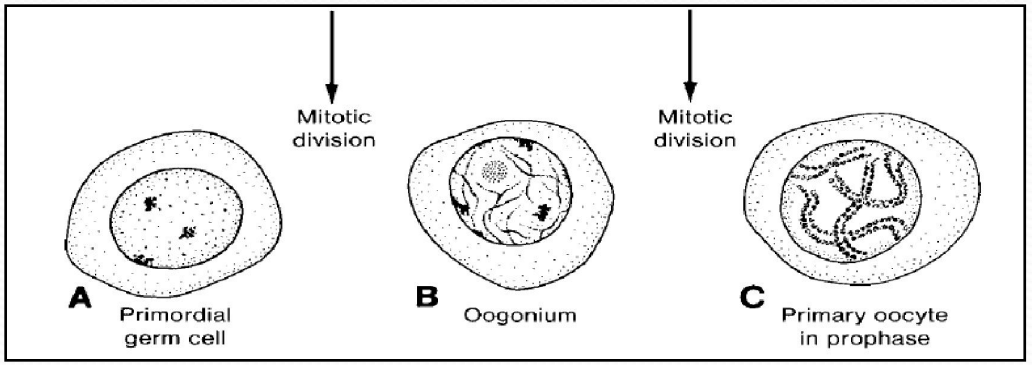
OOGENESIS

- **Maturation of Oocytes Begins Before Birth**
- Primordial germ cells differentiate into **oogonia.**
- These cells undergo a number of mitotic divisions and, by the end of the third month, are arranged in clusters surrounded by a layer of flat epithelial cells known as **follicular cells,** originate from surface epithelium covering the ovary
- The majority of oogonia continue to divide by mitosis, but some of them arrest their cell division in prophase of meiosis I and form **primary oocytes.**
- During the next few months, oogonia increase rapidly in number, and by the fifth month of prenatal development, the total number of germ cells in the ovary reaches its maximum, estimated at 7 million.
- Cell death begins, and many oogonia as well as primary oocytes become **atretic**. By the seventh month, the majority of oogonia have degenerated except for a few near **the surface of the ovary**.



- **<u>All surviving primary oocytes</u>** have entered prophase of meiosis I, and most of them are individually surrounded by a layer **follicular cells**.
- A primary oocyte, together with its surrounding flat epithelial cells, is known as a **primordial follicle**

Maturation of Oocytes Continues at Puberty

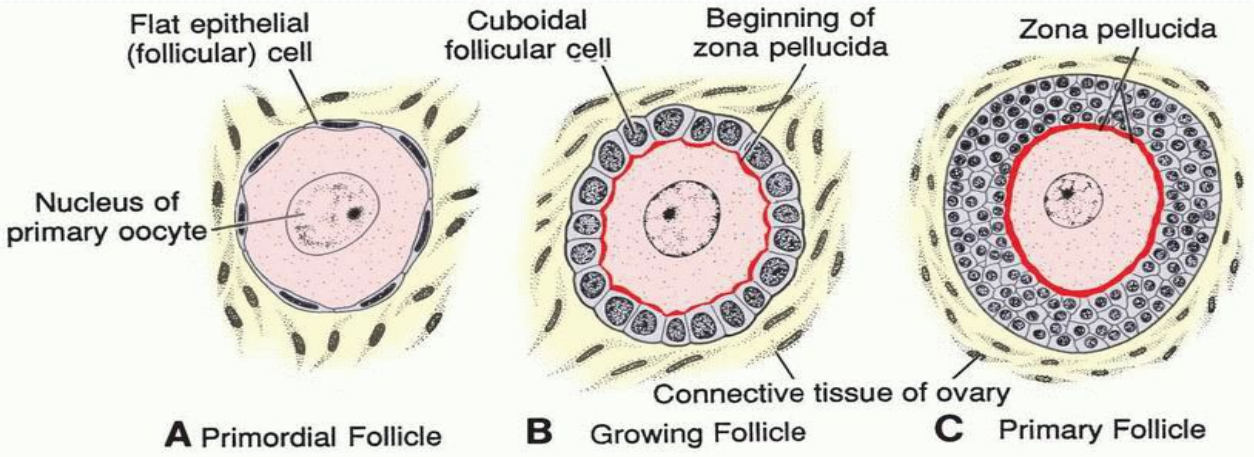
- Near the time of birth, all primary oocytes have started prophase of meiosis I, but instead of proceeding into metaphase, they enter the **diplotene stage.**
- **Primary oocytes remain arrested in prophase and do not finish their first meiotic division before puberty is reached. This arrested state is produced by oocyte maturation inhibition (OMI)**

