University of Baghdad
College of Medicine
2024-2025

Title: Gametogenesis

Grade: One

Module: HDTD

Speaker: Prof. Dr. Malak A. Taha

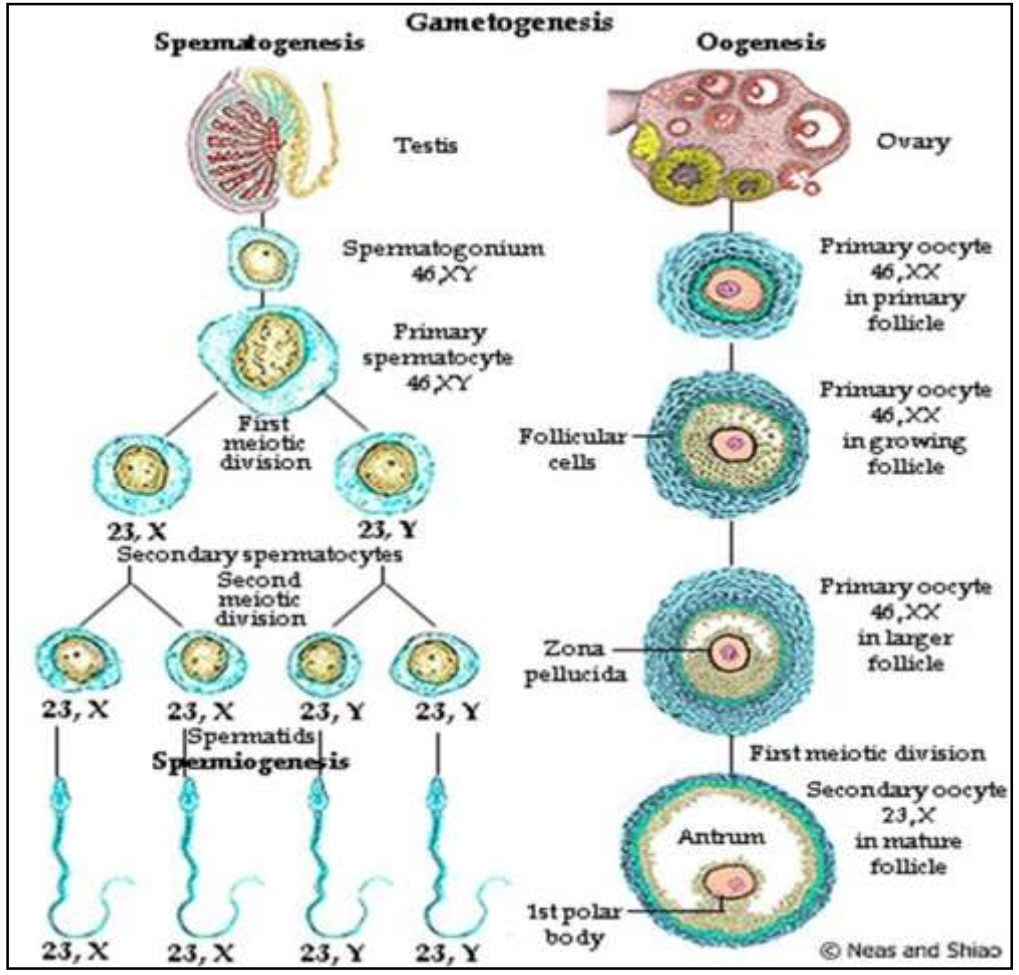
Date: 24-25/12/2024

OBJECTIVES

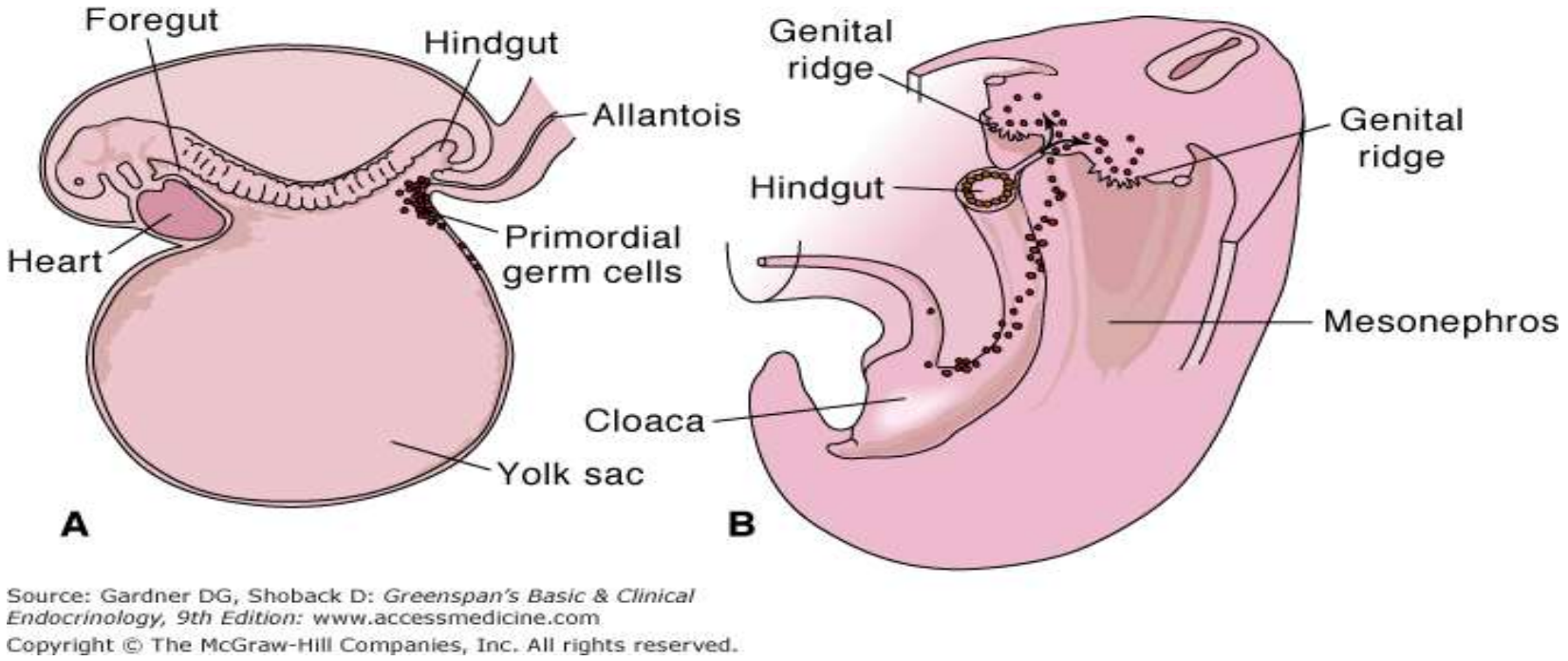
- Define
- ✓ Gametogenesis
- ✓ Oogenesis
- ✓ Spermatogenesis
- List the changes that occur during oogenesis from prenatal life to puberty
- List the changes that occur during spermatogenesis from prenatal life to puberty
- State some clinical correlates

Gametogenesis

- Is the **process** of **formation of gametes** from **germ cells** in the **testes** and **ovaries**



GAMETOGENESIS



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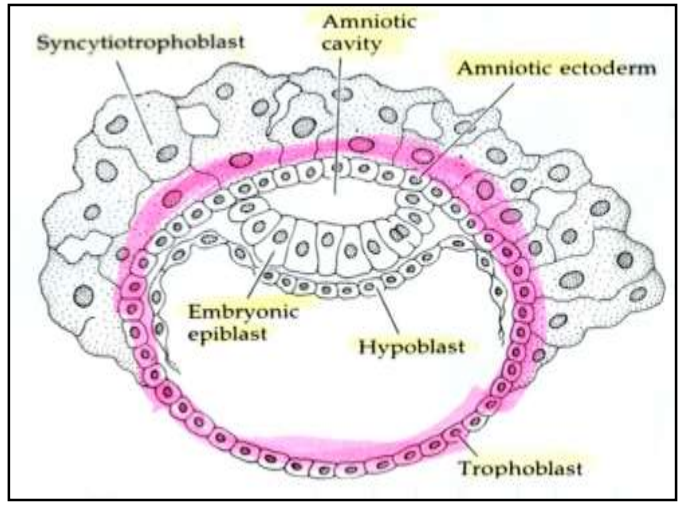


- Gametes are derived from **primordial germ cells** (PGCs) that are formed in the **epiblast** during the **2nd week**
- **PGCs**

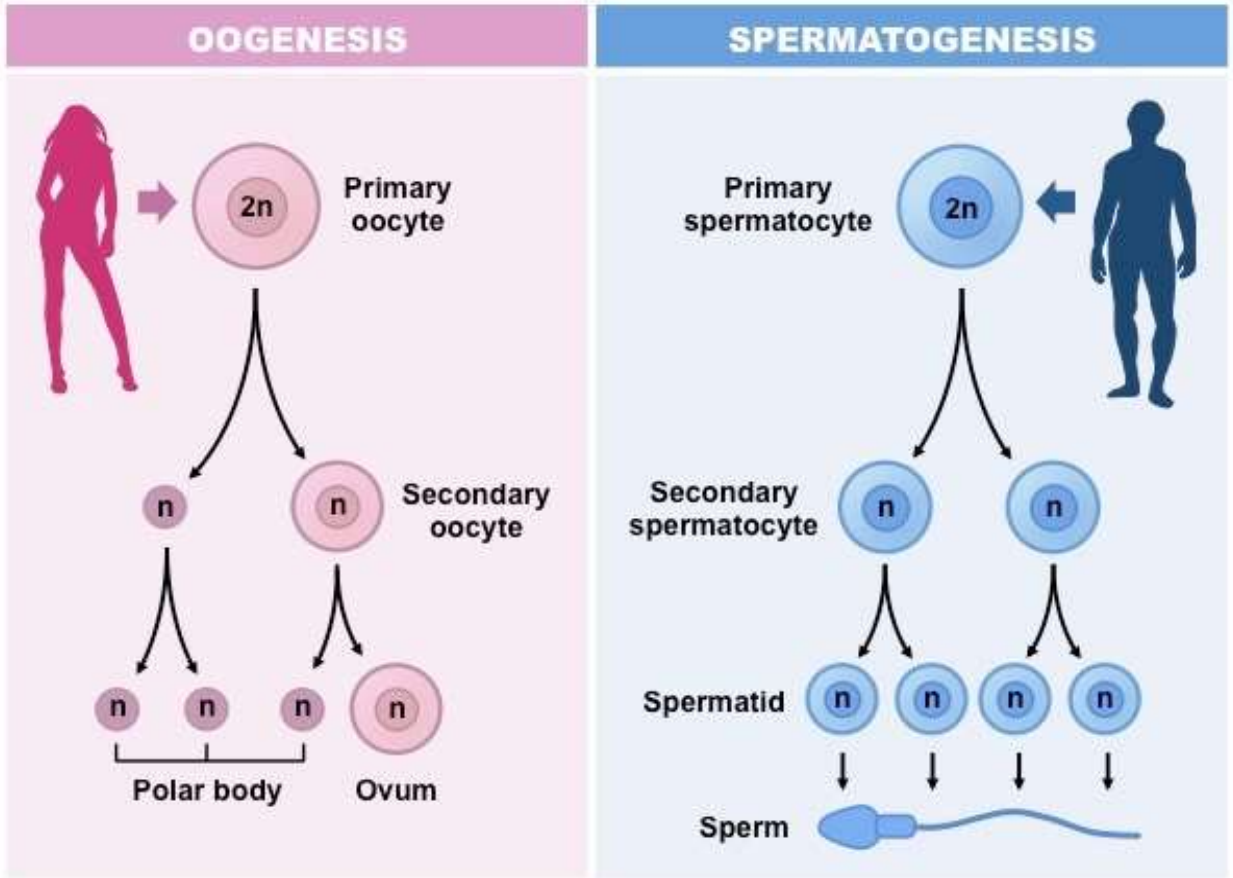
✓ migrate to the wall of the **yolk sac**

✓ During the **4th week**, these cells begin to migrate from the **yolk sac** toward the **developing gonads**, where they arrive by the end of the **5th week**.

