Development of Reproductive System

Embryology

Sex Differentiation

- Genetically, with fertilization:

(Y) sperm → male … (X) sperm → female

- (Y) chromosome has SRY gene $\xrightarrow{\text{encodes}}$ **TDF**

TDF causes the gonad to differentiate into testis

- Ductal system and ext. genitalia differentiate under hormonal influence (Testosterone & Estrogen)

Indifferent Gonad

- ***is Derived from:***
- ***Mesothelium*** **(mesodermal epithelium) lining the posterior abdominal wall.**

- ***Mesenchyme*** **(embryonic connective tissue).**

- ***Primordial Germ cells*****.**

Primordial Germ Cells

- **Appear early in the**

4th week

- **among the**

Endodermal cells

in the wall of the yolk sac

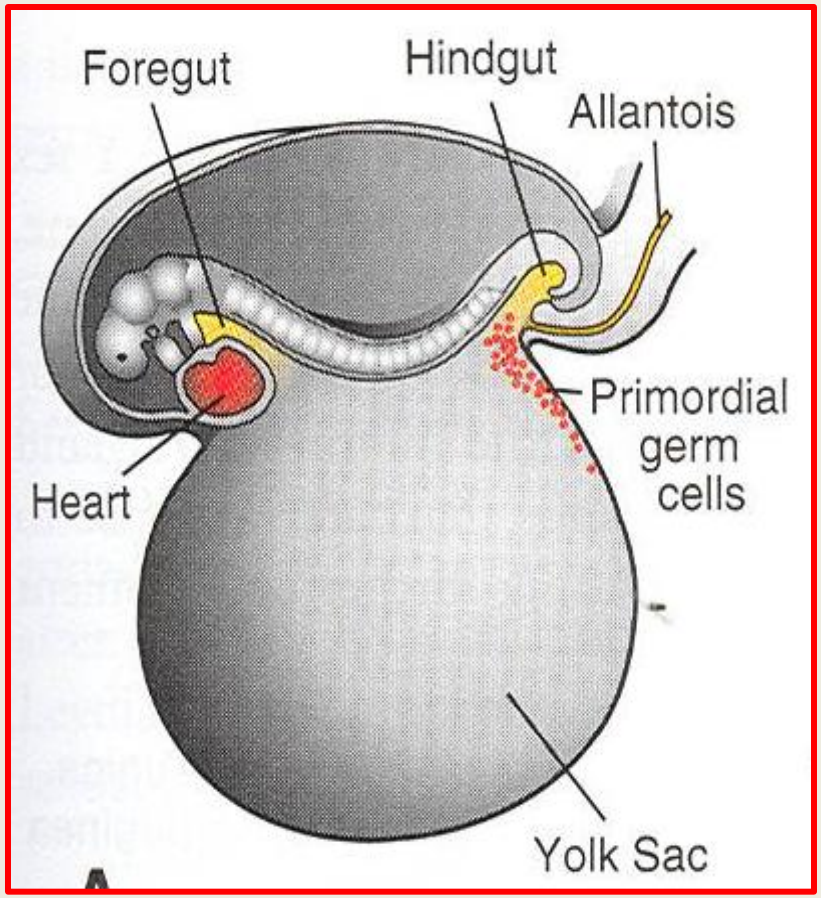
close to the Allantois.