:At puberty

- Each month, 15 to 20 follicles passing through three stages:

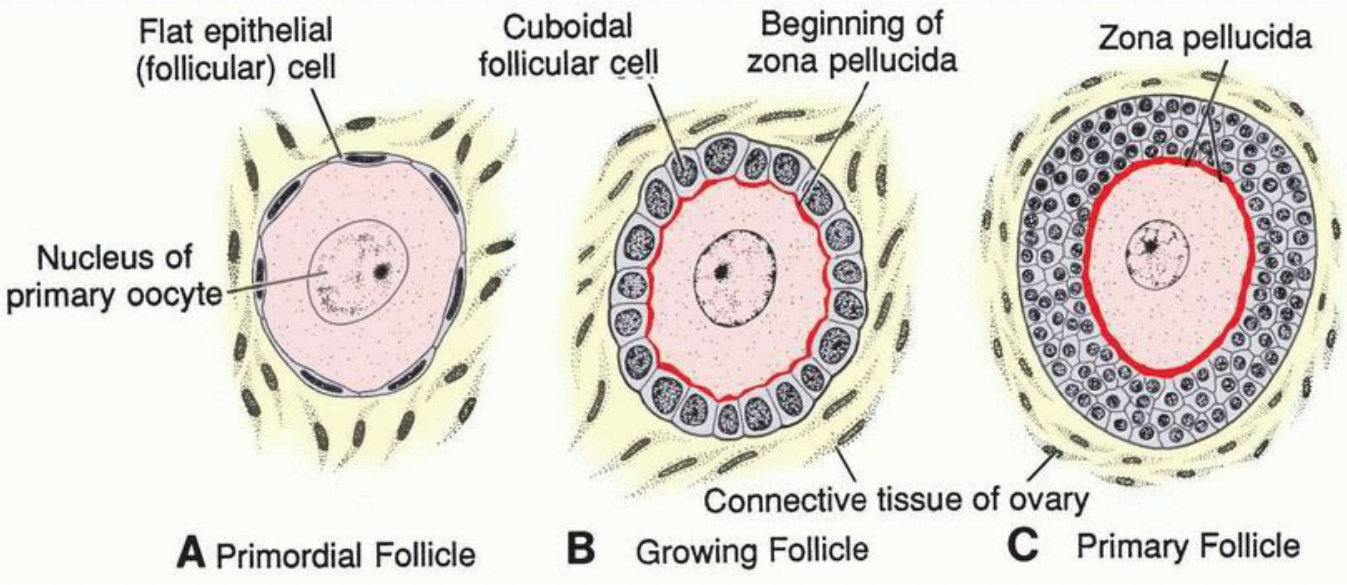
1. **primary** or **preantral follicle;**
2. **secondary** or **antral follicle;** and
3. **Preovulatory (Graafian follicle)**

- As the primary oocyte begins to grow, surrounding follicular cells change from flat to **<u>cuboidal</u>** and proliferate to produce a stratified epithelium of **granulosa cells,** and the unit is called a **primary follicle**

