



NEET - UG

NATIONAL TESTING AGENCY

Zoology - 1

Volume - 1



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REPRODUCTION IN ORGANISMS

- * Reproduction is most important characteristic feature of living organism.
- * Process a living organism can be sure that there is another individual of its kind to take its place when it dies

Life Span:

- * The period from birth to the natural death of an organism.
- * Can be few days to long as number of years
- * Cannot correlate with size of organism.

Average Life Span:

- * Average numbers of years survived or age reached by the member of a population.

Life Expectancy:

- * Number of years an individual can expect to live, is based on average life span.

Animal	Maximum Life span (Yr)	Example	Maximum Life span (Yr)
Ant queen	15	Turkey buzzard	118
Carp	47	Squirrel	16
Teed	36	Guinea pig	7.5
Bull frog	30	House mouse	35
Mud puppy	23	Horse	62
Cobra	28	Indian elephant	70
turtle	123	Hippocampus	49
Aligatre	68	Fin back whale	80
Gaint tortoise	152	Dog	20
Hummiry bird	8	Cat	28
Parrot	140	Lion	30
Swan	102	Tiger	25
owl	68	Pig	27
Eagle	55	Chimpanzee	45
		Rhesus monkey	29

Reproduction:

Means of self perpetuation of a race, in which new young similar looking individuals are formed.

Function:

- * It replaces the individuals dying due to senescence or ageing.
- * Replaced Individuals, removed from population due to predation/disease.
- * It introduces variation essentials for adoptability and struggle for existence.

Basic Feature of Reproduction:

- * Replication of DNA
- * Division of cells-may or may not involve meiosis
- * Growth due to synthesis of more protoplasm
- * Formation of reproductive unit
- * Elaboration and development of reproductive unit to form new young individuals.

Note:

Semelporous Organism:

- * Reproduce only once in their life time
Ex.-Annual plants, Sps. of salmon, Spiders, Bamboos

Iteroparous Organism:

- * Produce organism in successive cycle
Ex-Perennial plants
Iteroparous animals survive multiple seasons.

Type of Reproduction:

1. Asexual Reproduction:

- * New individuals develop directly from specialized or unspecialized part of single parents, without involving fusion of gametes or sex cell.
- * Also called **agamogenesis** or **agamogeny**
- * Somatic cell produce new individuals so cla **somatogenic** reproduction

Type of Asexual Rep.:

Fission: Mature individuals divide to form two or more similar and equal size daughter individually

Zoology

- * Type of fission (Fission may be)
 - **Simple Binary Fission:** Body divide into two equal half
 - **Longitudinal Binary Fission:** Plane of fission along longitudinal axis
 - **Oblique B. Fission:** Plane of fission at angle of transverse axis
 - **Transverse B. Fission:** Place of B. fission along the transverse axis of

Multiple Fission:

- * Nucleus divides by several times to produce many nucleuses, without any cytokinesis.
- * Ex- Plasmodium, monocytes, Amoeba.

Budding:

- * New individuals formed by mitosis/small bud
- * Small outgrowth of parents body develop into miniature individuals
- * Out growth formed on surface of body, detached and formed new young one.

Fragmentation:

- * Parents body breaks into distinct pieces.
Ex-Hydra Sea stars

Regeneration:

- * Specialized form of asexual reproduction in which organism can renew or restore **lost part** of body (know as **epimorphosis**).
Ex-tail of lizards.
- * If lost part can **form whole body**, from small body fragment known as **morphosis**.
Ex-Hydra

Cyst-Formation:

Enaystaion: During unfavourable condition.

Sporulation: Nuclei divide to form several and each encircled by amount of cytoplasm

Advantage of Asexual Reproduction:

- * It is uniparental
- * Rapid mode of reproduction
- * Young once are exact replicas of their parents
- * Simpler than sexual reproduction

Disadvantage of Asexual Reproduction:

- * Rapid mode of multiplication—large no of young one are formed → **overcrowding**.
- * There is **no mixing of genetic material** → so no new combination or variation
- * **No crossing over**—hence no linkage are not formed Has no role in evolution
- * Low adaptability in changing environment

2. Sexual Reproduction:

- * Production of offspring by fusion of specialized male and female haploid gametes.