In preparation for fertilization, Germ cells undergo :

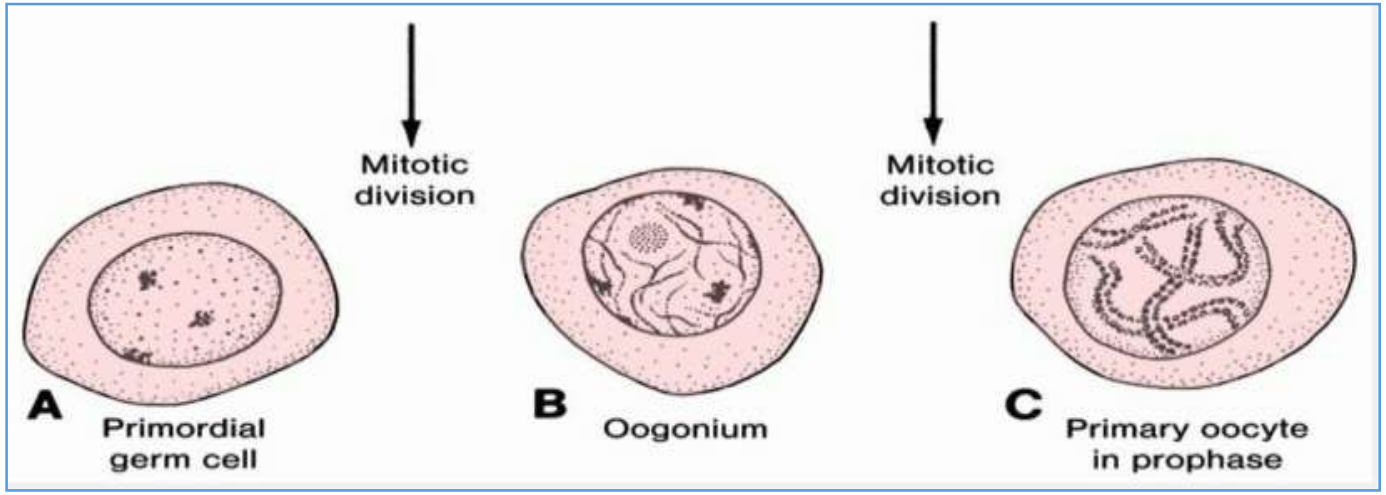
❑**Gametogenesis should include**

- **Meiosis** to reduce the number of chromosomes
- **Cytodifferentiation** to complete their maturation

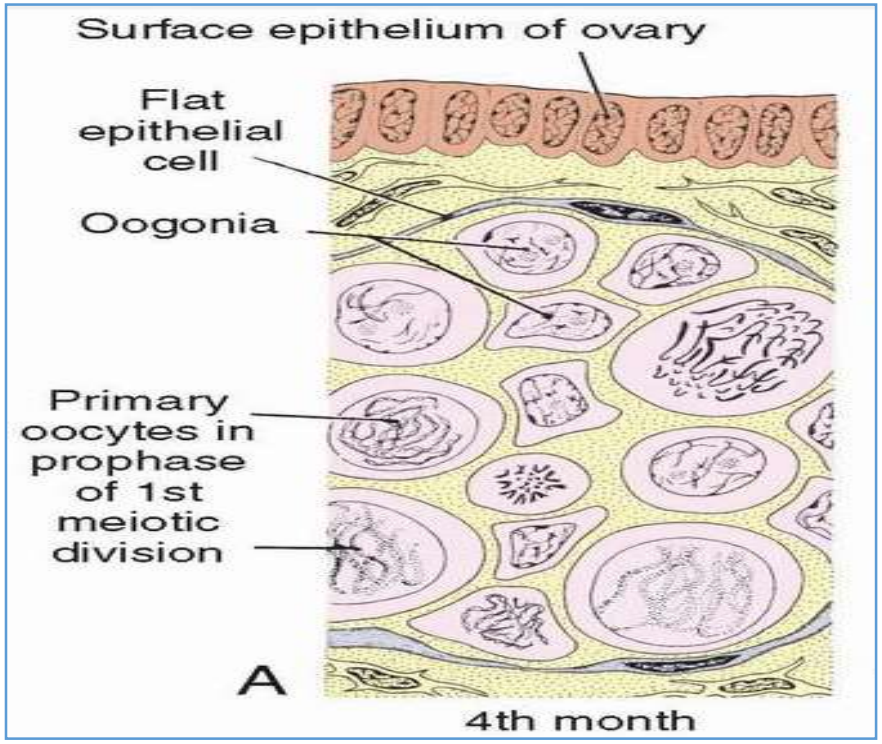


OOGENESIS

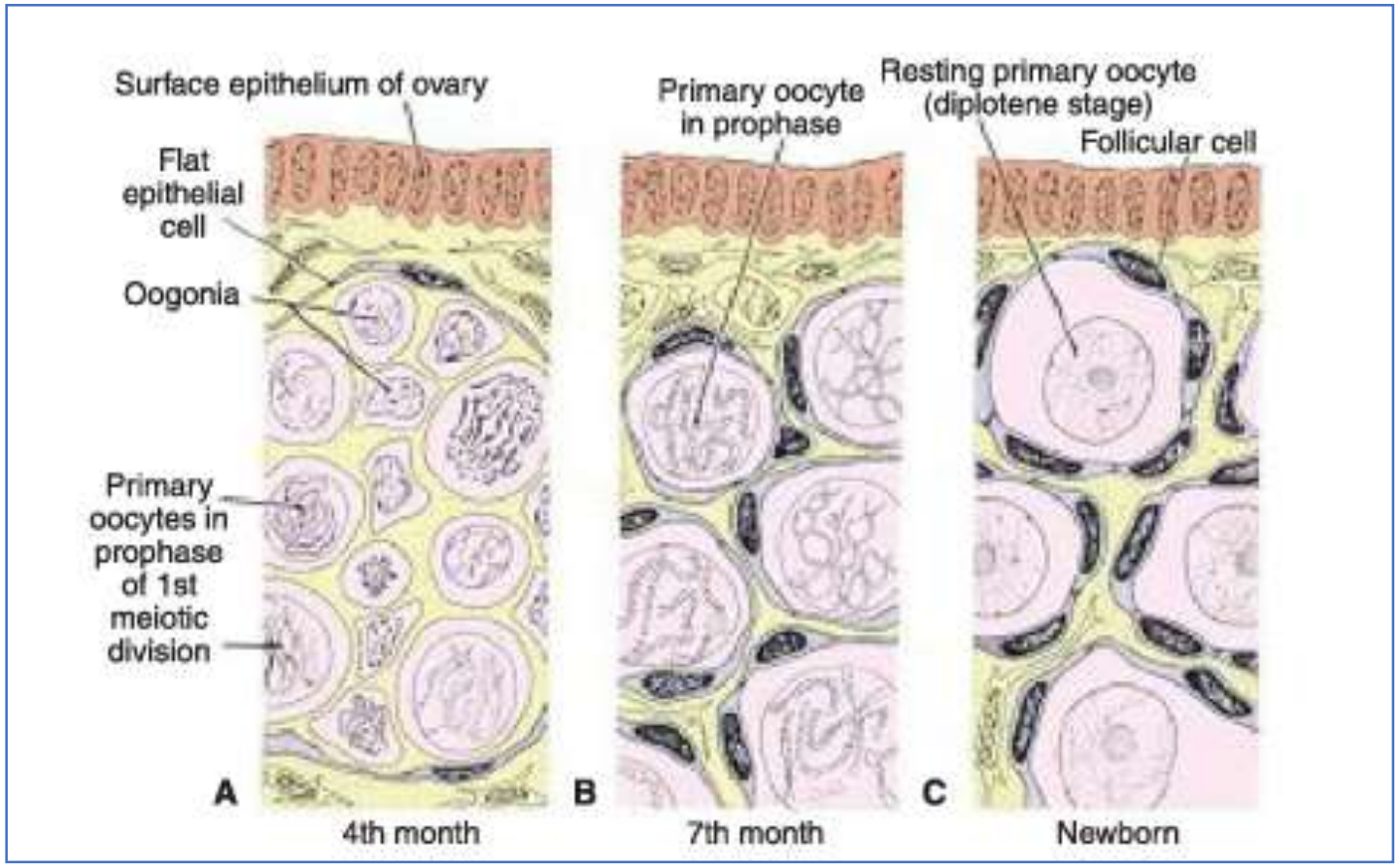
Is the process where by **oogonia** differentiate into **mature oocytes**



OOGONIA



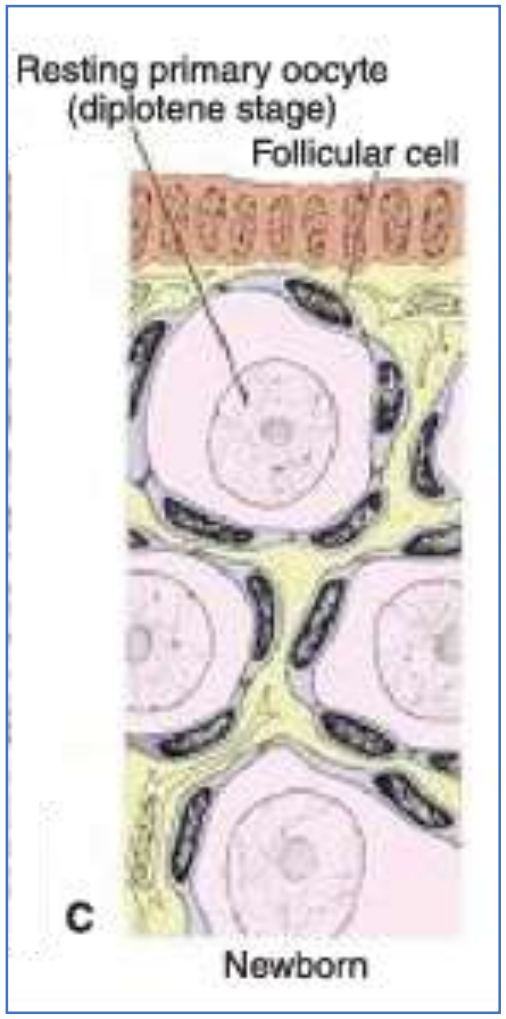
- **By the end of the 3rd month**,
- ✓ they are arranged in clusters surrounded by a layer of flat epithelial cells (**follicular cells**)
- ✓ the majority of **oogonia** continue to divide by mitosis,
- ✓ but some of them give rise to **primary oocytes**



- **By the 5th month of prenatal development**,
  - ✓ germ cells in the ovary reaches its maximum(7 million).
  - ✓ At this time, cell death begins

- **By the 7th month,**
  - ✓ the majority of oogonia have degenerated,
  - ✓ All surviving primary oocytes have entered prophase of meiosis I, and most of them are individually surrounded by a layer of follicular cells (**primordial follicle).**

Maturation of the oocytes
At birth and during childhood



❑**Near the time of birth**,

✓**all primary oocytes** have started prophase of meiosis I, but instead of proceeding into metaphase, they enter **the diplotene stage** , a resting stage during prophase.

