



# NEET - UG

NATIONAL TESTING AGENCY

## Zoology - 1



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## Human Reproduction:

- \* Ability to produce offspring similar to them or to self-Reproduction

### Importance:

- \* Reproduction is essential for continuity of sps.

### Human:

- \* Sexual dimorphism in human beings
- \* Externally male and female individuals are different this phenomenon is called **sexual dimorphism**

### Developmental Period:

That includes: Embryonic/Prenatal (natal = birth)  
Post embryonic/postnatal

### Embryonic Period (Prenatal Period):

- \* In human being this period passed in Mother's womb (Uterus)
- \* That includes events from formation of embryo to time of birth

### Post Embryonic Period (Post Natal Period):

- \* Period passed out side mother's womb
- \* That it includes events from birth to death of individuals

### Events in Human Reproduction:

- \* **Gametogenesis:** Gametes formation
- \* **Spermatogenesis:** Sperm formation
- \* **Oogenesis:** Egg formation
- \* **Insemination:** Transfer of sperm by male into female G. Tract.
- \* **Fertilization:** Fusion of male and female gametes
- \* **Zygote:** Single cell stage
- \* **Cleavage:** Rapid mitotic divisions of zygote (Which convert single celled zygote into multi cellular)
- \* **Implantation:** Attachment of blastocyst to uterine wall
- \* **Placentation:** Formation of placenta

- \* **Gastrulation:** Process by which blastocyst → Gastrula
- \* **Organogenesis:** Formation of specific tissue, Organ, Organ system from 3 germ layer.
- \* **Parturition (Child Birth):** Delivery of body

## # Sexual Organ:

### Primary Organs:

- \* Organs which produces gametes and
- \* Secretes sexual hormone
- \* Ex. Gonads : Testes and Ovary

**Note:** Development of primary sex organ depends on **sex chromosome** i.e. X and Y -Testes  
X and X -Ovary

### Secondary Sexual Organs:

- \* Organ which help in reproduction
- \* But do not produce gametes or sex hormone
- \* Ex. Male genital tract, female genital tract, Male accessory gland, female accessory gland
- \* Development of 2° sexual organ depends **upon sex hormone**

### External Sexual Character:

- \* Character which differentiate male and female
- Ex.
  - Body hair
  - Fat distribution
  - Muscle mass
  - Pitch of voice
  - Memory gland ( sex organ)
  - Breathing pattern - Prothoracic in female
  - Abdominal in male
  - Pattern of pelvic girdle
  - Shoulder

Zoology

## Duct System:

Ducts are mesodermal in origin

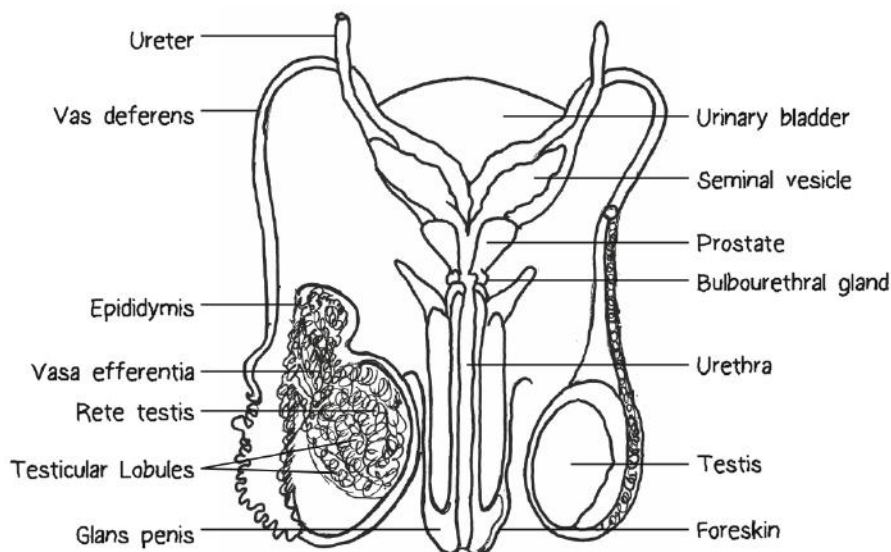
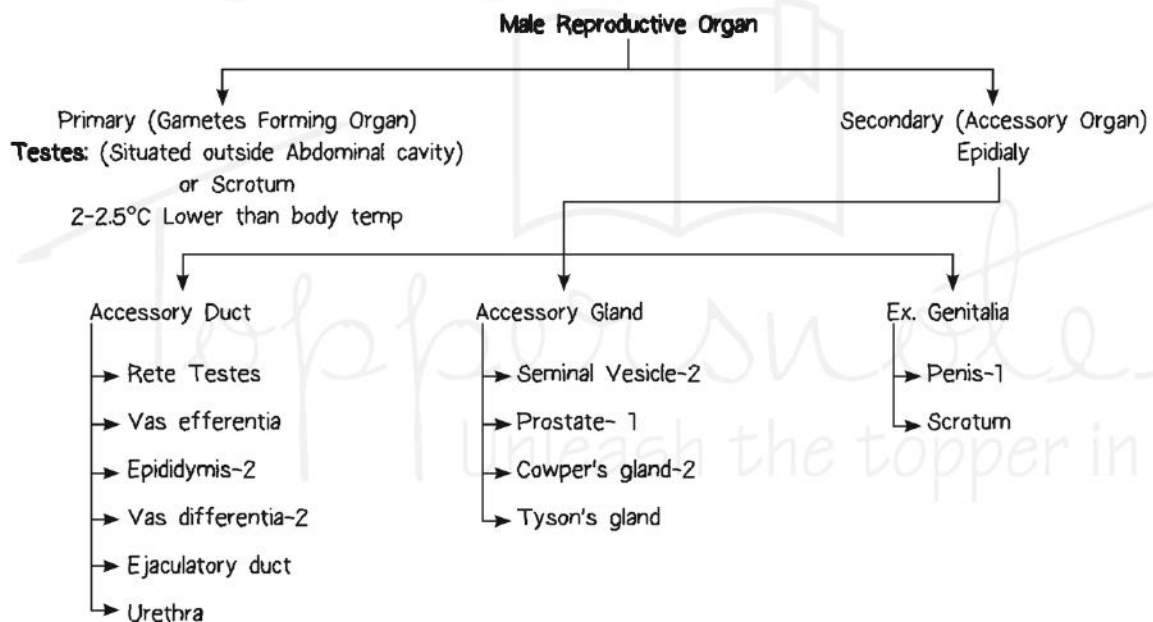
### A. Mullerian/Paramesonephric:

