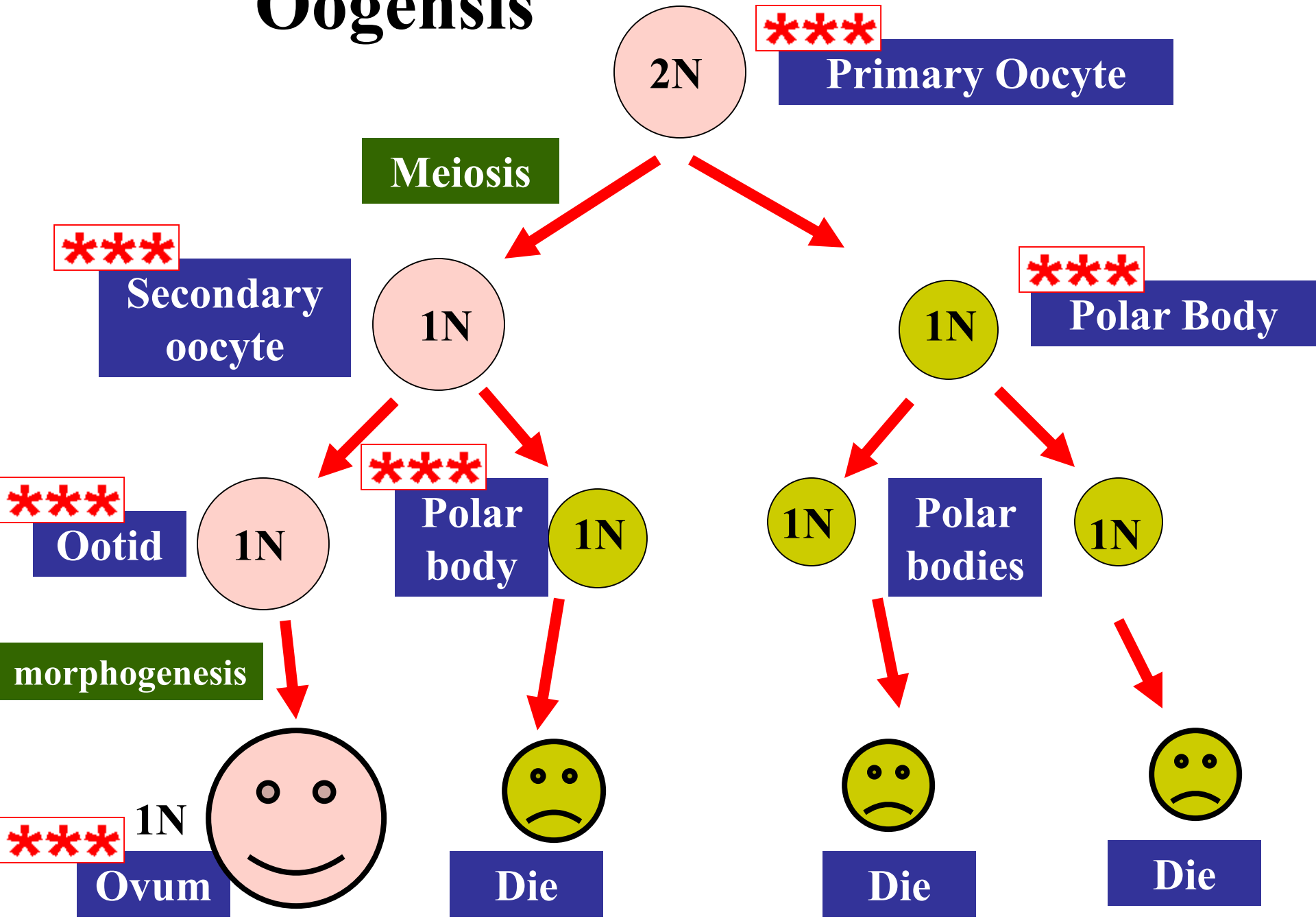
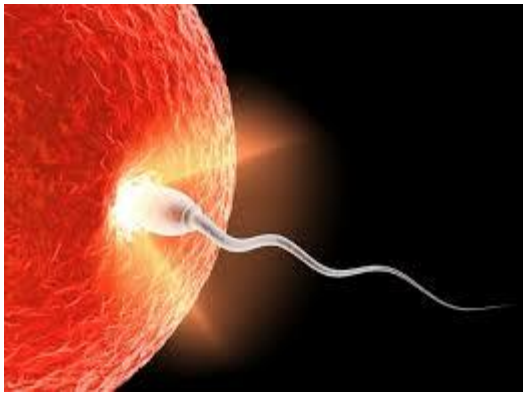
Dr. Sumeya

Oogenesis

Oogensis


2N
***
Primary Oocyte
Meiosis
***
Secondary oocyte
1N
1N
***
Polar Body
***
Ootid
1N
***
Polar body
1N
1N
Polar bodies
1N
morphogenesis
1N
***
Ovum
Die
Die
Die

Oogenesis

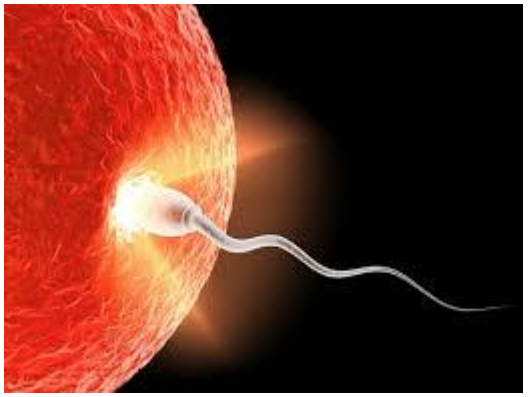


Is the process whereby oogonia differentiate into mature oocytes.

