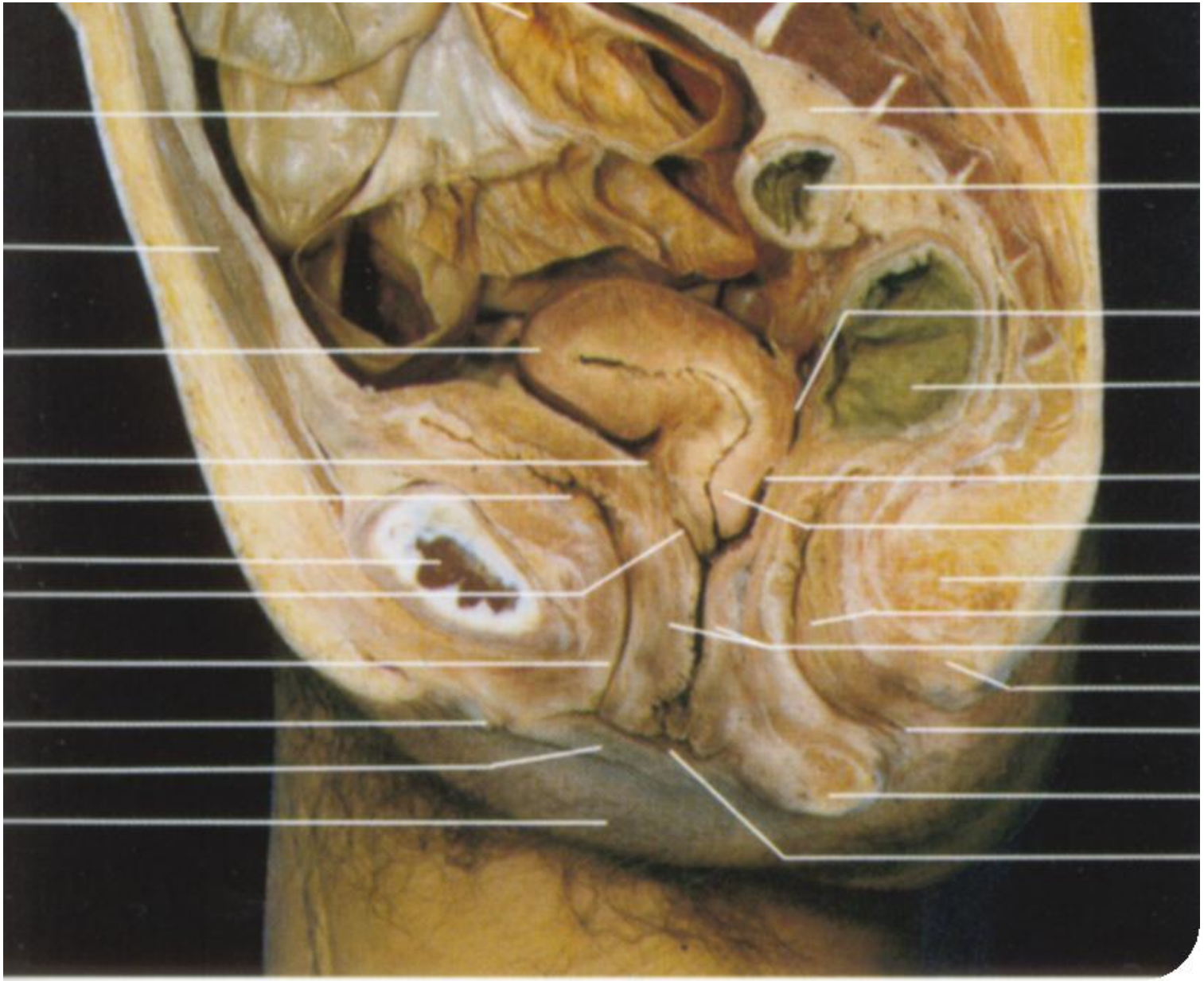
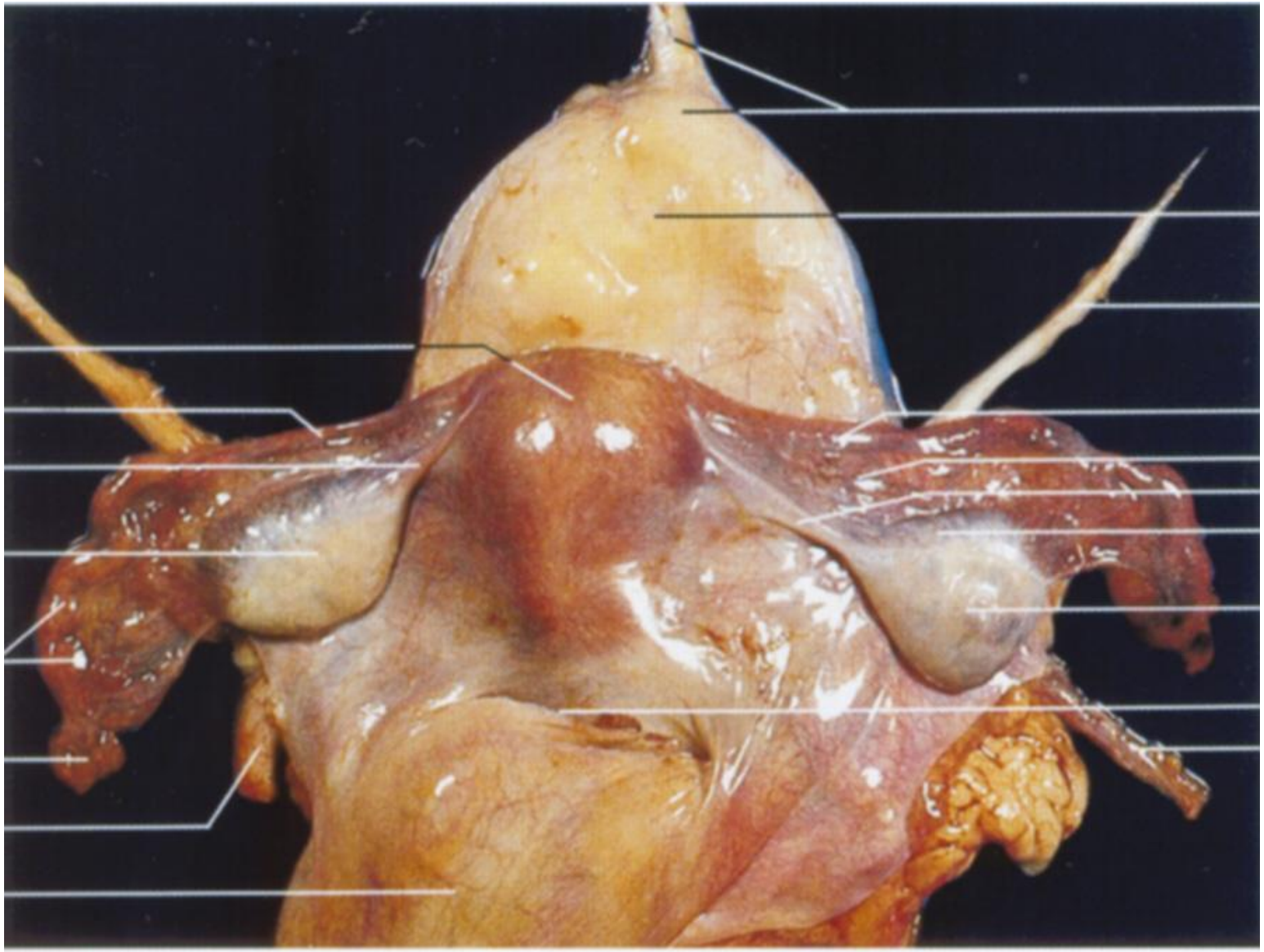
Oogenesis

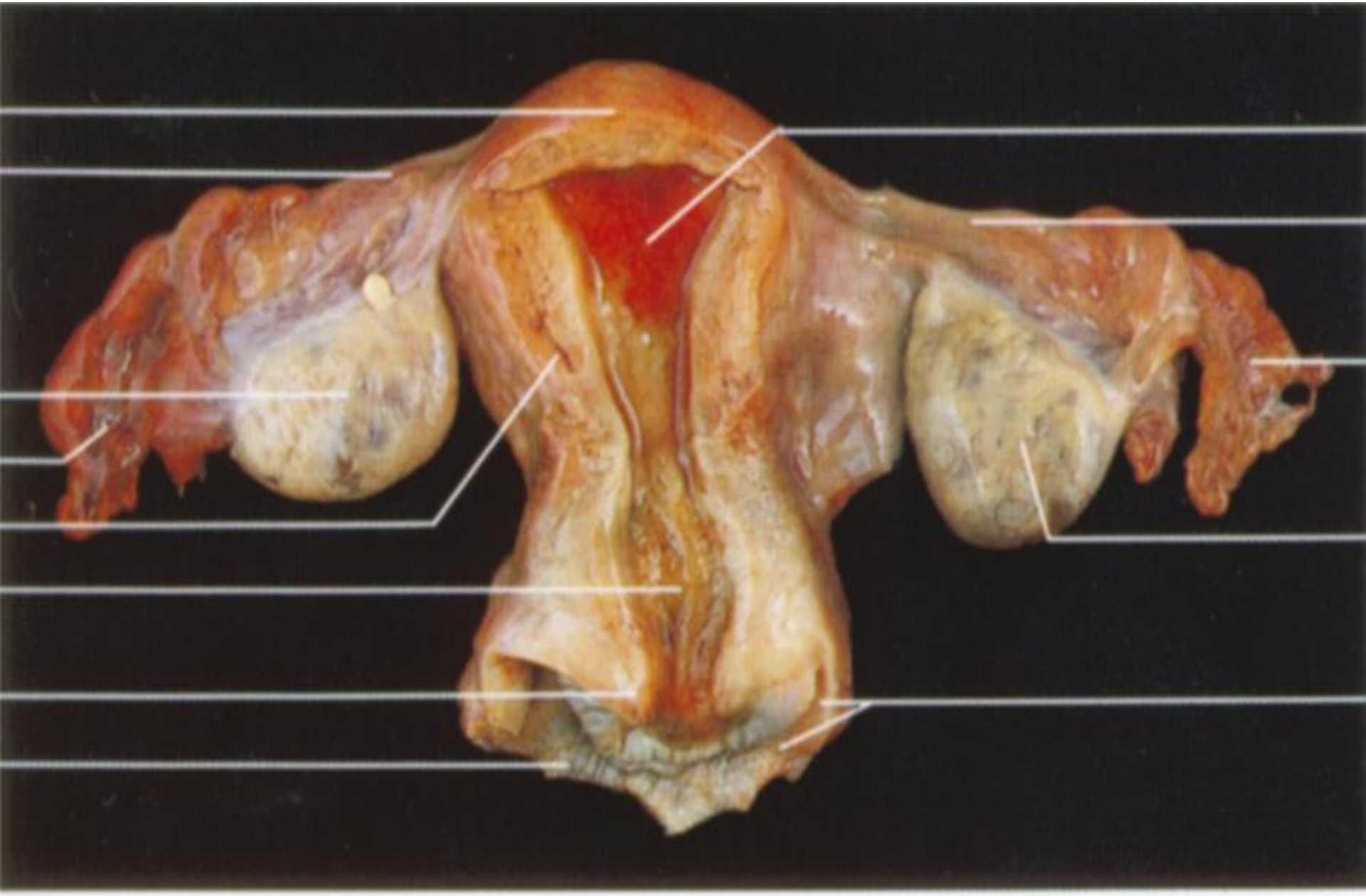
A process by which oogonia differentiate into mature oocyte