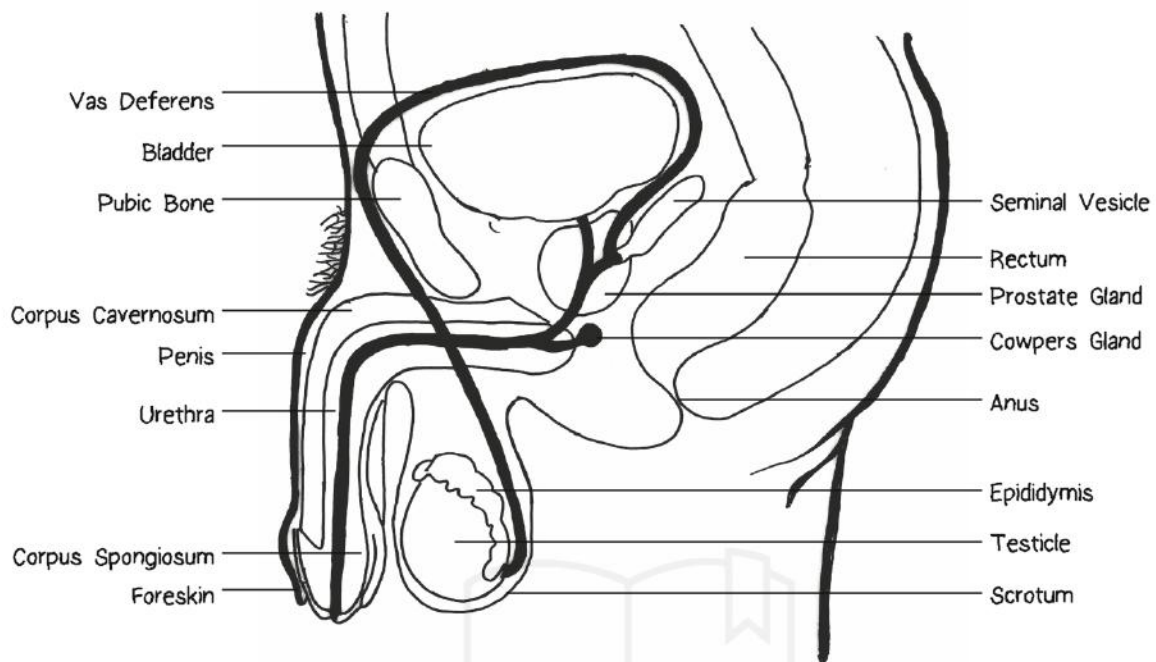
- \* Form female Rep. Tract

### B. Leydig/Mesonephric Duct/Wolffian/Archinephric Duct:

- \* Form male genital trait and trigon of Urinary bladder.

