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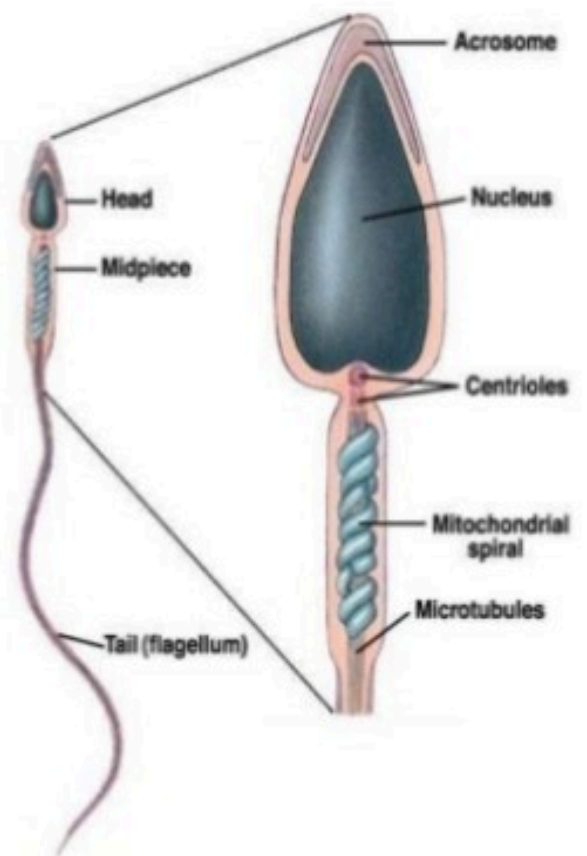
SPERMATOGENESIS

The process by which sperm develop to become mature sperm, capable of fertilizing an ovum

SPERM

Each day about 300 million sperm complete spermatogenesis.

- **Function:**
 - To move and carry genetic information to the egg.



Structure: 60 μ m long

❖ **Head**

- About **4-5 μ m** long contain Nucleus with 23 chromosomes (haploid or n).
- Anterior 2/3 portion of nucleus is covered by
- **Acrosome** – a caplike vesicle filled with **oocyte penetrating enzymes**, that help the sperm cells to penetrate secondary oocyte.
- (main enzymes are hyaluronidase & proteases)

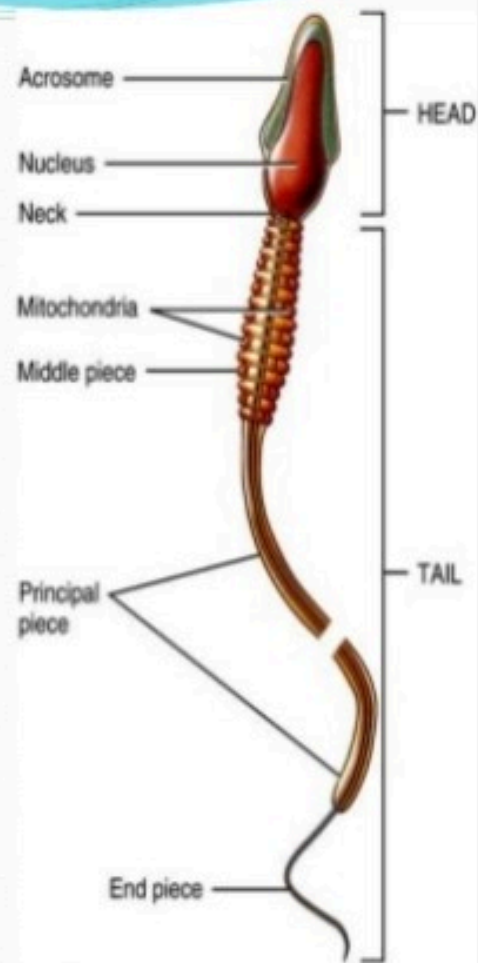


Figure 28.06 Tortora - PAP 12/e
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Tail

- Tail portion is sub divided in 4 parts :
- 1) **Neck** – contains centrioles forming **microtubules** that comprise remainder of tail
- 2) **Middle piece** – contains **mitochondria** arranged in a spiral, provide energy for the locomotion
- 3) **Principal piece** – longest portion of tail
- 4) **End piece** – terminal, tapering portion of tail
- Once ejaculated, sperm do not survive more than 48 hours in female reproductive tract

