MALE REPRODUCTIVE PHYSIOLOGY PART I

GUYTON & HALL, CHAPTER 81

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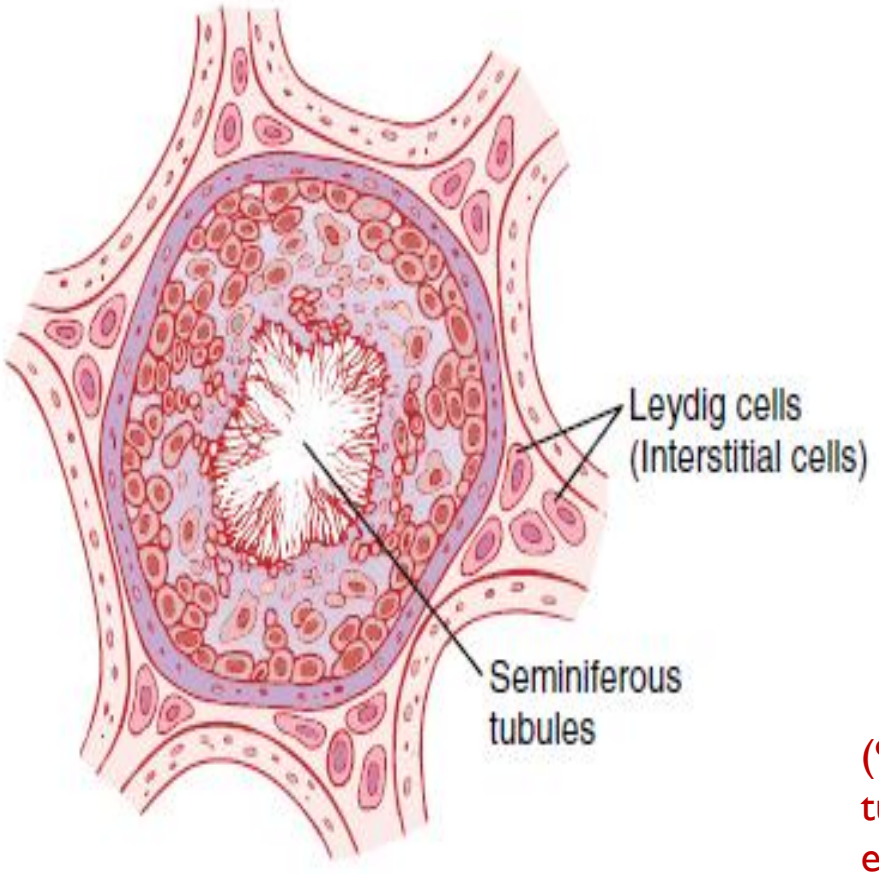
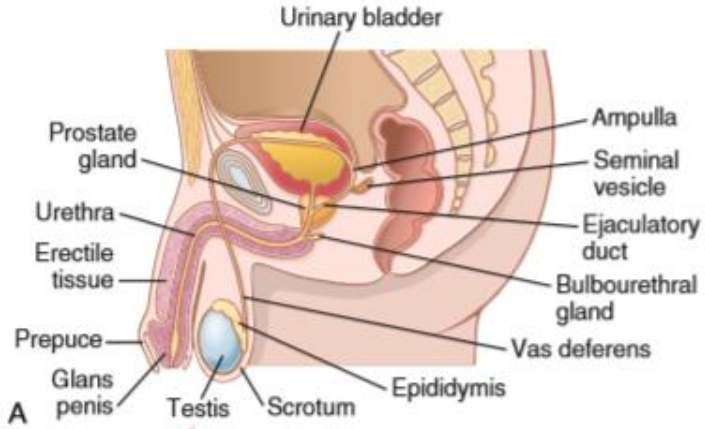
OBJECTIVES:

MALE REPRODUCTIVE SYSTEM I

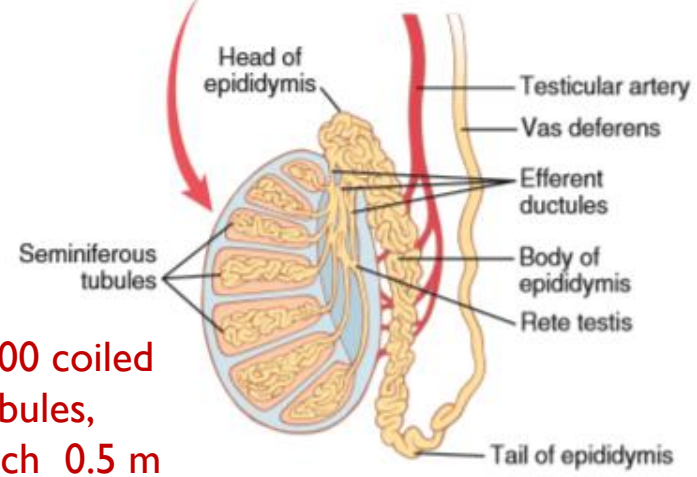
- Explain how the hypothalamus and anterior pituitary gland regulate the male reproductive function
- Explain the *spermatogenesis* and the functions of the male reproductive organs and glands

Male Reproductive Organs



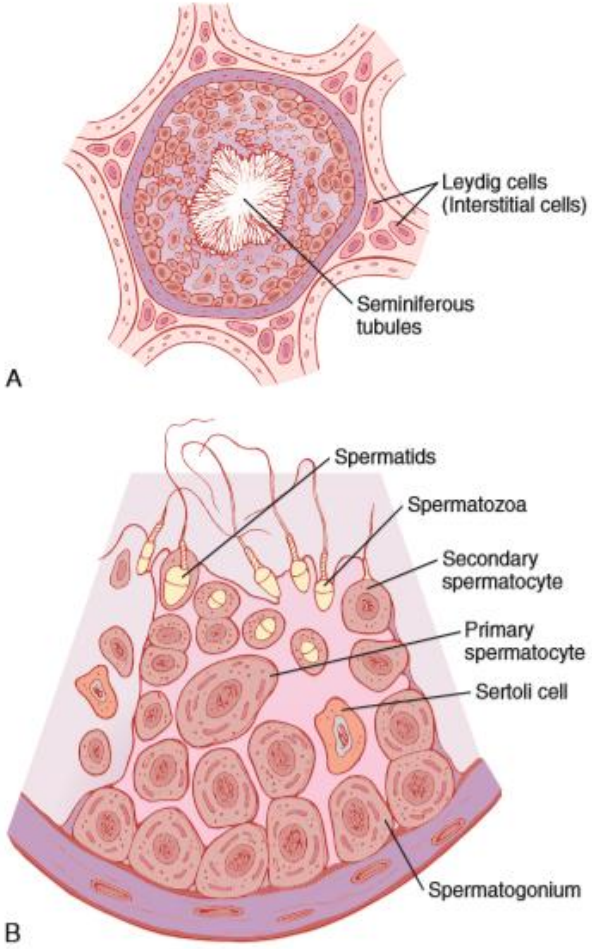


(6 m long)



(900 coiled tubules, each 0.5 m long)

SPERMATOGENESIS



- Formation of sperm from spermatogonia.
- Occurs in seminiferous tubules influenced by GnRH & gonadotropins of ant. pituitary hormones.
- Starts 10-13 years old > ↓ older people, climacteric
- *Sertoli cells: large with overflowing cytoplasmic envelopes that surround the developing spermatogonia around the central lumen of the seminiferous tubules. (nourish and support) (FSH)*
- *Leydig cells: lie with interstitium between the seminiferous tubules. (LH → testosterone)*
- *- numerous in the newborn male infants ONLY for the first few months of life*
- *- active at puberty & throughout adult life & secrete testosterone.*

Hormonal factors that stimulate spermatogenesis

1-Testosterone,

by the Leydig cells for growth and division of the testicular germinal cells.

2-Luteinizing hormone,

stimulates the Leydig cells to secrete testosterone.