## The Male Reproductive System





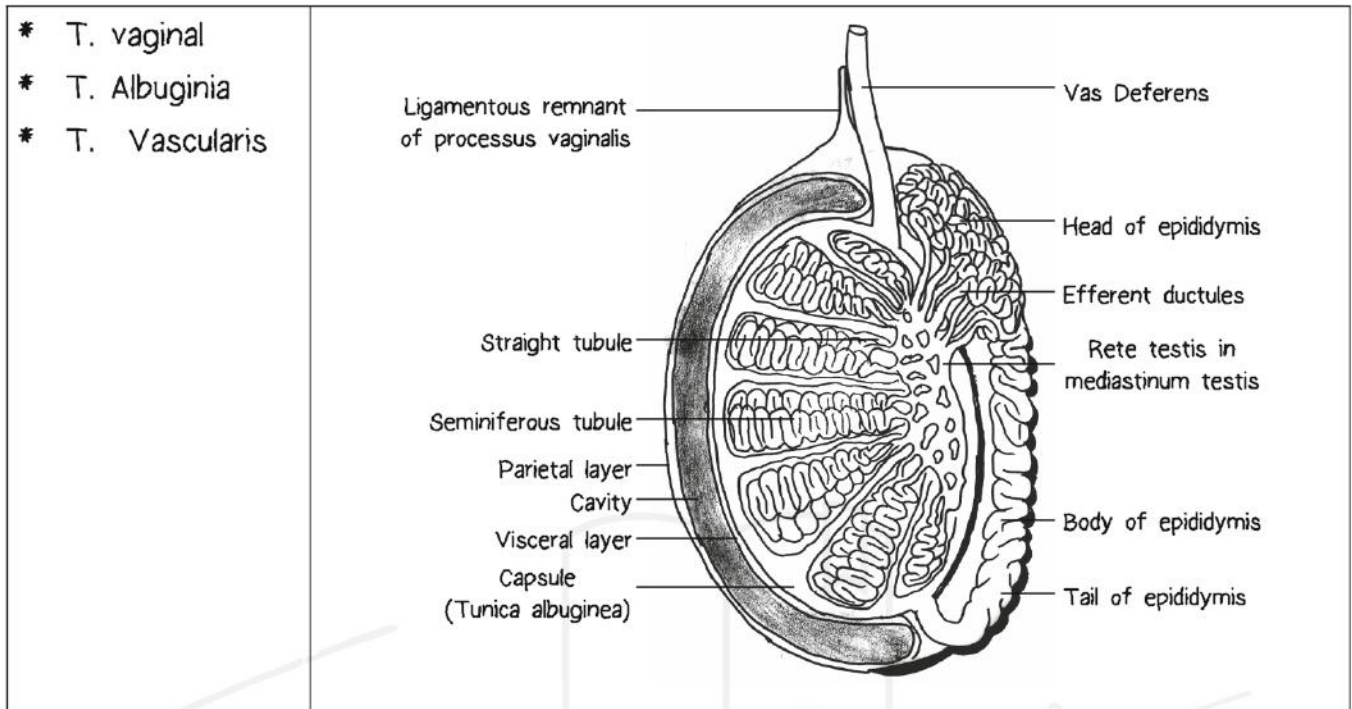
## Primary Sex Organs: Testes

- \* One Pair
- \* Mesodermal
- \* Situated: Outside abdominal cavity-within pouch called **scrotum**.
- \* **Scrotum**: To maintain 2-2.5°C less than body temp. for normal spermatogenesis
- \* **Development**: Testes develop in abdominal cavity, but in 7th months, it descends into scrotum through inguinal canal Under the influence of Testosterone

### Note:

- \* Animal in which testes always remains in abdominal cavity  
Ex. Cetacean, Elephant, Prototheria
- \* Animal in which testes descends into scrotum during only breeding seasons Ex. Rodent (Rat), Chiroptera (Bat)
- \* **Cryptorchidism** (crypt=hidden, orchid = testes)
- \* If testes fail to descend into scrotum
- \* Which can lead to infertility, cancer of testes
- \* **Orchiopexy**: Surgical transfer of testes into scrotum from A.cavity
- \* **Castration**: Destruction of testes to make aggressive animal calm and obedient
- \* **Orchiectomy**: Surgical removal of testes
- \* **Orchitis**: Inflammation of testes which can occur in mumps
- \* **Hernia**- is protrusion of viscous (soft tissue) through orifice
- \* For ex. **inguinal hernia**-intestine protrudes into Scrotum.

Wall of testes consist of following-protective layer:



**A. Tunica Vaginalis:**

- \* Outer most double layer
- \* Collection of fluid or blood in T. Vaginalis.

**B. Tunica Albuginea-Middle Layer:**

- \* Which divides testes into 250 compartments called testicular lobules
- \* Each T. Lobule contain 1-3 seminiferous tubule that produce sperm
- \* Each testis contain 750 seminiferous Tubules

**C. Tunica Vascularis:**

- \* Highly vascularised **inner most** layer
- \* Testes remain suspended into scrotum with help of spermatic cord which connect testes to abdominal cavity
- \* Spermatic cord consist of:
  - Vas deferens
  - Gonadal artery
  - Vein + Lymphatic + Nerves
  - Cremaster muscle

## Seminiferous Tubules:

- \* Around 750 seminiferous tubules in each testes which was considered as unit of Reproductive system
- \* It contain 2 type of cells:
  - **Germinal** cell/epithelium
  - **Sertoli/Nurse/Sustentacular** cell