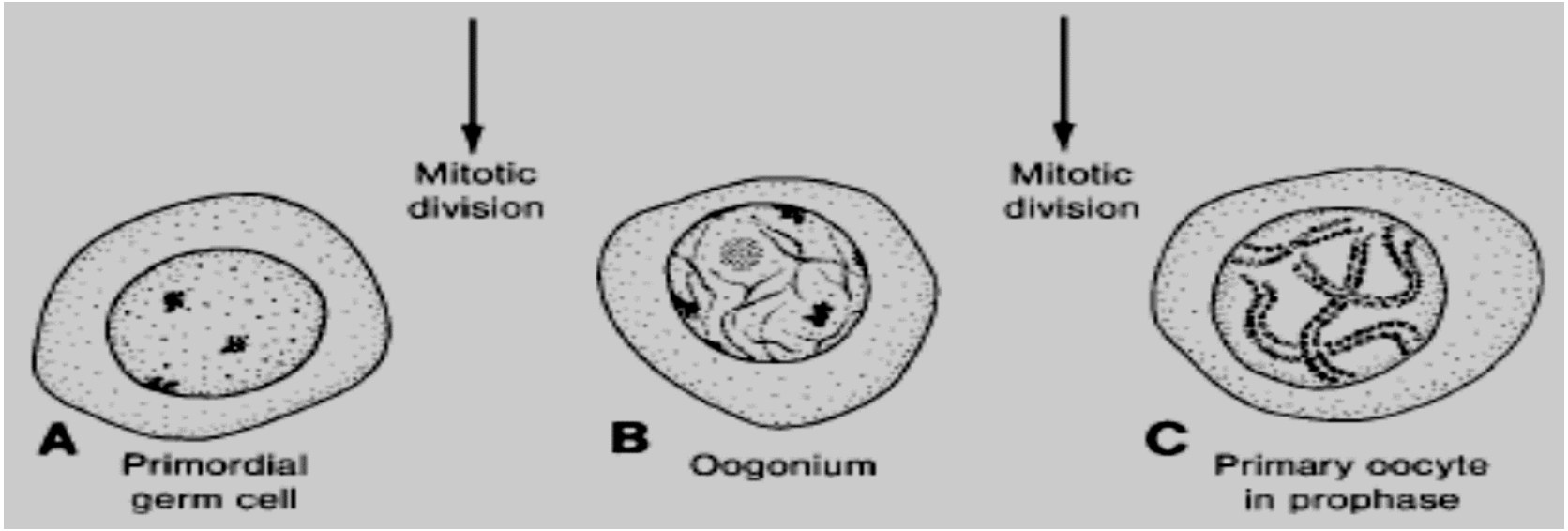
Maturation of Oocytes Begin Before Birth

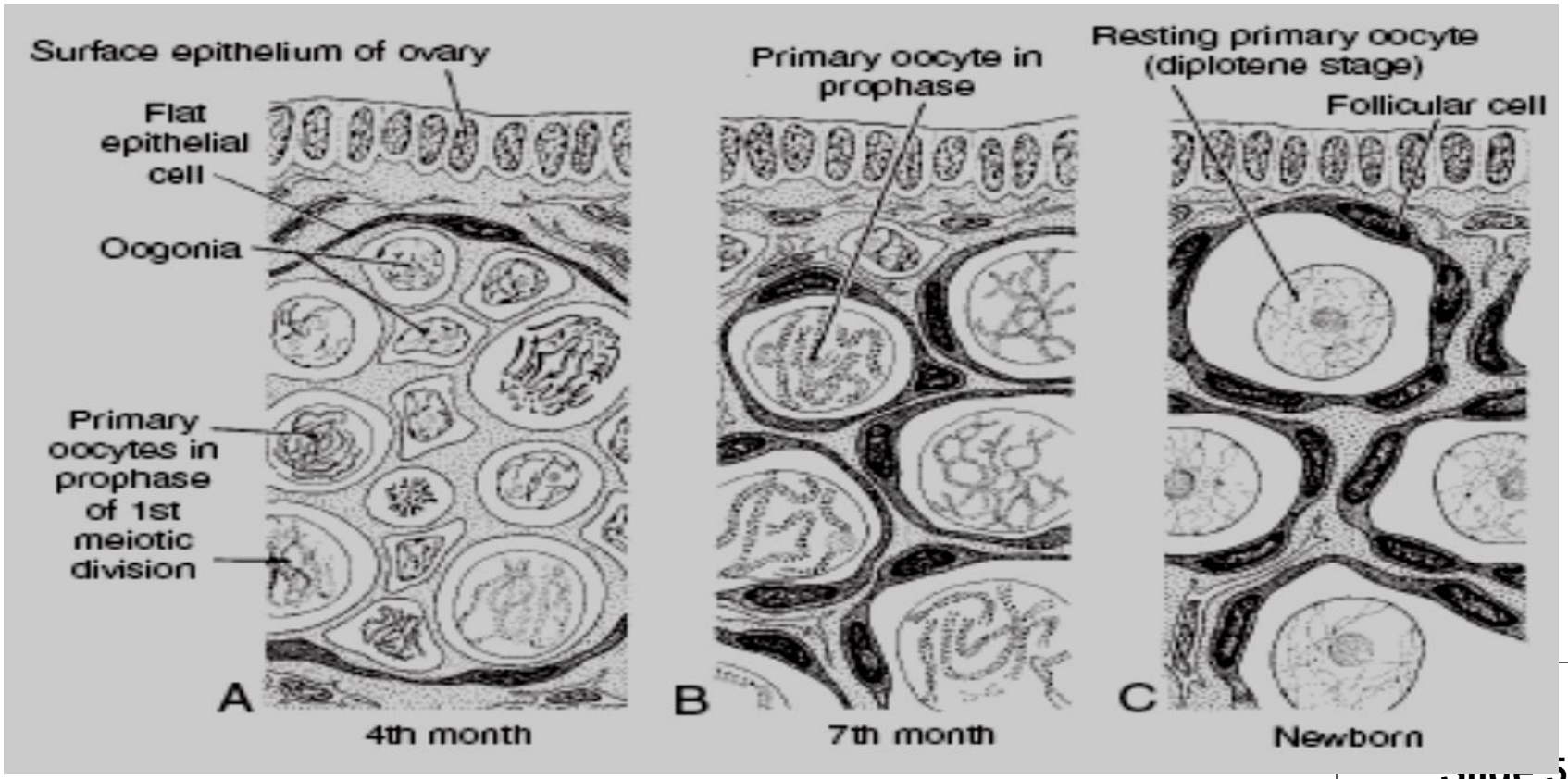
- Once PGCs have arrived in the gonad of a genetic female, they differentiate into oogonia .
- By the end of the **third month:** they are arranged in clusters surrounded by a layer of flat epithelial cells(follicular cells) originate from surface epithelium covering the ovary .
- All the oogonia in one cluster are properly derived from a **single cell**.
- Oogonia: **majority**: continue to devide by mitosis.