3-Follicle-stimulating hormone,

stimulates the Sertoli cells; without this, no spermatogenesis

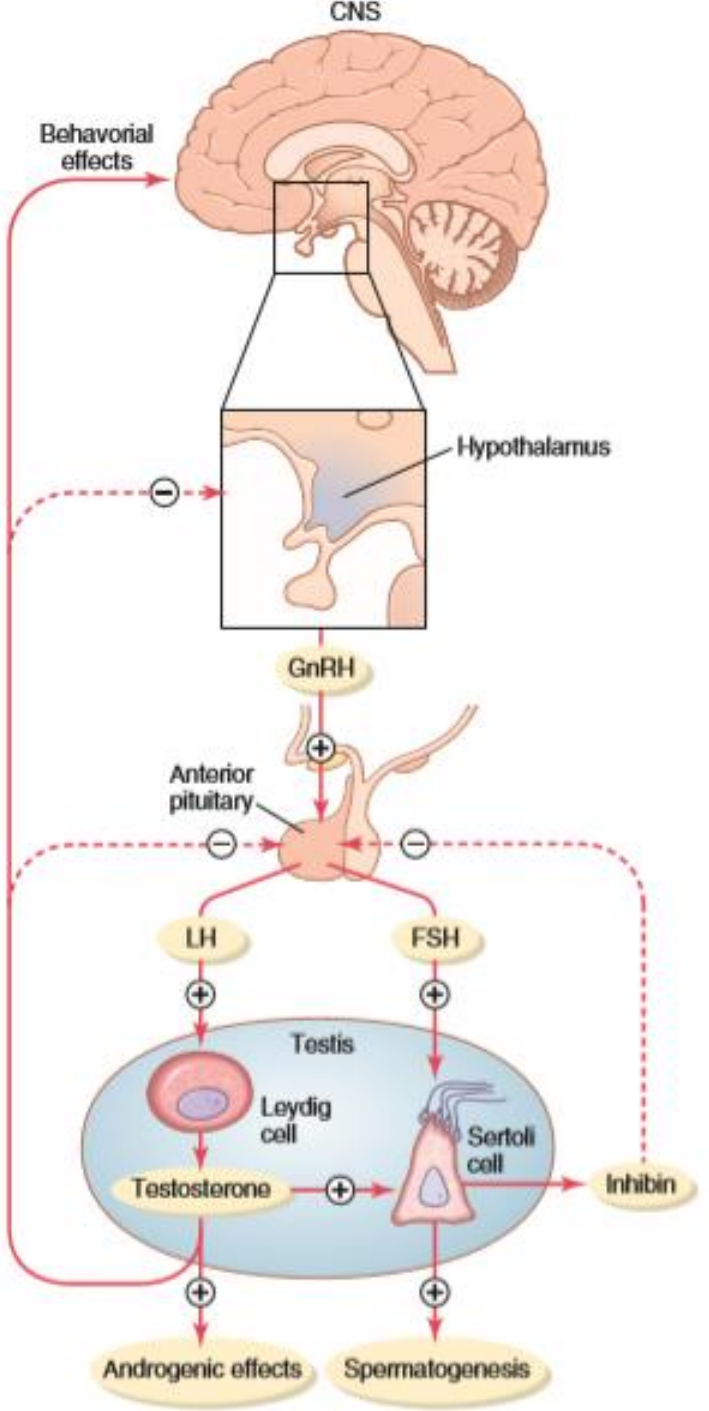
4-Estrogens

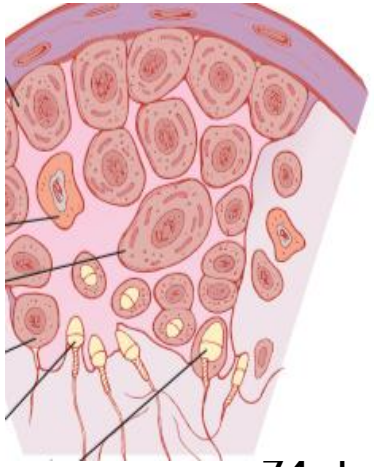
formed from testosterone by the Sertoli cells when they are stimulated by FSH hormone, are probably also essential.