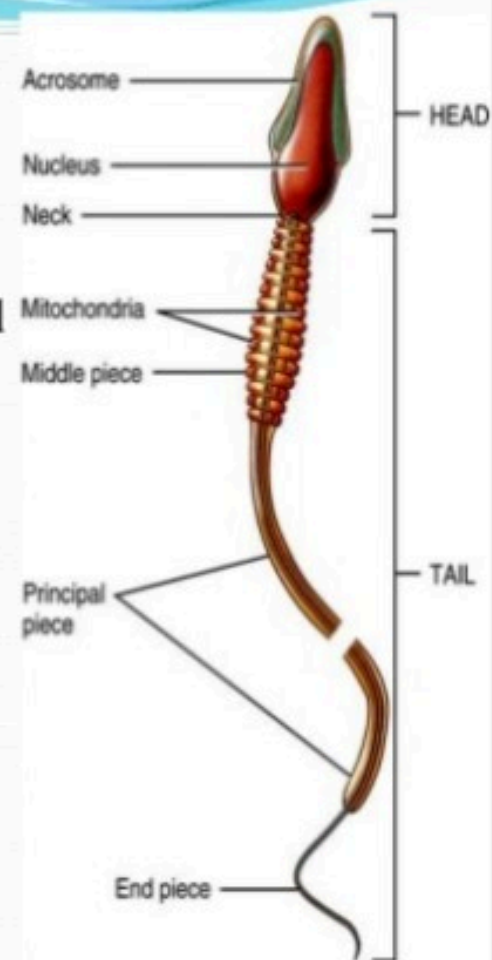
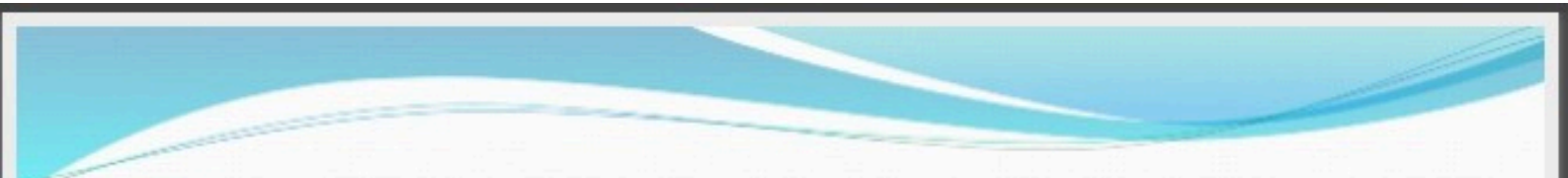



