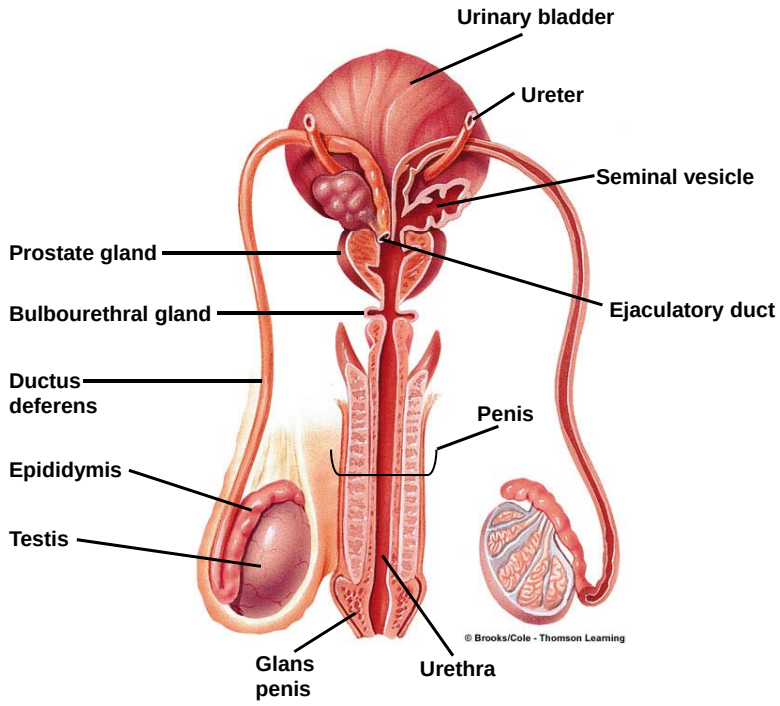
# Block 11 - Theme: Male sex hormones

## Physiology of primary and secondary male sex organs

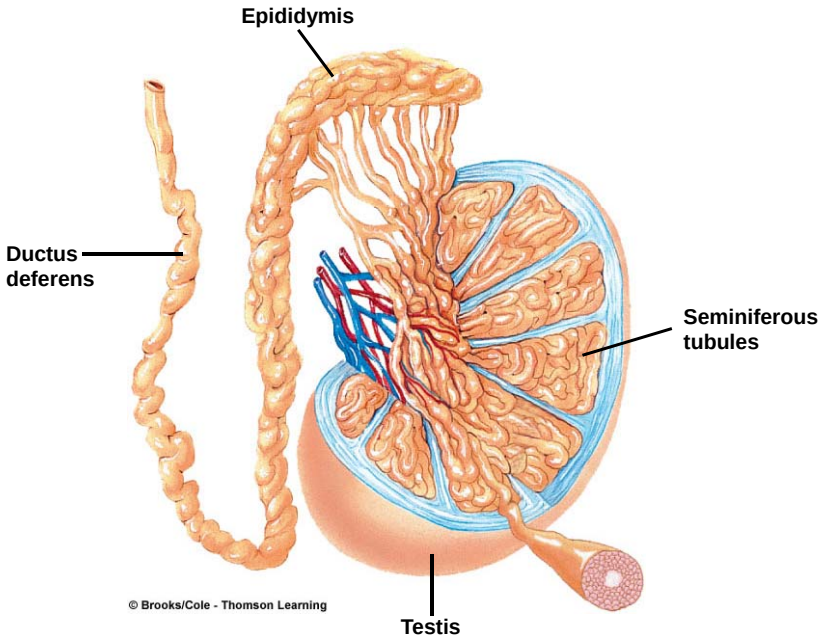
# Anatomical organisation

- Primary sex organ/gonad:
  - Testes
- Duct system:
  - For the conveyance of sperm and semen
- Accessory sex organs:
  - Seminal vesicles, prostate gland, urethra and penis
- External genitalia:
  - Scrotum, penis