5-Growth hormone,

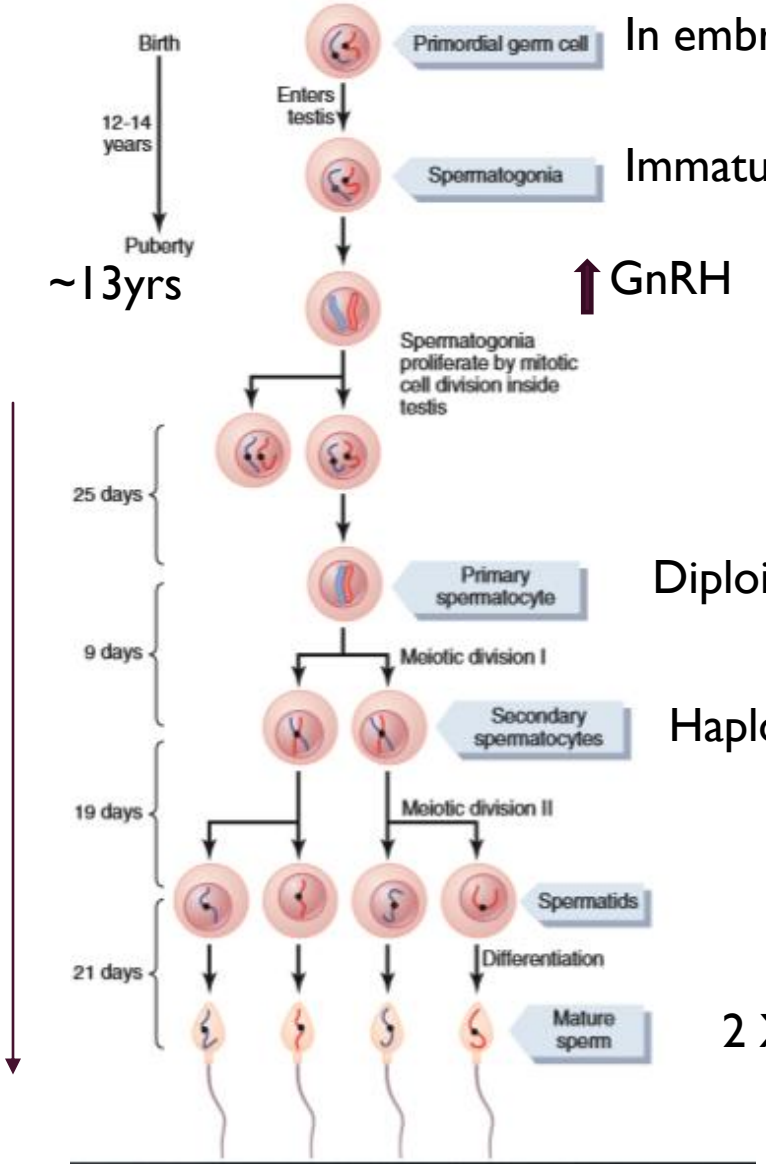
metabolic function in testes and promotes early division of the spermatogonia themselves; in pituitary dwarfs ? spermatogenesis?

Hypothalamic-anterior pituitary-gonad's axis





74 days



In embryo, migrate

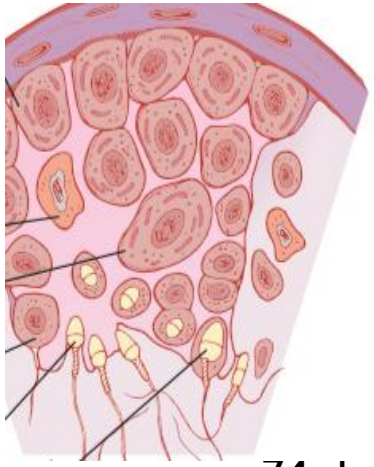
Immature, sem.