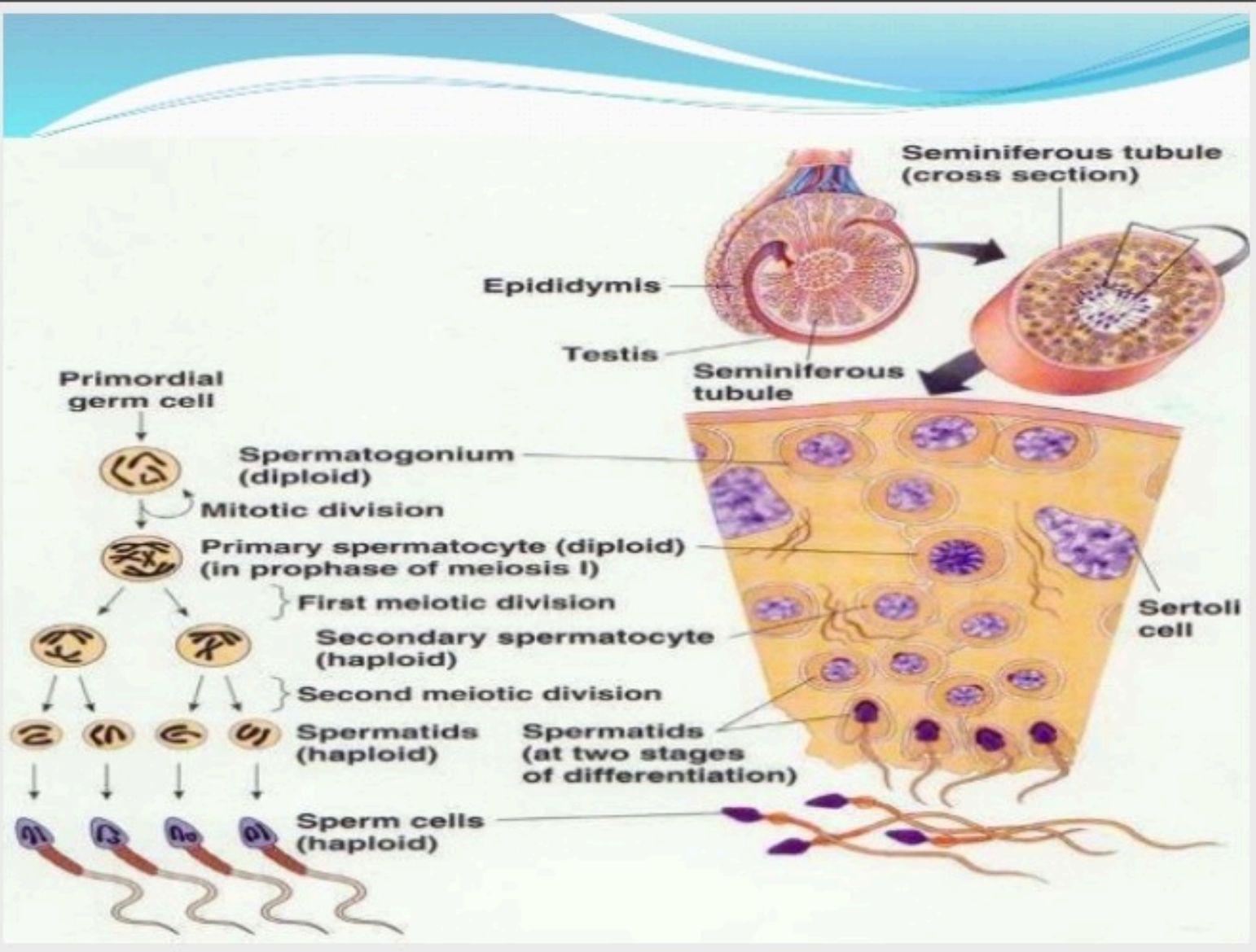
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Seminiferous tubule cells

- **Spermatogenic cells – sperm-forming cells**
 - Spermatagonia (stem cell) develop from primordial germ cells that arise in yolk sac and enter testes in **5th week of development**
 - Primary spermatocytes → secondary spermatocytes → spermatids → sperm cells → lumen
- **Sertoli cells or sustentacular cells– support cells**
 - Tight junction form blood-testis barrier – prevents immune response against sperm cell surface antigens

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- Nourish spermatocytes, spermatids and sperm, phagocytize excess spermatid cytoplasm, control movements of spermatogenic cells,
 - release sperm into lumen, produce fluid for sperm transport, secrete inhibin, regulate effects of testosterone and follicle-stimulating hormone (FSH)
 - **Leydig (interstitial) cells** found in spaces between seminiferous tubules
 - Secrete **testosterone**

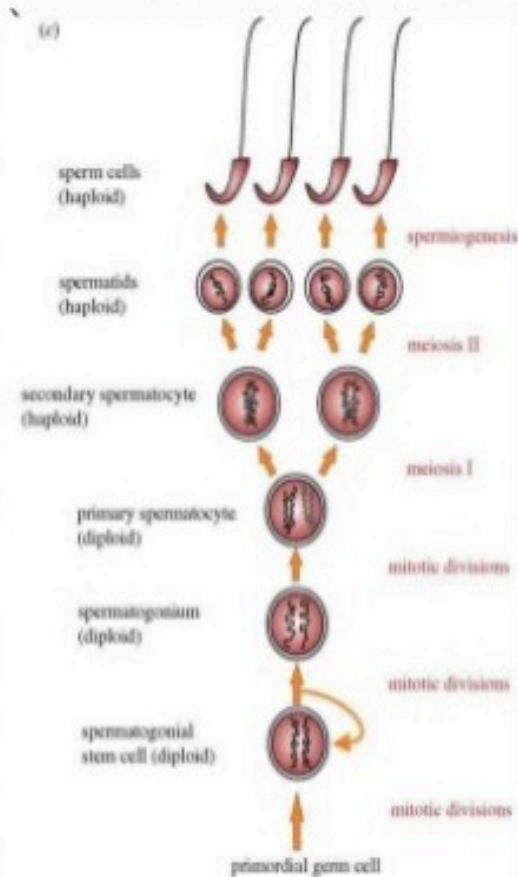
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- During formation of the embryo, the primordial germ cells migrate into the testes and become immature germ cells called spermatogonia