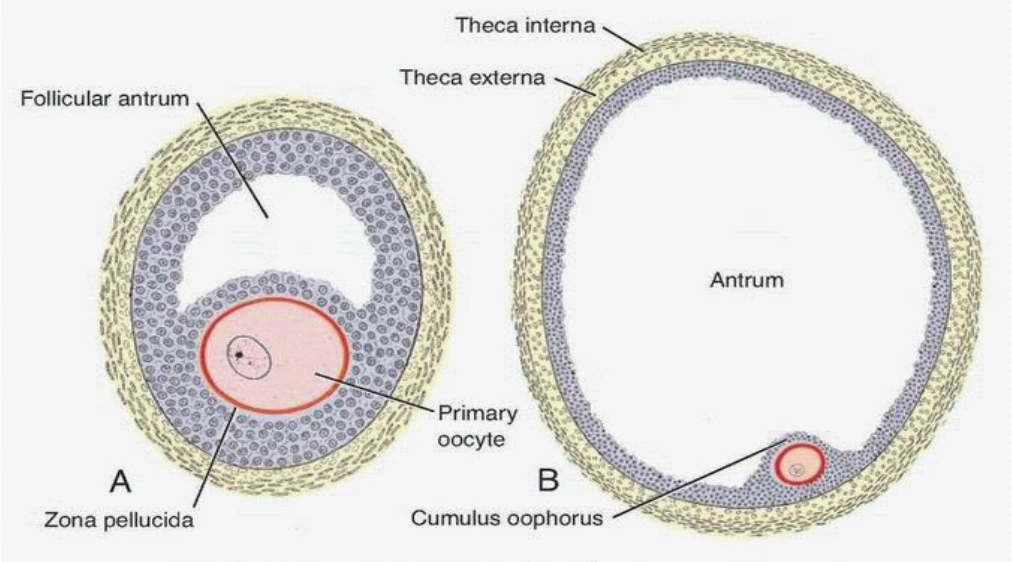


- Granulosa cells rest on a basement membrane separating them from surrounding ovarian connective tissue (stromal cells) that form the **theca folliculi**. Also, granulosa cells and the oocyte secrete a layer of glycoproteins on the surface of the oocyte, forming the **zona pellucida**.

- 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**.`



- As development continues, fluid-filled spaces appear between granulosa cells. Coalescence of these spaces forms the **antrum,** and the follicle is termed a **secondary (vesicular) follicle.** Initially, the antrum is crescent shaped, but with time, it enlarges.