Disadvantage:

Slow process

Advantage:

- * Has biological advantages
- * Promotes genetic variety among membrane of SPS

Events in Sexual Reproduction:

A. Pre Fertilization:

Gametogenesis: Spermatogenesis, Oogenesis

Gamete transfer

B. Syngamy or Fertilization:

Fusion of male and female gamete

Note: If fertilization not occurs- Parthenogenesis

C. Post Fertilization:

Events after fertilization

- * **Parthenogenesis:** Female gamete develops into new individual without being fertilizing by male.
- * **Type of parthenogenesis:**
 - * **Arrhenotoky:** Only male are produced, Ex.-bees, wasps, Turkey (Bird)
 - * **Thelytoky:** Only female are produced, Ex.-Lacerta, *Saxicola americana*,
 - * **Amphitoky:** Egg may develop both male and female. Ex.-Aphis(Aphids)

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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 → Gastrulla
- * **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

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Duct System:

Ducts are mesodermal in origin

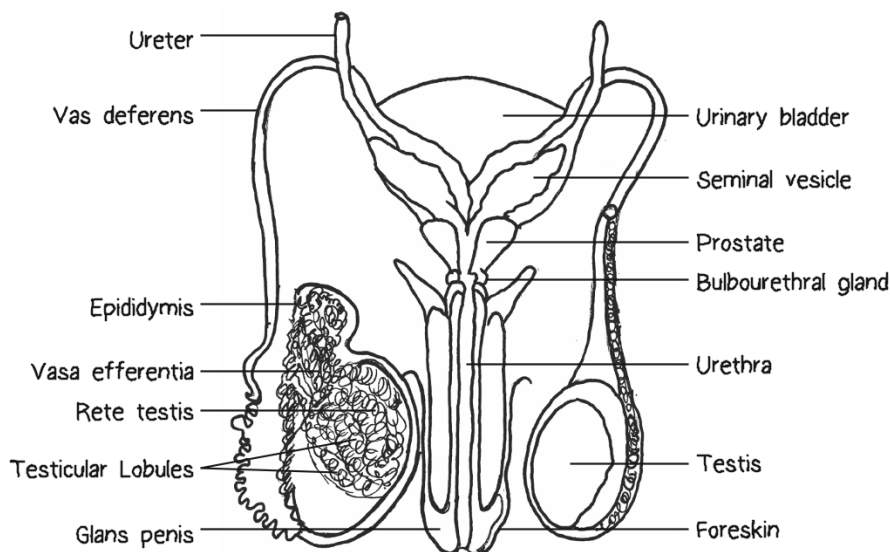
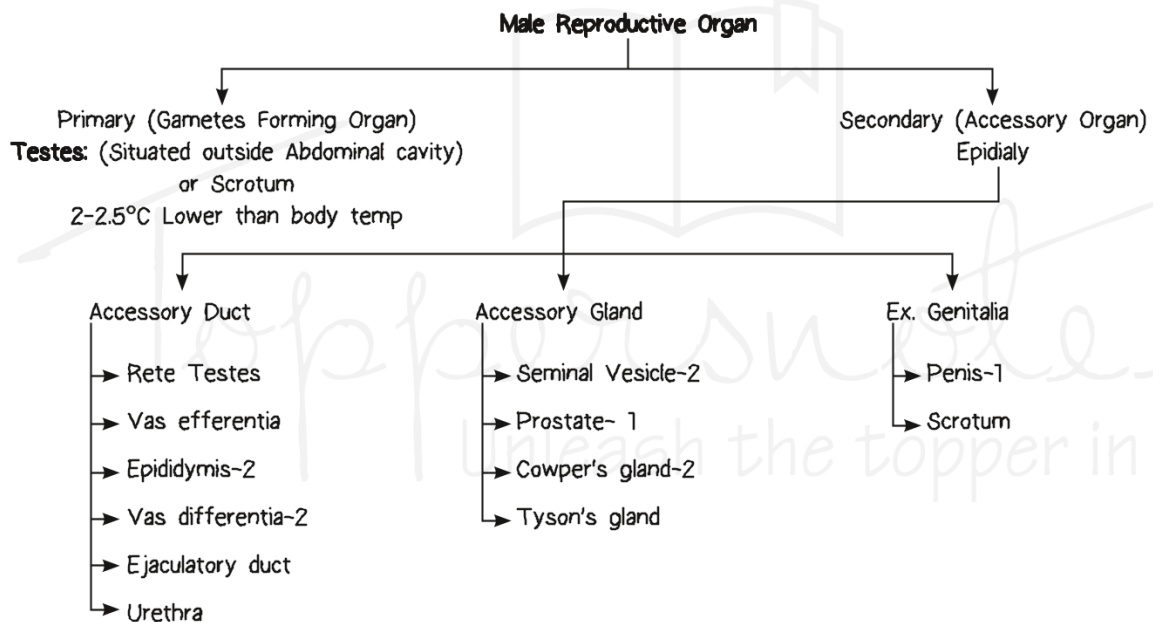
A. Mullerian/Paramesonephric:

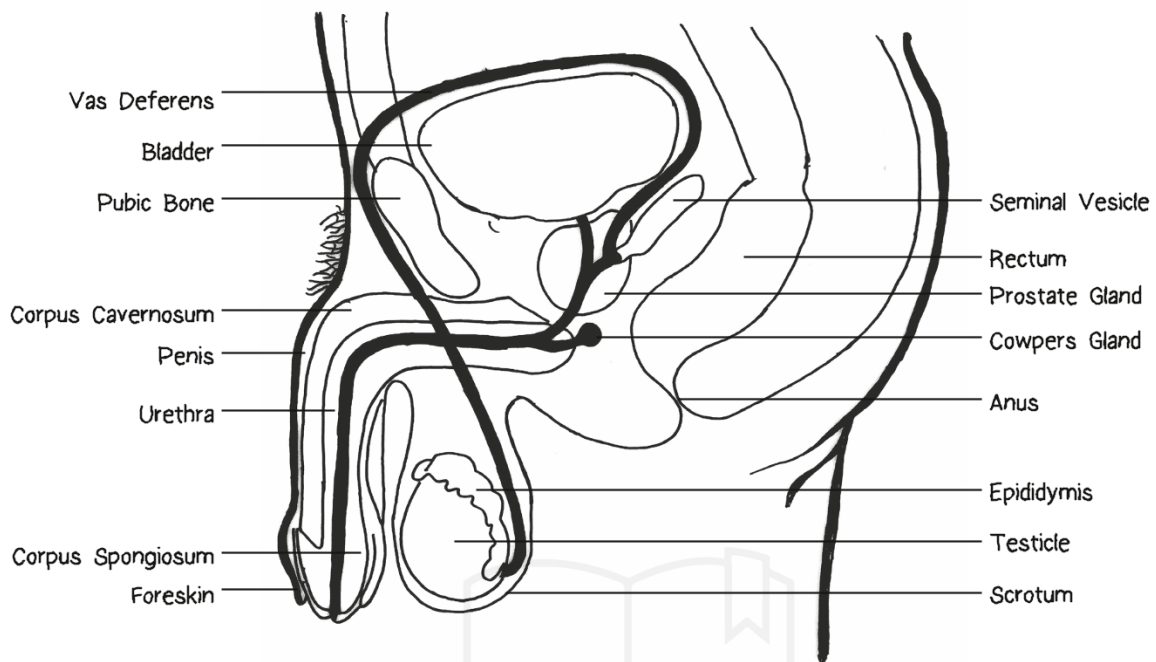
- * Form female Rep. Tract

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

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

The Male Reproductive System





Primary Sex Organs: Testes

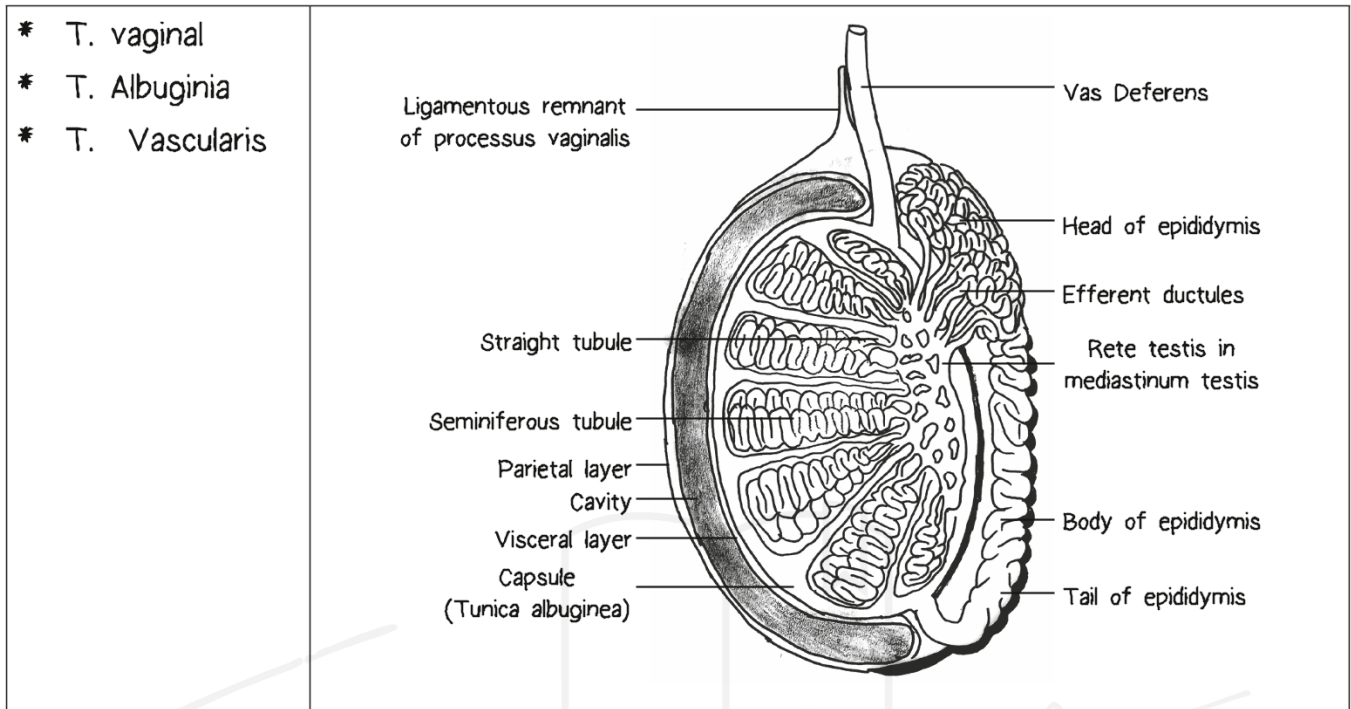
- * One Pair
- * Mesodermal
- * Situated: Outside abdominal cavity—within pouch called **scrotum**.