Female Pelvis-Sagittal section



Uterus, Uterine tubes & Ovaries





Oogenesis

Maturation begins before birth….arrested…. continues after puberty, throughout the reproductive life

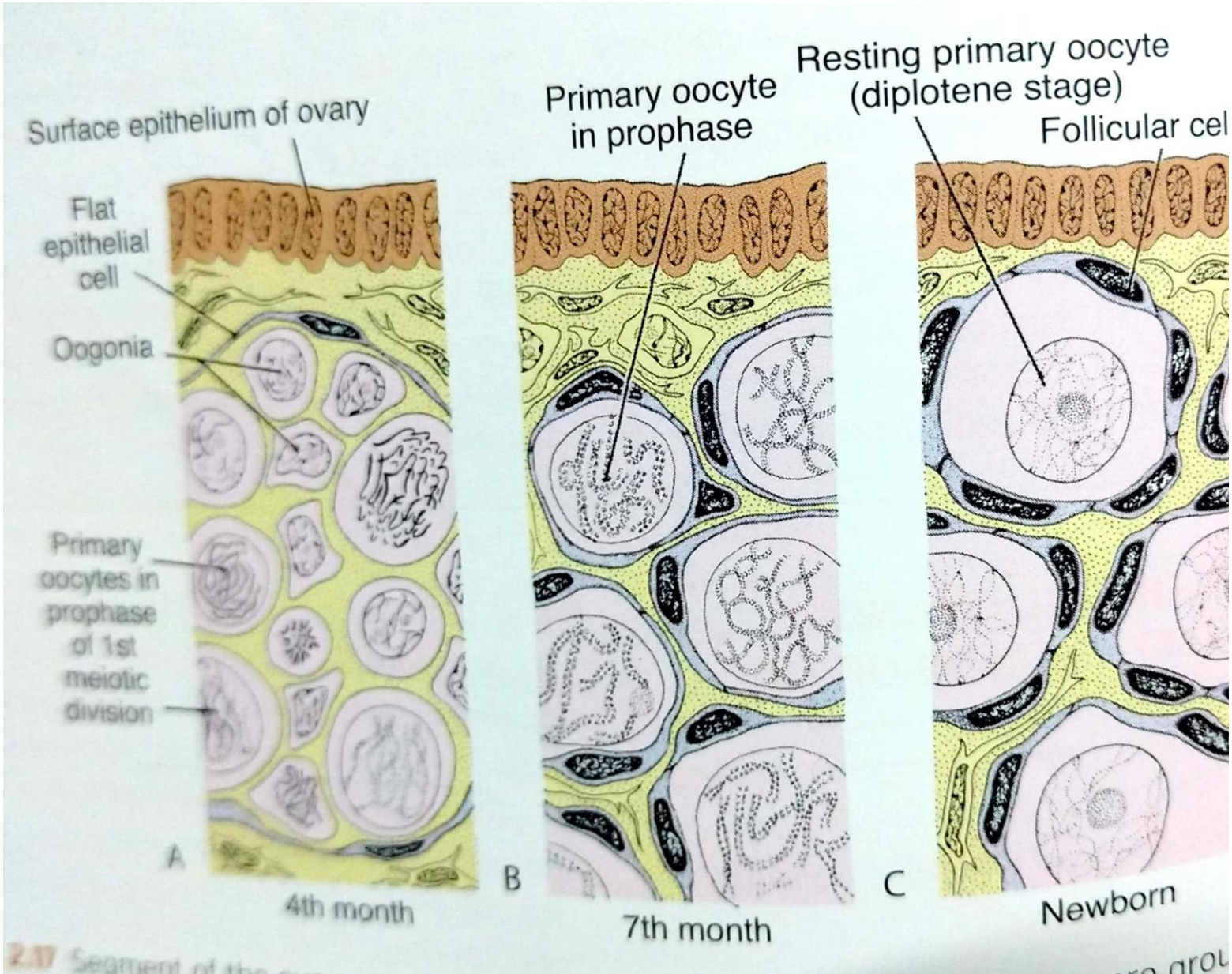
Involves activities of

- Hypothalamus
- Pituitary
- Ovary
- Uterus, Vagina & Uterine tubes
- Mammary Gland

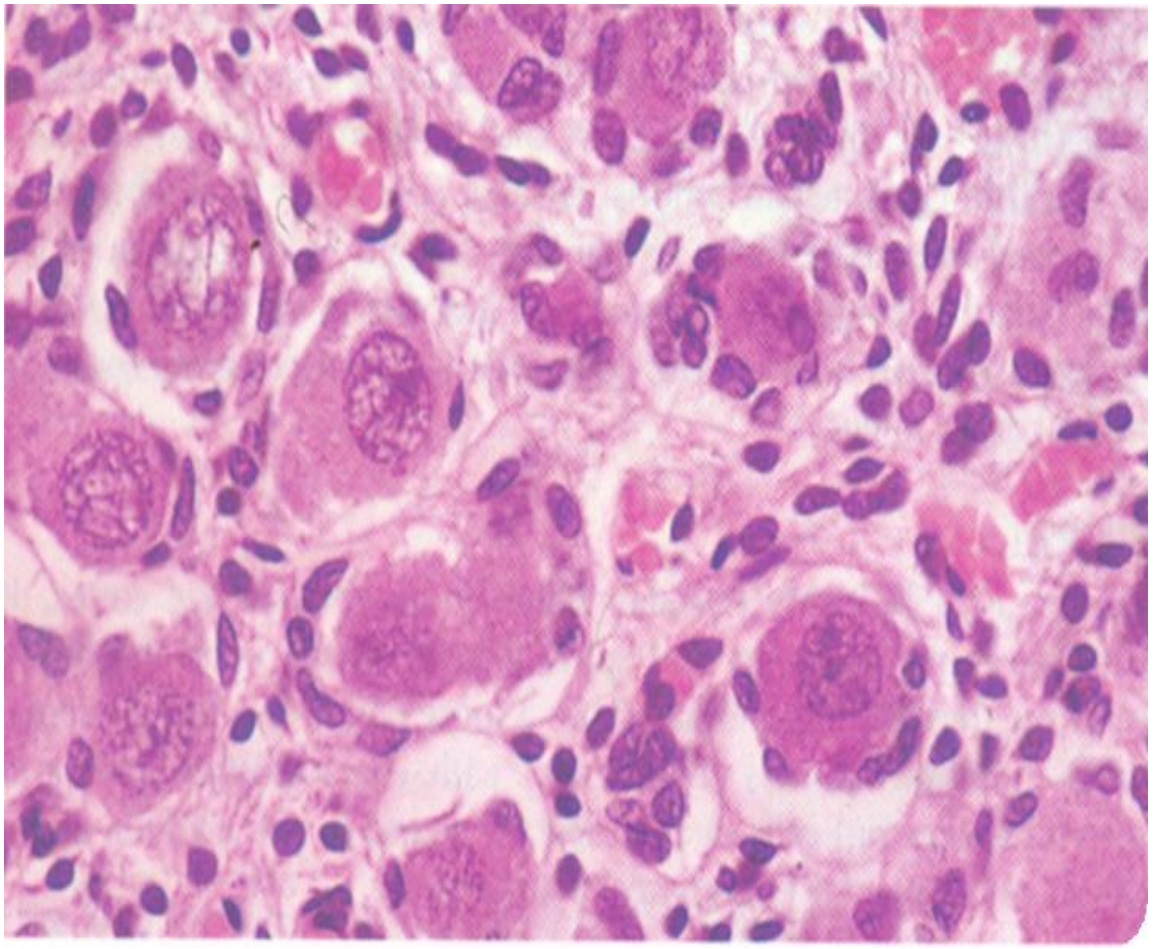
Oogenesis

- Three phases
    1. Prenatal : before birth
    2. Postnatal : after birth
    3. Post fertilization

Ovary
Different Stages of Development

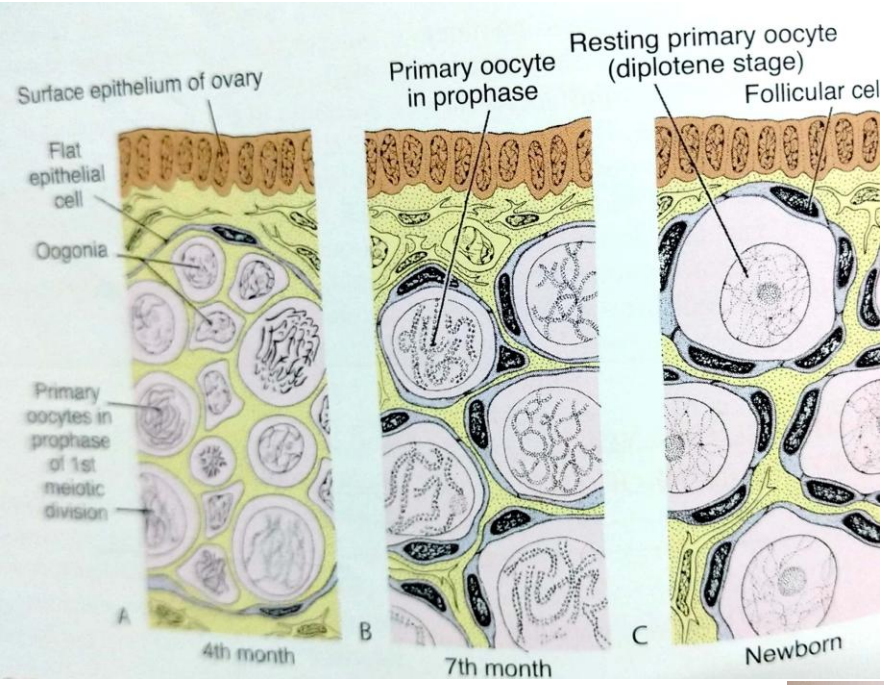


Oogenesis **Prenatal**

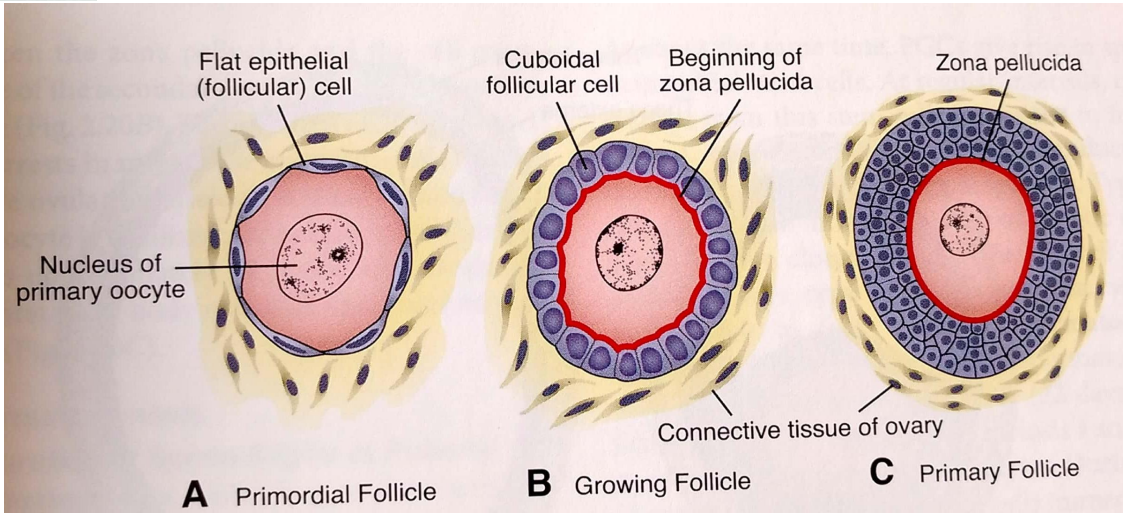


- Primordial germ cells
- Oogonia
- **Primary Oocyte**
- **M I**
- **Oocyte suspended in Diplotene phase of prophase of MI**