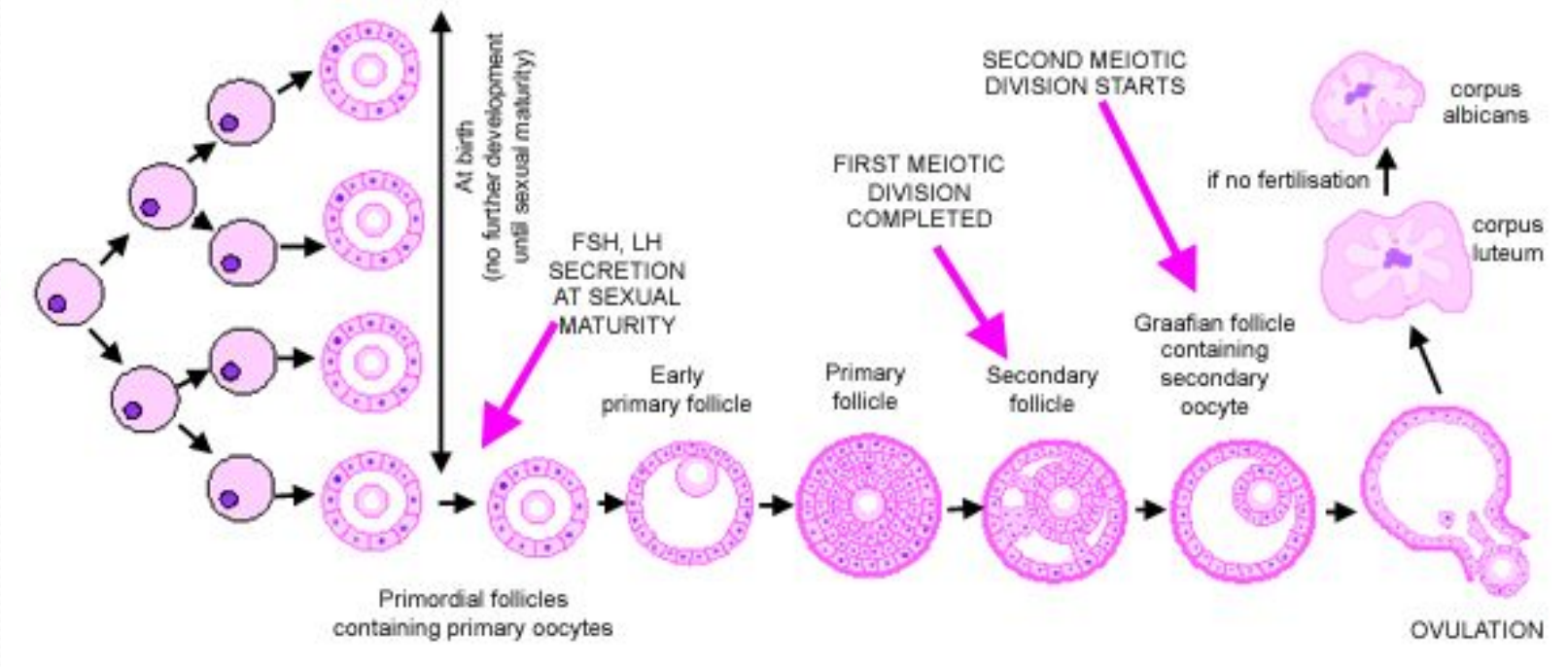


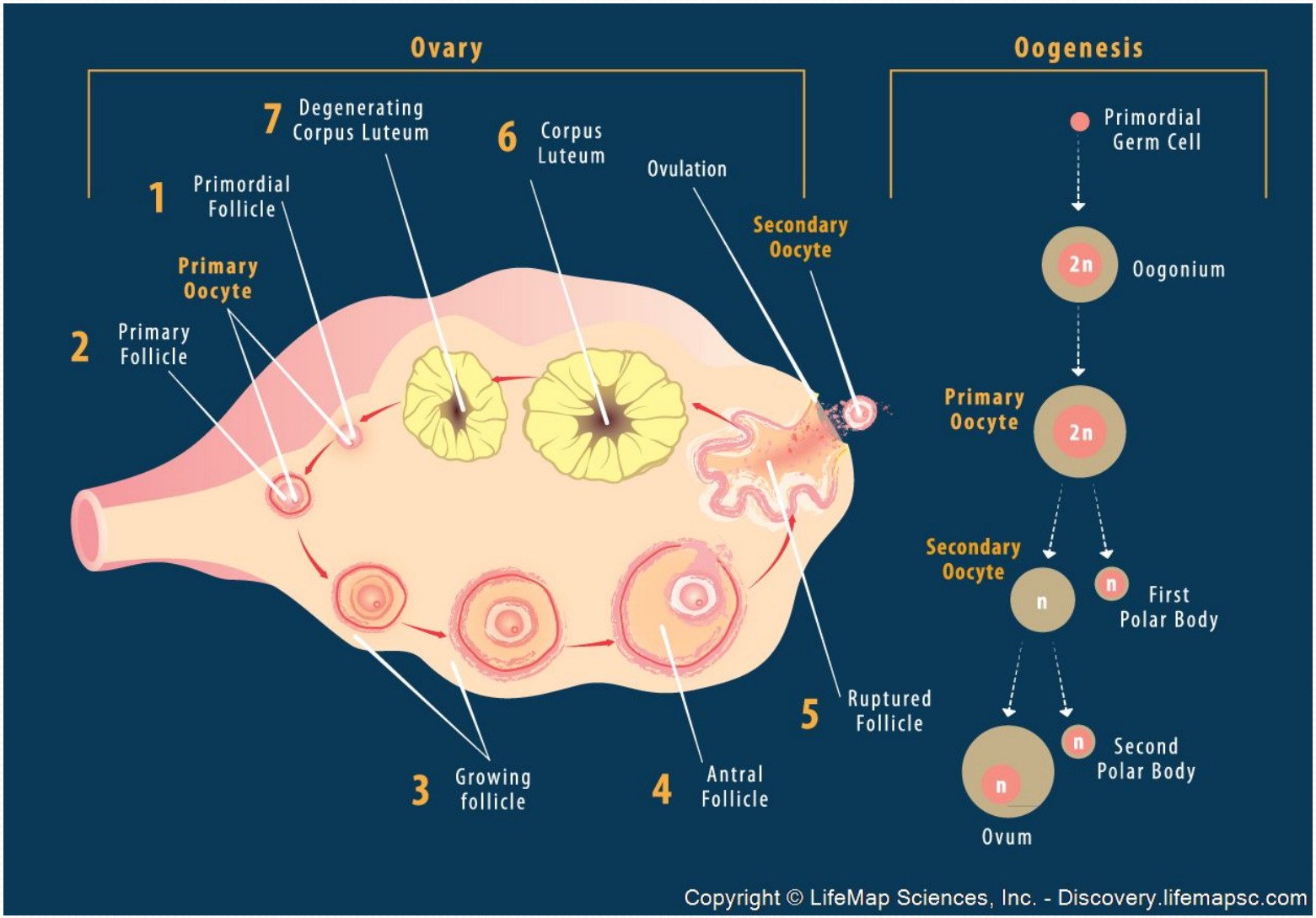
- When the secondary follicle is mature, a surge in **luteinizing hormone (LH)** induces the **preovulatory growth phase**. Meiosis I is completed, resulting in formation of two daughter cells of unequal size, each with 23 double structured chromosomes. One cell, the **secondary oocyte,** receives most of the cytoplasm; the other, the **first polar** body, receives practically none

- The 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.