✓ **The total number of primary oocytes** at birth is estimated to vary from **600,000** to **800,000**.

❑**During childhood**,

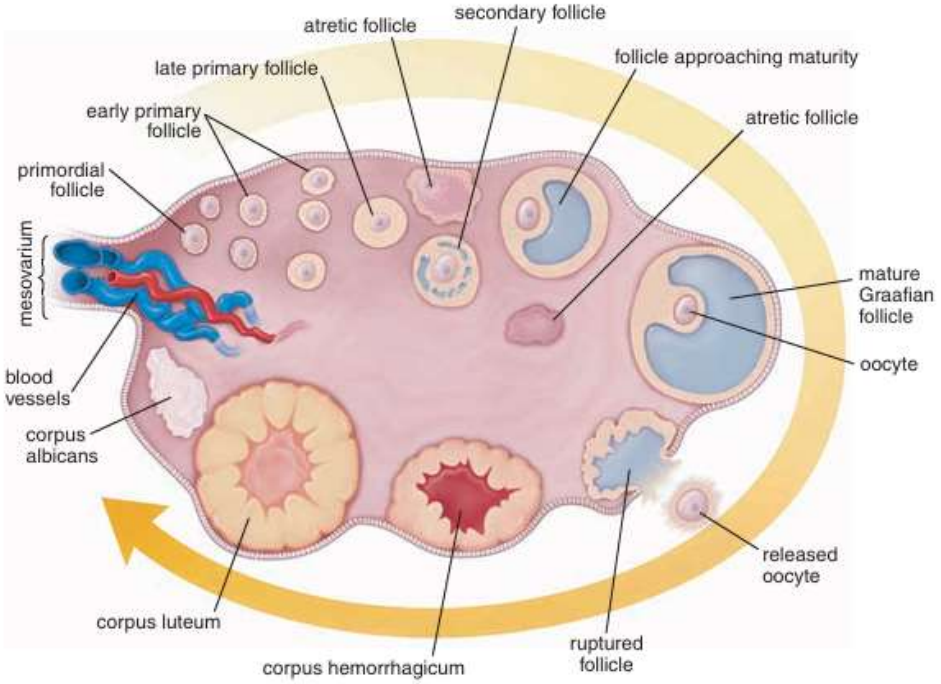
✓ most oocytes become atretic

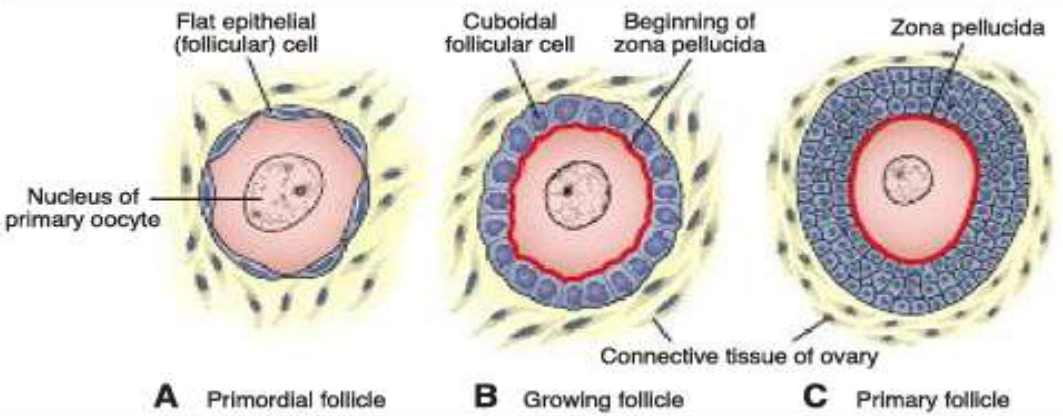
❑only approximately **40,000 oocytes** are present **by the beginning of puberty**,

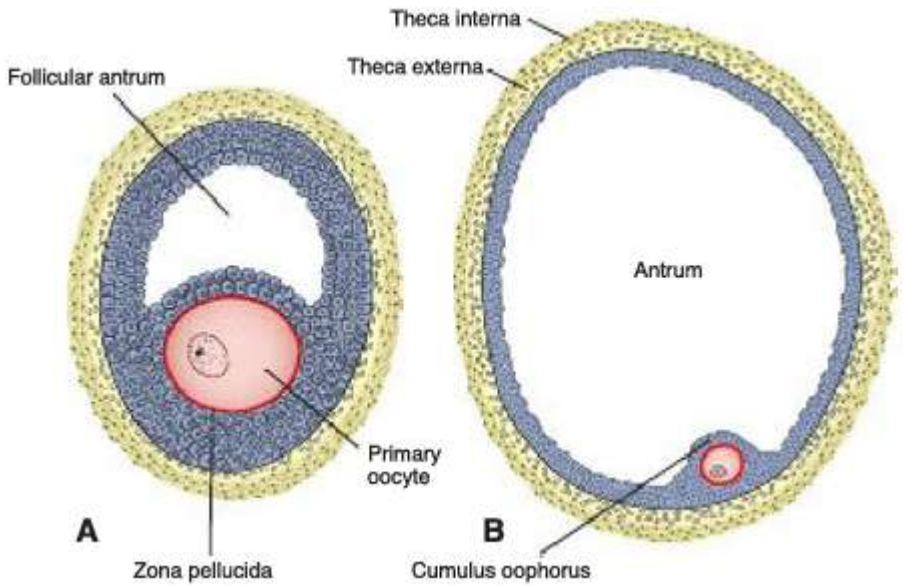
❑fewer than **500** oocytes will be ovulated

AT PUBERTY

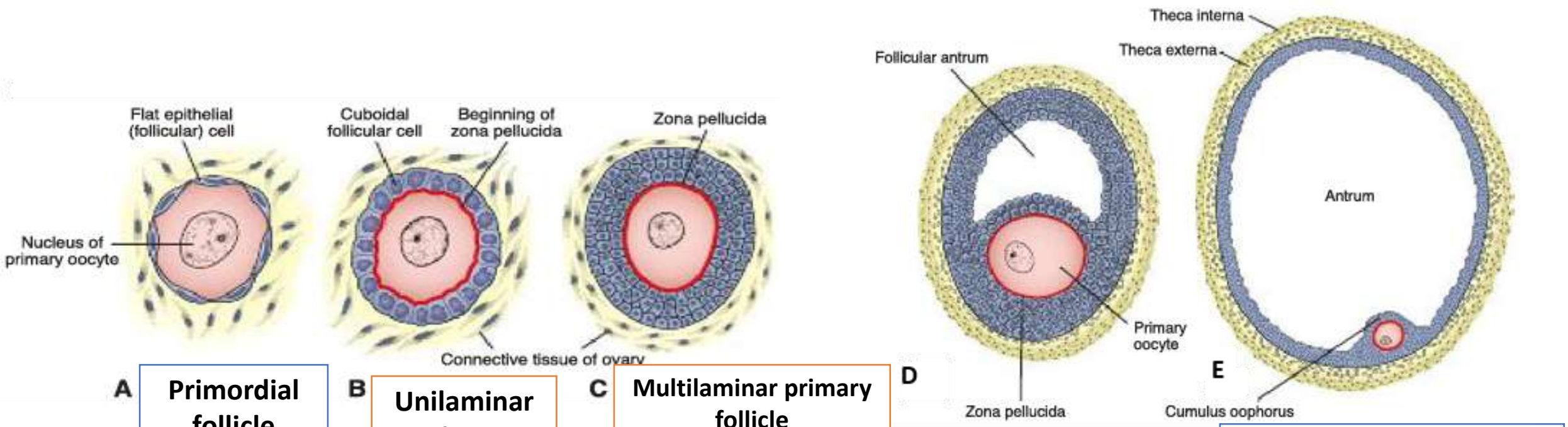
- Each month, **15 to 20 primordial follicles** begin to mature and passing through **three stages**:
  (1) Primary follicle
  (2) secondary (antral) follicle
  (3) Tertiary or mature vesicular (Graafian) follicle.
- Under normal conditions, only **one** of these follicles **reaches full maturity**, and the others **degenerate** and become **atretic**.