# Testis

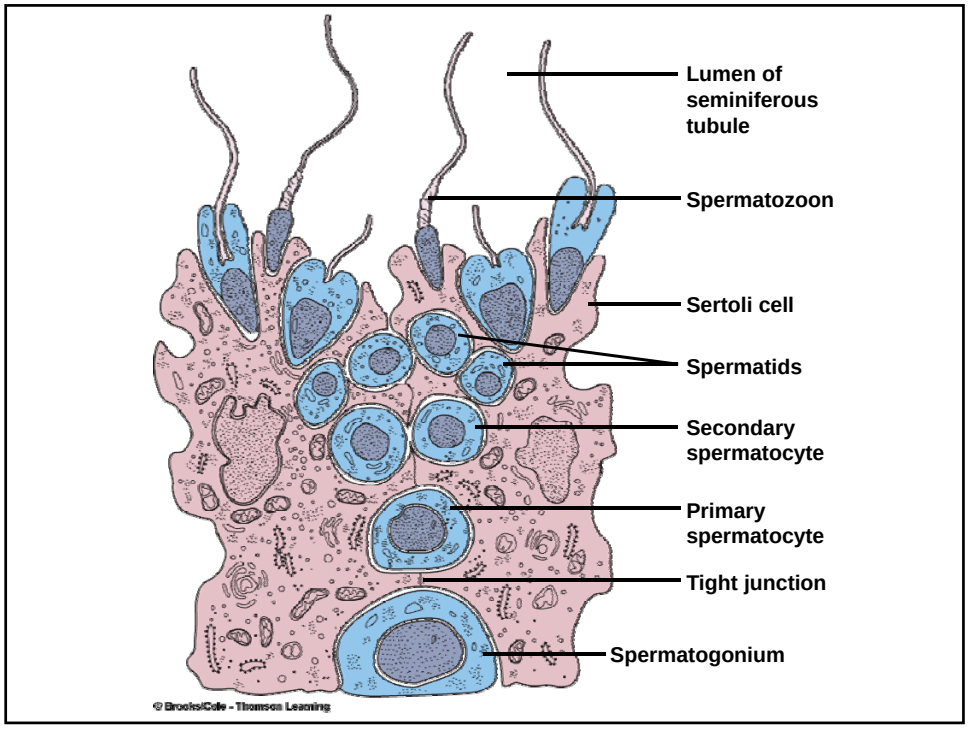
- Paired ovoid structures about 5 by 2.5 cm located in the scrotum.
- Each testis is enclosed by 3 coverings: tunica vasculosa, albuginea and vaginalis
- Parenchyma: each lobule of testis contains 1-4 coiled tubules known as seminiferous tubules, length of each is between 30-70 cm. Tubules form single, double or triple arches.
- Towards apex of each lobule, tubules unite with  with a straight narrow tubule which join and form a network of channels called rete testis
- See fig next slide



- From rete testis, 8-15 tubules called vas efferens arise. Vas efferens form head of epididymis and then converge to form duct of epididymis (4m).
- Duct of epi turns sharply at caudal pole of testis and passes as vas deferens.
- In between seminiferous tubules in the testis, there are some home secreting cells called interstitial cells of Leydig

Pathway for passage of sperm

Seminiferous tubules
↓
Rete testis
↓
Vas efferens
↓
Head of epidydimis
↓
Duct of epidydimis
↓
Vas deferens
↓
Ampulla
↓
Ejaculatory duct
↓
urethra




# Seminiferous tubule

- Wall is formed by 3 layers:
  - 1. outer capsule / tunica propia
  - 2. thin homogeneous basement membrane
  - 3. complex stratified epithelium which is consists of 2 types of cells:
    - » Germ / spermatogenic
    - » Supporting cells / cells of Sertoli

## Germ cell

- Lie between Sertoli cells and arranged in an orderly manner in 4-8 layers.
- In children, testis not fully developed. Therefore, only primitive germ cells called spermatogonia are present.
- With onset of sexual maturity, spermatogenic cells are represented in all stages of differentiation, viz., from periphery to lumen: spermatogonium→ primary spermatocyte → secondary spermatocyte → spermatid.