Spermatogenesis

- Takes 65-75 days
- Begins with spermatogonia – diploid ($2n$)
 - Stem cells undergo mitosis to replace themselves and some continue development
- **Primary spermatocytes** – diploid ($2n$)
 - Each duplicates its DNA and meiosis begins
- **Meiosis I** – homologous pairs line up, crossing over occurs
 - Secondary spermatocytes (haploid or
 - 2 cells at end of Meiosis I
 - Each chromosome made up of 2 chromatids attached at centromere
- **Meiosis II** – 2 chromatids separate
 - Spermatids – 4 haploid cells of single chromatid at end of meiosis II



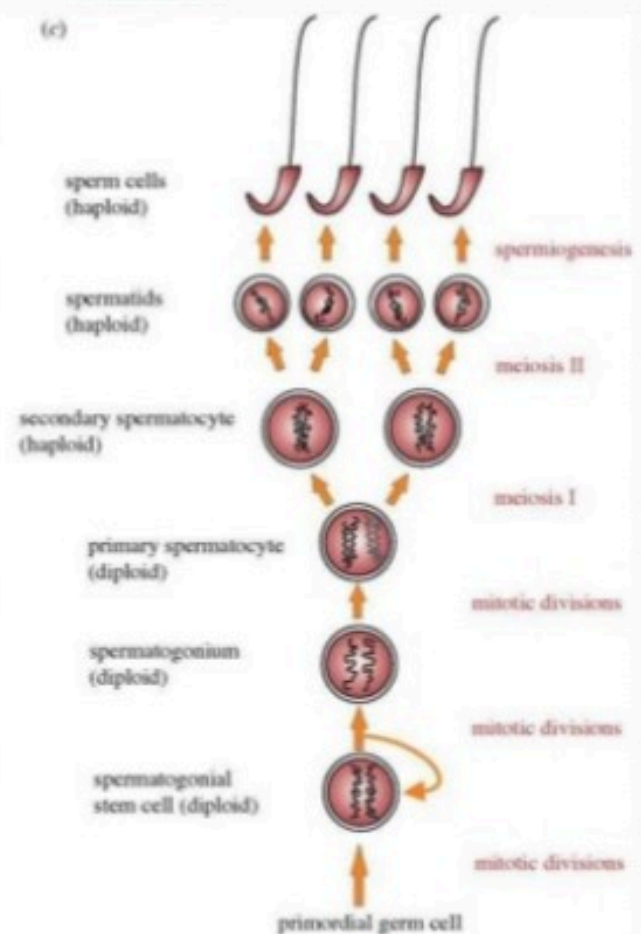
Cells remain attached to each other by cytoplasmic bridges

Spermiogenesis – development of spermatids into sperm

Spherical spermatids transform into elongated sperm

Acrosome and flagella form, mitochondria multiply
Sertoli cells dispose of excess cytoplasm