- In summery:
- Before birth----□ primordial follicle **arrested in prophase** I of Meiosis I until-□ puberty --□□ secondary follicle (with antrum)---□ LH surge--□ preovulatory stage (meiosis I is complete, 37 hours before ovulation)---□ formation of two daughter cells of unequal size-□ 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.

Summary


At birth
(no further development until sexual maturity)
FSH, LH SECRETION AT SEXUAL MATURITY
FIRST MEIOTIC DIVISION COMPLETED
SECOND MEIOTIC DIVISION STARTS
if no fertilisation
corpus albicans
corpus luteum
Early primary follicle
Primary follicle
Secondary follicle
Graafian follicle containing secondary oocyte
Primordial follicles containing primary oocytes
OVULATION


Ovary
Oogenesis
7 Degenerating Corpus Luteum
6 Corpus Luteum
Ovulation
1 Primordial Follicle
Secondary Oocyte
Primary Oocyte
2 Primary Follicle
Primordial Germ Cell
2n
Oogonium
Primary Oocyte
2n
Secondary Oocyte
n
n
First Polar Body
5 Ruptured Follicle
n
n
Second Polar Body
n
Ovum
3 Growing follicle
4 Antral Follicle
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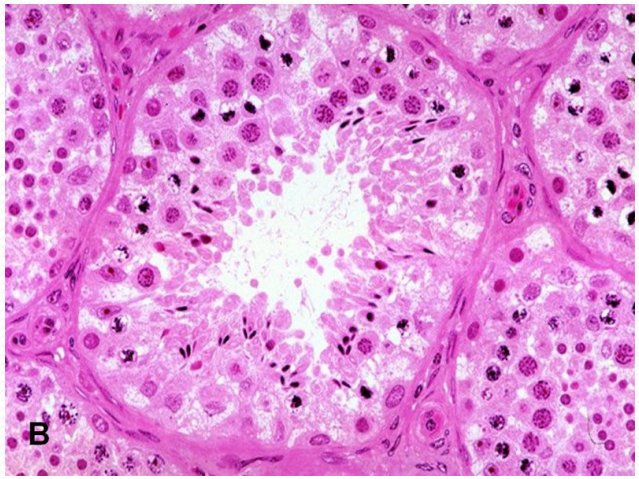
SPERMATOGENESIS

- **Spermatogenesis,** which begins at puberty, includes all of the events by which **spermatogonia** are transformed into **spermatozoa.**
- At birth, germ cells in the male can be recognized in the sex cords (**seminiferous tubules)** of the testis surrounded by supporting cells called (**Sertoli cells).**