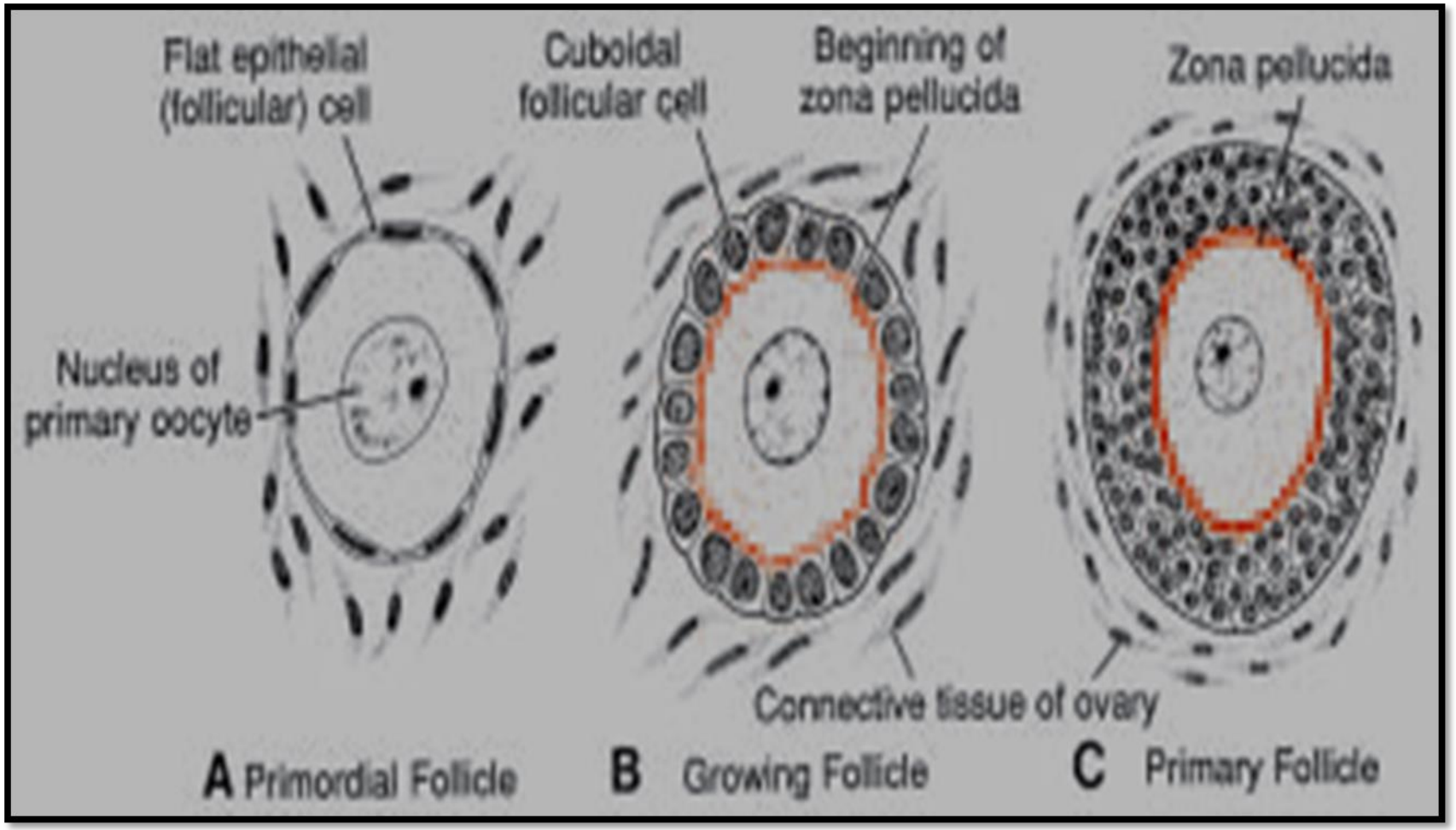
some: enter meiosis and arrest their cell division in prophase MI forming **primary oocytes** .



- **5th month:** total number of germ cells(oogonia + primary oocytes) reach maximum(**7 millions**) .
- **At this time:** cell death begins leading to many oogonia and primary oocytes degenerate and become **atretic** .
- **7th month**: the majority of ***oogonia*** ----- **degenerate** except **few** near a surface.
- All surviving ***primary oocytes*** ------ entered **prophase of miosis 1** , and most of them are individually surrounded by a layer of flat follicular epithelial cells.
- A primary oocyte, together with its surrounding flat epithelial cells, is known as a **primordial follicle**


Mitotic division
Mitotic division
A
Primordial germ cell
B
Oogonium
C
Primary oocyte in prophase


Surface epithelium of ovary
Flat epithelial cell
Oogonia
Primary oocytes in prophase of 1st meiotic division
A
4th month
Primary oocyte in prophase
B
7th month
Resting primary oocyte (diplotene stage)
Follicular cell
C
Newborn

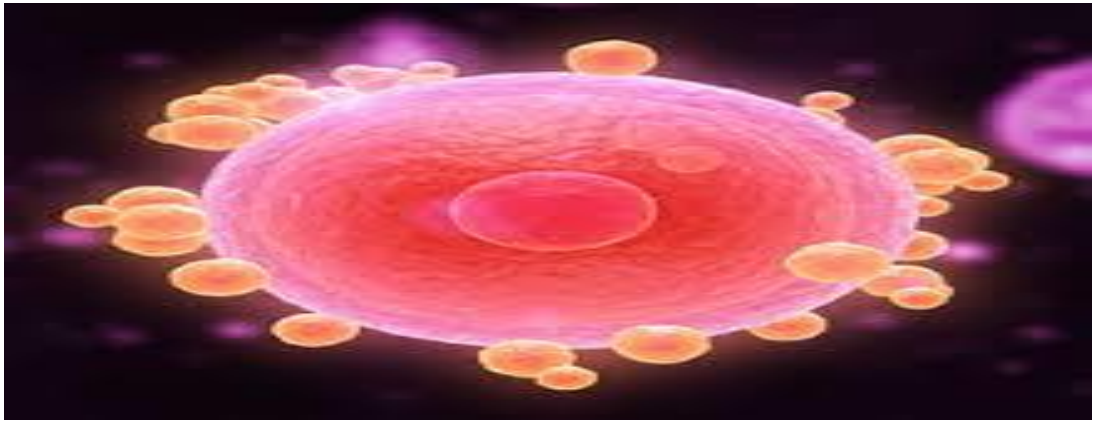

Flat epithelial (follicular) cell
Cuboidal follicular cell
Beginning of zona pellucida
Zona pellucida
Nucleus of primary oocyte
Connective tissue of ovary
A Primordial Follicle
B Growing Follicle
C Primary Follicle