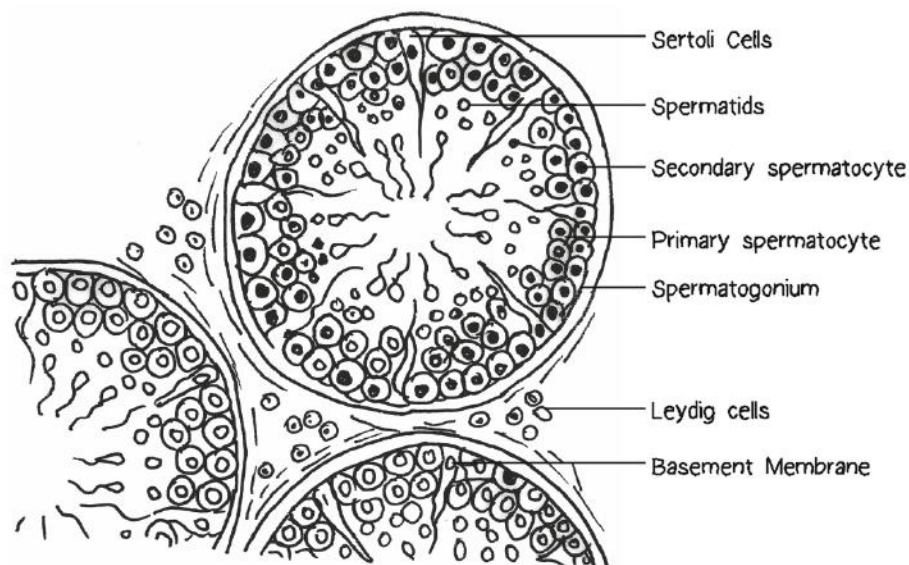
### A. Germinal Cell/Epithelium (Single Layered):

- \* **Simple cuboidal** cell-Male germ cell
- \* Produces sperm-(Spermatogonia)

### B. Sertoli/Sustentacular/Nurse Cell: Columar Cell

#### Function:

1. Sertoli cell support developing germ cell
2. Provide nutrition to developing spermatids
3. Involved in phagocytosis of dead cells
4. It secretes **ABP** (Androgen binding protein), that maintain normal testosterone conc. in S. Tubule.
5. Secrete another **protein-Inhibits**: That suppresses FSH synthesis
6. It produces **Blood Testes Barrier** (BTB). Because sperm being the haploid cells are immune-non competent cell.
7. Secrete factor essential for **spermatogenesis**.
8. Secrete **MRF**(Mullerian Regression factor) or MIS





Zoology

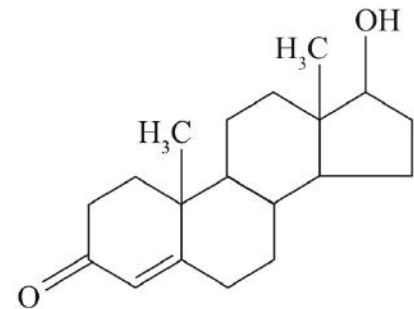
**Note:** In female inhibition secreted by granules cell  
MIS-Mullerian inhibitory substance to destroy Mullerian duct

**Note:** Early embryo contain 2 ducts

- A. **Wolffian Duct:** Which give else to male reproduction system
- B. **Mullerian Duct:** Which give size to female reproduction system
- \* So if embryo is male then Mullerian duct is destroyed by MRF secreted by sertoli cells.

**C. Leyding's Cell or Interstitial Cells-Endocrine Part of Testis:**

- \* Present in between the S. tubule in connective.
- \* **Secrete:** Androgen-e.g. Testosterone and DHT, (Di-hydroxy testosterone) or Male sex hormone.
- \* Under the influence of LH/ICSH secreted by Author pituitary.



**Testosterone:** (19 carbons Str.) Derived from steroid.

**Function of Testosterone Hormone:**

- \* Responsible for transfer of testes in Scrotum.
- \* Spermatogenesis formation after puberty.
- \* Development of secondary sexual character at the age of puberty which includes:
  - Development of beard, moustache
  - Broadening of shoulder
  - Deepening of voice
  - Aggressive nature
  - Musculature
- \* Promote Ca<sup>+</sup> deposition in bones
- \* Promote cholesterol deposition in blood vessel
- \* Which can lead to atherosclerosis or CAD (Coronary artery disease) more in male than female, as estrogen inhibits
- \* Promote protein anabolism and healing
- \* Can cause baldness
- \* Highest **thermogenic** effect

**Ques.:** Which hormone can be used in male contraceptive pills

- i. Estrogen
- ii. Progesterone
- iii. Testosterone
- iv. Estradiol

## Accessory Gland:

- \* Seminal vesicle- 1 pair
- \* A Prostate
- \* Bulbourethral Gland- 1 pair
- \* Their secretion is **Seminal Plasma**
- \* **Contains:** Fructose, Prostaglandin, citric acid,  $Ca^{++}$ , and certain enzymes.
- \* **Semen:** Seminal plasma (90%) + sperm (10% vas differential)

### A. Seminal Vesicle:

One pair

- \* It is misnomer (name does not fit its function): i.e. it does not store sperm.
- \* Situated behind bladder in front of rectum.
- \* It account for 60-70% of semen.

#### **Its secretion**

1. **Fructose:** Provide nutrition to sperm.

Seminal vesicle is **only gland of body which secretes fructose**, so in rape cases, presence of fructose is detected in female genitalia.