Spermiation – release from connections to Sertoli cells
Not yet able to swim

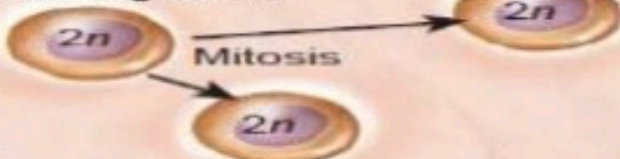


Basement membrane of seminiferous tubule

Superficial

Some spermatogonia remain as precursor stem cells

Spermatogonium



Some spermatogonia pushed away from basement membrane

Differentiation

Primary spermatocyte

DNA replication, tetrad formation, and crossing-over

MEIOSIS

Meiosis I

Secondary spermatocytes

Each chromosome has two chromatids

Meiosis II

Spermatids

Cytoplasmic bridge

SPERMIOGENESIS

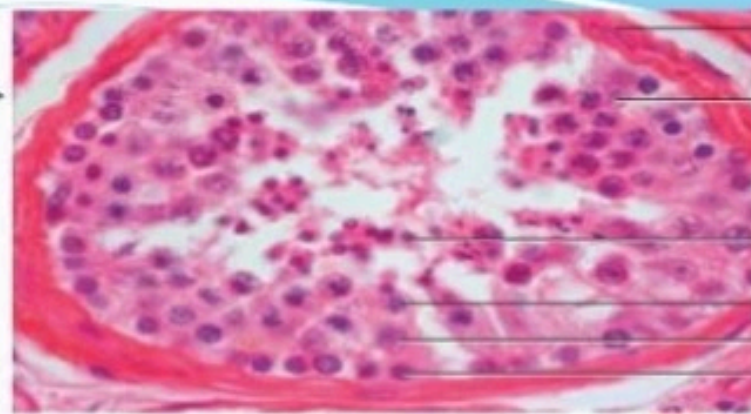
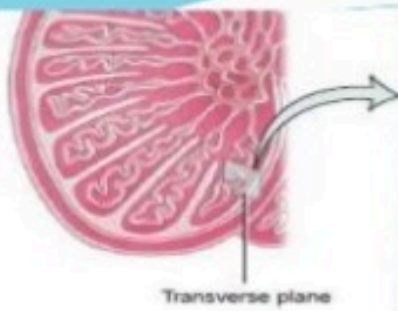


Spermatozoa

Deep

Lumen of seminiferous tubule





Basement membrane

Sertoli cell

Spermatid (n)

Secondary spermatocyte (n)

Primary spermatocyte ($2n$)

Spermatogonium ($2n$) (stem cell)

LM 100x

(a) Transverse section of several seminiferous tubules

Leydig cell

Blood capillary

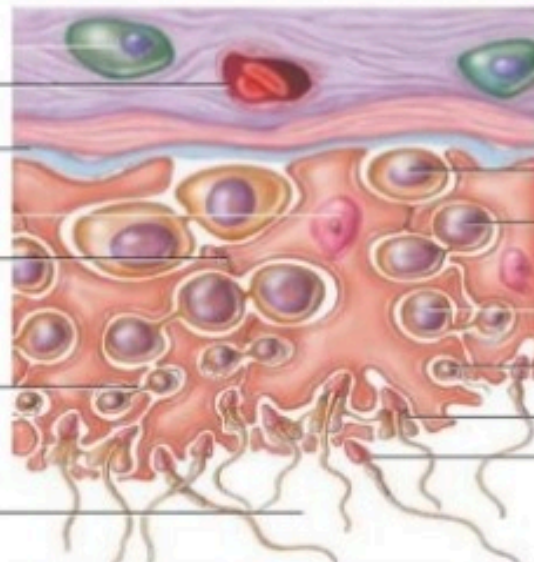
Basement membrane

Sertoli cell nucleus

Blood-testis barrier (tight junction)

Cytoplasmic bridge

Lumen of seminiferous tubule



SPERMATOGENIC CELLS:

Spermatogonium ($2n$) (stem cell)

Primary spermatocyte ($2n$)

Secondary spermatocyte (n)

Early spermatid (n)

Late spermatid (n)


Sperm cell or spermatozoon (n)