## Sertoli cells

- Large and tall irregular columnar cells extending from basement membrane to lumen of seminiferous tubule
- Germ cells are attached to Sertoli cells by means of cytoplasmic connections.
- Adjacent Sertoli cells near basement membrane are attached with one another by tight junctions and form a blood-testis barrier
- They support germ cells so also called sustentacular cells

## Functions of Sertoli cells

- Support and nourish germ cells until spermatozoa are released from them.
- Provide hormonal and other substances necessary for spermatogenesis
- Convert androgens into estrogen. Enzyme aromatase present in Sertoli cells is responsible for conversion.
- Secrete ABP (androgen binding protein)
- Secrete inhibin
- Secrete Mullerian regression factor (MRF) in fetal testes, MRF also called MIS.

## Functions of testis

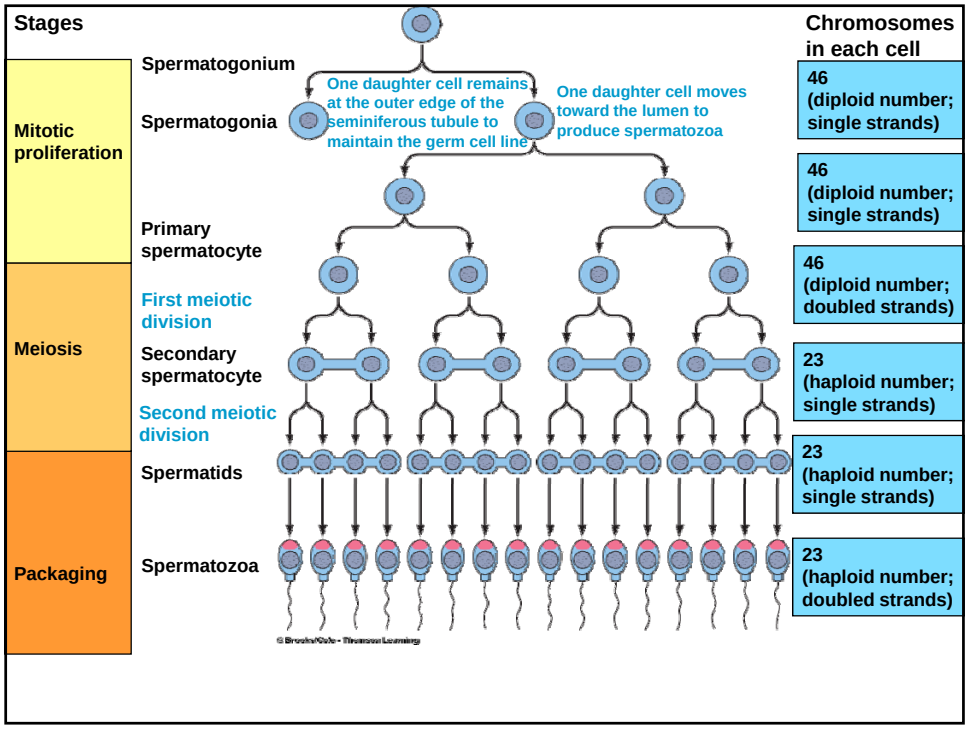
- Performs 2 functions:
  1. Gametogenic
  2. Endocrine

- Gametogenic function = Spermatogenesis:
  is the process by which the male gametes called spermatozoa / sperm are formed from primitive germ cells / spermatogonia in testis

# Stages of spermatogenesis

- Occurs in 4 stages:

1. Proliferation
2. Growth
3. Maturation
4. transformation

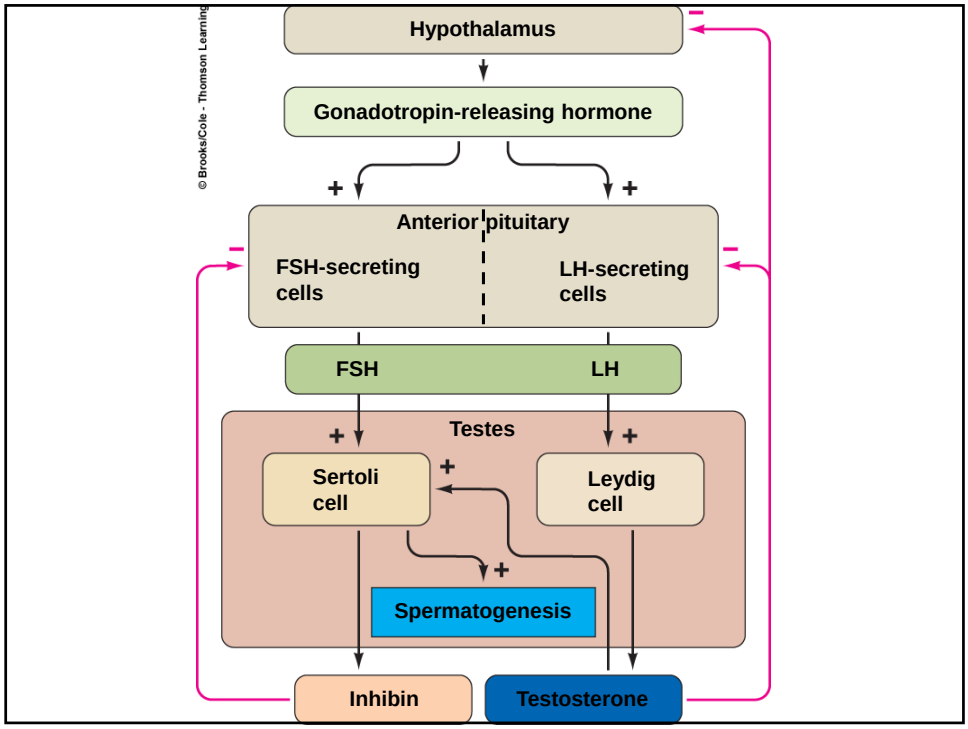


## Role of Sertoli cells in spermatogenesis

- Support and nourish germ cells
- Provide hormonal and other substances necessary for spermatogenesis
- Secrete androgen binding protein which is essential for testosterone activity, particularly on spermatogenesis
- Release the sperms into lumen of semi-niferous tubules

## Role of hormones in spermatogenesis

- FSH
- Testosterone
- Oestrogen
- LH
- GH
- Inhibin
- Activin




Other factors affecting spermatogenesis

- ↑ in temperature prevents spermatogenesis. (normally, temp in scrotum is 2 $^{0}$C less than body temp. Low temp is essential for spermatogenesis)
- Infectious diseases e.g. mumps

# Endocrine function of testes

- Male sex hormones = androgens
- Testis secretes 3 androgens:
  1. Testosterone
  2. Dihydrotestosterone
  3. Androstenedione
- Sertoli cells secrete inhibin, which inhibits secretion of FSH from pituitary, but does not possess any androgenic action

# Androgens

- Source:
  - Testis – interstitial cells of Leydig
  - Adrenal cortex – zona reticularis
- Chemistry:
  - Steroid hormones synthesised from cholesterol
- Synthesis:
  - See diagram
- Transport:
  - ⅔ by a β globulin, ⅓ by albumin

# Functions of testosterone

## In fetal life

- 3 functions in fetus:

1. Sex differentiation of fetus – Mullerain duct gives rise to female acc organs and Wolffian duct gives rise to male acc sex organs

1. Development of accessory sex organs

1. Descent of testes

## In adult life

1. On sex organs

- ↑ size of penis, scrotum and testes
- Necessary for spermatogenesis

2. On secondary sexual characters

- Muscular growth
- Bone growth
- Changes in skin
- Hair distribution
- Change in voice
- BMR
- Electrolyte and water balance
- blood

## Mode of action of testosterone

- It is converted into dihydrotestosterone target cells of acc sex organs
- In brain it is converted into oestrogen
- Dihydrotestosterone combines with receptor proteins
- Hormone receptor complex migrates to nucleus, binds with a nuclear protein and induces DNA-RNA transcription