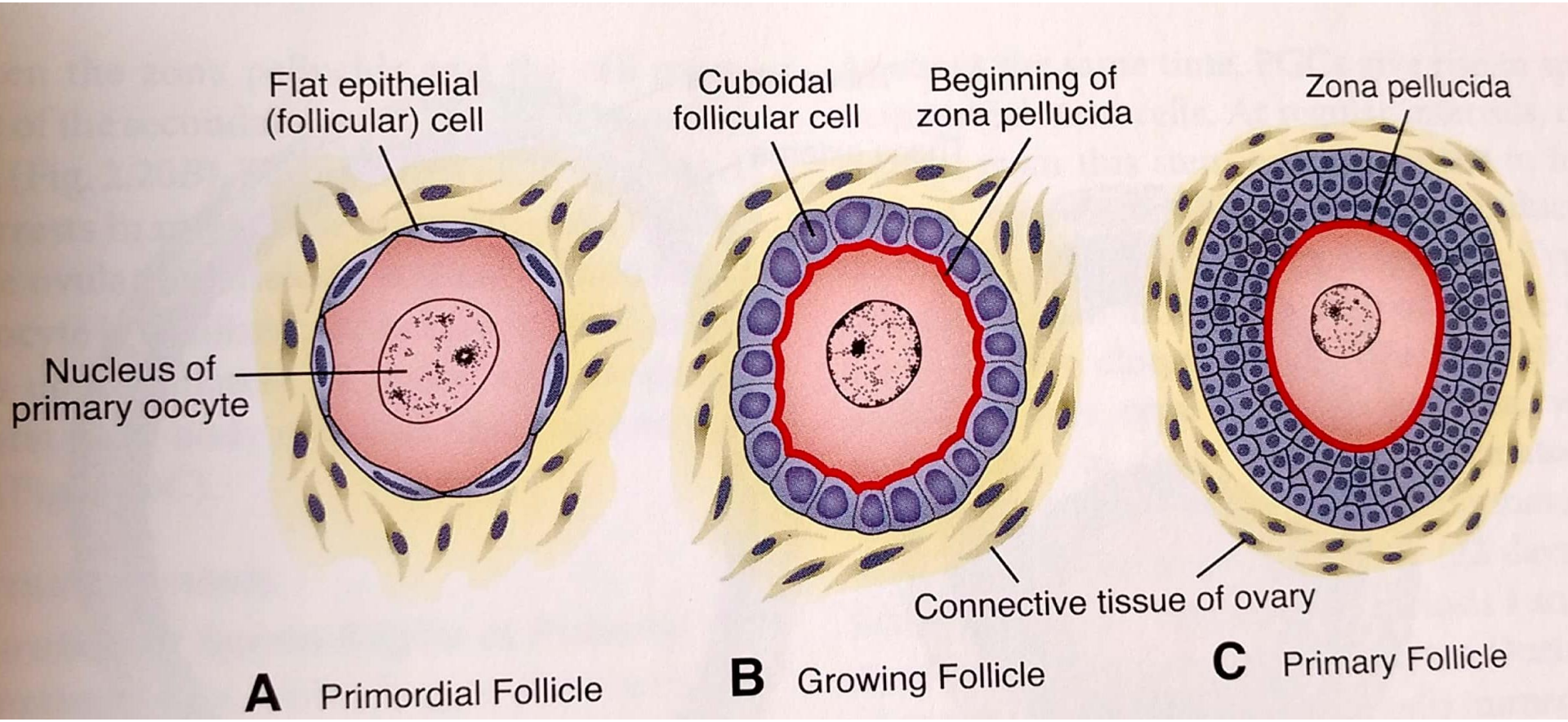
Ovary
Different Stages of Development



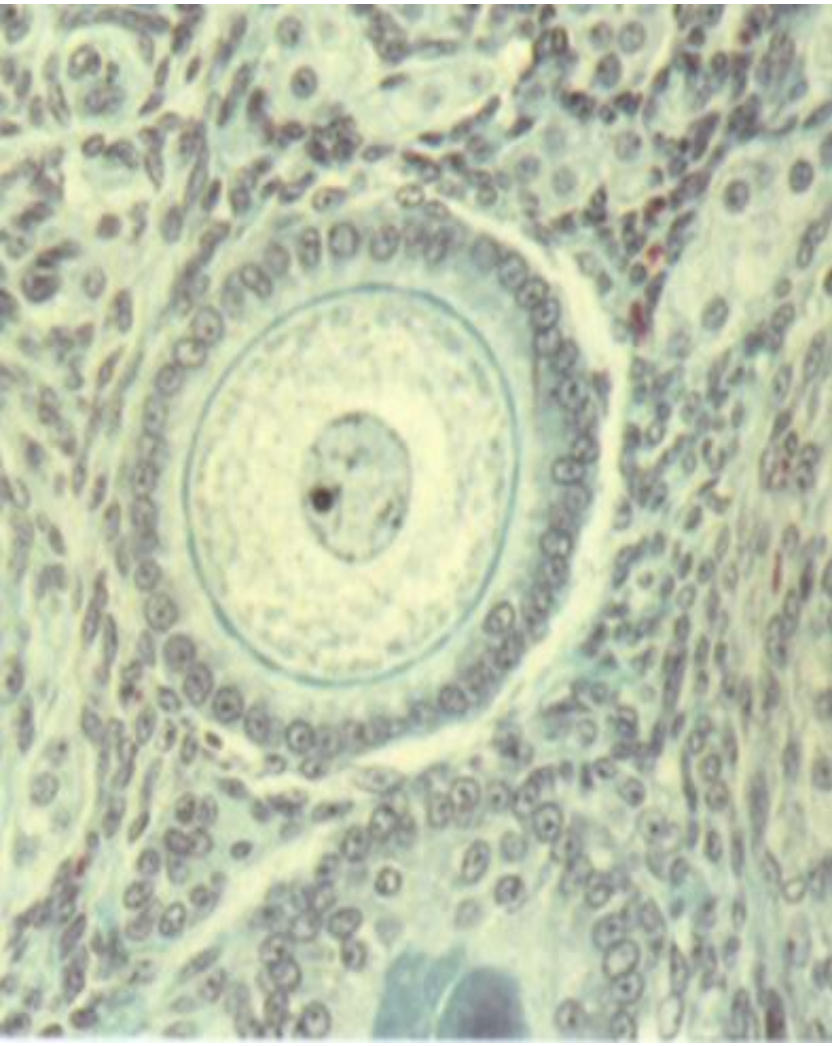
Ovarian Follicles
In various Stages Of Development



Ovarian Follicles In various Stages Of Development



Oogenesis - Postnatal



- Follicular cells- **Cuboid**

- Faint layer of Zona Pellucida between The Primary oocyte And The follicular cells

Stages of **Postnatal** Maturation

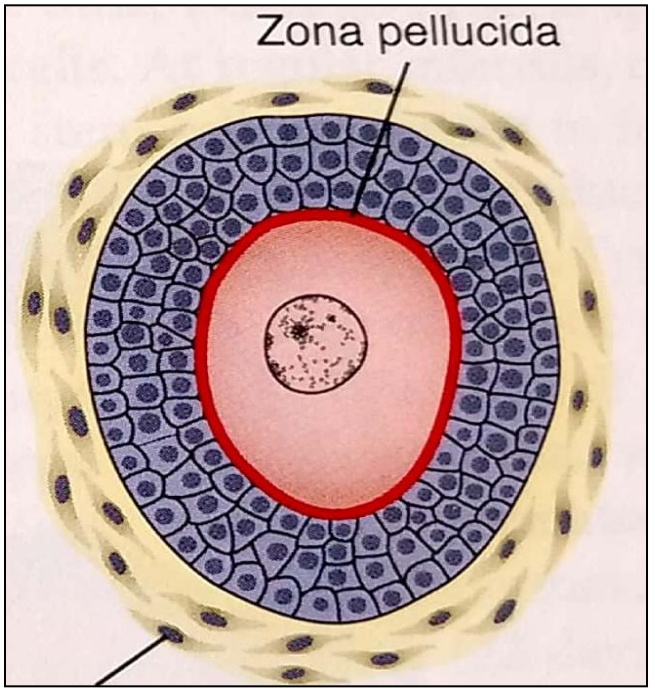
Primary follicle- (around Puberty)

1) Oocyte surrounded by multilayered cells

2) Stromal Cells-Theca Interna and Externa

3) Oocyte increases in size

4) Presence of Zona Pellucida



- **Primary oocyte** remain arrested in **prophase**

  and do not finish their first meiotic division

  before **puberty** is reached

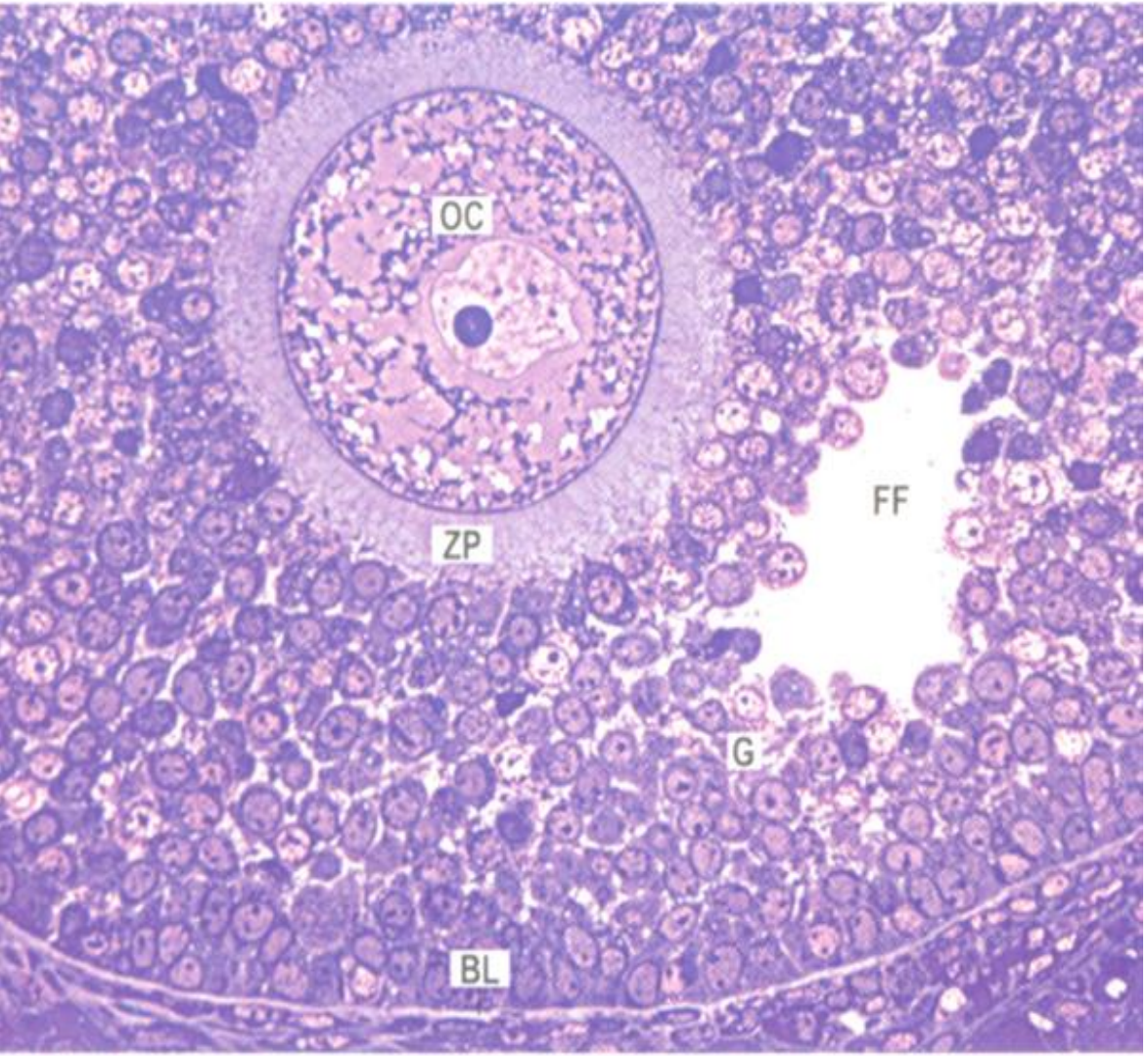
- The arrested state is produced by

  oocyte maturation inhibitor (OMI),

  secreted by

  follicular cells

Primary to Secondary Follicle



- Theca Interna
- Granulosa cells

Beginning of fluid filled cavity

- Antral follicle

- Zona Pellucida
- Oocyte

Zona Pellucida

- A glycoprotein coat that surrounds the oocyte
- Secreted by granulosa cells & oocyte
- **Functions**:

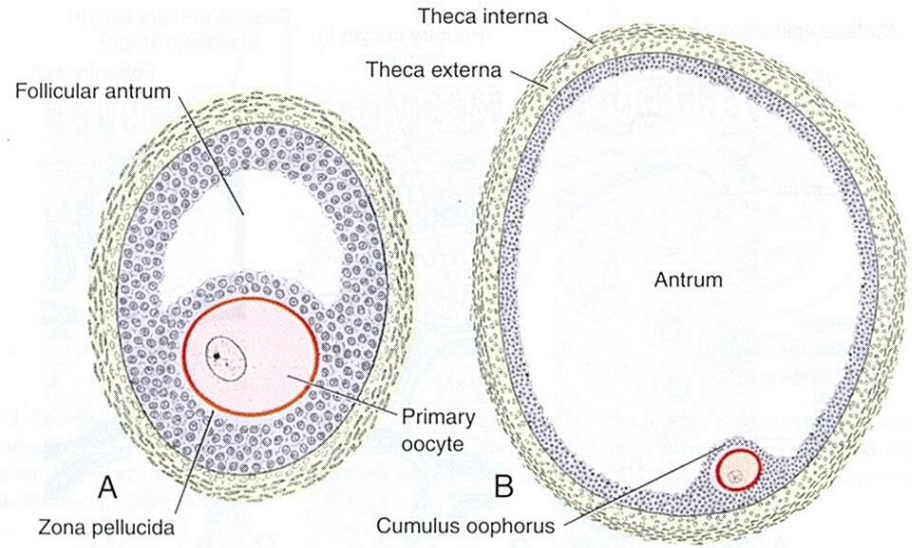
1. Facilitates binding of sperms & induces an acrosomal reaction
2. Prevents implantation before the zygote reaches the uterine cavity

- **Fate**:

Disappears on 5^{th} or 6^{th} day - implantation

Granulosa Cells

- Are derived from follicular cells
- Provide nourishment to primary oocyte till puberty
- Secrete zona pellucida (with oocyte)
- Secrete follicular fluid / liquor folliculi
- Secrete oestrogen (with theca interna cells)



- **Secondary Follicle**

1) Fluid filled spaces between granulosa cells – **antrum**

   Follicle: Vesicular or **antral follicle**

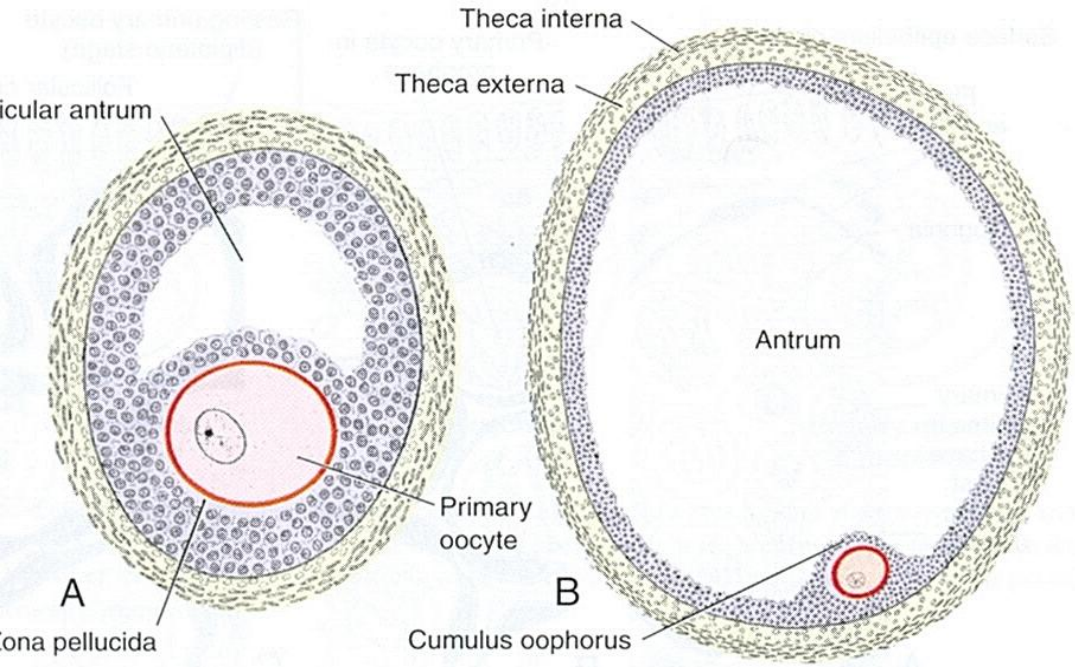
2) Membrana Granulosa

3) Cumulus Oophorus

4)**Theca Interna and Granulosa cells secrete Oestrogen**

Theca Interna and Granulosa cells secrete Estrogen

- The uterine endometrium enters the proliferative phase
- Thinning of cervical mucus to allow passage of sperms
- Anterior pituitary is stimulated to secrete LH

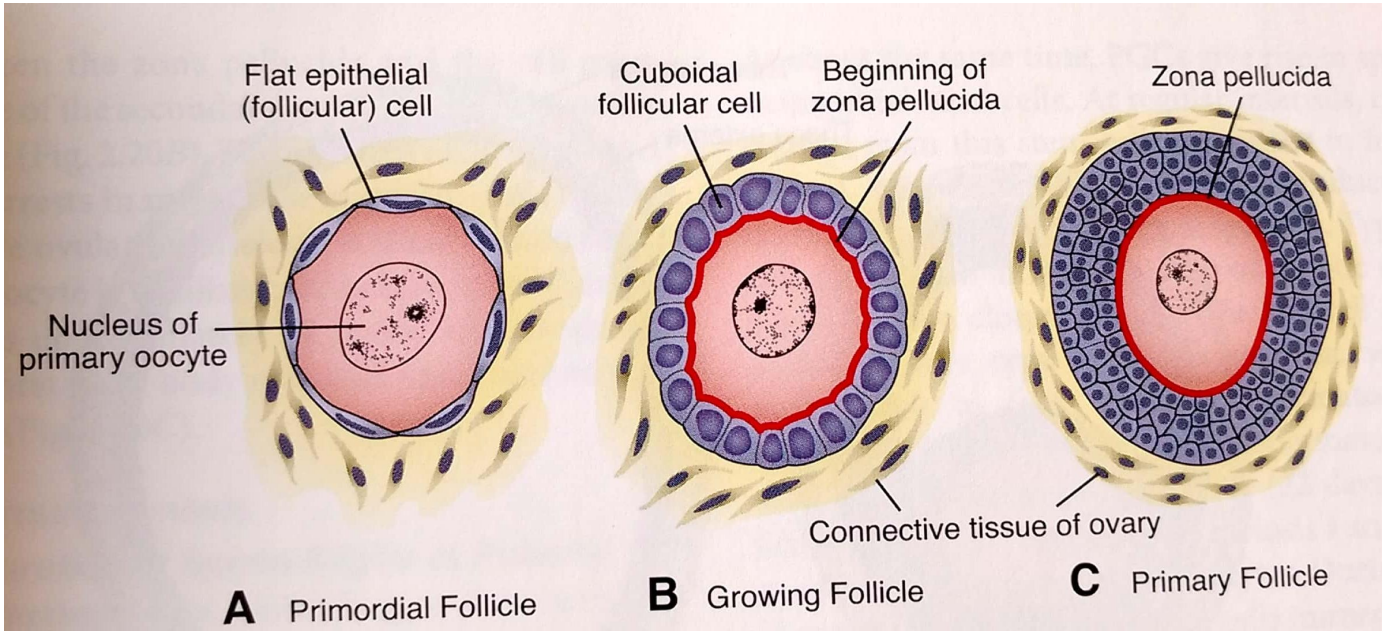


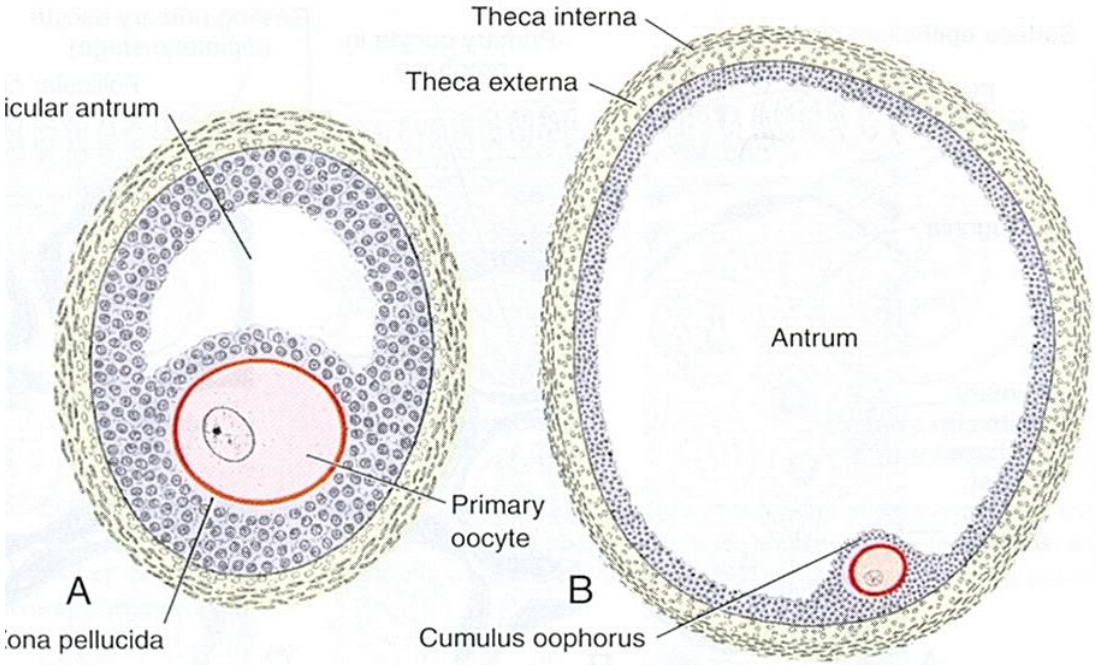
- First Week of Menstrual Cycle
- **Tertiary Follicle / graafian follicle**