2. **Prostaglandin:**

Local hormone causes contraction of smooth muscle in female genital tract so, So sperm can reach to ovum.

3. **Citrate:** Directly used in aerobic sperm nutrition.

4.  **$Ca^{++}$ :** Sperm motility.

5. **Inositol**

6. **Clotting Factor (Fibrinogen):** Form cloths of semen to adhere in female genital trait

### B. Prostate Gland:

- \* Chestnut shaped
- \* One in number-collection of 30-40 tubules-alveolar glands.
- \* Lies at the base of bladder, Surrounds the first part of Urethra
- \* **Its secretion** account for 25- 30% of semen
- \* Specific **Milky white** color and **odour of semen** due to **prostates secretion**.
- \* Its secretion contain: -  $Ca^{++}$ , Zn, **Citric Acid** and **Fibrinolysine**.
- \* **Fibrinolysine:** Causes release of sperm by dissolving the sperm clot as semen in coagulated.
- \* **Prostatitis:** Inflammation of prostate glands

### C. Cowper's Gland or Bulbourethral Gland:

- \* Pea sized, laying adjacent to urethra at the base of penis
- \* Its secretion is part of **pre ejaculation**, which release before ejaculation/emission
- \* Which neutralized the activity of urethra and
- \* Function as lubrication and alkaline.

**Note:** Sperm active in alkaline medium

- \* Inactive in **neutral medium**
- \* Dead in acidic medium
- \* PH of female genital trait is acidic.

### Accessory Duct:

#### 1. Rete Testes: (Tubuli Recti)

- \* Ducts situated in testes (Intra testicular)
- \* All somniferous tubules first opens into tubuli recti, which ultimately open into rete testes
- \* **Function:** It causes contraction of sperm and transfer sperm from somniferous tubules into vas efferentia.

#### 2. Vas Efferentia (Ductuli Efferentia):

- \* 10-15 small ducts arise from rete testes
- \* It transfer sperm from rete testes into epididymis

**Note:**

Intra testicular duct system	Extra testicular duct System
<b>Includes:</b> Tubules Recta, Rete testes and Vas efferentia (Ductuli efferentia)	It consist of tubes which conduct sperm from testes to the outside

#### 3. Epididymis:

- \* 10-12 vas efferentia combined to form folded and coiled tube str.
- \* Length-6 meter (20 feet) highly coiled structure
- \* Consists of 3 part:
  - i. **Caput or Head or Globus Major:** Initial part
  - ii. **Body or Globus Normal:** Middle part.
  - iii. **Tail or Caudal or Globus Minus:** It give rise to vas defers

### Function:

- \* Temporary storage of sperm **up to one month**.
- \* Transfer of sperm from vas efferentia → Vas differentia
- \* **Functional maturation of sperm take place in it**, in which activation of **CETSPER protein** present in tail, so tail wagging movement started.
- \* Sperm transferred from S. tubules in epididymis by rhythmic contraction of smooth muscle present in rate testes and vas efferentia

### 4. Vas Deferens:

- \* Partially coiled tubes
- \* 45 cm long tube which **come out into abdominal cavity, through inguinal canal**
- \* Vas differentia fuses with duct of seminal to form ejaculatory duct.
- \* Contain dilated part ca. **ampulla** where sperm are stored.

**Note:** After **vasectomy** up to two month sperm can be released from this ampulla, that's because vasectomy does not provide immediate benefits of contraception.

### 5. Ejaculatory Duct:

- \* Small duct which get opened into urethra
- \* Two tubes each formed by union of duct from S.V and vas difference
- \* Passes through prostate and joins urethra

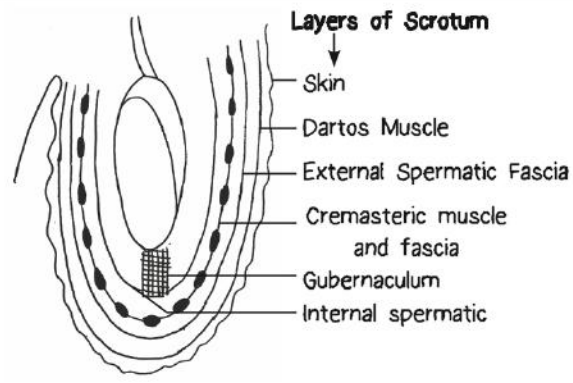
### External Genitalia:

Consist: Scrotum and Penis

#### A. Scrotum:

- \* Pouch like structure situated outside lower abdominal part.
- \* Testes are situated in Scrotum.
- \* Scrotum involved in **thermoregulation** of testes for spermatogenesis.
- \* **During summer**—Cremaster and Dartos muscle remain relaxed and temperature of testes is lowered by counter heat exchange.
- \* **During winter**
  - **Contraction of Dartose M.** ↑ Wrinkle in scrotum reducing surface area for heat.
  - **Contraction of Cremaster** causes elevation of testes, comes near abdominal cavity thus temperature of testes is maintained