GnRH

Diploid 46 ch

Haploid 23 ch

2 X, 2 Y



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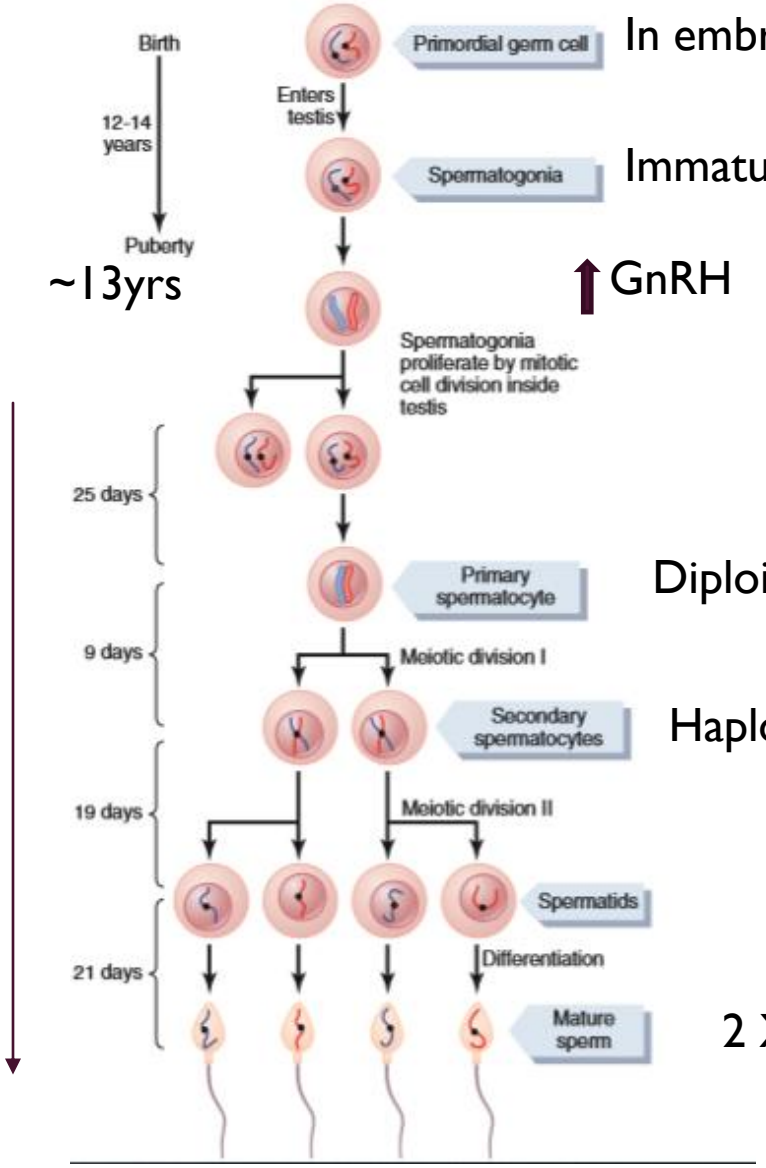

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Leydig Cells

- Testosterone is formed by the *interstitial cells of Leydig*
- They constitute about 20 % of the mass of the adult testes
- Leydig cells are almost nonexistent in the testes during childhood when the testes secrete almost no testosterone
- But they *are* numerous in the newborn male infant for the first few months of life and in the adult male after puberty; at which they secrete large quantities of testosterone.

- injection of purified LH into a child at any age or secretion of LH at puberty causes testicular interstitial cells that look like fibroblasts to evolve into functioning Leydig cells.