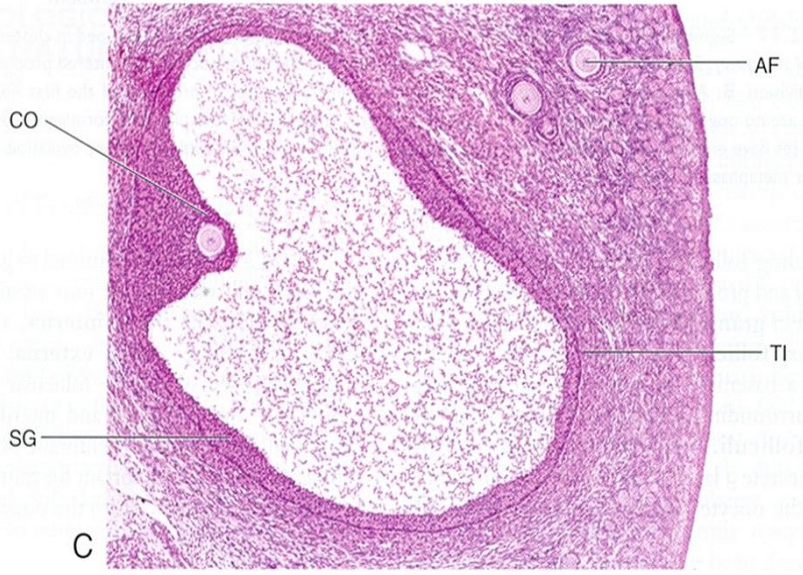
1) Follicle increases in size

2) Oocyte and Corona break away from the cumulus and float freely in liquor folliculi

Follicles : Various stages of development







At midcycle – LH surge

- Elevates the concentration of maturation factor, causing oocyte to **complete MI**
  (two daughter cells of unequal size, with 23 double structured chromosomes) &
  initiate MII

- Stimulates production of progesterone by follicular stromal cells

- Causes follicular rupture and ovulation

Just Prior to Ovulation

Primary Oocyte completes-

M-I within Zona Pellucida giving rise to

1) II ry Oocyte

2) 1st Polar Body

No 'S' phase between M-I and M-II

II ry oocyte begins-**M-II**

Arrested at Metaphase in Spindle formation-

Completed only if fertilization occurs-

2nd ry oocyte-- Ovum, polar body

Polar body- ----2 polar bodies (variable)

Contd

- **Stigma -** Follicle moves to the surface of the Ovary

OVULATION

- Release of II ry oocyte with 1st polar Body within Zona pellucida

  + Corona Radiata

  + Liquor folliculi

Into the Peritoneal cavity

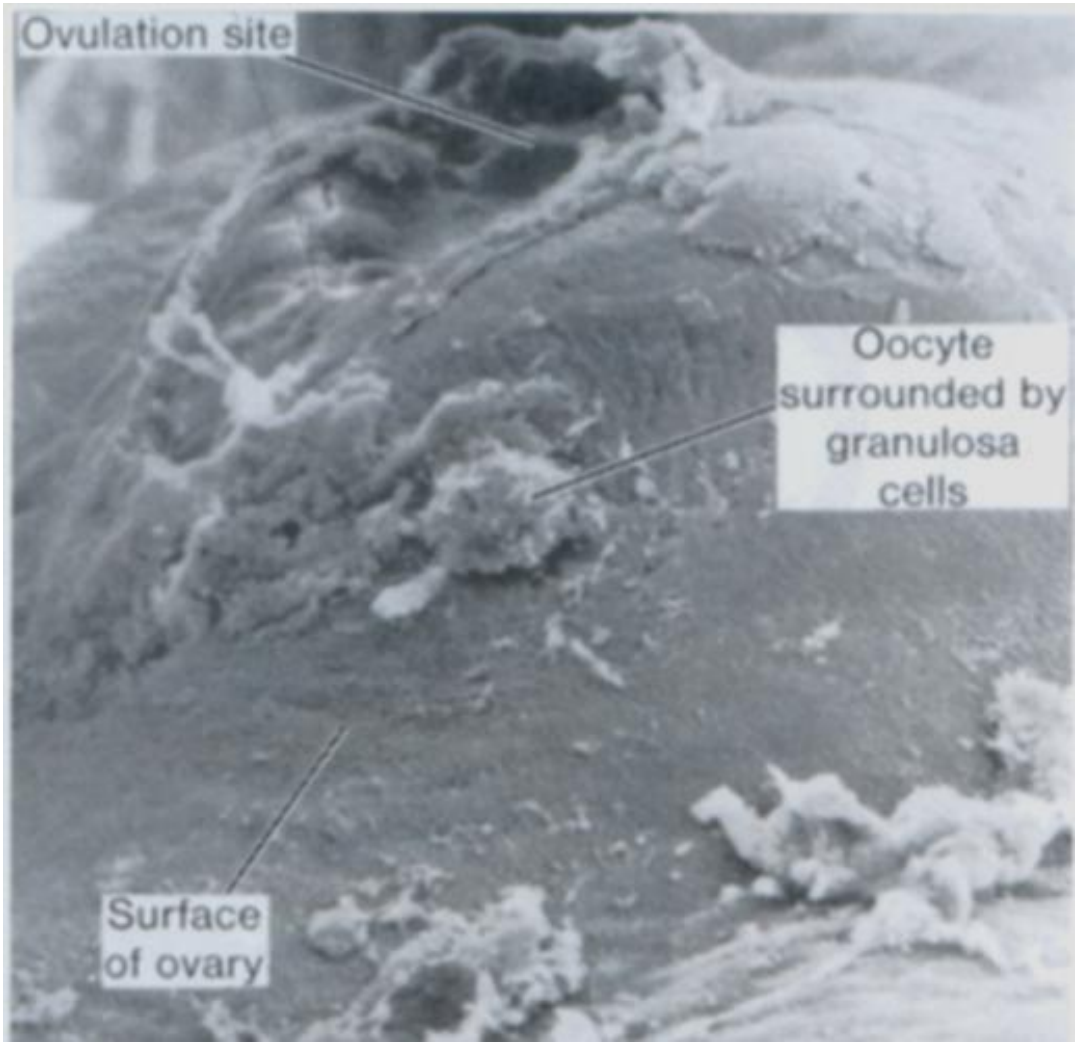
Factors leading to Ovulation

- High concentration of LH in the blood

……. **Increased activity of enzyme collagenase**

- High concentration of prostaglandins …. Contraction of smooth muscles in the wall of the ovary
- Increased pressure of fluid in the follicular cavity

Ovulation - Surface of the Ovary, Ovum



Oocyte with Zona Pellucida & Granulosa cells

Fate of Ovum

- **Ovulation** – 14 days prior to next menstruation
- Not Viable after 24 hrs
- Oocyte degenerates if No fertilization

Oogenesis

- Oogenesis takes place in the cortex of ovary
- Primordial germ cell arrive at gonads of genetic female
- Differentiate into the oogonium
- No. of mitotic divisions
- End of three months – arranged in clusters
- Get surrounded by epithelial cells, follicular cells
- Follicular cells: derived from surface epithelium of ovary
- Majority of oogonia continue to divide by mitosis
- Some of them arrest their cell division enlarge to form primary oocyte
- At birth, all primary oocytes enter prophase of MI
- Division is arrested & resumes only at puberty
- At puberty at each cycle 15-20 primary oocytes resume MI & is completed just before ovulation

Ovulation

Short note

- What
- Where
- When
- How
- Factors responsible
- Factors inhibiting
- Fate
- Appropriate diagrams

Ovulation

Ovulation is independent of copulation

- Ascertaining features of ovulation

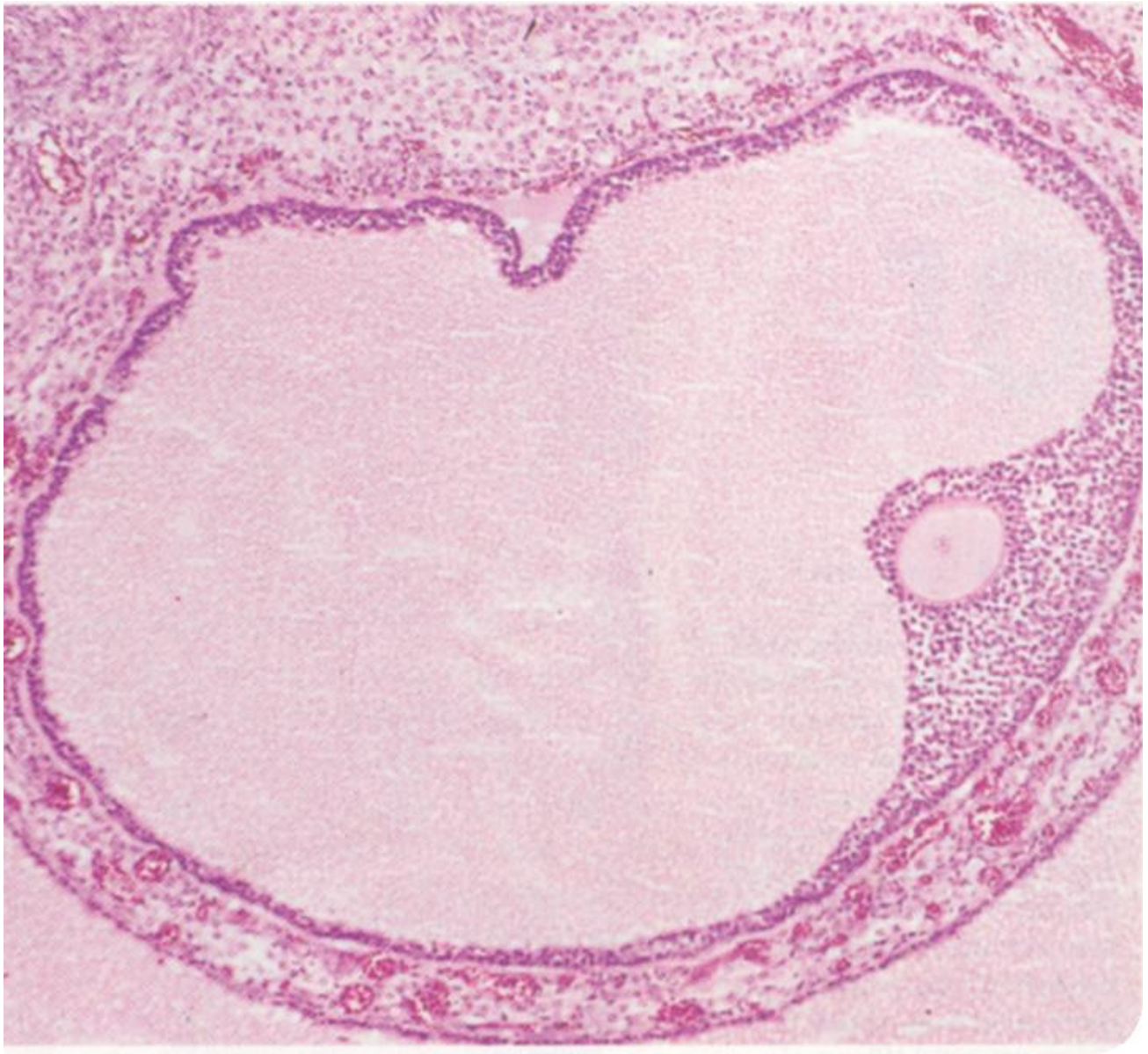
1. **Endometrium**-Histological examination
2. **Cervix**-Thinner, profuse, and clearer mucus
3. **Vagina**-Cornification +++ layers
4. **Ovary**-Direct observation
5. **Hormones**- Blood estrogen, progesterone
6. **Abdomen**-Lower abd. Pain - Mittleschmerz
7. **Body Temp**- Slight rise in Midcycle