Maturation of follicles



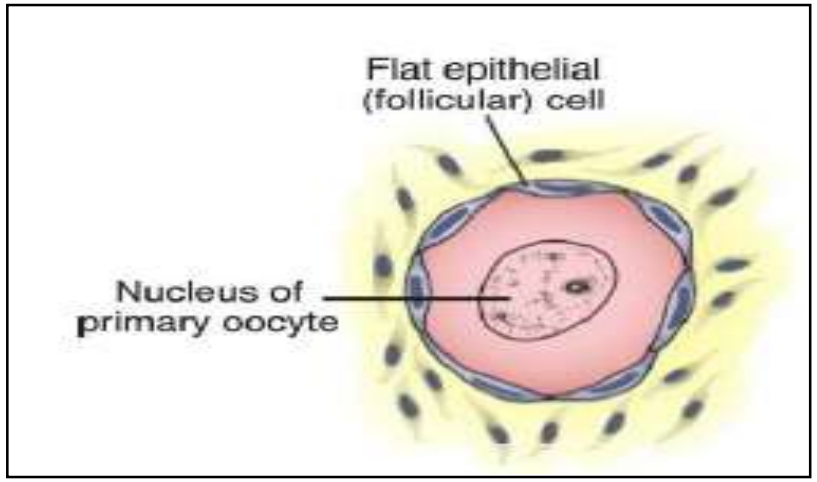
Primordial follicle

Unilaminar primary follicle

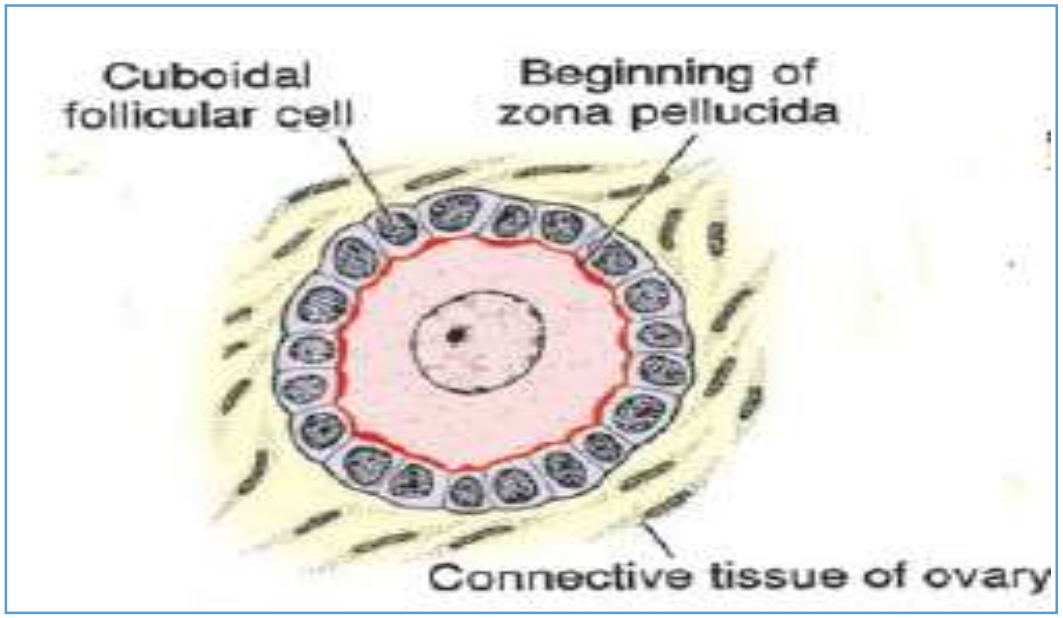
Multilaminar primary follicle

Secondary (Vesicular, Antral) follicle

Tertiary (Mature Vesicular ,G afian) follicle



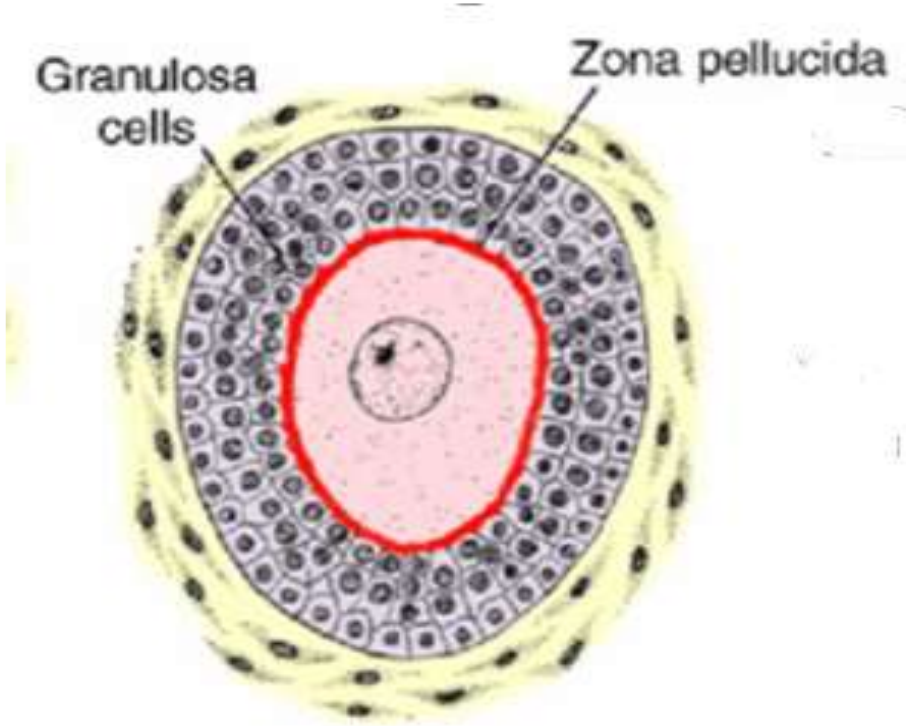
PRIMORDIAL FOLLICLE



UNILAMINAR PRIMARY FOLLICLE

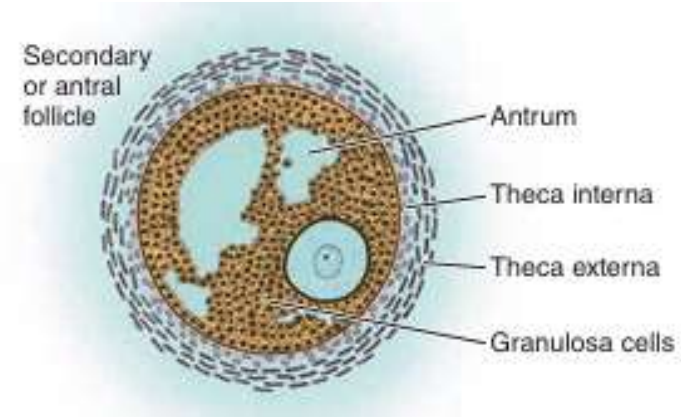
- Primary oocyte surrounded by a layer of cuboidal epithelium
- Beginning of zona pellucida

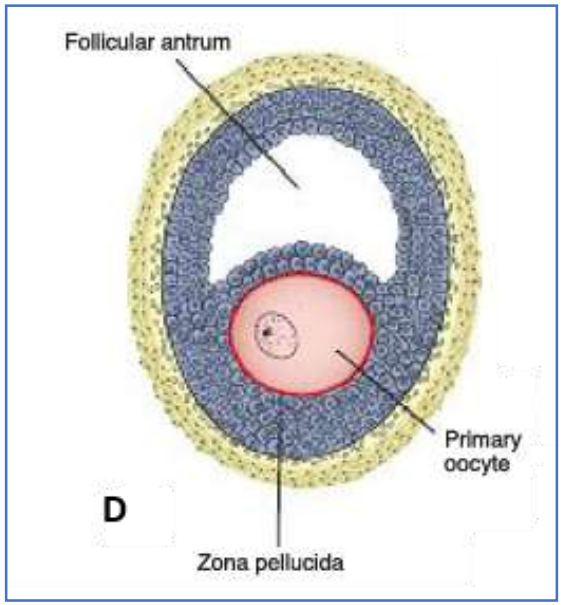
MULTILAMINAR PRIMARY FOLLICLE



- **Zona pellucida**
- **Follicular cells** proliferate and produce a **stratified epithelium** of granulosa cells
- **Theca folliculi** **(**surrounding ovarian connective tissue)

SECONDARY (VESICULAR , ANTRAL)



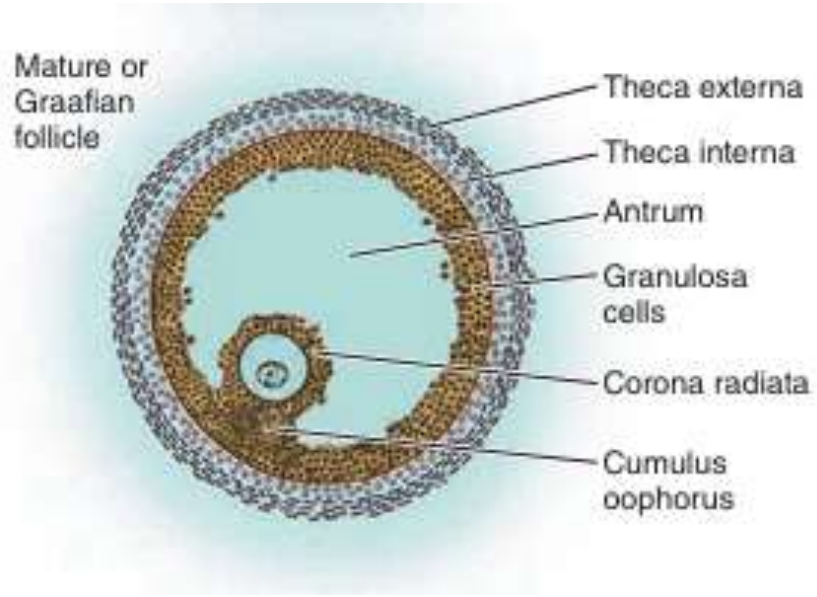


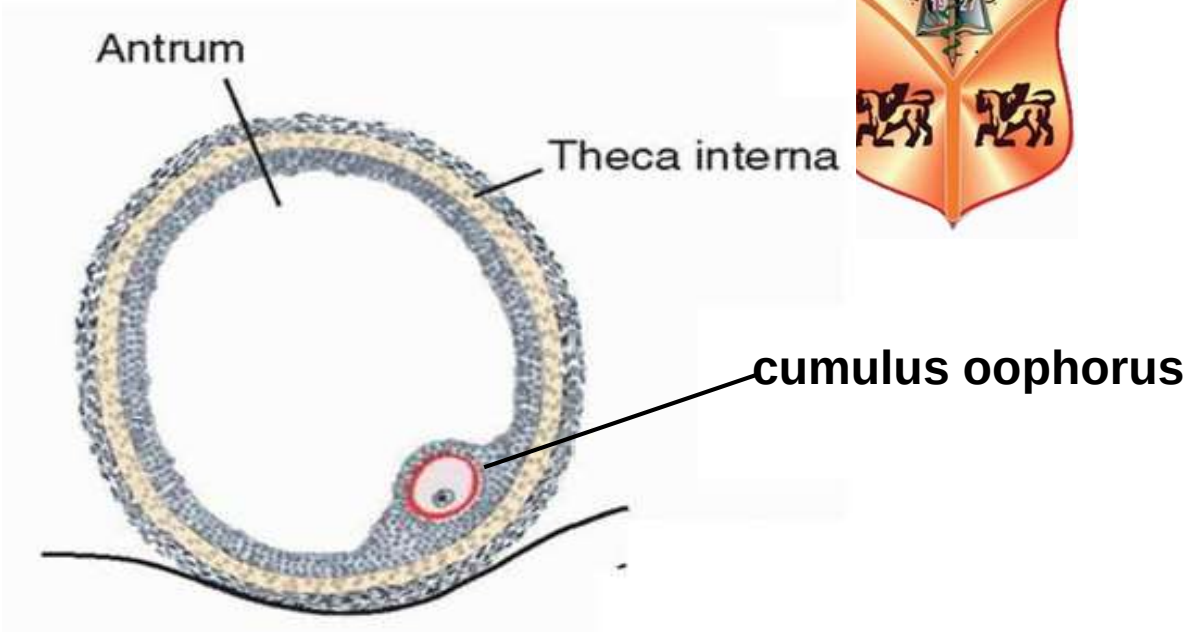
- **fluid –filled spaces** appear between the granulosa cells.
- coalescence of these spaces form **the antrum** which is crescent shaped, but with time, it enlarges .
- cells of the **theca folliculi** organize into

✓theca interna (secretory cells)

✓theca externa (fibrous)