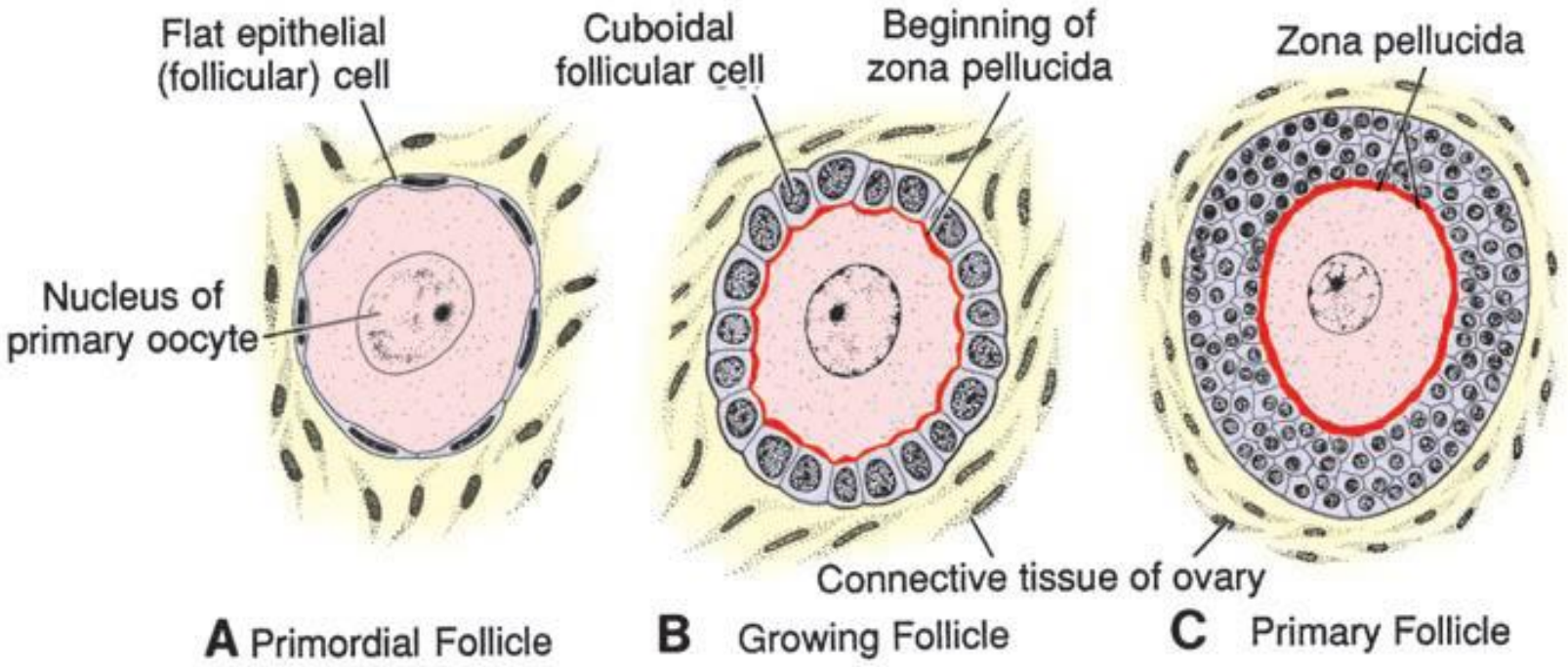
Maturation of Oocytes Continues at Puberty

- **Near birth time**: all primary oocytes ------- started **prophase of meiosis I**, but instead of proceeding into ***metaphase***, they enter the **diplotene stage,** a resting stage during prophase that is characterized by a lacy network of chromatin

- *Primary oocytes remain arrested in prophase and do not fi nish their fi rst meiotic division before puberty is reached*.
- This arrested state is produced by **oocyte maturation inhibitor (OMI)**, a small peptide secreted by follicular cells.
- The total number of primary oocytes at birth is estimated to vary from **600,000 to 800,000**. During childhood, most oocytes become atretic; only approximately **40,000** are present by the beginning of puberty, and fewer than **500** will be ovulated.

- Some oocytes that reach maturity **late** in life have been dormant in the diplotene stage of the fi rst meiotic division for 40 years or more before ovulation------- vulnerable to damage with age and increase chromosomal abnormalities.




Flat epithelial (follicular) cell
Cuboidal follicular cell
Beginning of zona pellucida
Zona pellucida
Nucleus of primary oocyte
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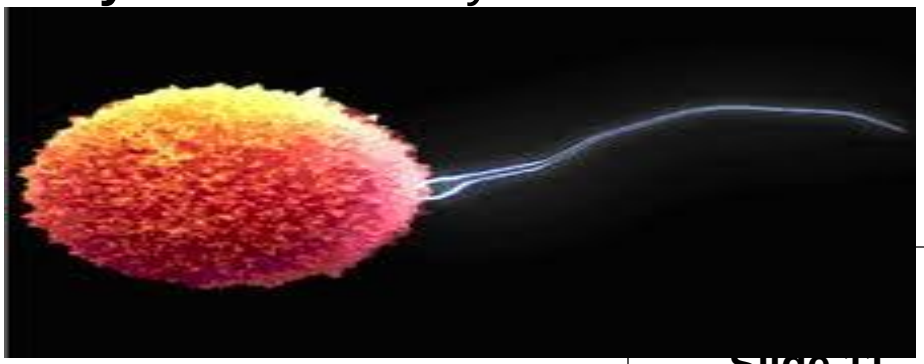
- At puberty, 15 to 20 primordial follicles monthly begin to mature passing in 3 stages:1-Primary or preantral

  2-Secondary or antral or vesicular

  3-Preovulatory(Graafian follicle)
- Some of these die, while others begin to accumulate fluid in a space called the **antrum**, thereby entering the **antral** or **vesicular stage**
- Fluid continues to accumulate such that, immediately prior to ovulation, follicles are quite swollen and are called **mature vesicular follicles** or **Graffi an follicles**. The antral stage is the longest, whereas the mature vesicular stage encompasses approximately 37 hours prior to ovulation.

- As primordial follicles begin to grow, surrounding follicular cells change from flat to cuboidal and proliferate to produce a stratified epithelium of **granulosa cells,** and the unit is called a **primary follicle .**

- **Granulosa cells:** rest on a basement membrane separating them from surrounding ovarian connective tissue (stromal cells) that form the ***theca folliculi*.**
- Also, **granulosa cells + the oocyte** secrete a layer of glycoproteins on the surface of the oocyte, forming the **zona pellucida.**



- As follicles continue to grow, cells of the ***theca folliculi*** organize into an inner layer of secretory cells, the **theca interna,** and an outer fibrous capsule, the **theca externa.**

- Also, **small, finger-like processes of the follicular cells extend across the zona pellucida and interdigitate with microvilli of the plasma membrane of the oocyte. These processes are important for transport of materials from follicular cells to the oocyte.**