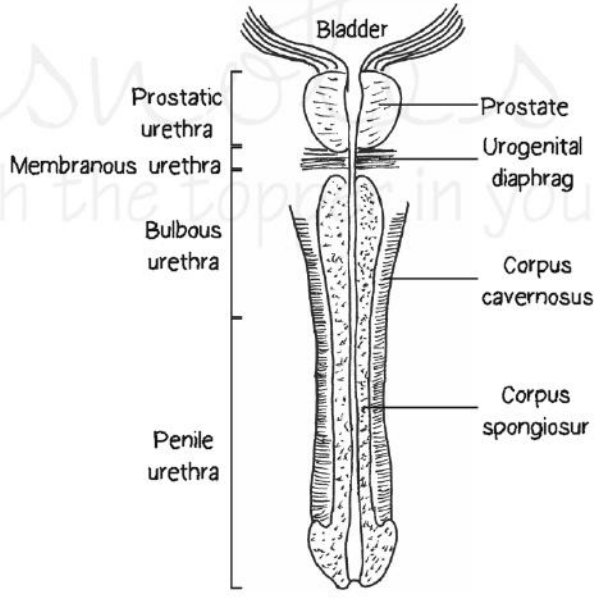
Zoology

<p>Its wall having 5 layers: <b>Skin, Dartos, Ext. Spermatic fascia, cremaster muscle and internal spermatic fascia.</b></p> <p>* Tricks to remember: Some Desi Engineer Created It</p> <p><b>Some</b> = Skin, <b>Desi</b> = Dartos, <b>Engineer</b> = External spermatic fascia, <b>Created</b> = Cremaster muscle, <b>It</b> = Internal spermatic fascia.</p>	 <p><b>Layers of Scrotum</b></p> <ul style="list-style-type: none"> <li>Skin</li> <li>Dartos Muscle</li> <li>External Spermatic Fascia</li> <li>Cremasteric muscle and fascia</li> <li>Gubernaculum</li> <li>Internal spermatic</li> </ul>
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**Note: Gubernaculum:** Thick fibrous cord that connect testes to scrotum  
Two lobes of Scrotum is connected though Raphae.

Urethra:

- In male it is called urinogenital duct: (Provide common pathway for urine and semen)
- Get opened outside the body through urethral meatus situates at glans penis

<p>3. It is divided into 3 path</p> <p><b>A. Prosthetic Urethra:</b></p> <ul style="list-style-type: none"> <li>* 3-4 cm long</li> <li>* Surrounded by prostate</li> </ul> <p><b>B. Membranous Urethra:</b></p> <ul style="list-style-type: none"> <li>* smallest part</li> <li>* 1 cm 10 y</li> <li>* Cowpeas gland open in this</li> </ul> <p><b>C. Penile or Spongy Urethra:</b></p> <ul style="list-style-type: none"> <li>* Longest part 12- 14 cm</li> <li>* Situated in carpus spongiosum of penis</li> </ul>	
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Penis:

Male copulatory organ

- \* Consist of 3 erectile columns of tissue:
- \* 2 situated at-Dorso-lateral region → called-**corpora cavernosa**.
- \* 1 situated at-ventro- medial part → **Clacarpus spongiosum** → having orethra.

- \* These erectile tissues are separated by **tunica Albuginea**.
- \* Terminal dilated part called **glans penis**, consist of **carpus spongiosum**.
- \* Glans penis consist of **slit like external urethral orifice** or **meatus**—for release of semen and urine
- \* Glans is covered by **loose fold of skin** called **prepuce** or **fore skin**.
- \* Which contain **peritrichal** or **Tyson's gland**.
- \* These gland secrete white sebaceous substance called — **smegma**

**Note:** **Circumcision**—surgical removal of prepuce

- \* Erection of penis occurs under the **control** of **parasympathetic nerve**.
- \* Nerve originates which ↑es **VIP** (Vasoactive Intestinal Polypeptide) and **NO** (Nitric Oxide) in penis.

**Note:** (Nitric Oxide) in penis, due to which blood vessel of penis get filled with blood causing erection.

- \* **Ejaculation of semen** under the control of **sympathetic system**.
- \* Semen is ejaculated due to contraction of → **Bulbocavernosus muscle**