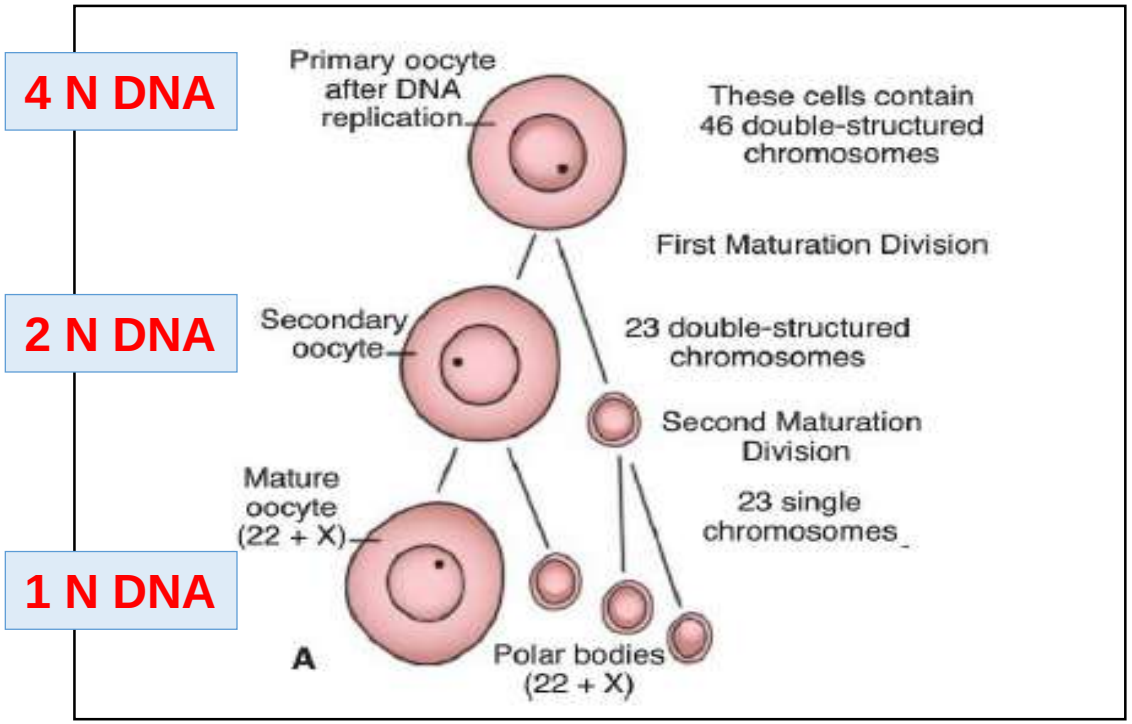
TERTIARY FOLLICLE

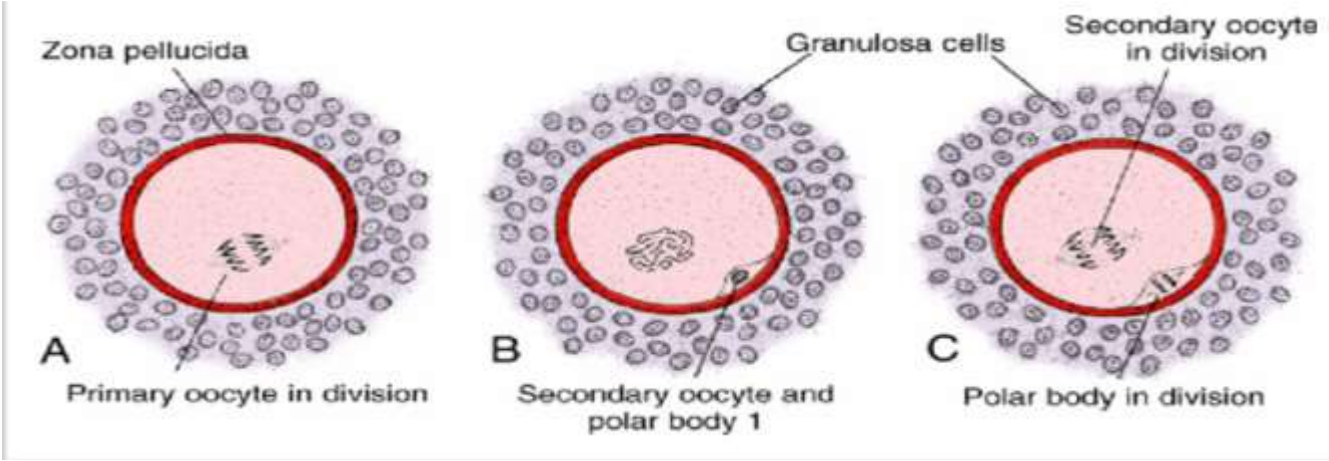




- **Granulosa cells** surrounding the oocyte form the **cumulus oophorus.**
- At maturity, the mature (graafian) follicle may be **25 mm** or **more** in diameter.

MATURATION OF THE OOCYTE

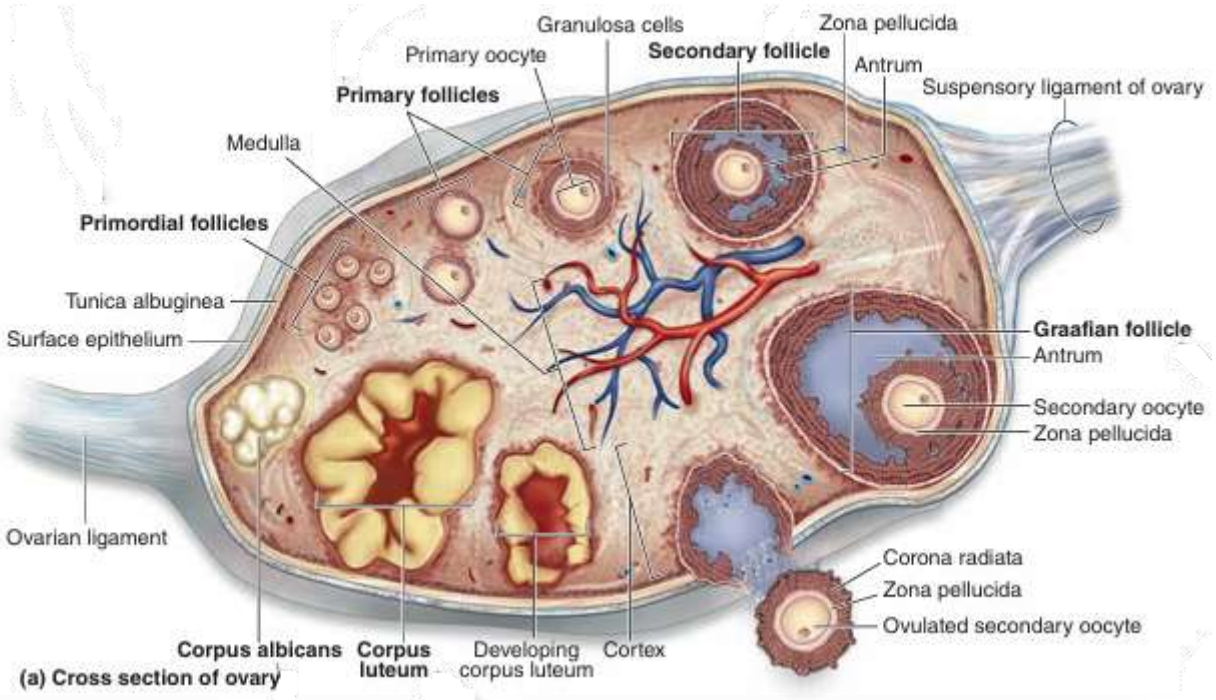


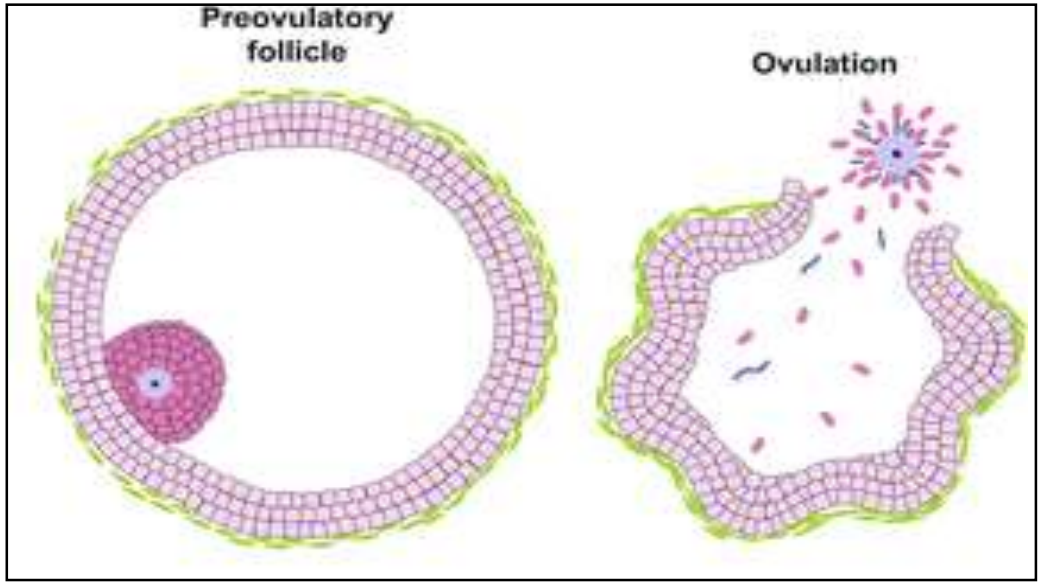


- **Meiosis I** is completed, resulting in formation of **two daughter cells** of **unequal size**, each with **23 double-structured** chromosomes .
- **One cell**, the **secondary oocyte**, receives most of the cytoplasm; **the other**, the **first polar body**, receives practically none.
- The cell then enters meiosis II but arrests in metaphase approximately 3 hours before ovulation.