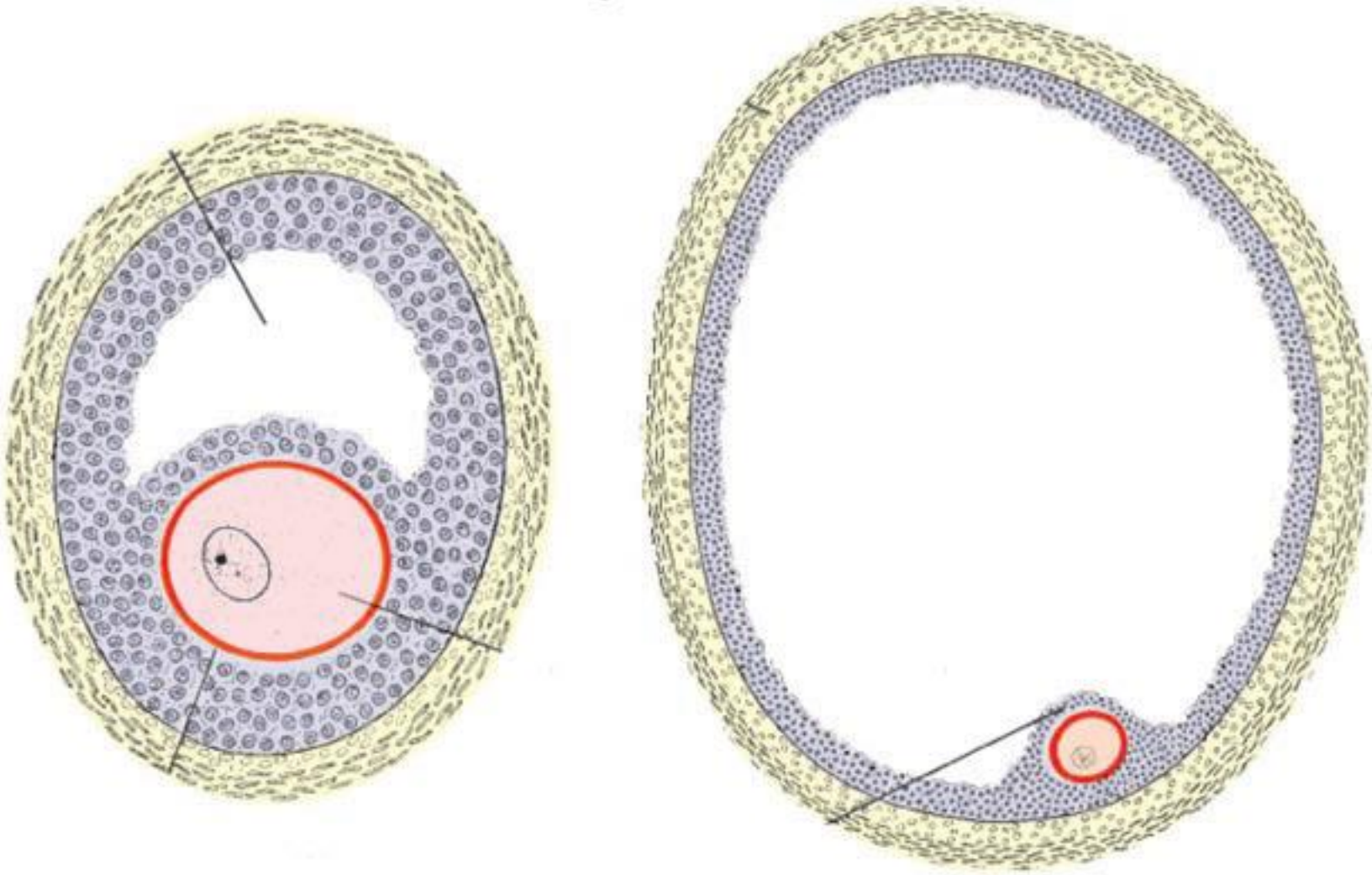
- As development continues, fluid-filled spaces appear between granulosa cells. Coalescence of these spaces forms the **antrum,** and the follicle is termed a **vesicular or an antral follicle.**
- Initially, the antrum is crescent-shaped, but with time, it enlarges. Granulosa cells surrounding the oocyte remain intact and form the **cumulus oophorus.**
- At maturity, the **mature vesicular (Graafian) follicle** may be 25 mm or more in diameter. It is surrounded by the **theca interna**, which is composed of cells having characteristics of steroid secretion, rich in blood vessels, and the **theca externa**, outer fibrous capsule layer which gradually merges with the ovarian connective tissue

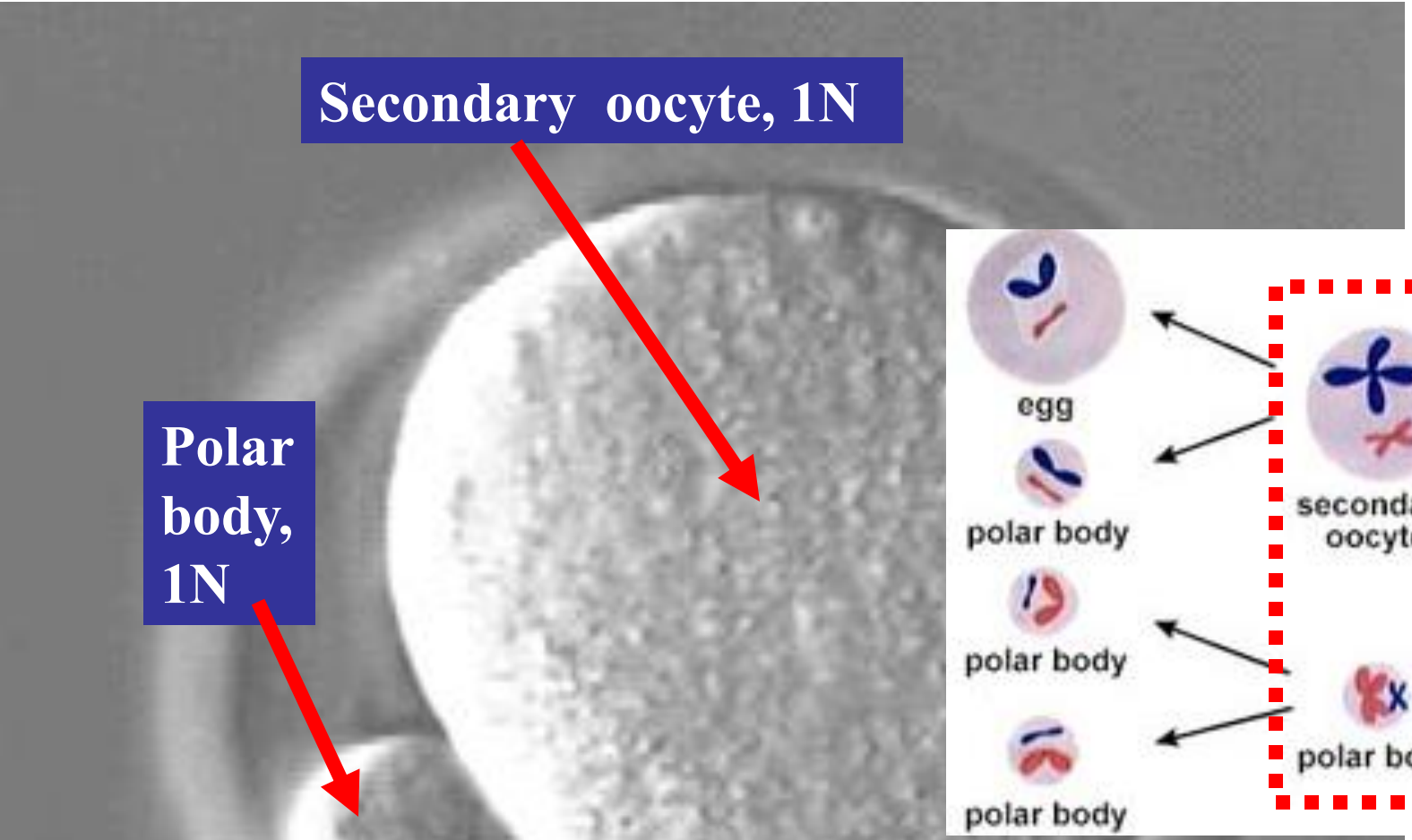
- With each ovarian cycle, a number of follicles begin to develop, but usually only one reaches full maturity. The others degenerate and become atretic.