- * **Scrotum**: To maintain 2-2.5°C less than body temp. for normal spermatogenesis
- * **Development**: Testes develop in abdominal cavity, but in 7th months, it descends into scrotum through inguinal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

Zoology

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

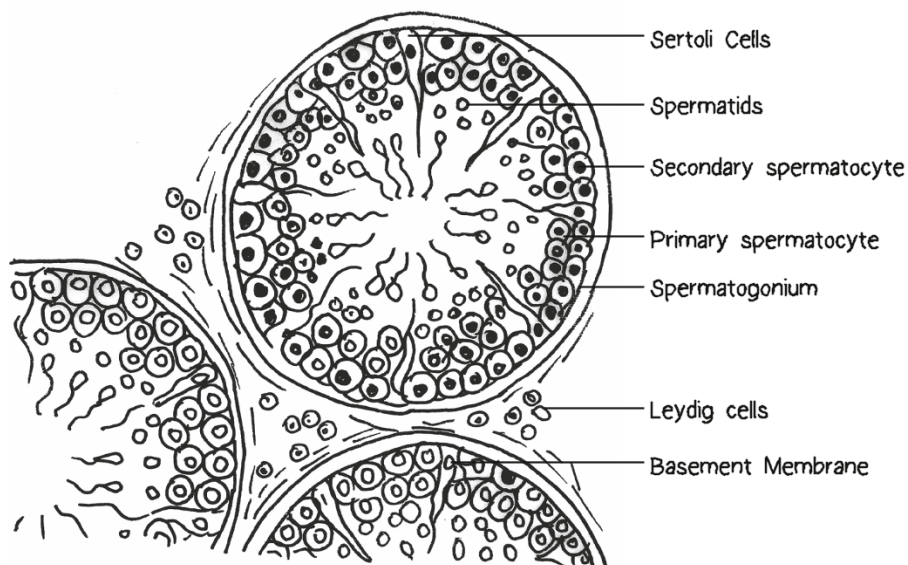
A. Germinal Cell/Epithelium (Single Layered):