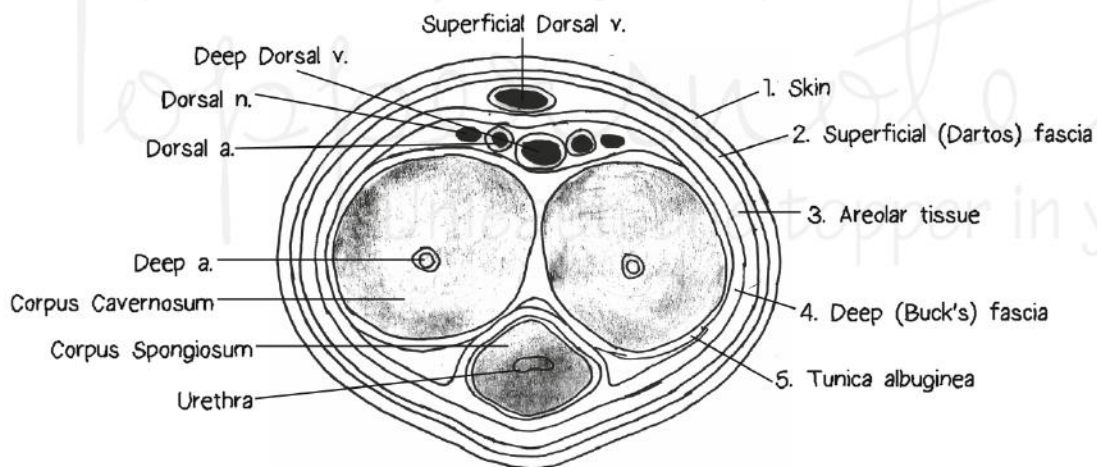


Fig. T.S. of Male Urethra

## Semen:

- \* Mixture of sperm (10%) and seminal fluids (90%).
- \* Liquid part consist of secretion of
  - Semiferrous tubule
  - S. Vesicle
  - Prostate gland
  - Bulbourethral gland

Zoology

- \* Ejaculation contain average of-(2.5-5 ml)
- \* With sperm count (Concentration) of 200- 300 million sperm
- \* Out of these sperm For normal fertility:
  - at least 60% sperm must have normal shape and size and
  - at least 40% of the show vigorous motility.
- \* When sperm falls below- 20 million/Person is infertile
- \* Slightly alkaline-7.2 to 7.7 pH

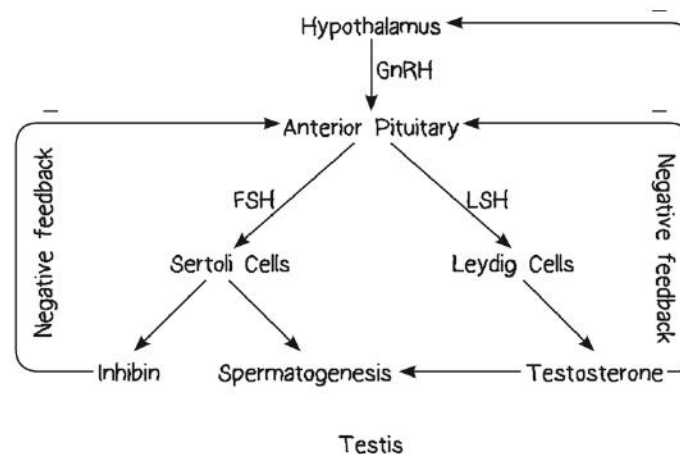
Note: Path of sperm through male body:

- \* Seminiferous Tubules → Rete testes → Vasa efferentia → Epididymis → vas differensia → ejaculatory Duct → Urethra