Testis: Seminiferous Tubules
H&E staining

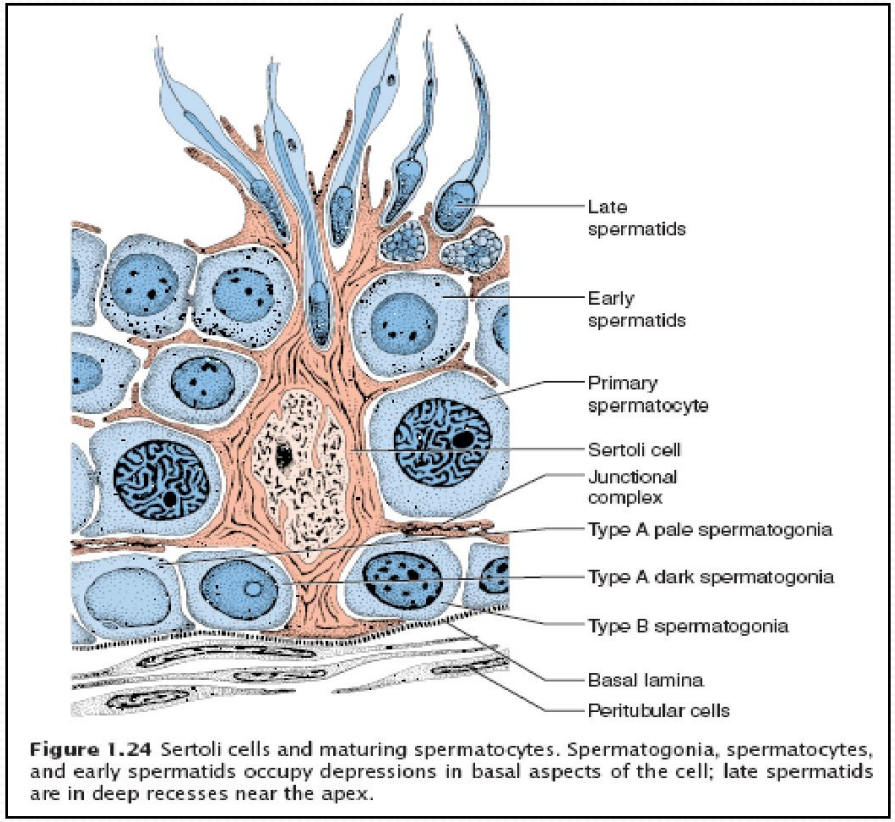
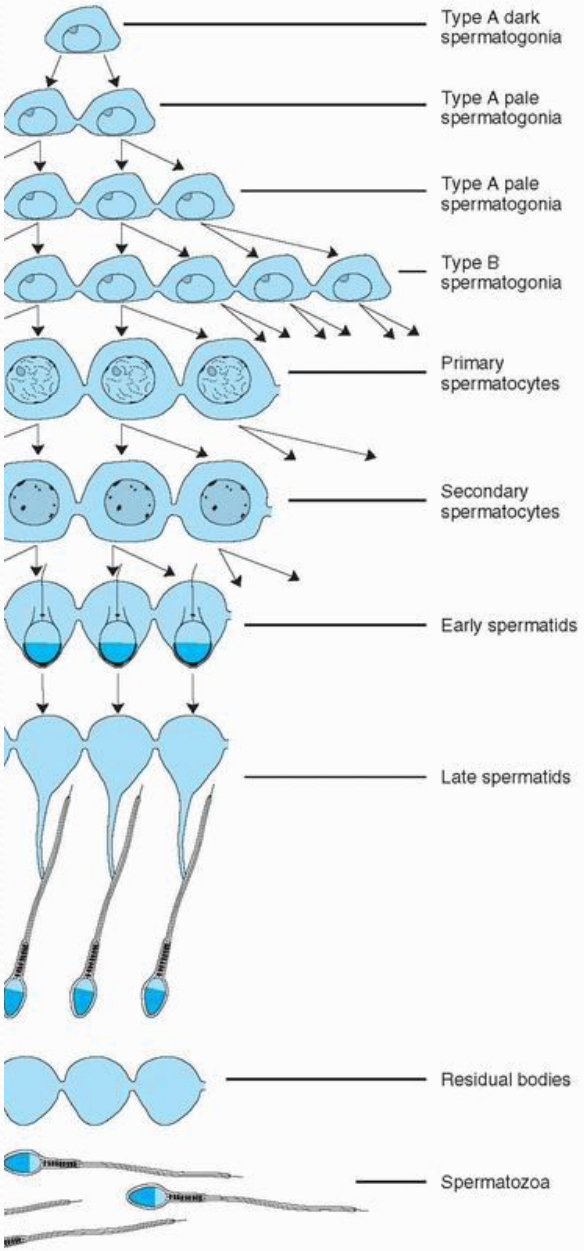


Figure 1.24 Sertoli cells and maturing spermatocytes. Spermatogonia, spermatocytes, and early spermatids occupy depressions in basal aspects of the cell; late spermatids are in deep recesses near the apex.