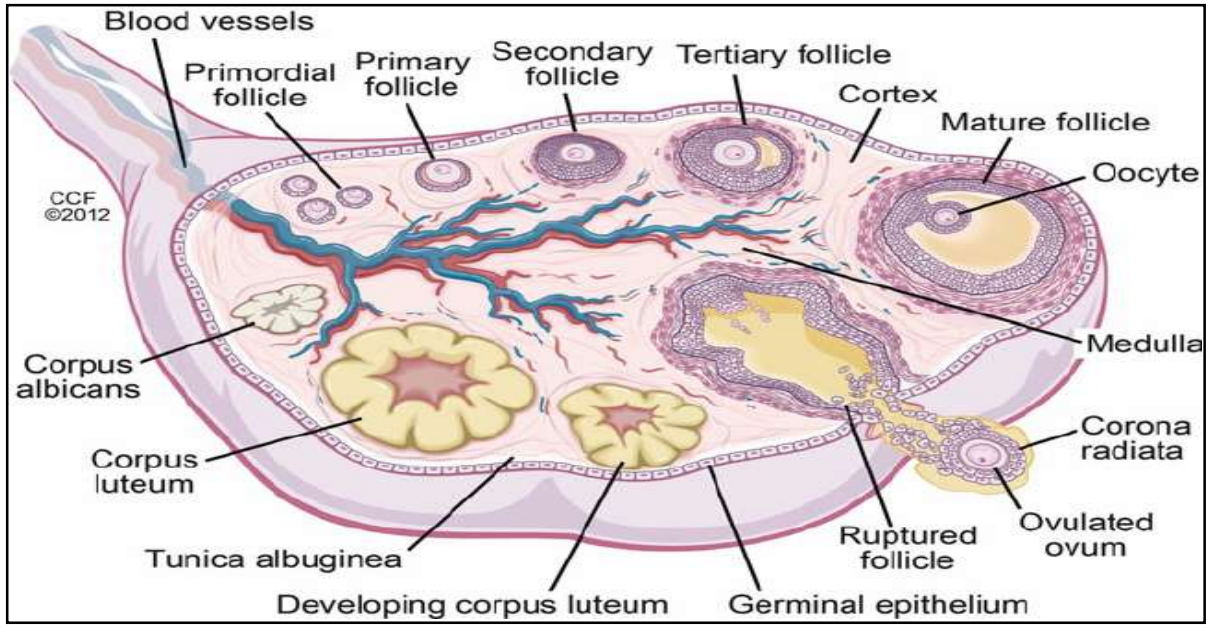
OVULATION

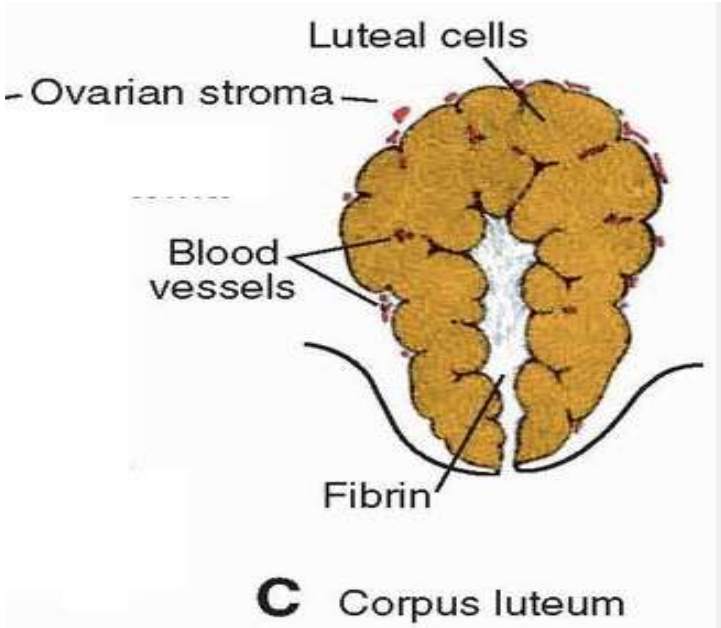
- The oocyte, in metaphase of meiosis II, is discharged from the ovary together with a large number of cumulus oophorus cells.
- Some of the **cumulus oophorus cells** then rearrange themselves around the zona pellucida to form the **corona radiata**
- **Meiosis II is completed only if the oocyte is fertilized**; otherwise, the cell degenerates approximately 24 hours after ovulation.





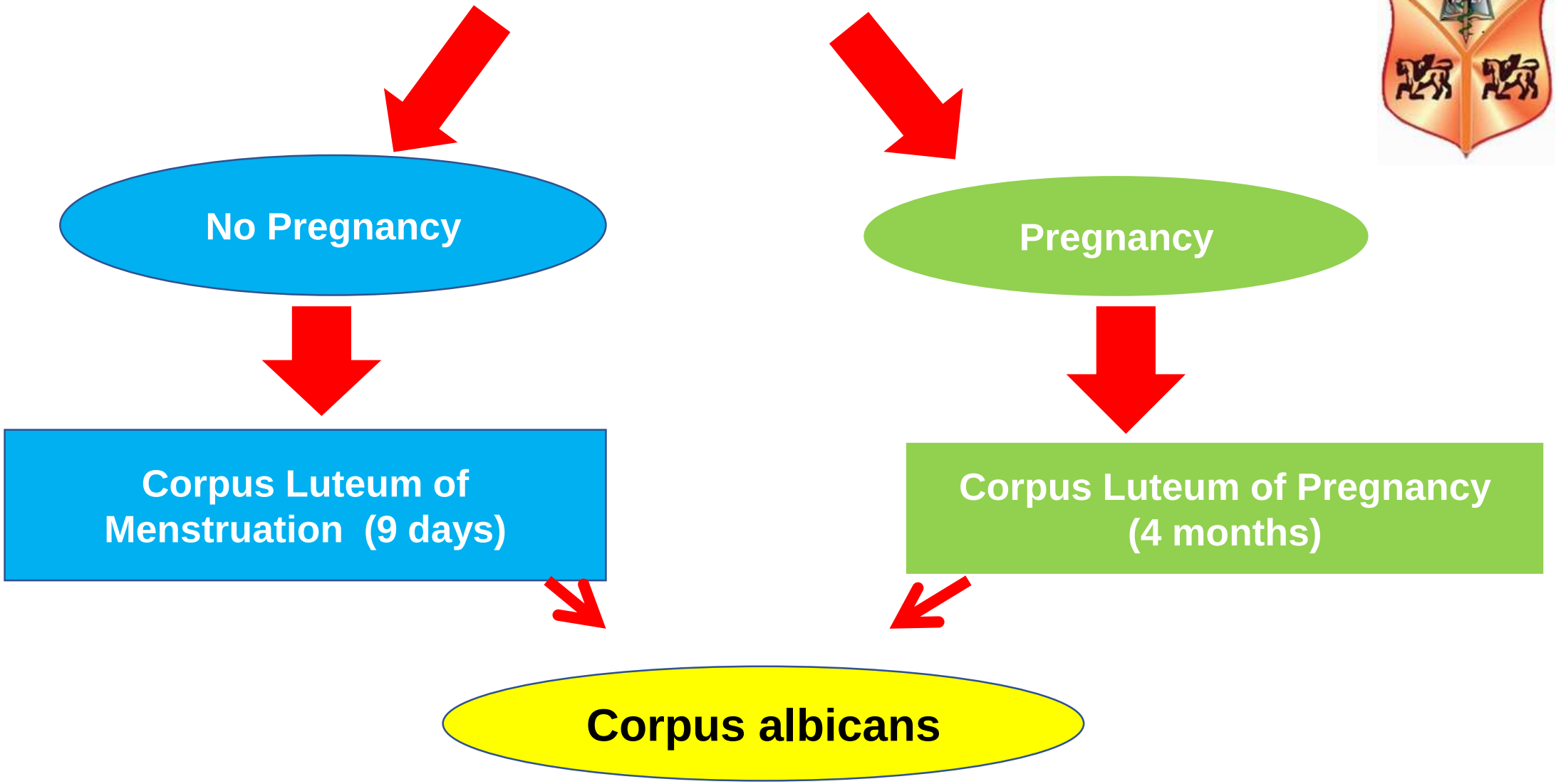
CORPUS LUTEUM

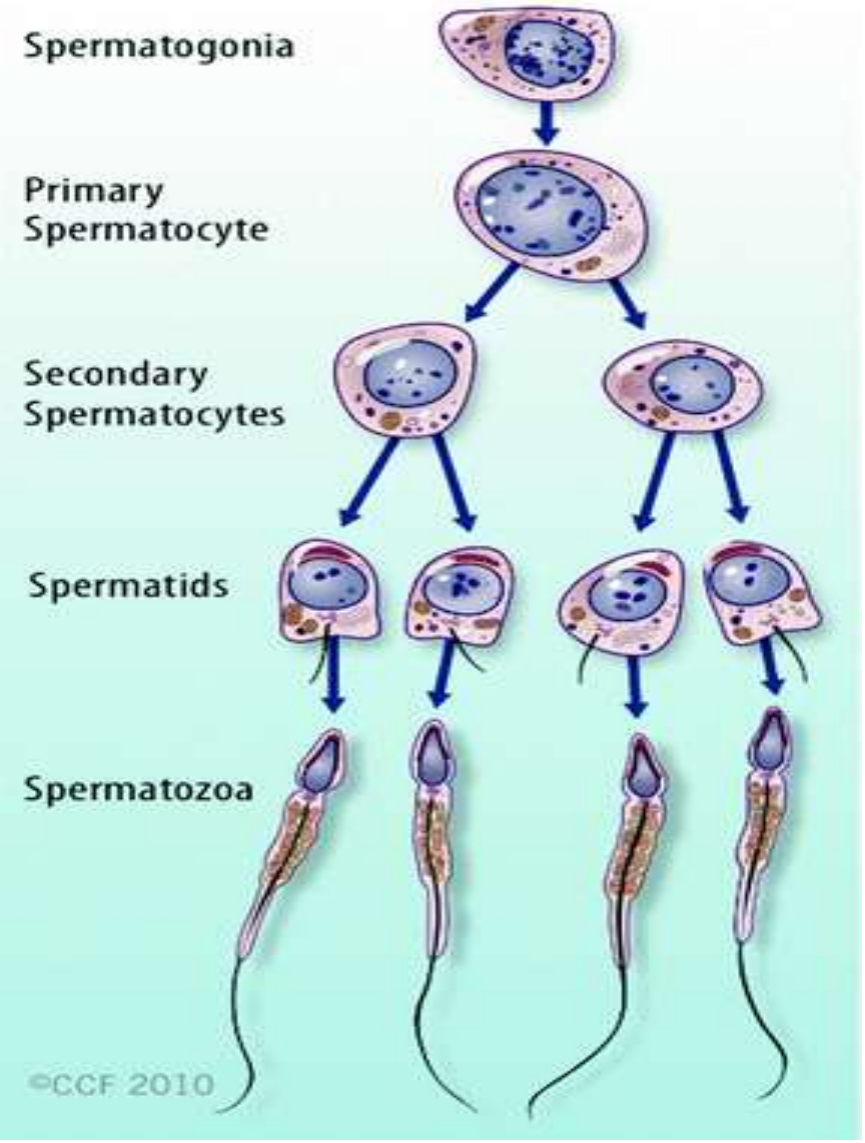




- After ovulation, **granulosa cells** together with **cells from the theca interna**, change into **lutein cells**,
- secrete the hormone progesterone