## Regulation of testosterone secretion

- In fetus:
  - Secretion from testis is stimulated by HCG
  - HCG stimulates development of Leydig cells and promotes testosterone secretion
- In adults:
  - LH or ICSH stimulates Leydig cells and quantity of testosterone secreted is directly proportional to amount of LH
  - Secretion of LH from ant pit is stimulated by LHRH from hypothalamus
- Feedback control:
  - Testosterone regulates its own secretion by negative feedback, see diag

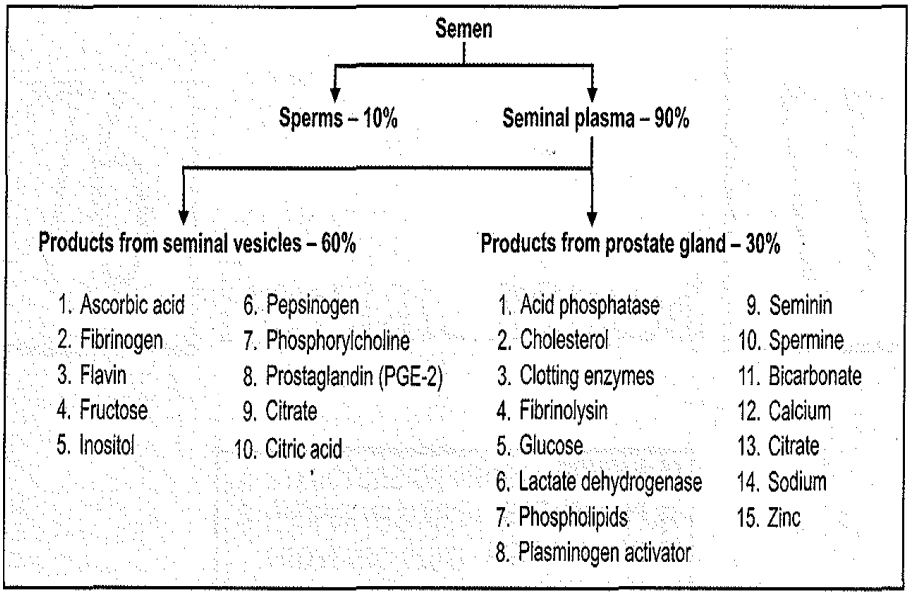
# Seminal vesicles

- Structure:
  - Paired glands situated on either side of prostate gland
  - Lined by complex folded mucus membrane
  - Mucus membrane is formed by pseudo striated columnar epithelium
  - Secretions are added to semen via ampulla of vas deferens

- Properties:
  - Secretion from seminal vesicles is mucoid and viscous
  - It is neutral/slightly alkaline in reaction
  - Forms 60% of semen

- Composition:
  - Secrete many important substances
  - Fig 77.1 for products of seminal vesicle secretion

FIGURE 77-1: Composition of semen




## Functions of seminal vesicle secretion

- Nutrition to sperms:
  - Fructose and other nutritive substances are utilized by sperm after being ejaculated into female genital tract
- Clotting of sperm:
  - Fibrinogen from secretions is converted into coagulum as soon as semen is ejaculated
- On fertilization:
  - PG enhances fertilization of ovum by increasing the receptive capacity of cervical mucosa for sperms and causes reverse peristaltic movement of uterus and fallopian tubes.

## Prostate gland

- Structure
  - It consists of 20-30 separate glands which open separately into urethra. Glands are tubulo-alveolar in nature lined by columnar cells. Secrete prostatic fluid
- Properties:
  - Secretion is a thin, milky alkaline fluid – 30% of semen
- Composition:
  - Fig 77.1

## Functions of prostatic fluid

1. Maintenace of sperm motility
2. Clotting of semen
3. Lysis of coagulum

# Semen

- Nature of semen:
  - Semen is a white/grey fluid that contains spermatozoa/sperms. It is collection of fluids from testes, seminal vesicles, prostate gland and bulbourethral glands.
- Properties of semen:
  - 2-6 ml/ejaculation. It is alkaline with pH of 7.5
- Composition:
  - Contains 10% sperm and 90% of fluid part which is called seminal plasma, see fig 77.1