- When the secondary follicle is mature, a surge in **luteinizing hormone (LH)** induces the preovulatory growth phase. Meiosis I is completed, resulting in formation of two daughter cells of unequal size, each with 23 double-structured chromosomes

- One cell, the **secondary oocyte,** receives most of the cytoplasm; the other, the **first polar** body, receives practically none. The fi rst polar body lies between the zona pellucida and the cell membrane of the secondary oocyte in the perivitelline space

The cell then enters meiosis II but arrests in metaphase approximately 3 hours before ovulation. Meiosis II is completed only if the oocyte is fertilized; otherwise, the cell degenerates approximately 24 hours after ovulation. The fi rst polar body may undergo a second division





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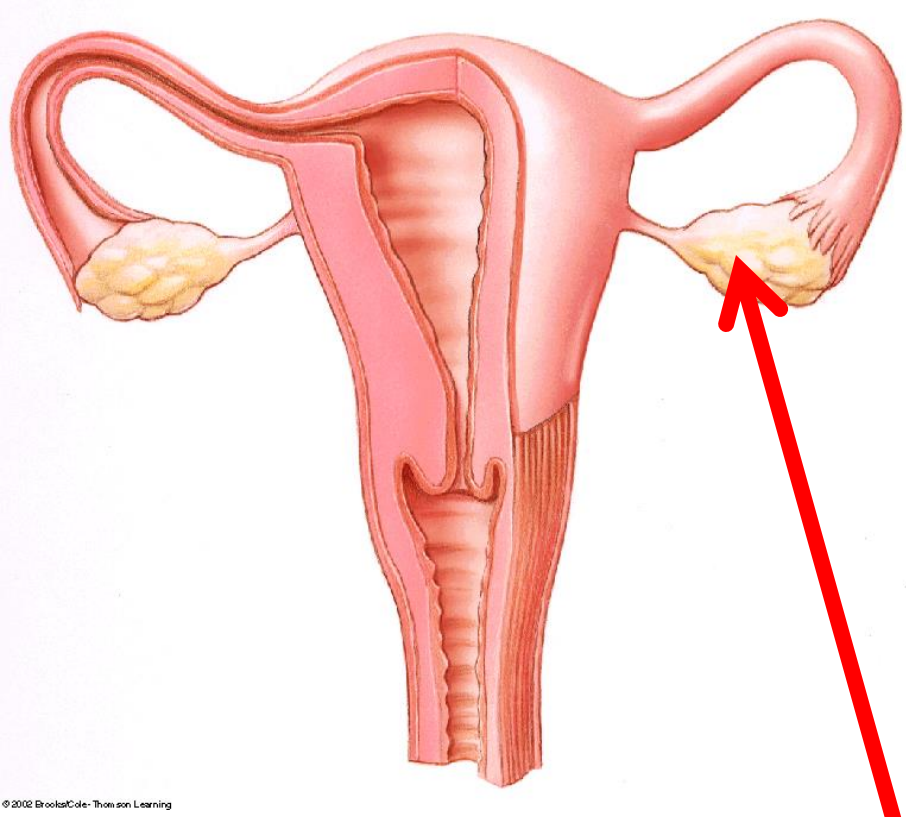
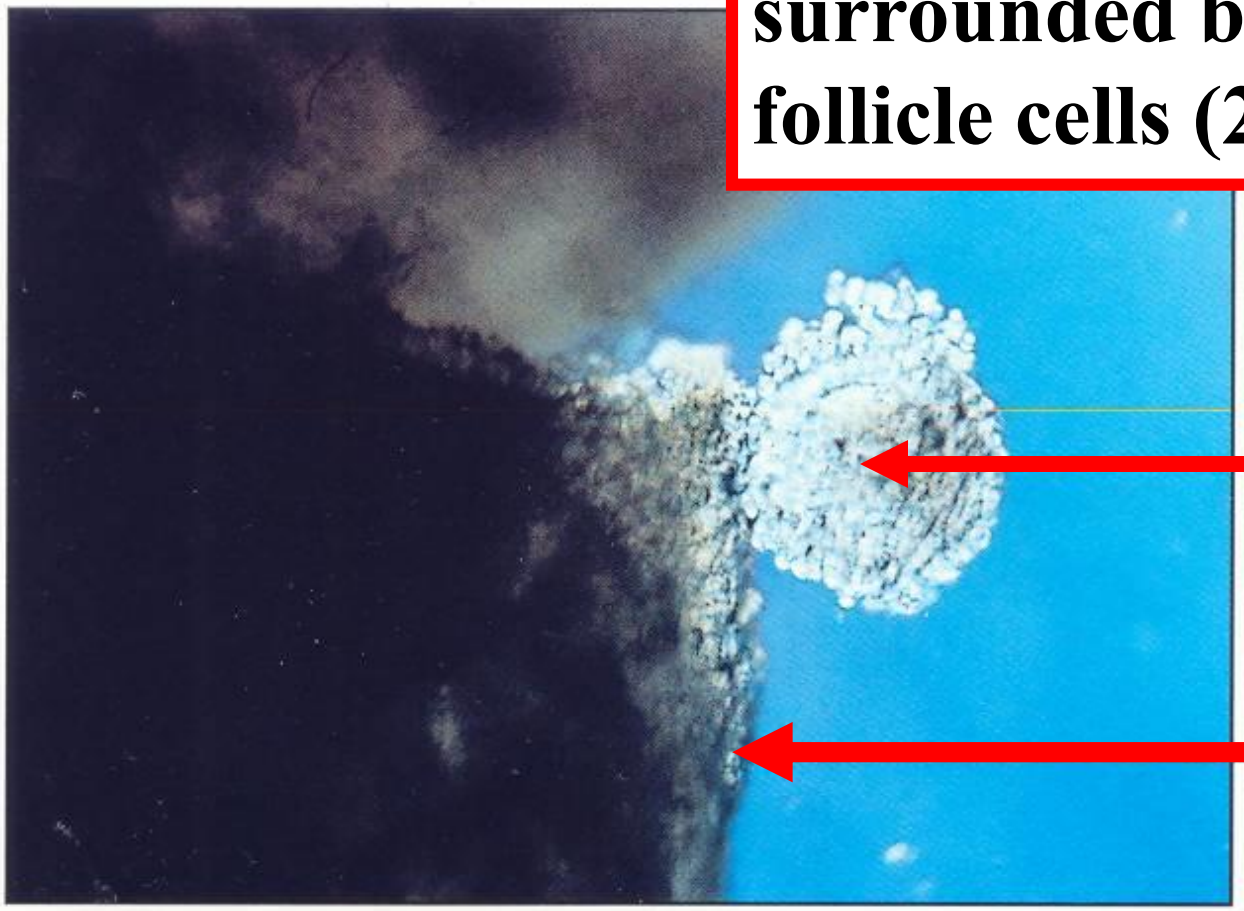
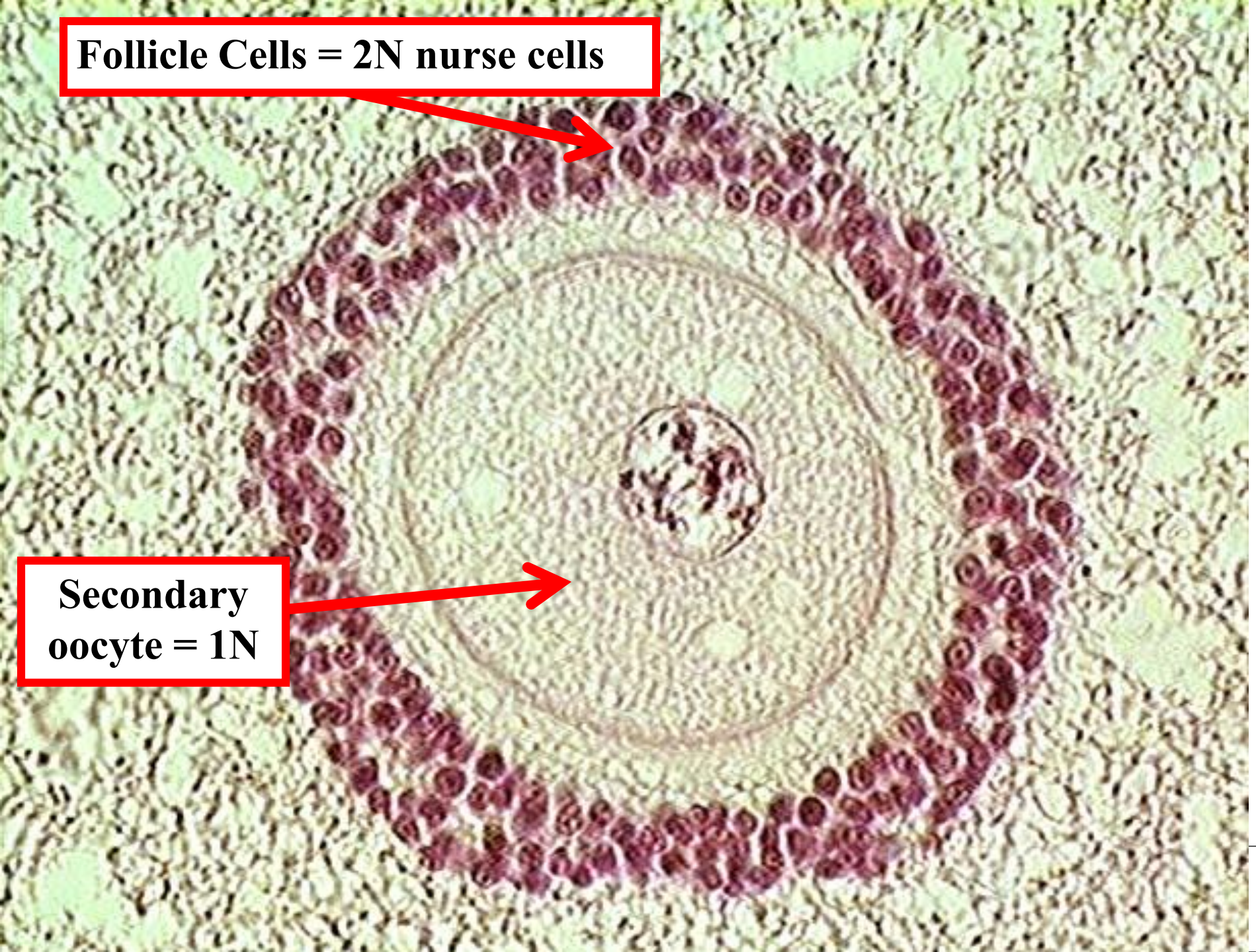
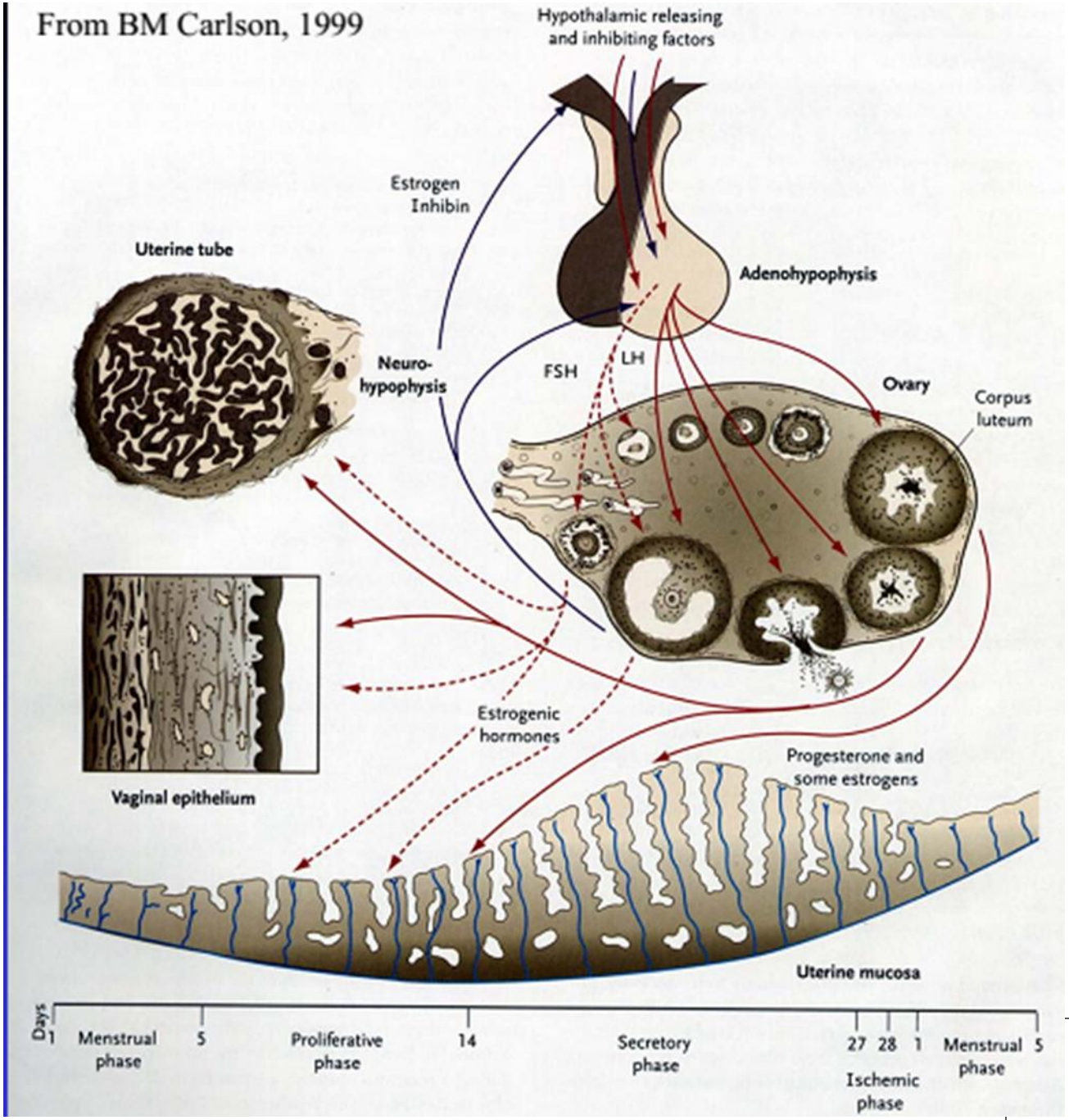