Fate of the corpus luteum

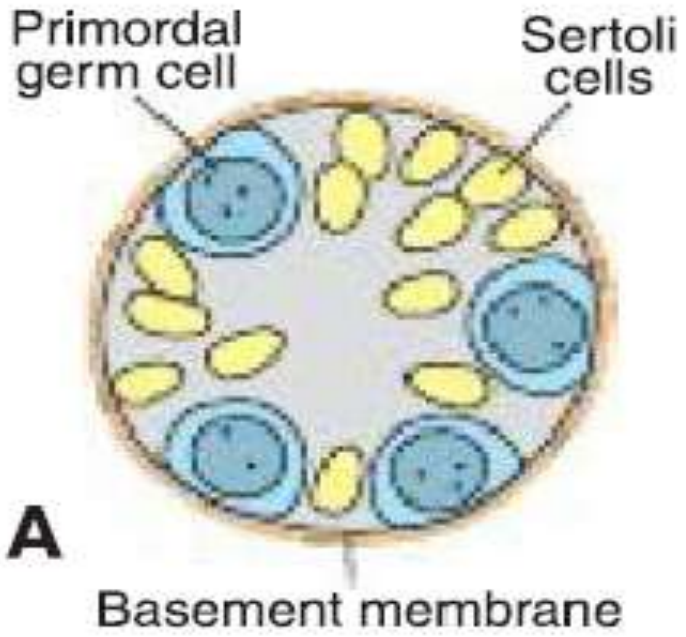




SPERMATOGENESIS

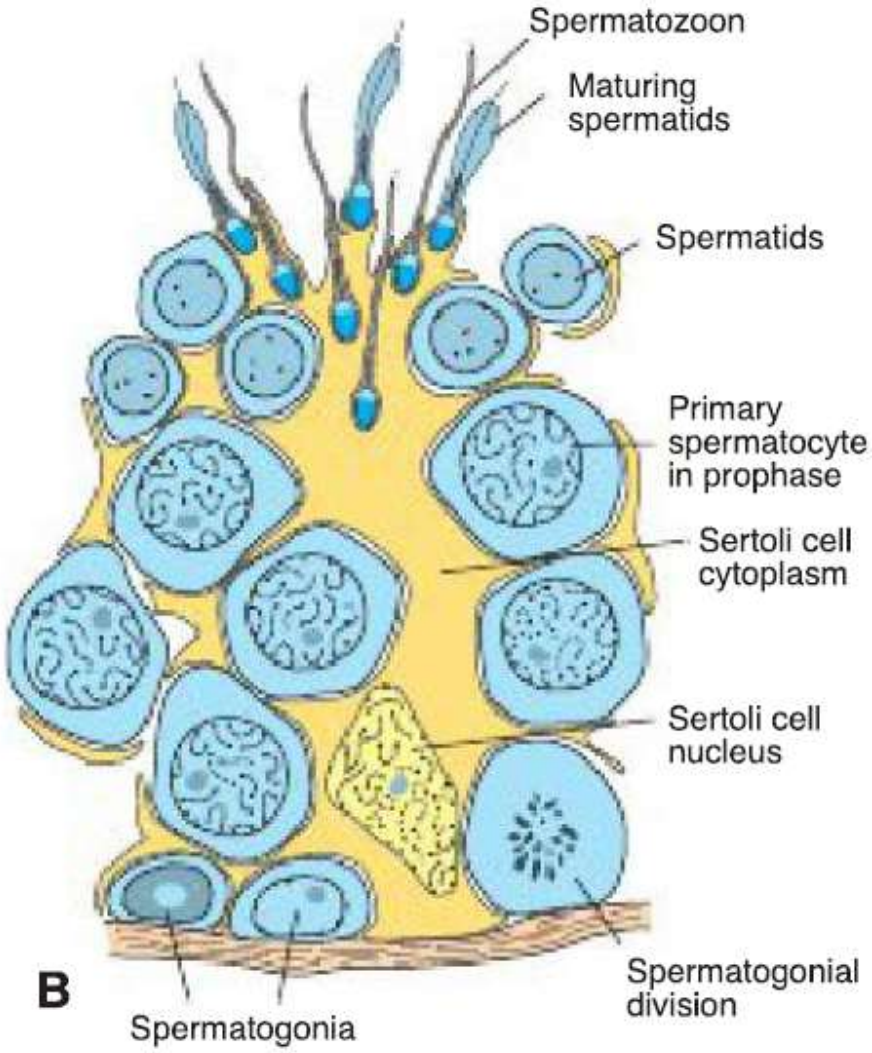
Is a complex series of changes by which **spermatogonia** are transferred into **spermatozoa**

IN THE MALE INFANT



- **Germ cells** can be recognized in **the sex cords of the testis** as large, pale cells surrounded by supporting cells .
- **Supporting cells** become **sustentacular cells, or Sertoli cells** .

SHORTLY BEFORE PUBERTY,



- The **sex cords** acquire a lumen and become the **seminiferous tubules.**
- At about the same time, primordial germ cells give rise to **spermatogonial stem cells.**
- Maturation of Sperm begins at Puberty

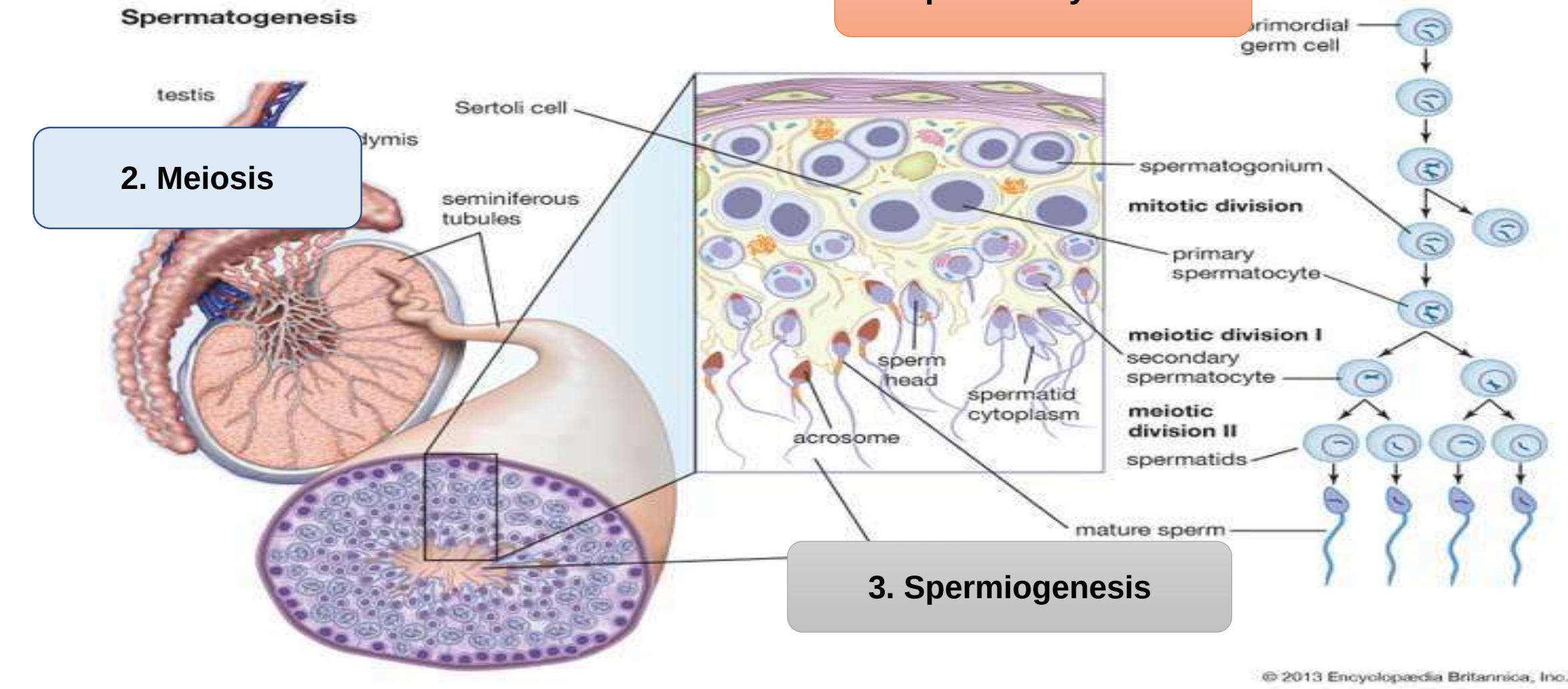
Spermatogenesis

can be divided into 3 phases :