Oogenesis----Summary

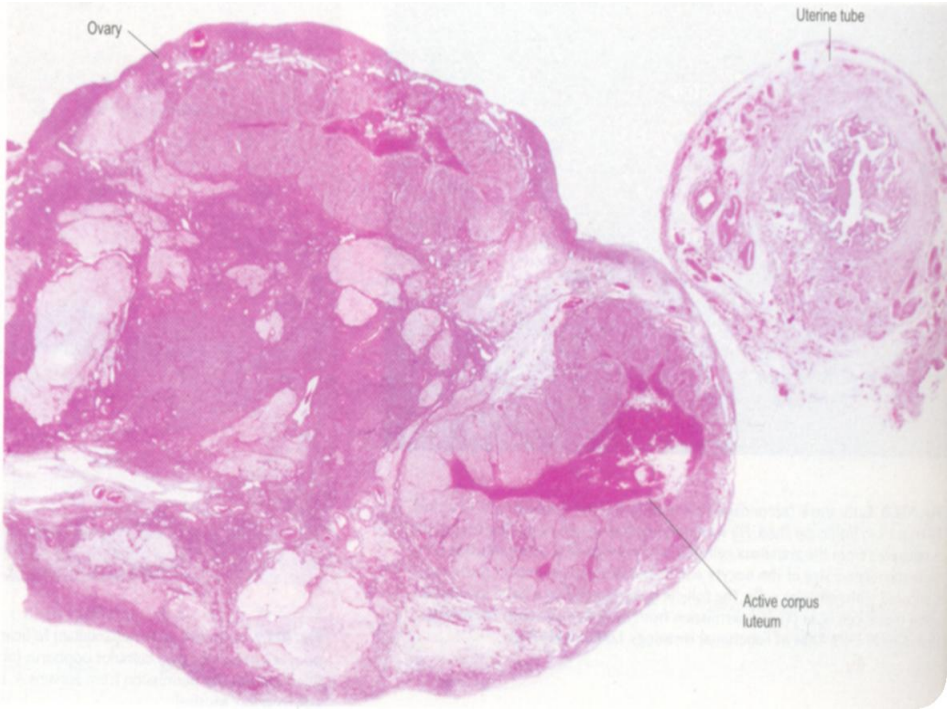
PRENATAL

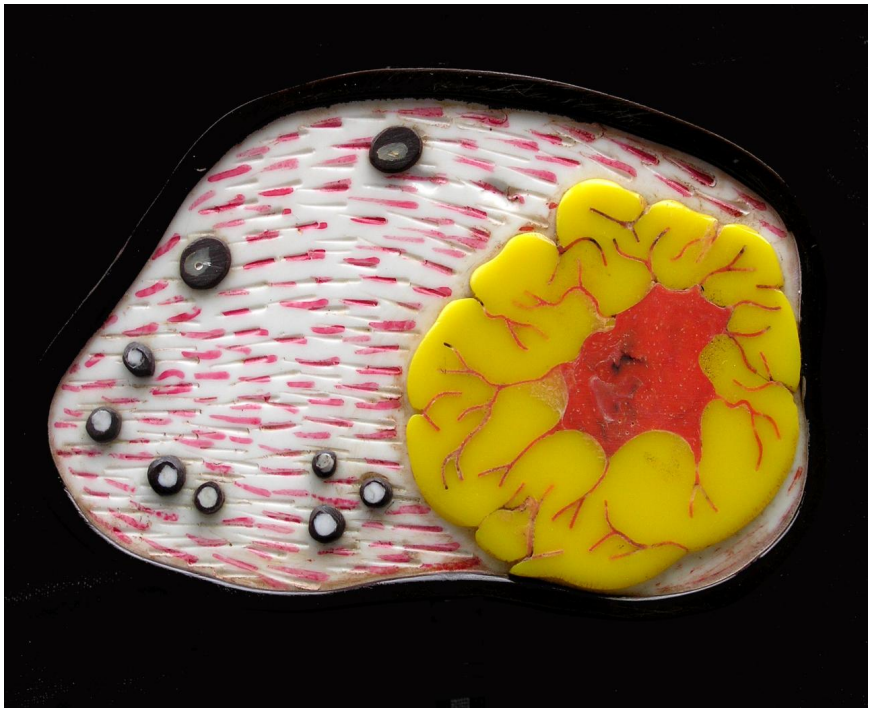
8-10 weeks	Oogonia
12 weeks	I ry Oocyte
16-18 weeks	70,00,000
BIRTH: primary oocyte	**6 - 8,00,000**
Puberty	40,000
Reproductive Life	400 - 500
Every Month	**1 (one)**

Graafian Follicle



Corpus Luteum





- **Corpus Luteum - Yellow body**

- Immediately on Ovulation- Stage of **Collapse**

- 2nd, 3rd day---------- Stage of **Vascularity**
  Progesterone secretion

- 4th day---------- Stage of **Maturity** in
  Luteal cells, capillaries

- **8th day---** **Peak period of activity**

In Absence of fertilization

- 2-5 days prior to next M C-- Stage of Retrogression

- Corpus Albicans

Fate of Corpus Luteum

Fertilization

C L of pregnancy

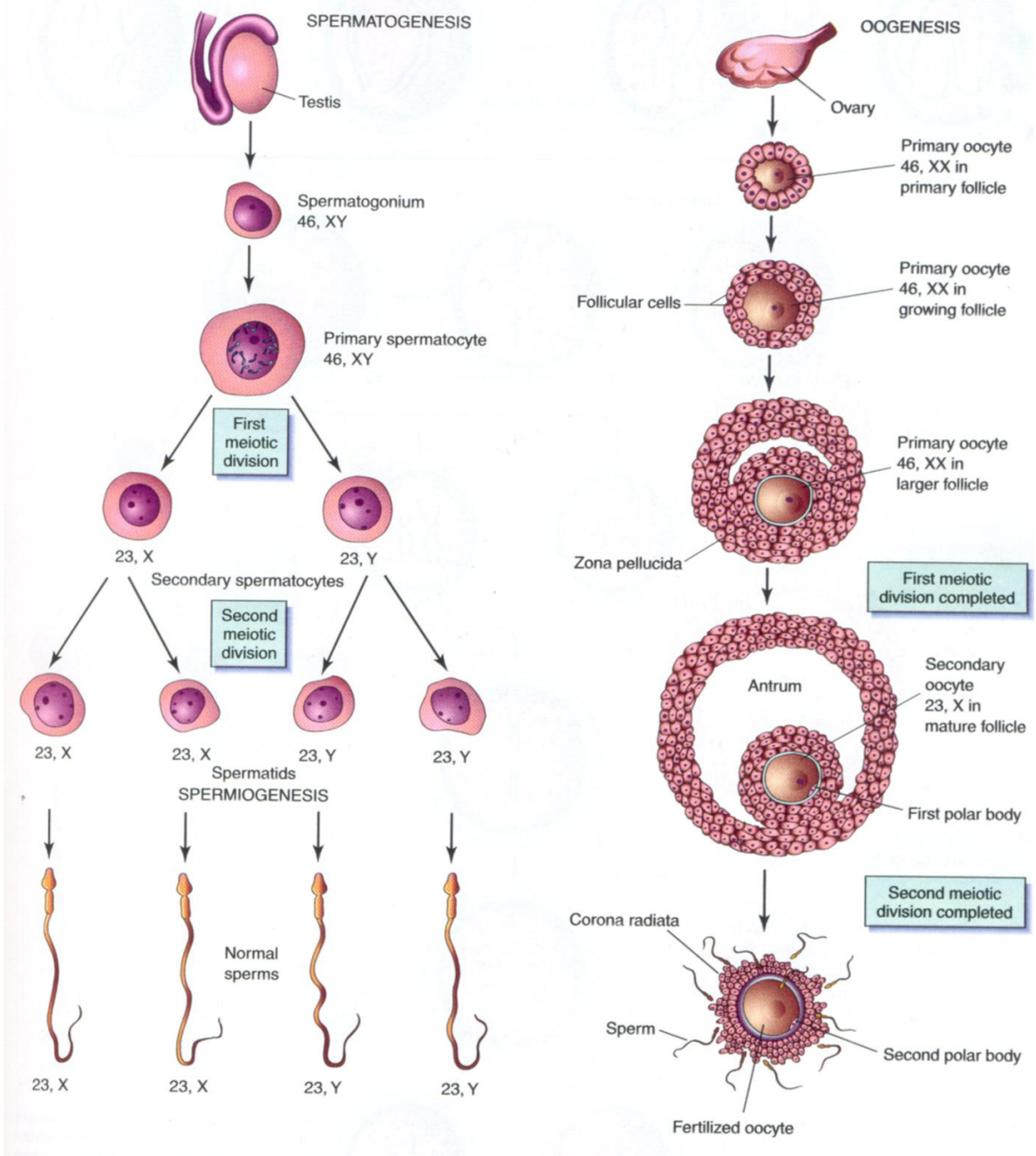
- Corpus Luteum + + es in size for 3 months
- Actively secretes Progesterone till the end of 4^{th} month
- Slow retrogression-after 4^{th}month once the Placenta takes over the function
- Corpus Albicans

Absence of fertilization

C L of Menstruation

- Fatty degeneration
- Fibrosis
- Cell shrinkage
- Less vascularity
- Corpus Albicans