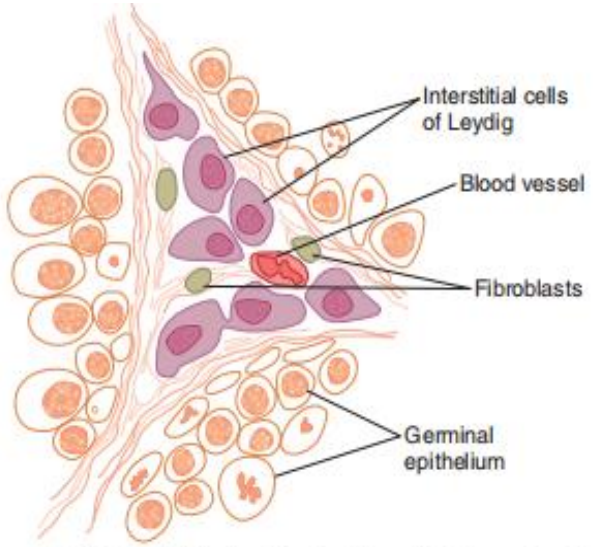


Figure 81-7. Interstitial cells of Leydig, the cells that secrete testosterone, located in the interstices between the seminiferous tubules.

PHYSIOLOGY OF MATURE SPERM:

- Mature sperm are motile (1-4mm/min) & capable of fertilizing the ovum & their activity is enhanced in a neutral & slightly alkaline medium & depressed in mildly acidic medium.
- ejaculated sperm live in the female genital tract for **only 1 to 2 days**
- **The acrosome** (Golgi) stores large quantities of **hyaluronidase** (to digest proteoglycans) **and proteolytic enzymes** (to digest proteins).

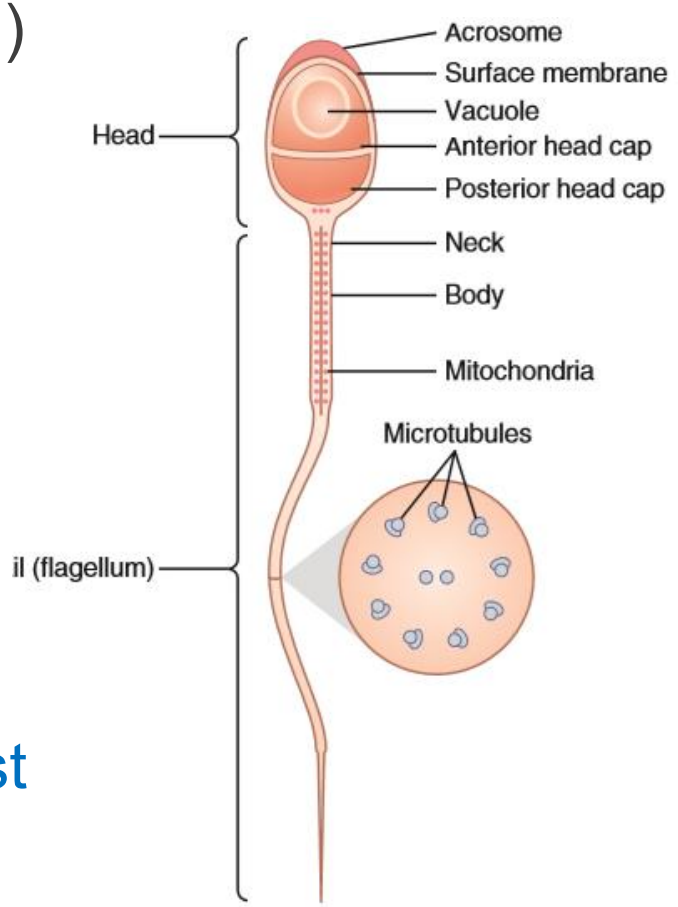


Figure 81-4. Structure of the human spermatozoon.

MATURATION OF SPERM IN THE EPIDIDYMIS

- After their formation in the seminiferous tubules, sperms require several days to pass through the epididymis (non-motile).

- After 18 to 24 hrs→ they develop the capability of motility in epididymis

- (some inhibitory proteins in the epididymal fluid prevent final motility until after ejaculation).

STORAGE OF SPERMS

The 2 testes of adult human form up to 120 million sperms each day.