Hormonal control of testes

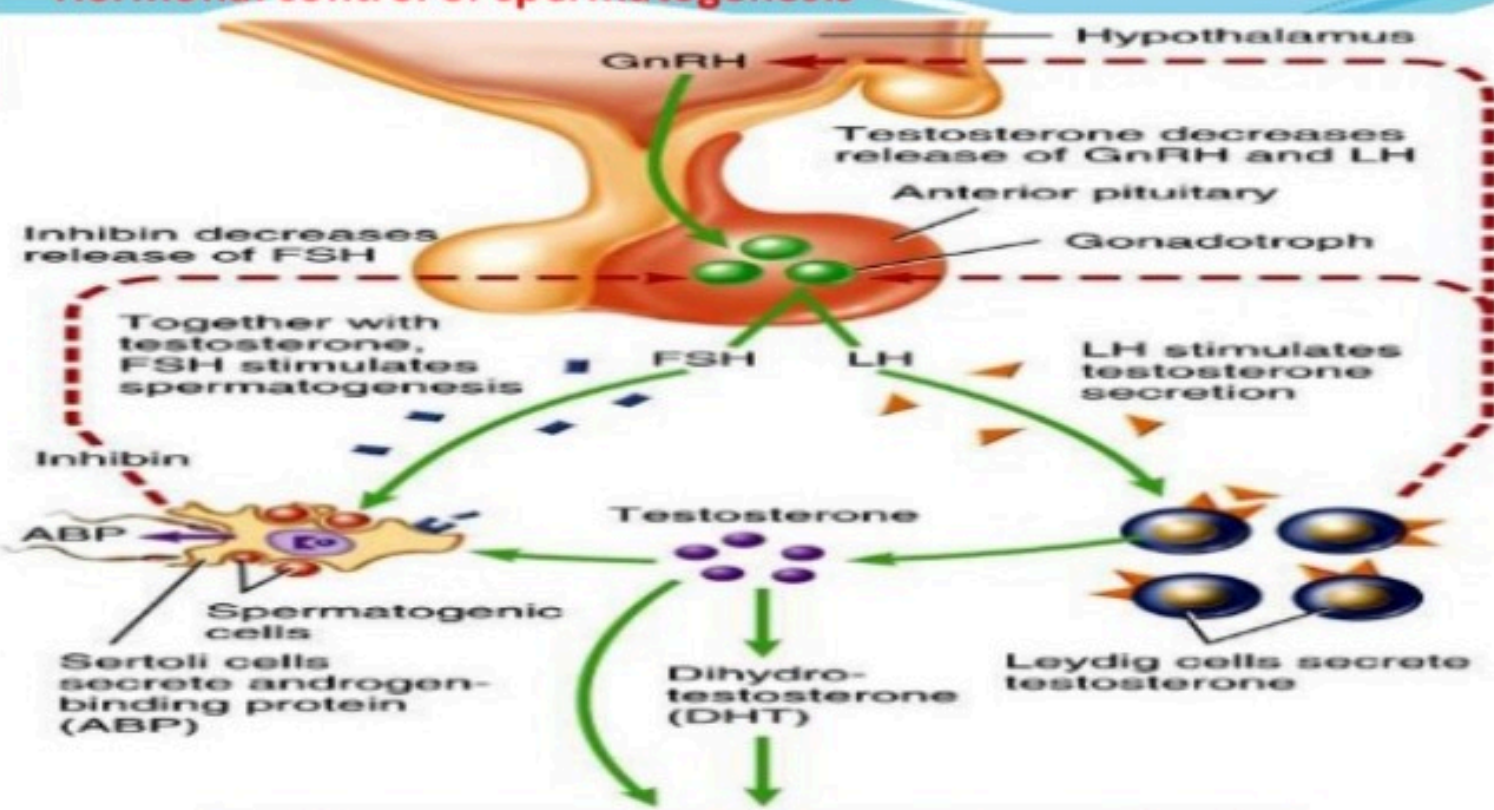
- At puberty, secretion of **gonadotropin-releasing hormone (GnRH)** increases
- Stimulates **anterior pituitary to** increase secretion of luteinizing hormone (LH) and follicle-stimulating hormone (FSH)

- **LH** stimulates Leydig cells to secrete **testosterone**
 - Synthesized from cholesterol mainly in testes
 - Suppresses secretion of LH and GnRH via negative feedback

- **Enzyme 5 alpha-reductase** converts testosterone into **dihydrotestosterone (DHT)** in external genitals and prostate

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- **FSH** acts indirectly on spermatogenesis
 - FSH and testosterone act on **Sertoli cells** to stimulate secretion of **androgen-binding protein (ABP)**
 - ABP binds testosterone keeping concentration high
 - Testosterone stimulates spermatogenesis
 - Sertoli cells release **inhibin** which **inhibits FSH**

Hormonal control of spermatogenesis



- Male pattern of development (before birth)
- Enlargement of male sex organs and expression of male secondary sex characteristics (starting at puberty)
- Anabolism (protein synthesis)

Key:

	LH		FSH		Testosterone
	LH receptor		FSH receptor		Androgen

Androgens (testosterone and DHT)

- **Prenatal development**

- Testosterone stimulates male pattern of development of reproductive system ducts and descent of testes
- DHT stimulates development of external genitalia

- **Development of male sexual characteristics**

- At puberty, they bring about development of male sex organs and **development of male secondary sexual characteristics**

- **Development of sexual function**

- Androgens contribute to male sexual behavior, spermatogenesis and sex drive (libido)

- **Stimulation of anabolism**

- Stimulate protein synthesis – heavier muscle and bone mass in men



EJACULATION

- **Ejaculation** is the discharge of semen from the penis.
- During orgasm, the semen is forcefully expelled from the body by strong muscular contractions of sperm ducts.

Semen

- Volume 1.5- 4.5 ml
- White, opalescent colour
- Slightly alkaline pH
- 100-125 million sperms/ml

Gland	Approximate %
testes	2–5%
seminal vesicle	65–75%
prostate	25–30%
bulbourethral glands	< 1%

Sperm pathway:

Testis – epididymis – vas deferens – Ejaculatory Duct -urethra



**THANK
YOU**