NORMAL GAMETOGENESIS



Control of Ovulation

- **Induction of Ovulation** –gonadotropic hormones

  Polyovulation, polyembryony

- **Suppression of Ovulation-**

  Estrogen - suppresses- **F.S.H.**

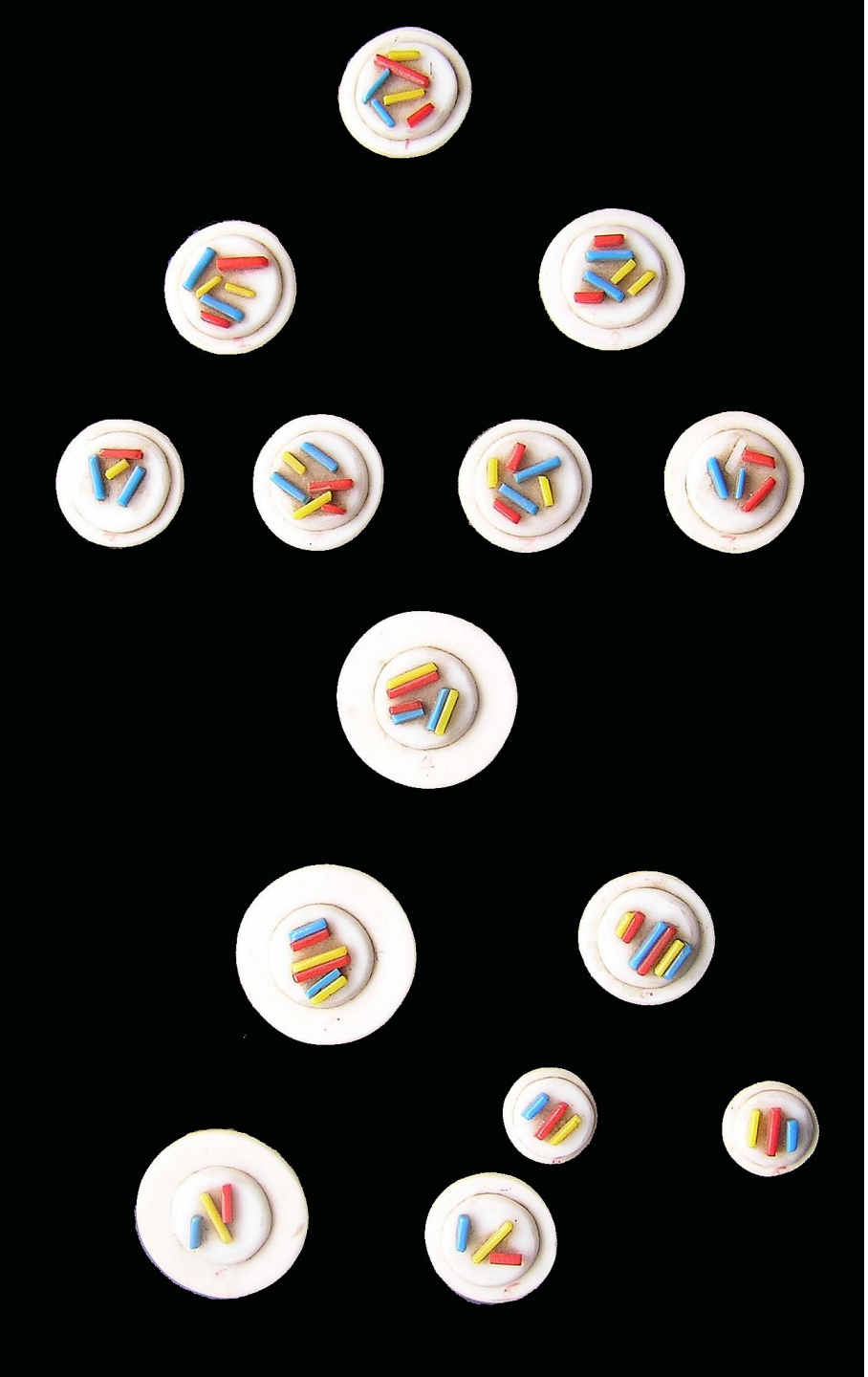
  Progesterone - suppresses- **L.H.**

  (render cervical mucus- thick, with low Ph)

Factors affecting Ovulation

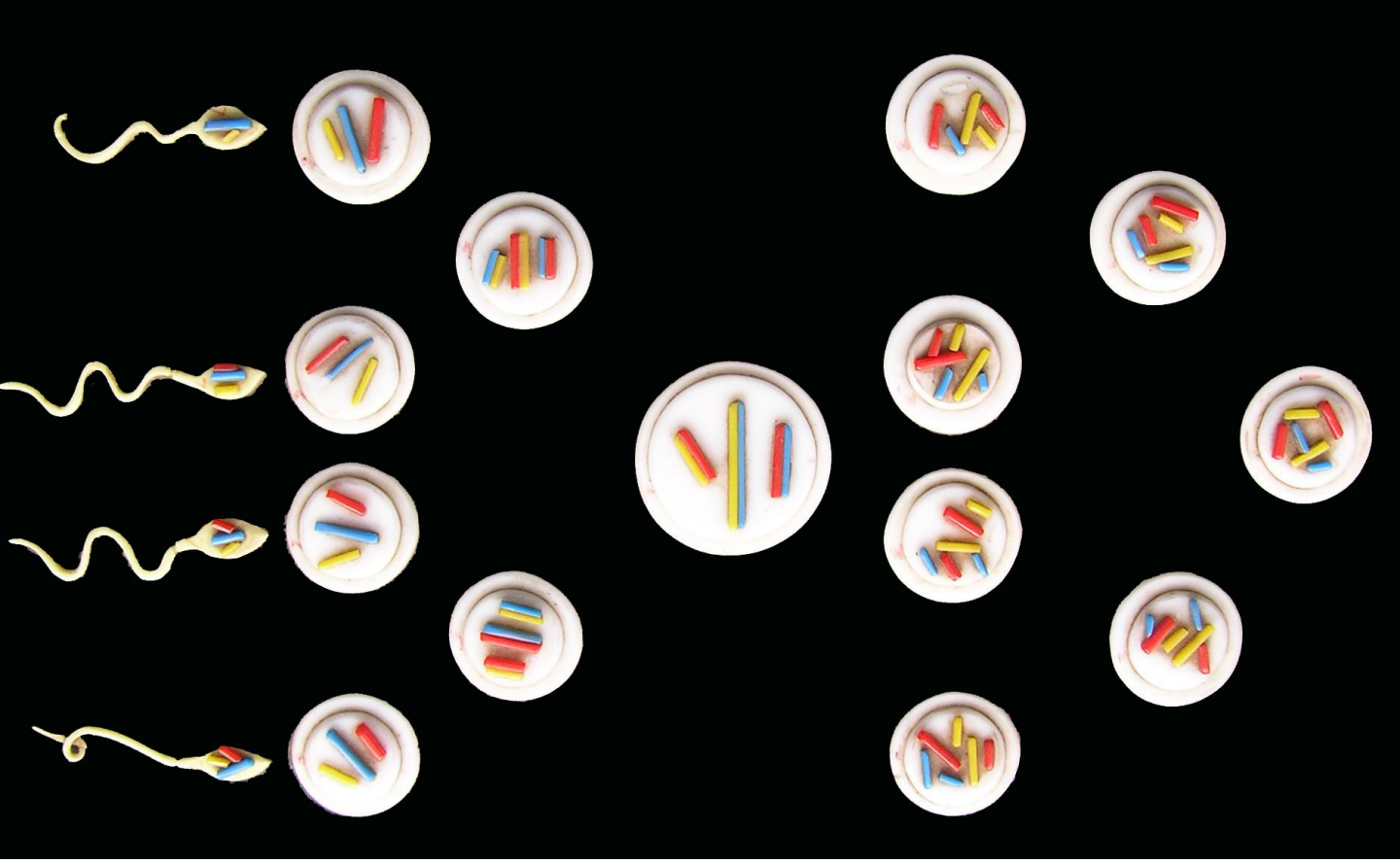
- **Age-** Ideal age---18-35
- **Pregnancy-**Normal ovulation suppressed.
- **Lactation-** Usually suppressed ovulation
- **Disease-** Malnutrition, extreme obesity
  Endocrine disorders
  Genetic disorders
  Emotional Factors
  Environmental factors

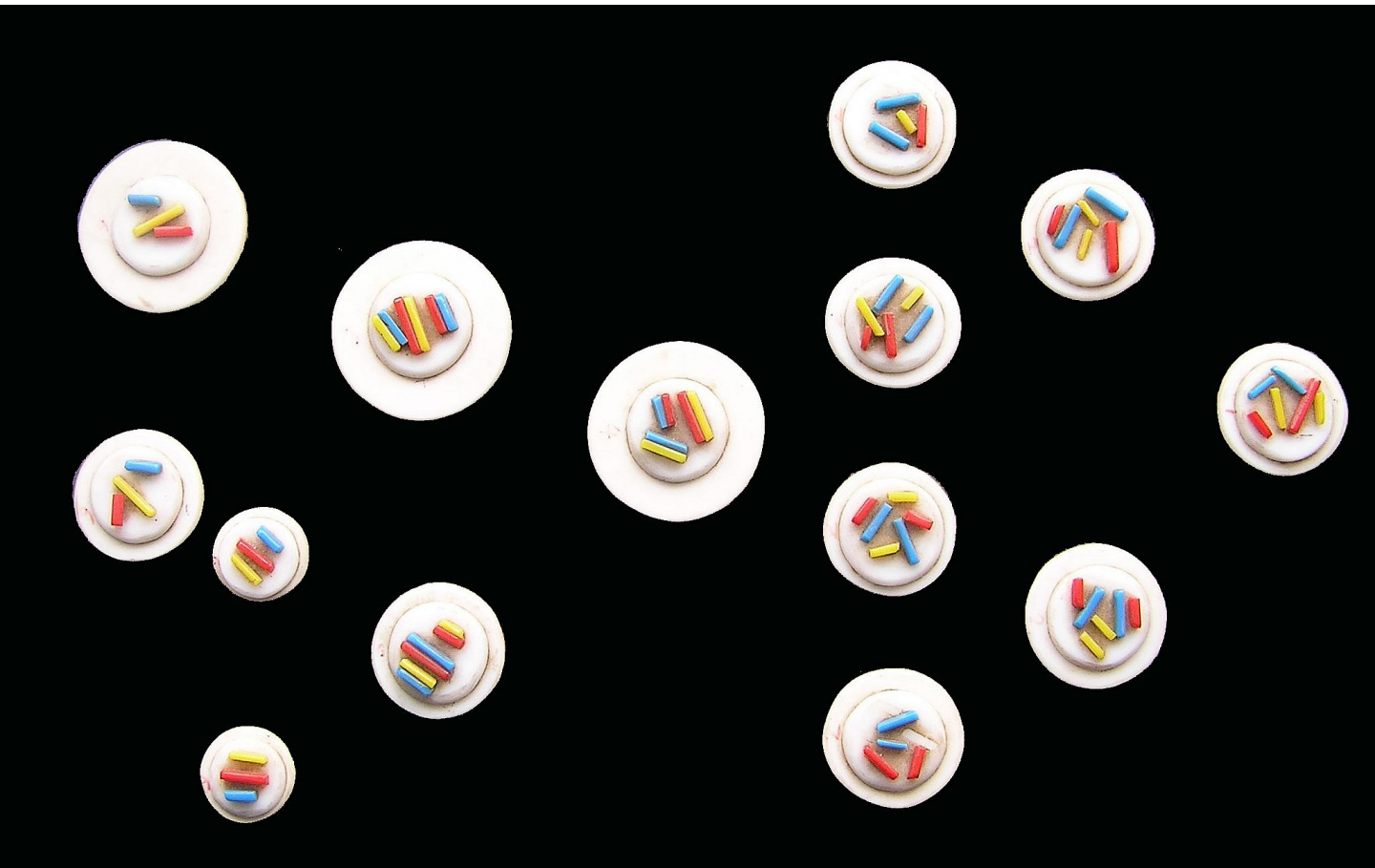
- The fact that risk of having children with chromosomal abnormalities increases with maternal age indicates that primary oocytes are vulnerable to damage as they age.