– Most are stored in the epididymis

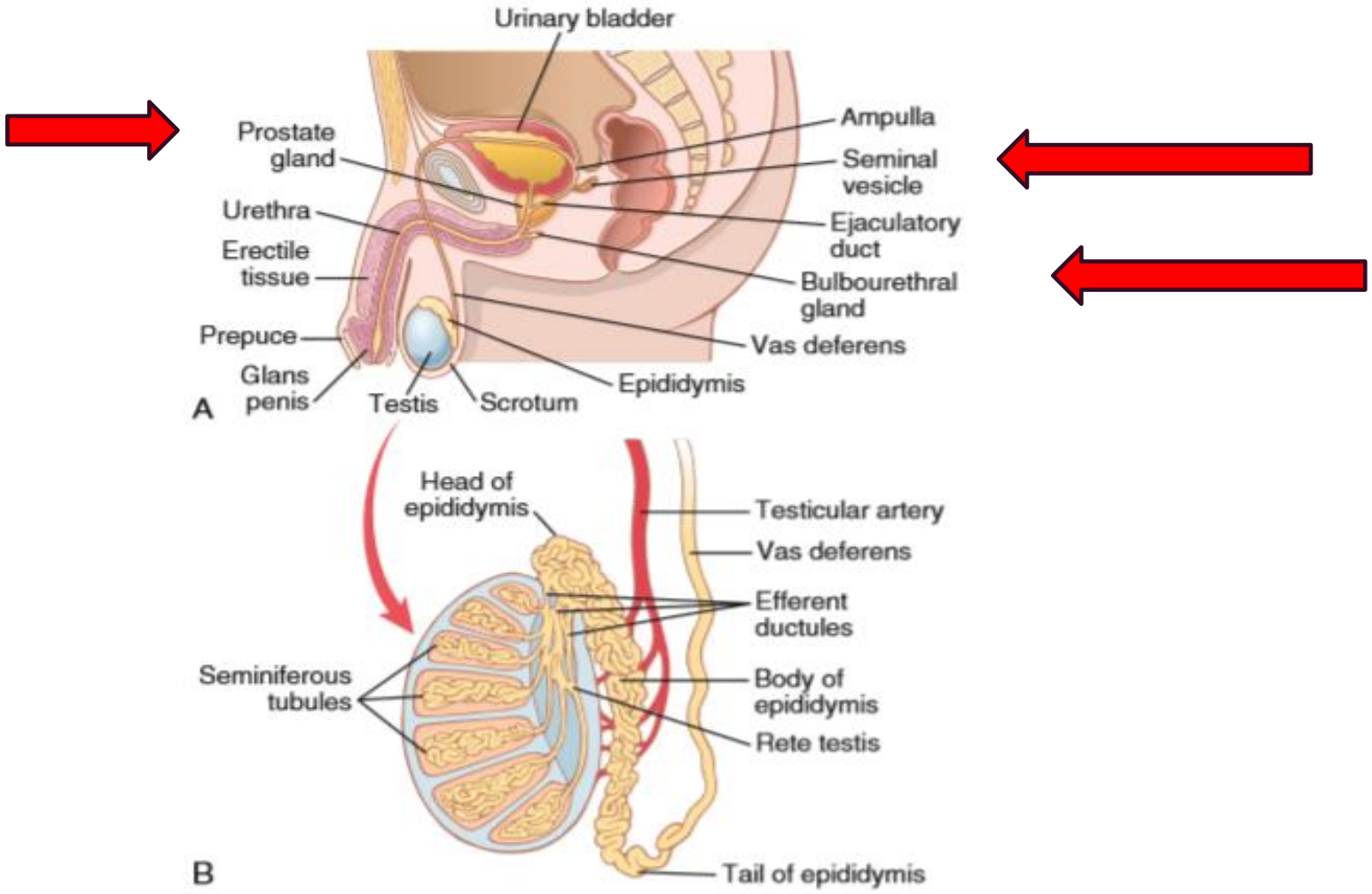
– Small amounts are stored in the vas deferens.

- Suppressed but still maintain fertility for a month at least

After ejaculation, the sperm becomes motile & capable of fertilizing the ovum "maturation"

– The sertoli cells and epithelium of the epididymis secrete nutrient fluid which contains (testosterone & estrogens), enzymes & nutrients essential for sperm maturation.