- **The primordial germ cells**

have an *Inductive Influence*

on the differentiation of

the gonad into ovary or testis

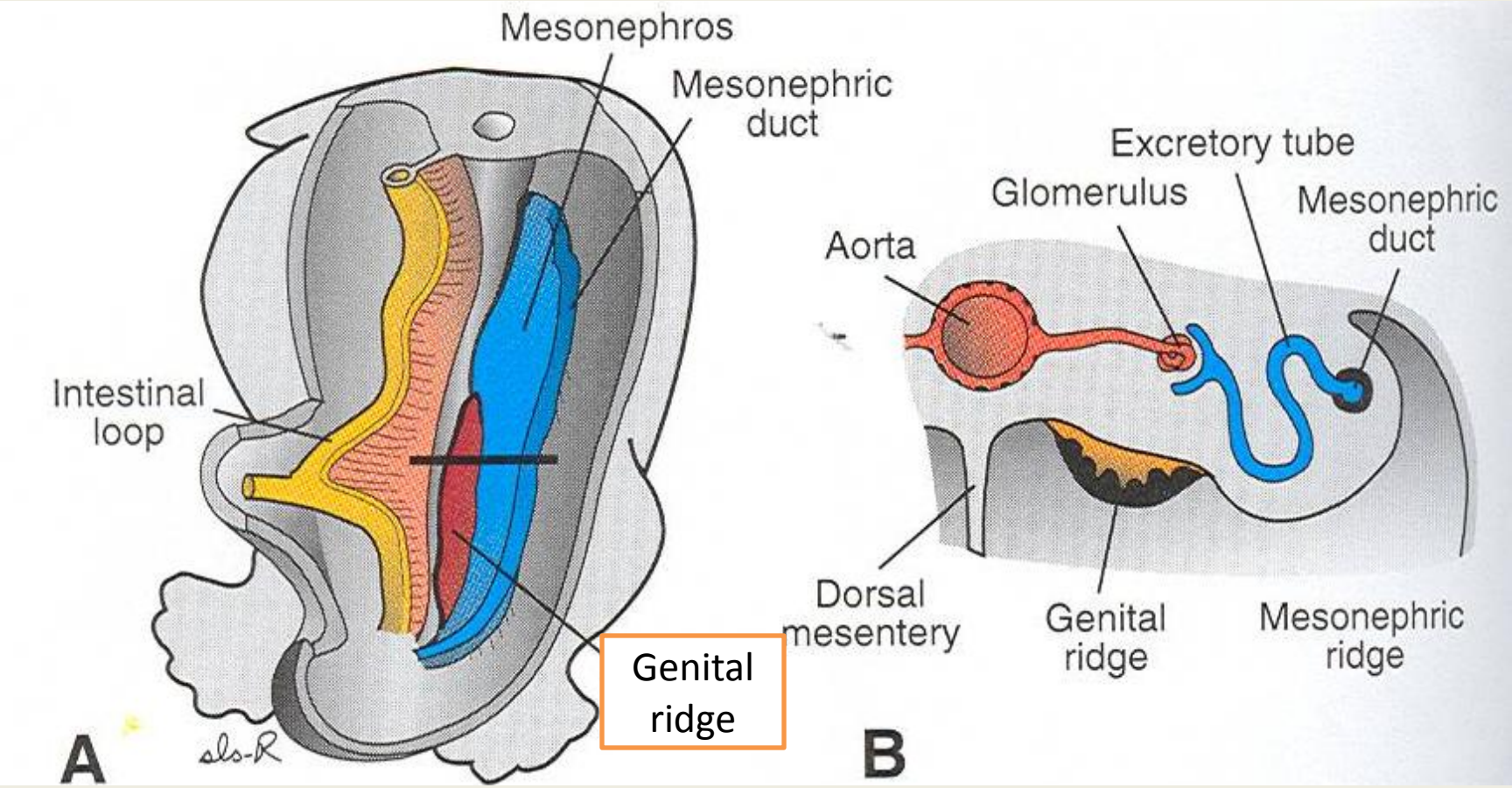


Genital (Gonadal) Ridge

- **It appears during the *5th week***

- **as a pair of longitudinal ridges, on the medial side of the Mesonephros.**
- **They are formed by proliferation of (Mesothelium) and condensation of underlying Mesenchyme. (epithelium + C.T.)**

