, AI, TI and PII
oocyte II blocked at M II (n, Q)
1st polar body (dies)
Ovulation (2nd arrest)
14
(no fertilization) oocyte II degenerates
fertilization
oocyte II continues AII, TII
④ Differentiation
Fertilization (2nd motivator)
2nd polar body
ootid (n, Q/2)
+ Q (Q/2) sperm
2n Q
Ovum
Primordial follicle (700x10^6)
Primary
Secondary
Tertiory
4 months
Pubirty
Cavitary
Graffian follicle
yellow body at day 21
fertilization
no fertilization
remains 3 months
It degenerates
white body at day 28



Doc.e *Schematic correlation between oogenesis and folliculogenesis.*