- * **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

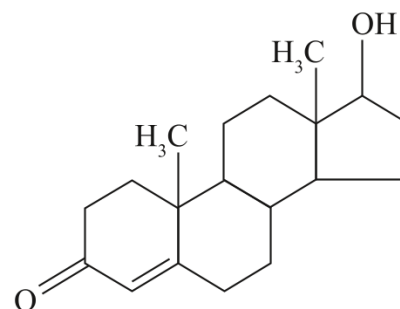
Note: In female inhibition secreted by granules cell
MIS-Mullerian inhibitory substance to destroy Mullerian duct

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^+ 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 secrets 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 clots of semen to adhere in female genital tract

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 **prostate 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
Includes: 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 tube each formed by union of duct from S.V and vas difference
- * Passes through prostate and joined urethra

External Genitalia:

Consist: Scrotum and Penis

A. Scrotum:

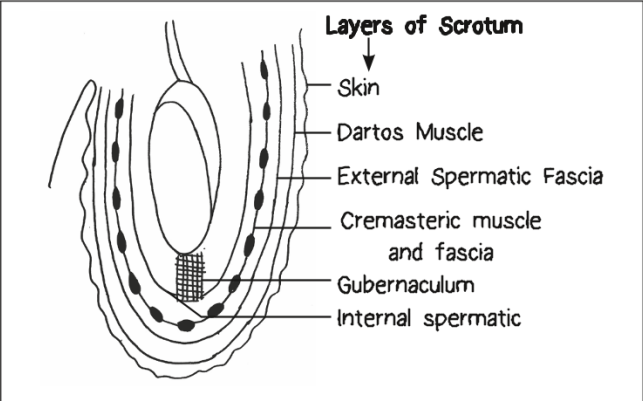
- * Pouch like structure situated outside lower abdominal part.
- * Testes are situated in Scrotum.
- * Scrotum involved in **thermoregulation** of testes for spermatogenesis.
- * **During summer**—Cremaster and Dartos muscle remain relaxed and temperature of testes is lowered by counter heat exchange.
- * **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

Its wall having 5 layers: **Skin, Dartos, Ext. Spermatic fascia, cremaster muscle and internal spermatic fascia.**

* Tricks to remember: Some Desi Engineer Created It

Some = Skin, **Desi** = Dartos, **Engineer** = External spermatic fascia, **Created** = Cremaster muscle, **It** = Internal spermatic fascia.



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

3. It is divided into 3 path

A. Prosthetic Urethra:

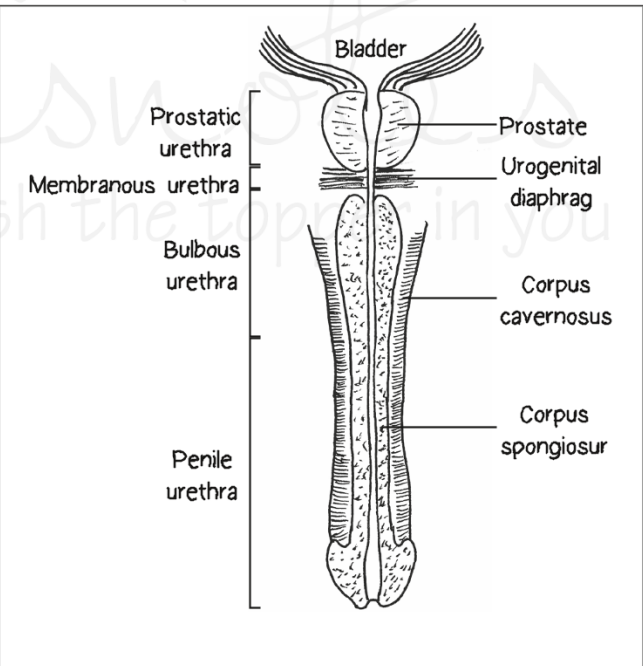
- * 3-4 cm long
- * Surrounded by prostate

B. Membranous Urethra:

- * smallest part
- * 1 cm 10 y
- * Cowpeas gland open in this

C. Penile or Spongy Urethra:

- * Longest part 12- 14 cm
- * Situated in carpus spongiosum of penis



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.