Genital (Gonadal) Ridge



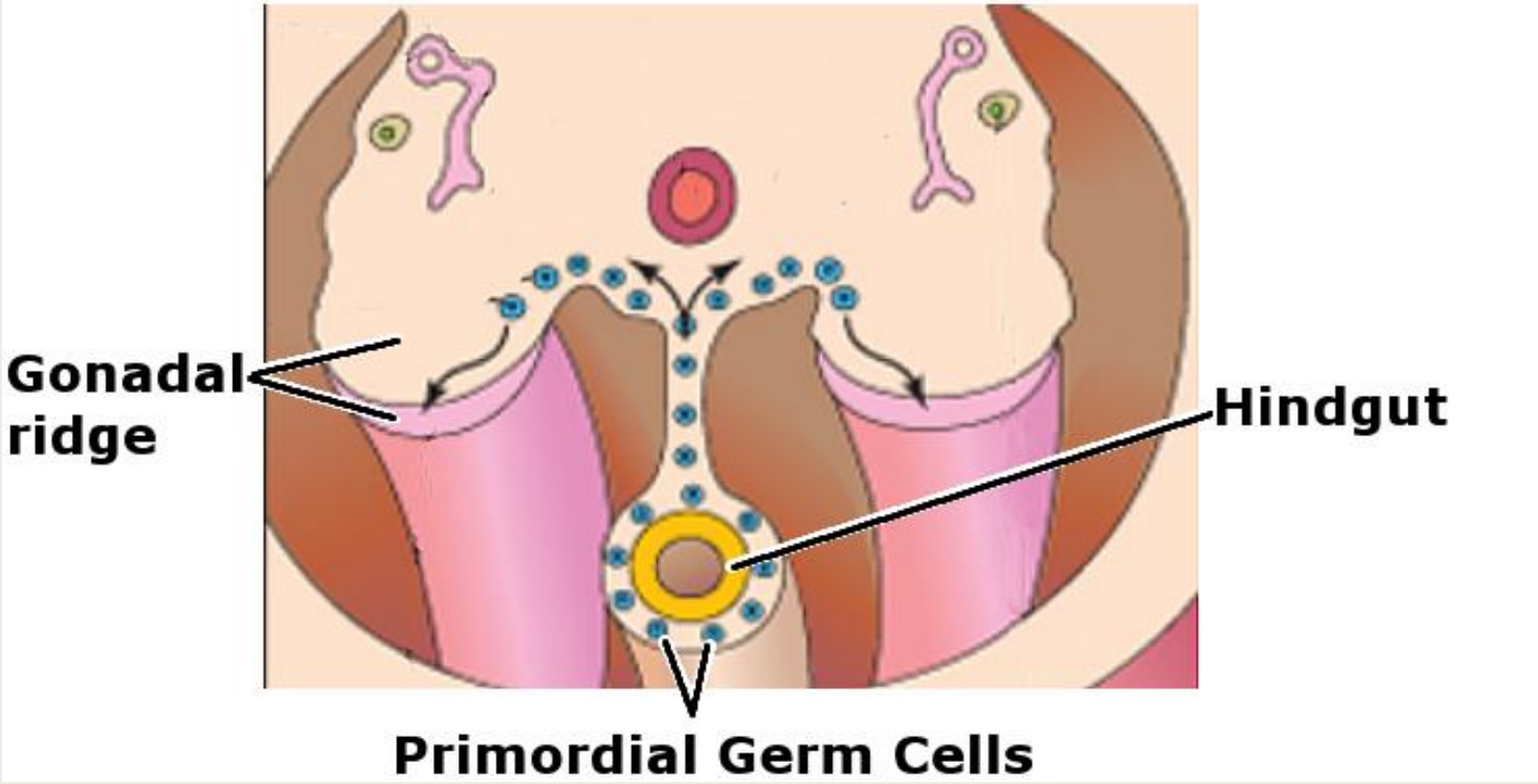
Primitive (Primary) Sex Cords

- ***In the 6th week,*** **primordial germ cells migrate along the dorsal mesentery of the hind gut to invade the gonadal ridge which result in the formation of Primary Sex Cords.**

- **Primary sex cords = indifferent gonad**

= mesothelium + embryonic mesenchyme

+ primordial germ cells


Gonadal ridge
Hindgut
Primordial Germ Cells

Gonadal Differentiation

- **Gonads acquire male or female morphological characteristics about the *7th week* of development.**