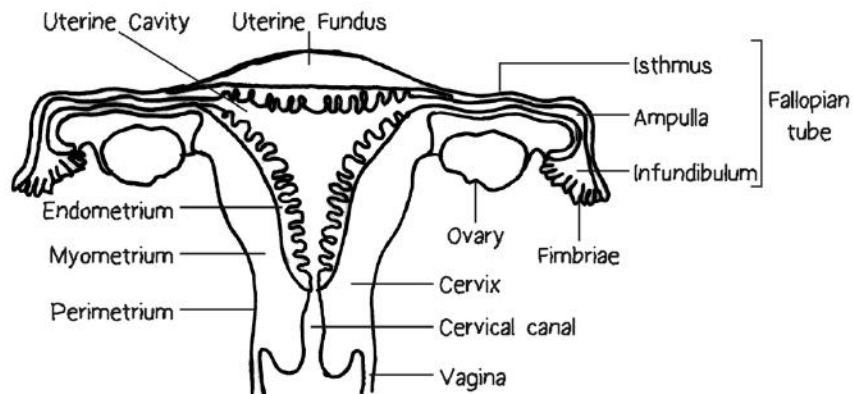
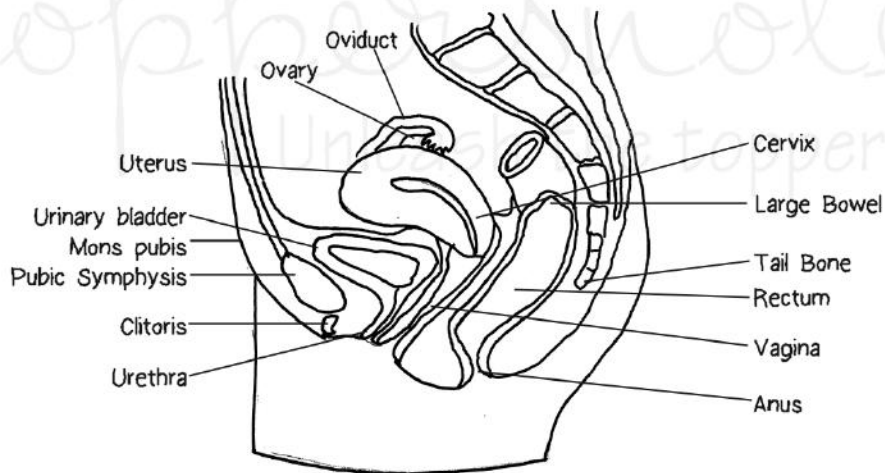
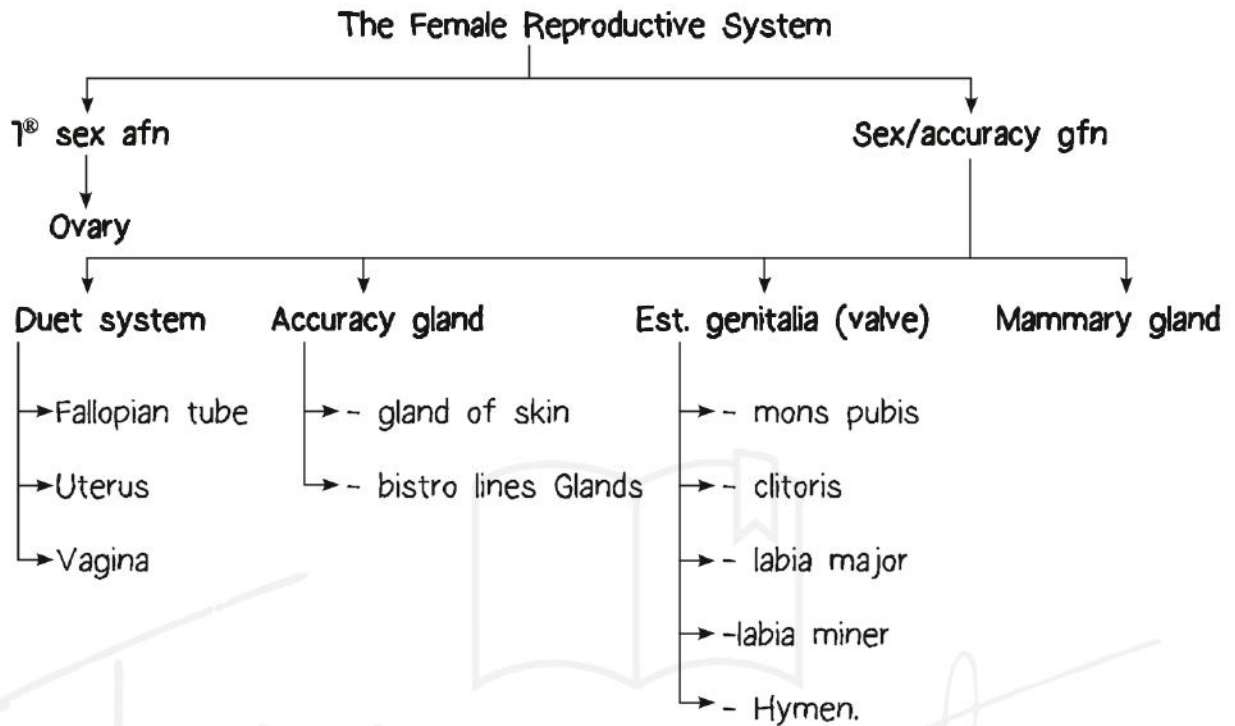
Disorder:

- \* **Varicocile:** Swelling of scrotum due to dilate of testicular vein
- \* **BPH (Benign Prostate Hypertrophy):** Enlargement of Prostate
- \* **Prostate Cancer-** PSA = Prostate specific antige is highly
  - It is the most common cancer in male worldwide but in India, mouth cancer is the most common cancer in male
- \* **Impotence:** Failure of erection of penis
- \* **Sterility:** Inability to produce offspring

Hormonal Control:



# THE FEMALE REPRODUCTIVE SYSTEM





## # Primary sex Organ: Ovary

- \* Produces-ova and
  - **Female sex humane:** Estrogens and progesterone.
- \* **Shape**-small, almond like and flattered body.
- \* **Size**-2-4cm.
- \* **Location**-near kidney
  - Remain attached to lower abdominal cavity Throw-**mesovarium** (ovary supporter by mesovarium).
  - Connected to pelvic wall one either side of uterus by ligament.
- \* **Wall of ovary consist of:**
  - Peritonium-outer most
  - Germinal epithelium-simple cuboids (middle)
  - Tunica albugenia-inner most
- \* Internal tissue of ovary is called stroma.
- \* Stoma is divided into two zone:
  - \* -**Peripheral** → **cortex:** Contain follicle in deferent developmental stage
  - \* -**Central**→**Medulla:** Contain blood vessels.

### Accessory Duct System:

- \* Formed by mularian duct System.
- \* Consist of following structure:

#### 1. Fallopian Tube/Uterine Tuber/Oviducts:

- \* Length 10-12cm
- \* **Mesosalphinax** (membrane which support the fallopian tube)
- \* It consists of following Pert:

##### a. Infundibulum:

- \* Funnel shaped str. Situated near ovaries.
- \* Its edges possess finger like process cla. **Fimbries.**
- \* Fimbrie causes transfer of ovum from coelom into fallopian tube.

**Note:** After evolution of ovum enter into coelom so **human egg** is **colonic egg**.

##### b. Ampulla:

- \* Most dilated part of fallopian tube
- \* The ampullary region where fertilization takes place.