# Sperm

- Total count is about 100 to 150 million/ml of semen
- Sterility occurs when sperm count falls below 20 million/ml
- After ejaculation survival time is 24-48 hours at a temp equivalent to body temp.
- Rate of motility of sperm in female tract is 3mm/min. Sperm reach fallopian tube in 30-60 min after sexual intercourse. Uterine contractions facilitate movement of sperms

## Structure of spermatozoon / sperm

- 60 µ long. Consists of 4 parts:

1. Head:

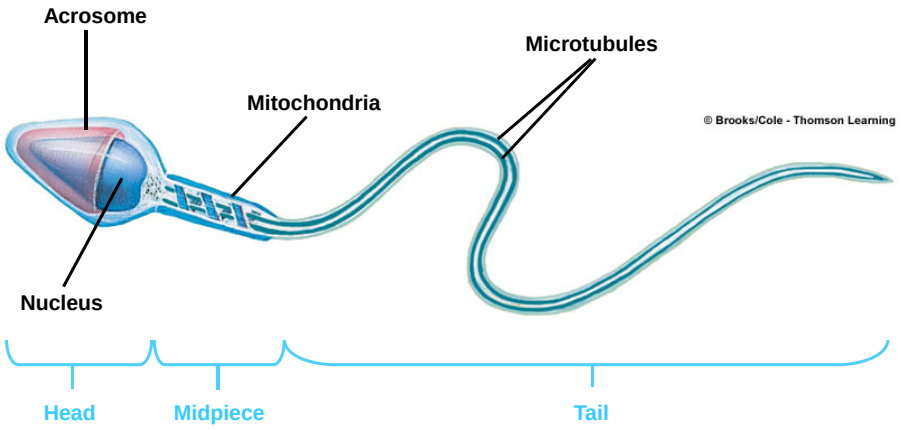
   Formed by condensed nucleus, thin cytoplasm and cell membrane. Acrosome – hyaluronidase and proteolytic enzymes

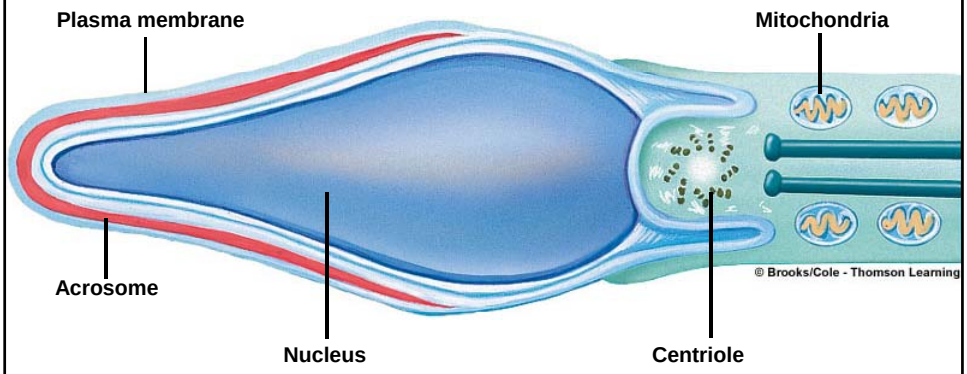
2. Neck
3. Body:

   Axial filament is surrounded by a closely wound spiral fialment consisting of mitochondria

4. Tail:

   Chief or main piece and terminal or end piece






## Qualities of semen - minimum required qualities for fertility are:

1. Volume per ejaculation at least 2 ml
2. Sperm count – at least 2 million
3. No. of sperm in each ejaculation – 40 million
4. 75% of sperm per ejaculation must be alive
5. 50% of sperm must be motile
6. 30% must have normal shape and structure
7. Sperms with head defect < 35%
8. Sperm with midpiece defect < 20%
9. Sperm with tail defect must be < 20%