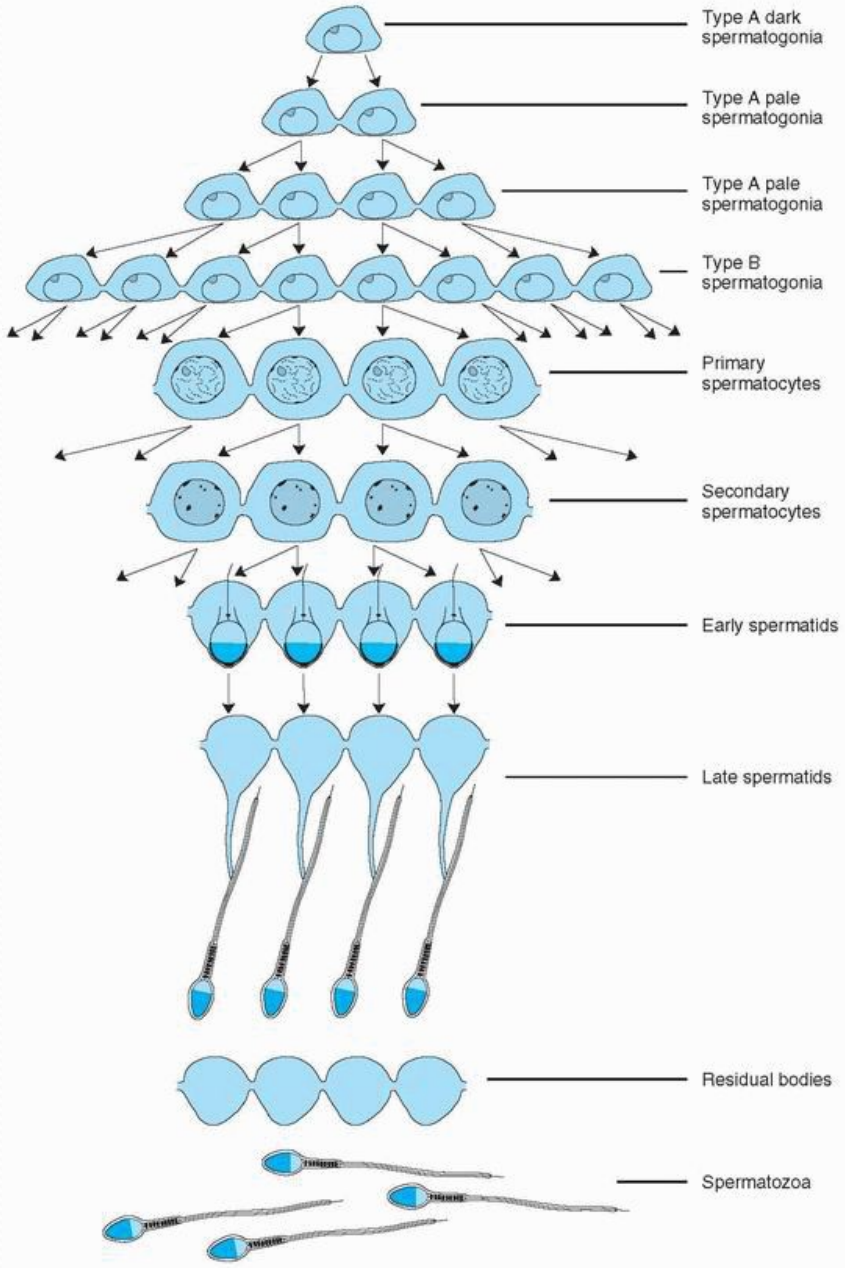
SPERMATOGENESIS

- Shortly before puberty:
- primordial germ cells give rise to spermatogonial stem cells, cells emerge from this stem cell population to form **type A spermatogonia,** and their production marks the initiation of spermatogenesis.
- Type A cells undergo a limited number of mitotic divisions to form a clone of cells. The last cell division produces **type B spermatogonia,** which then divide to form **primary spermatocytes.**
- Primary spermatocytes then enter a prolonged prophase (22 days) followed by rapid completion of meiosis I and formation of **secondary spermatocytes.** During the second meiotic division, these cells immediately begin to form haploid **spermatids, but** cytokinesis is incomplete.



SPERMATOGENESIS

Successive cell generations are joined by **cytoplasmic bridges**. Thus, the progeny of a single type A spermatogonium form a clone of germ cells that maintain contact throughout differentiation.



- Spermatogenesis is regulated by:

- **luteinizing hormone (LH)** production by the pituitary. LH binds to receptors on Leydig cells and stimulates testosterone production, which in turn binds to Sertoli cells to promote spermatogenesis.
- **Follicle stimulating hormone (FSH)** its binding to Sertoli cells stimulates testicular fluid production and synthesis of intracellular androgen receptor proteins.

Spermiogenesis

- Its the transformation of spermatids into spermatozoa**.**
- These changes include (*a*) formation of the **acrosome,** (*b*) condensation of the nucleus; (*c*) formation of neck, middle piece, and tail; and (*d*) shedding most of the cytoplasm.
- In humans, the time required for a spermatogonium to develop into a mature spermatozoon is approximately 64 days.
- When fully formed, spermatozoa enter the lumen of seminiferous tubules, pushed toward the epididymis by contractile elements in the wall of the seminiferous tubules.
- spermatozoa obtain full motility in the **epididymis**.