SECRETION OF MALE GLANDS



Seminal Vesicles Function

– During emission and ejaculation: mucoid material containing fructose, citric acid & nutrient substances & large quantities of prostaglandins & fibrinogen. Emptied after vas difference empties the sperms

The prostaglandins help in fertilization in two ways:

1- by reacting with the female cervical mucus making it more receptive to sperm movement.

2- by causing backward reverse peristaltic contractions of the uterus & fallopian tubes to move the ejaculated sperm toward the ovaries(upper end of FT).

Prostate Gland Function

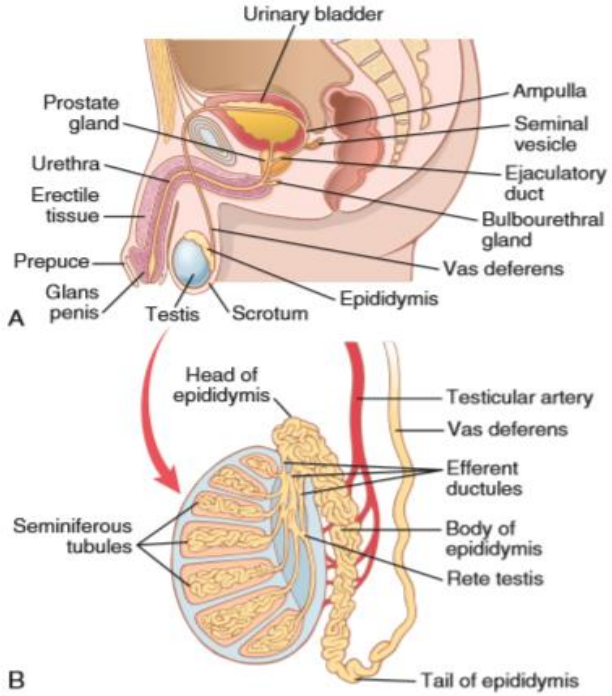
During emission, The prostate gland contracts and secretes ***thin milky fluid*** containing; Ca2+, citrate ion, phosphate ion, a clotting enzyme & profibrinolysin. The alkaline prostatic fluid is important for sperm motility and successful fertilization of the ovum .

Alkaline prostate fluid function:

1- helps to neutralize the slightly acidic fluid of the vas deferens (due to the presence of citric acid and metabolic product of the sperm which inhibits its fertility).

2- helps to neutralize the acidic vaginal secretions (pH 3.5-4.0) to optimize it for better sperm motility (pH 6.0-6.5)

SEMEN



Ejaculated semen (pH 7.5)

is composed of :

– the fluid & sperm from the **vas deferens** (~10%) milky
– fluid from the **seminal vesicles** (~60%) mucoid
– fluid from the **prostate gland** (~30%) clotting enzyme
– small amounts from the mucous glands the **bulbourethral glands**.

SPERM VIABILITY

- After ejaculation, their max life span is 24-48 hrs at body temperature
- At lower temperature, for weeks
- When frozen, for years

Capacitation of the Spermatozoa

- Freshly ejaculated semen undergoes "**capacitation**" within 1-10 hours.

1. inhibitory factors are washed out by uterine and fallopian fluids
2. the sperm swims away from cholesterol vesicles(acrosome gets thinner)
3. the membrane of the sperms becomes more permeable to Ca^{++}

ACROSOME ENZYMES, THE "ACROSOME REACTION," AND PENETRATION OF THE OVUM

- large quantities of *hyaluronidase* and *proteolytic enzymes* in the acrosome of the sperm.
  - Hyaluronidase depolymerizes the hyaluronic acid polymers in the inter cellular cement that holds the ovarian granulosa cells together.
  - The proteolytic enzymes digest proteins in the structural elements of tissue cells that still adhere to the ovum.
- Sperm should penetrate zona pellucida, ant sperm binds receptors in ZP, in minutes the acrosome dissolves, pathways open, within 30 min (cell membranes fuse)
- **Why only one sperm enter**? Within a few minutes after sperm penetration Ca++ diffuses to oocyte releasing cortical granules that permeate in ZP and prevent other sperms