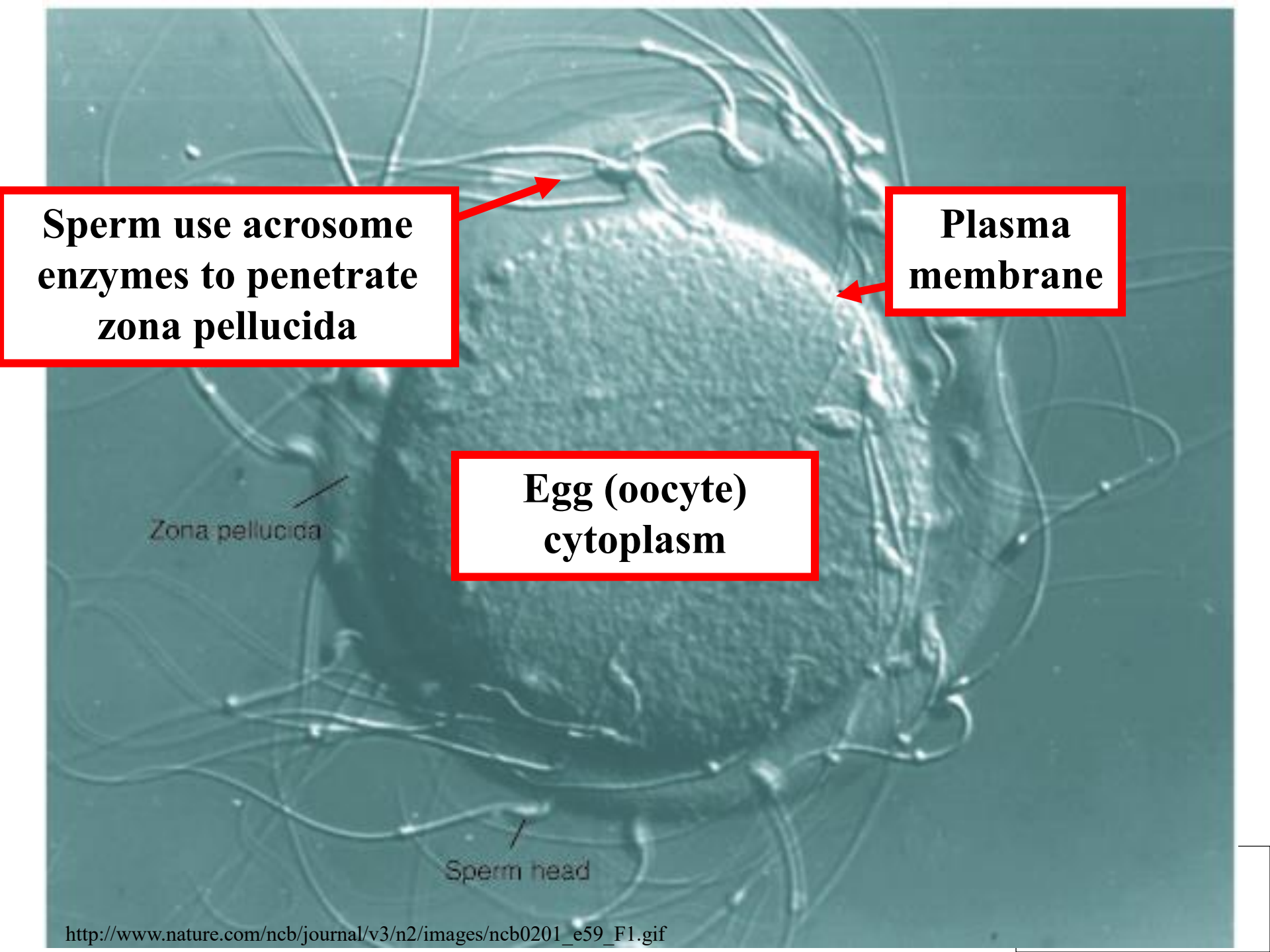
Ovary releases Secondary Oocyte and Follicle Cells

Release of secondary oocyte (1N) surrounded by follicle cells (2N)




Follicle Cells = 2N nurse cells
Secondary oocyte = 1N


From BM Carlson, 1999
Hypothalamic releasing and inhibiting factors
Estrogen
Inhibin
Uterine tube
Adenohypophysis
Neuro-hypophysis
FSH
LH
Ovary
Corpus luteum
Vaginal epithelium
Estrogenic hormones
Progesterone and some estrogens
Uterine mucosa
Days
1
Menstrual phase
5
Proliferative phase
14
Secretory phase
27
28
1
Ischemic phase
Menstrual phase
5



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THANK YOU