1. Spermatocytosis

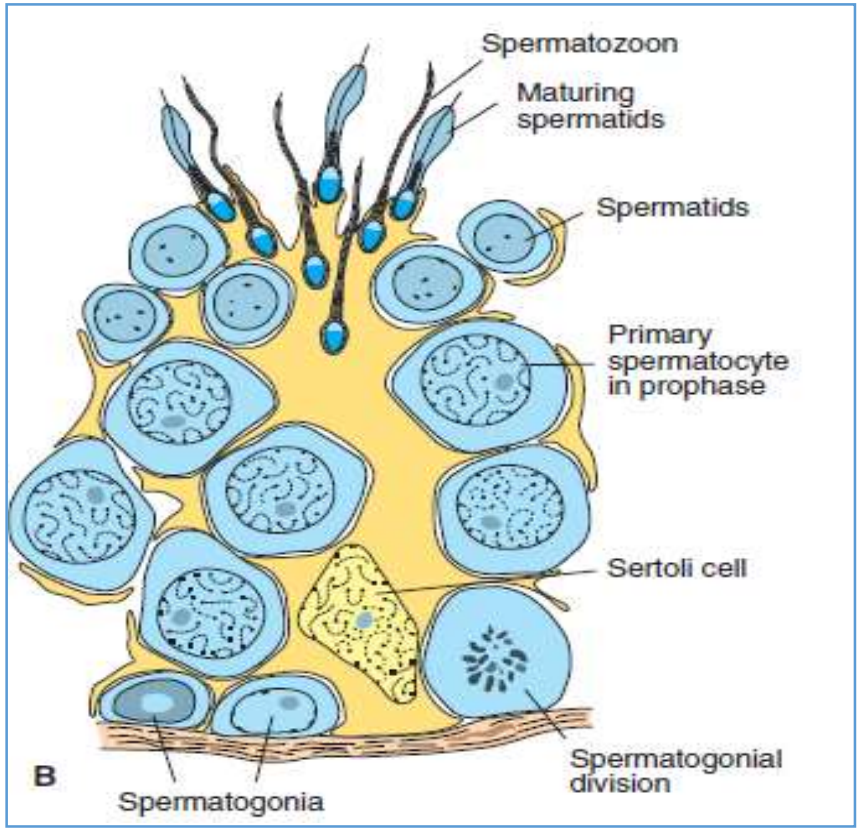
2. Meiosis

3. Spermiogenesis

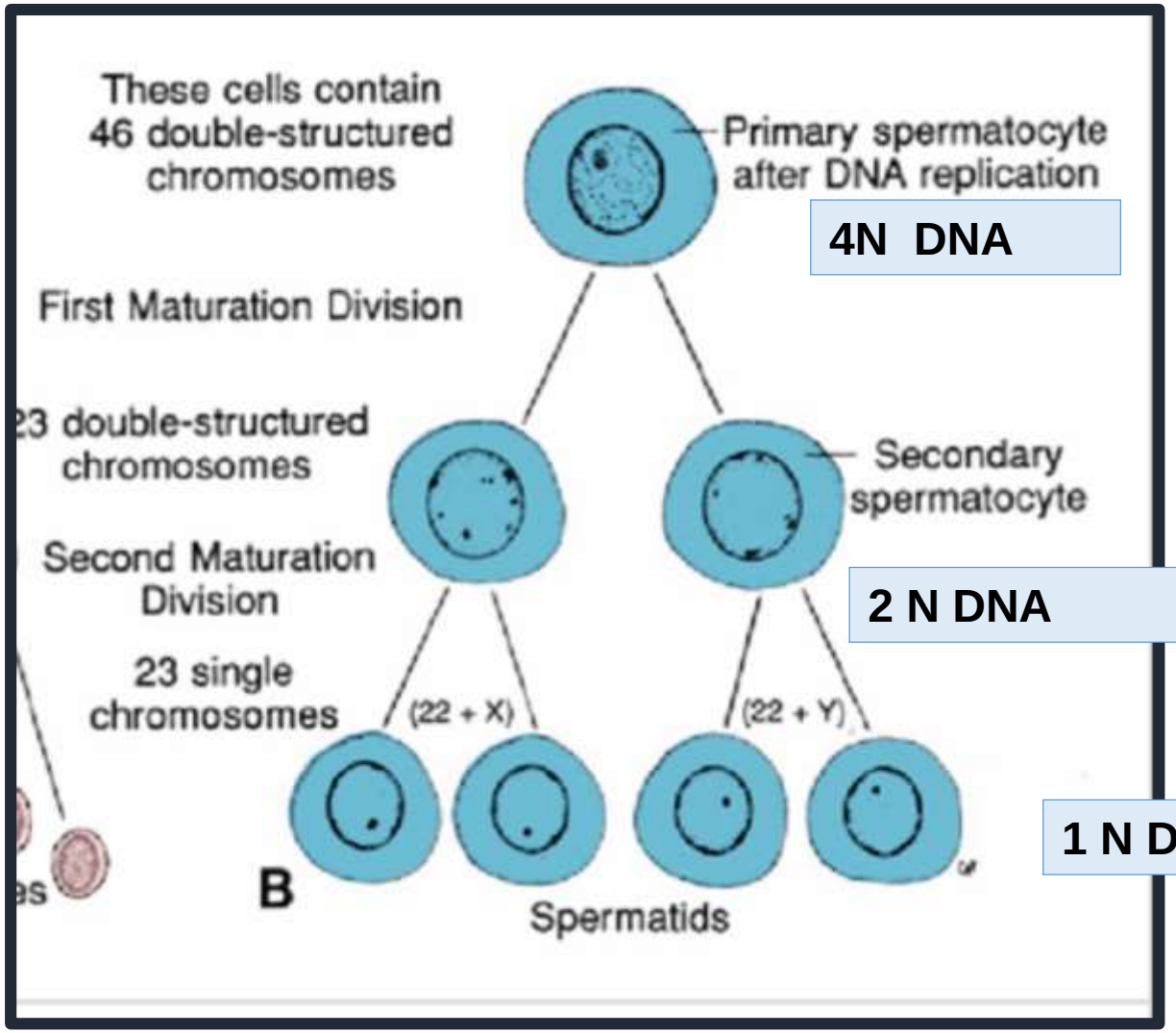


SPERMATOCYTOSIS

- Spermatogonia proliferate by **mitotic division** to
- replace themselves
- Produce **primary spermatocytes**

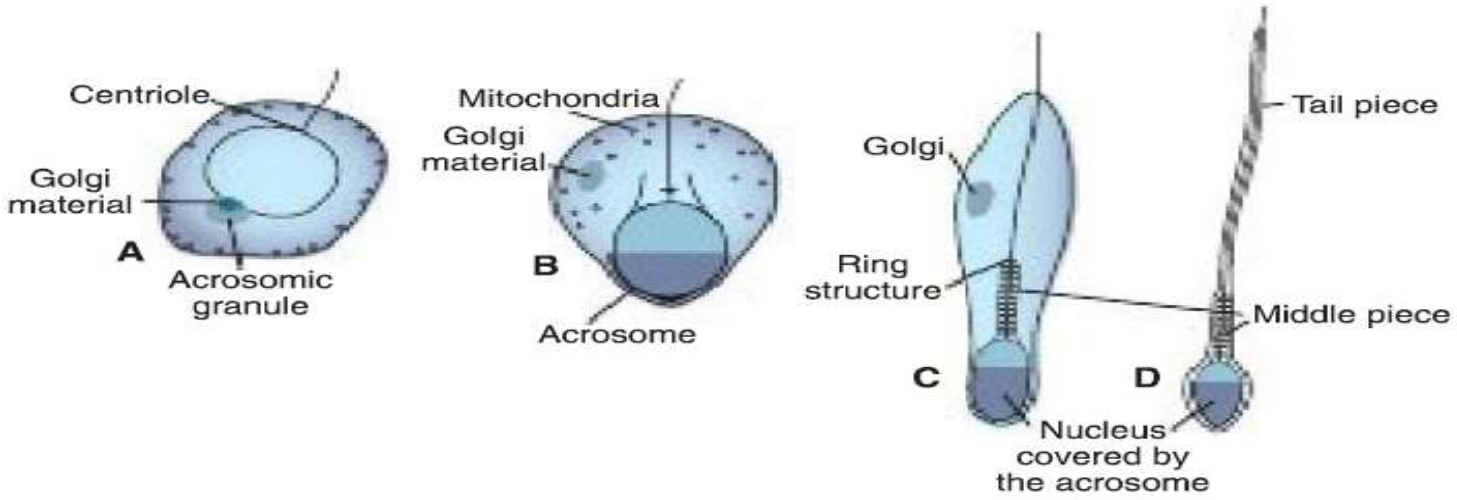


MEIOSIS



- 2 successive divisions
- **Meiosis I** produce **secondary spermatocytes**
- **Meiosis II** produce **spermatids**

SPERMIOGENESIS



- The series of changes resulting in the **transformation of spermatids into spermatozoa** include

(a) **Formation of the acrosome**, which covers half of the nuclear surface and contains enzymes to assist in penetration of the egg during fertilization ;

(b) **Condensation of the nucleus**;

(c) **Formation of neck, middle piece, and tail**;

(d) **Shedding of most of the cytoplasm**.

Abnormal Gametes

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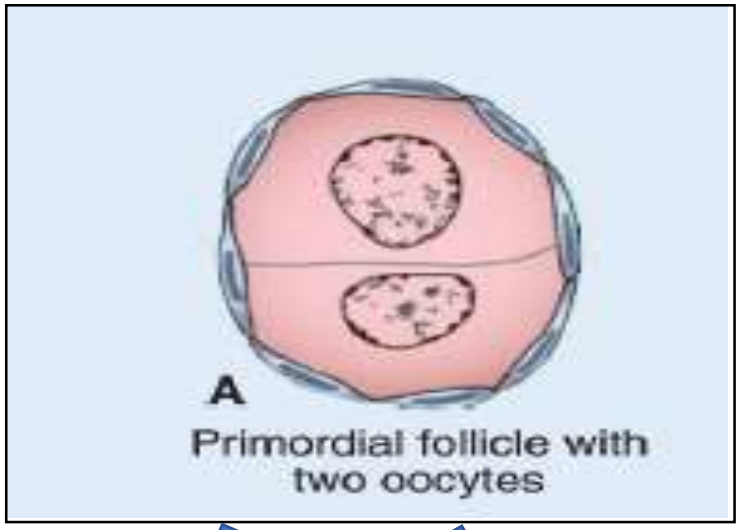
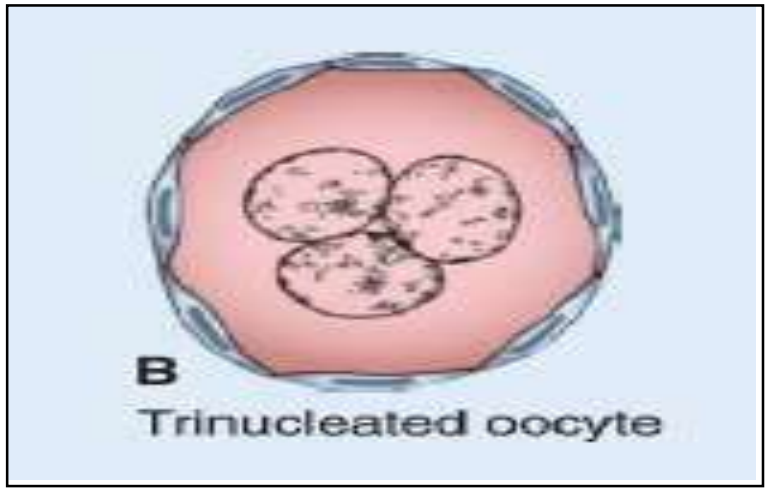


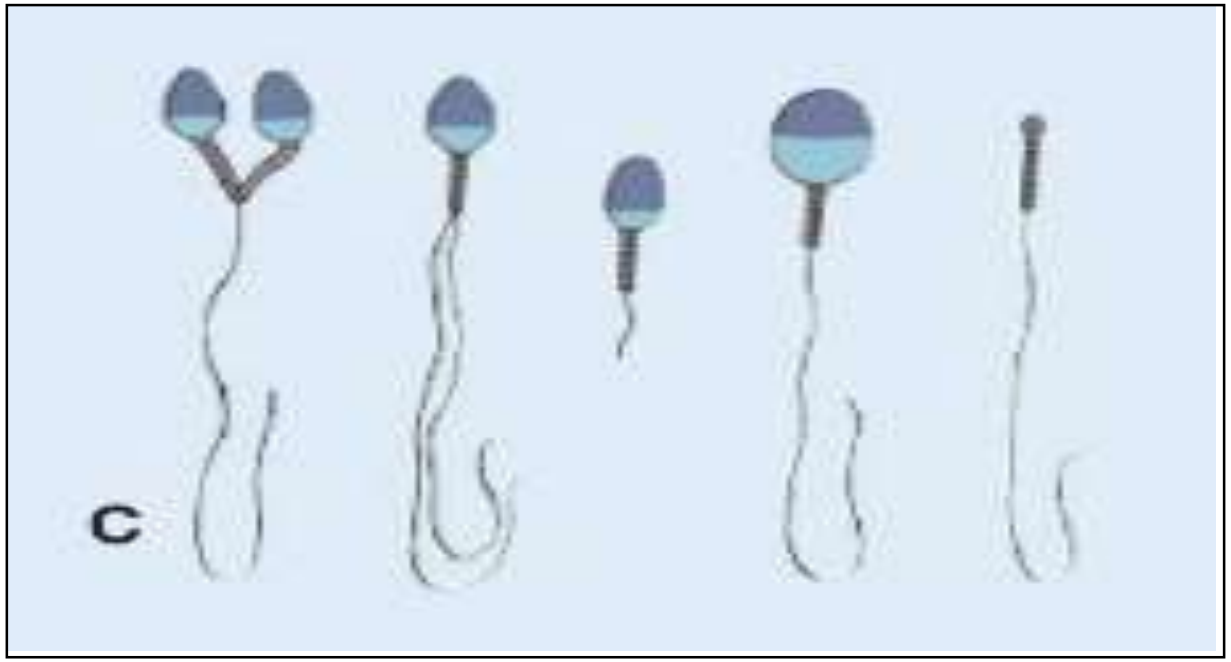


- **Twins or Triplets**

Degenerate before reaching maturity

Die before reaching maturity

Abnormal spermatozoa



- up to 10% of all spermatozoa have observable defects.
- Sperm with morphologic abnormalities probably do not fertilize oocytes

SUMMARY

- **Oogenesis** begins before birth while **spermatogenesis** begins at puberty
- At puberty , in female every month,**15 to 20 follicles** begin to grow, and as they mature, they pass through three stages: (1) **primary** or **preantral**, (2) **vesicular or antral**, and (3) **mature vesicular or Graafian follicle.**
- The **primary oocyte** remains in prophase of the **first meiotic division** until the **secondary follicle** is mature.
- The **secondary oocyte** is arrested in **metaphase of meiosis II** approximately **3 hours** before ovulation and will not complete this cell division until fertilization
- In the male, **primordial cells** remain dormant until puberty, and only then do they differentiate into spermatogonia. These stem cells give rise to **primary spermatocytes**, which through two successive meiotic divisions produce four **spermatids .**
- **Spermiogenesis** a series of changes including (1) formation of the acrosome; (2) condensation of the nucleus; (3) formation of neck, middle piece, and tail; and (4) shedding of most of the cytoplasm.
- The time required for a **spermatogonium** to become a **mature spermatozoon** is approximately **74 days.**


Thank you