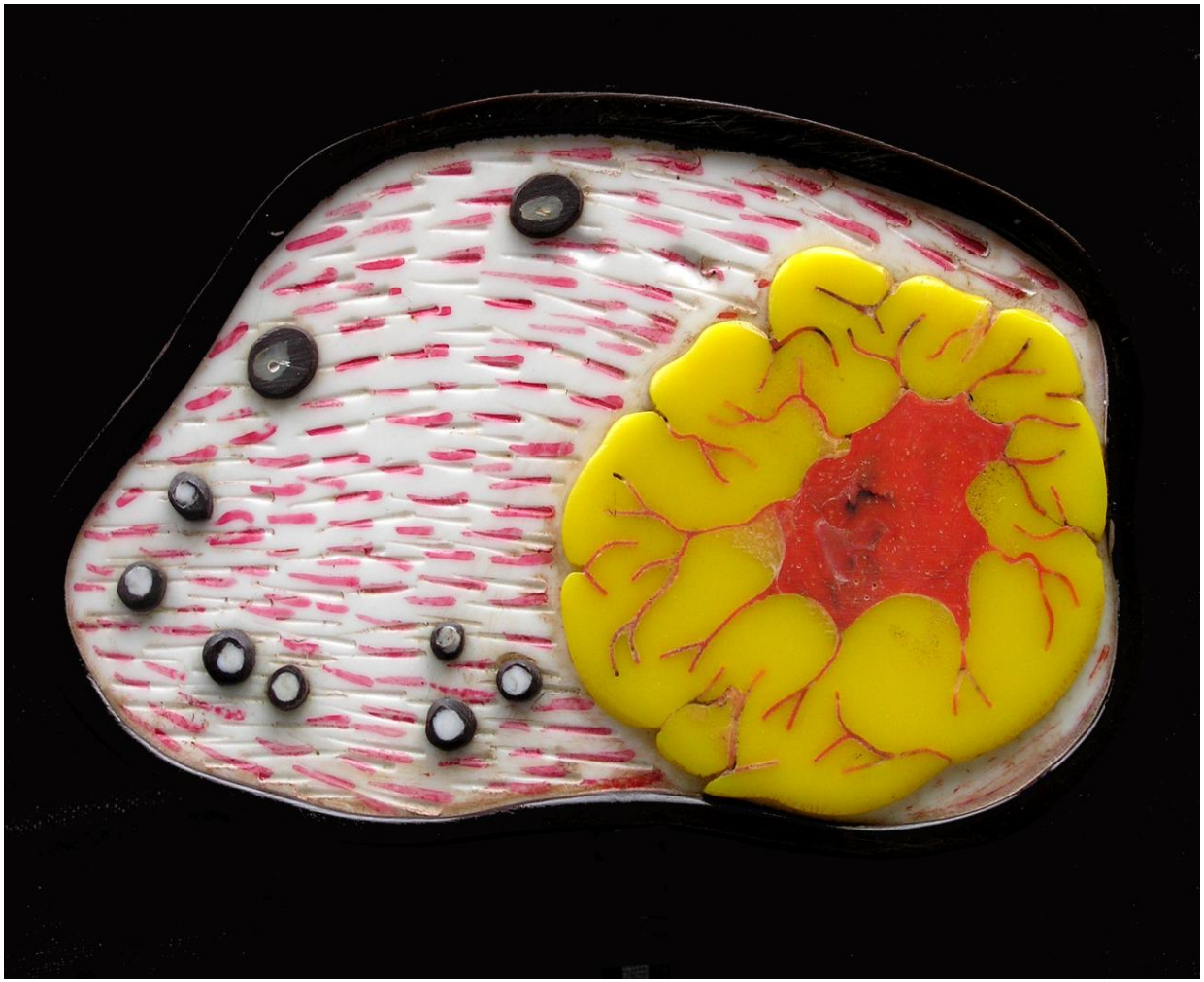
- Oogonia
- Oogonia
- Primary Oocyte
- 2^{nd}oocyte,1^{st}polar body

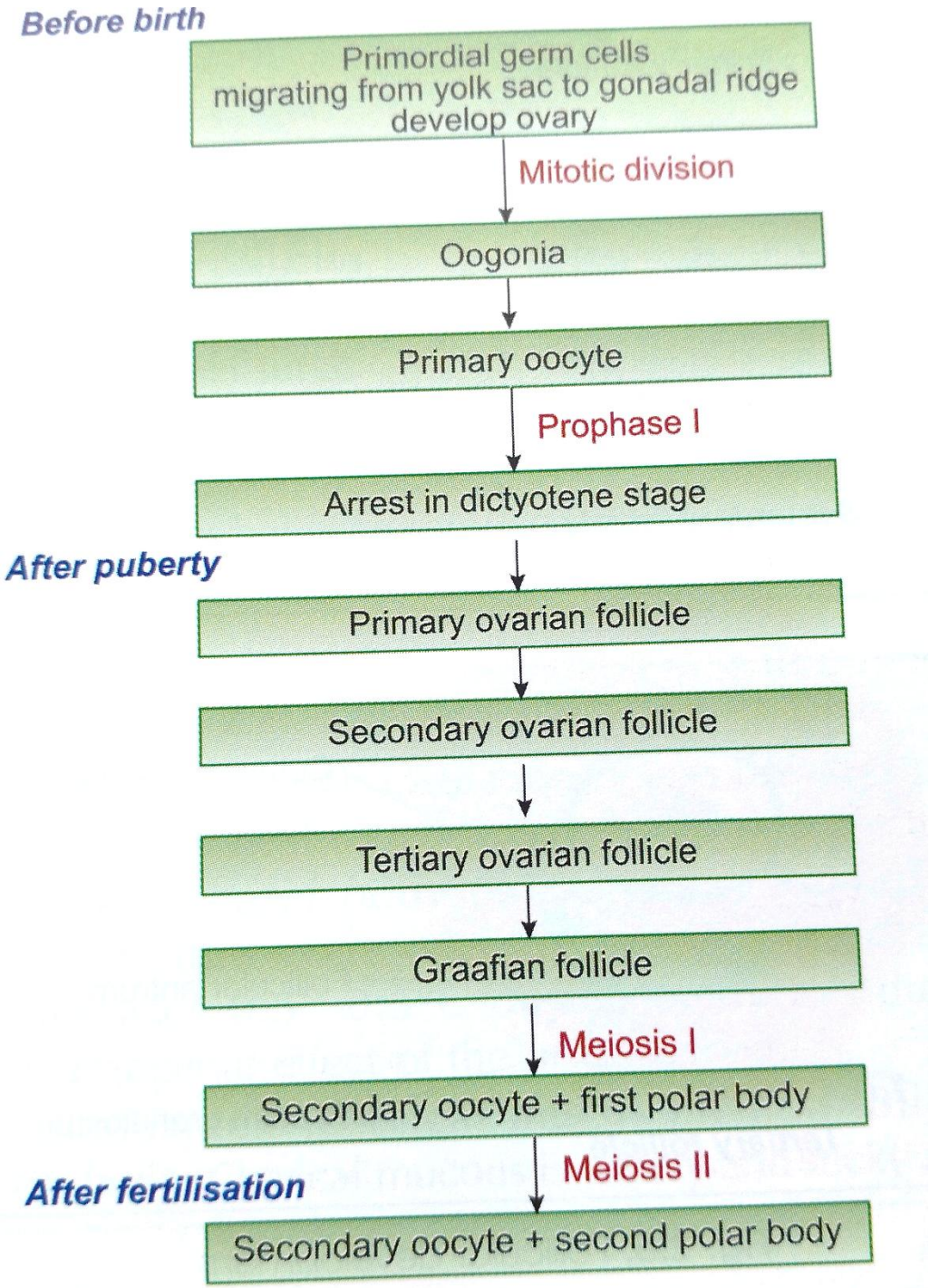
Ovum,3 polar bodies

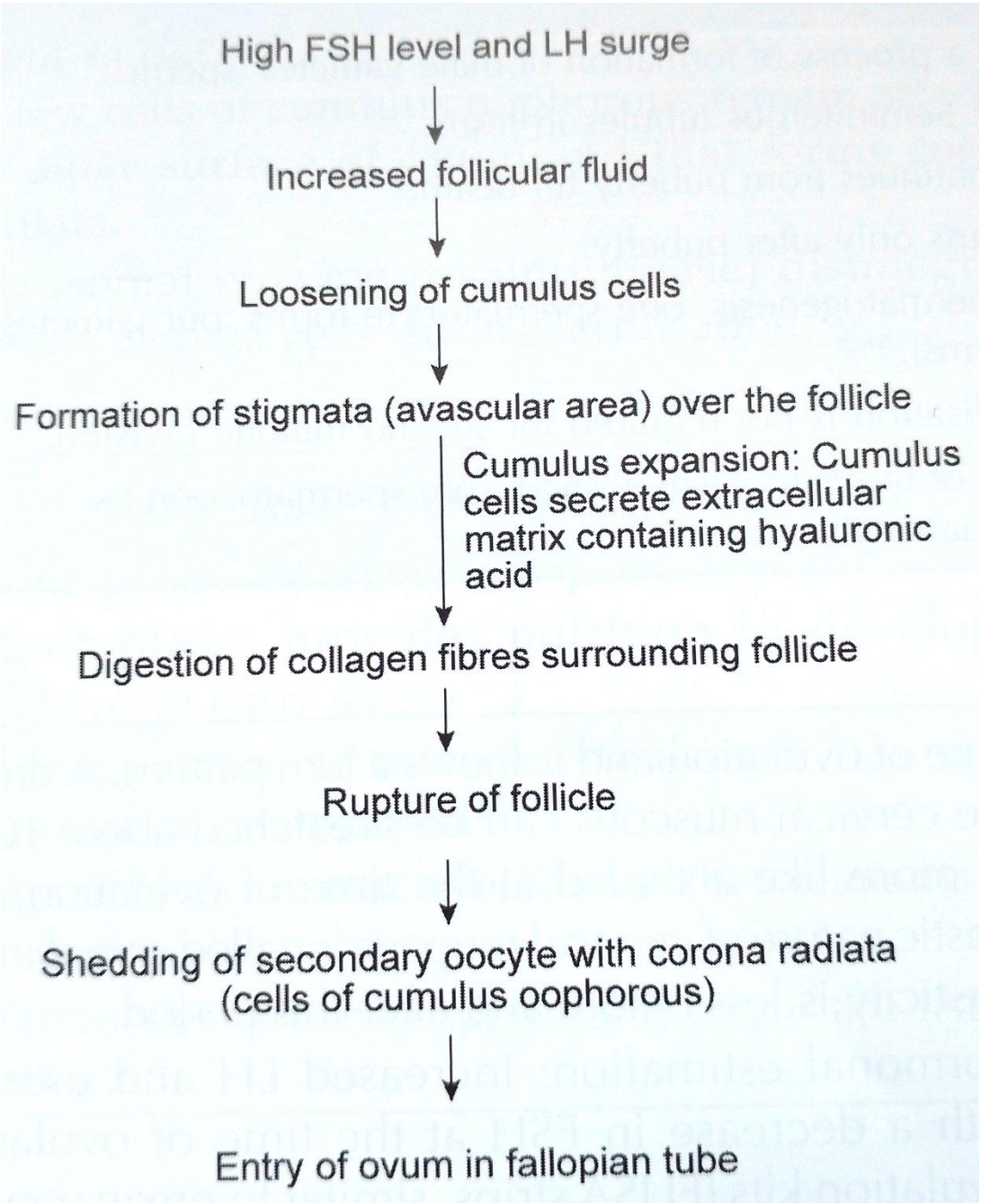




Corpus Luteum




Before birth
Primordial germ cells migrating from yolk sac to gonadal ridge develop ovary
Mitotic division
Oogonia
Primary oocyte
Prophase I
Arrest in dictyotene stage
After puberty
Primary ovarian follicle
Secondary ovarian follicle
Tertiary ovarian follicle
Graafian follicle
Meiosis I
Secondary oocyte + first polar body
Meiosis II
After fertilisation
Secondary oocyte + second polar body


High FSH level and LH surge
Increased follicular fluid
Loosening of cumulus cells
Formation of stigmata (avascular area) over the follicle
Cumulus expansion: Cumulus cells secrete extracellular matrix containing hyaluronic acid
Digestion of collagen fibres surrounding follicle
Rupture of follicle
Shedding of secondary oocyte with corona radiata (cells of cumulus oophorous)
Entry of ovum in fallopian tube

Thank You