Indifferent Gonad

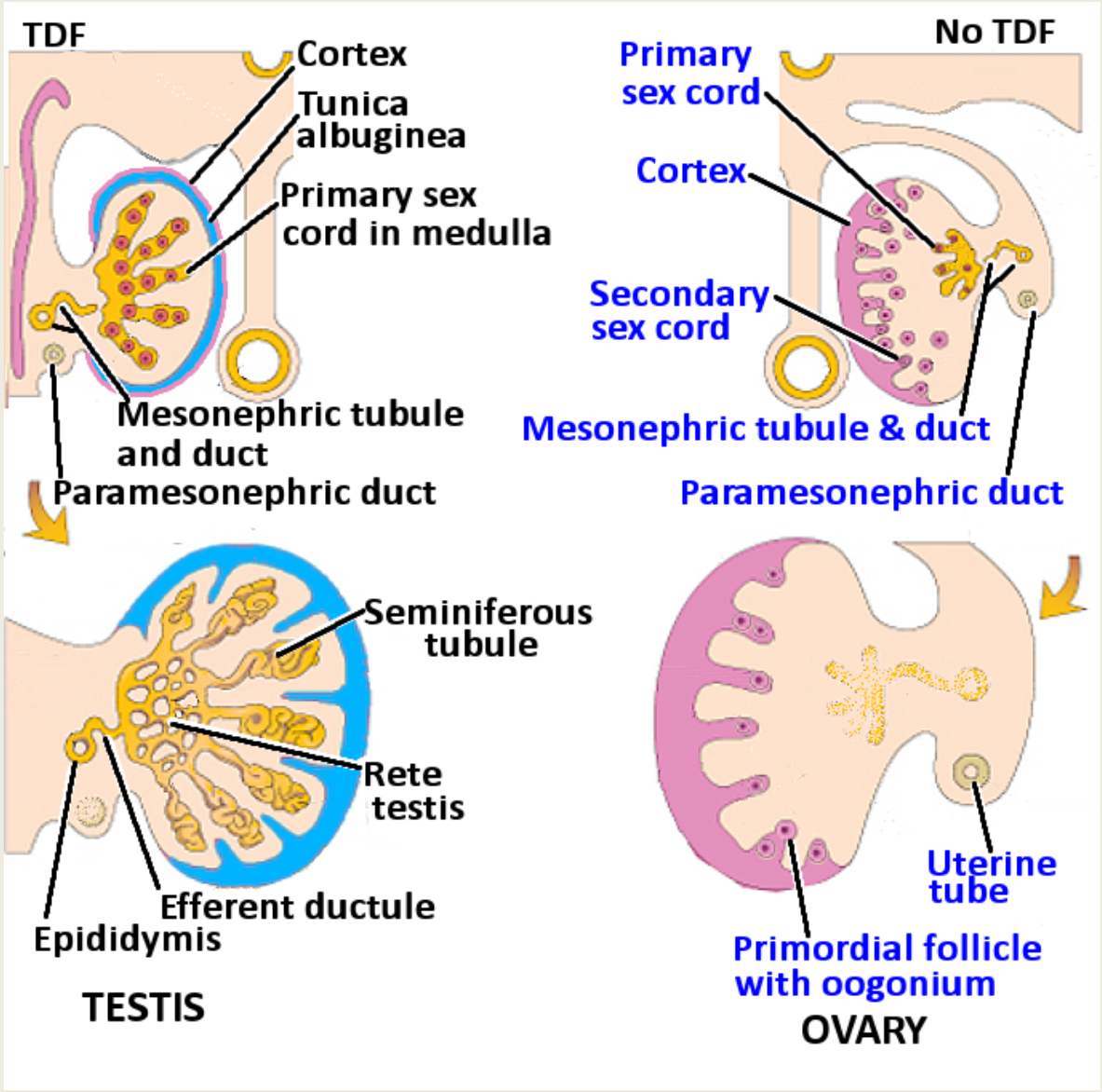
- ***Consists of***
  - ***External Cortex***
  - ***Internal Medulla.***
- ***Embryos with XY Sex Chromosomes:***
- ***Medulla differentiates into Testis and the Cortex Regresses.***
- ***Embryos with XX Sex Chromosomes:***
- ***Cortex differentiates into Ovary and the Medulla Regresses.***

10th week

- Y → medulla develop & cortex regress
  → thick T.albugenia

T
D
F

- X → cortex develop & medulla regress
  → no T.albugenia


TDF
Cortex
Tunica albuginea
Primary sex cord in medulla
Mesonephric tubule and duct
Paramesonephric duct
Seminiferous tubule
Rete testis
Efferent ductule
Epididymis
TESTIS
No TDF
Primary sex cord
Cortex
Secondary sex cord
Mesonephric tubule & duct
Paramesonephric duct
Uterine tube
Primordial follicle with oogonium
OVARY

Male System

Development of Testes

- ***Primordial Germ Cells → Spermatogonia***
- ***Surface Epithelium → Sertoli cells***
- **Mesenchyme → interstitial cells of leydig**

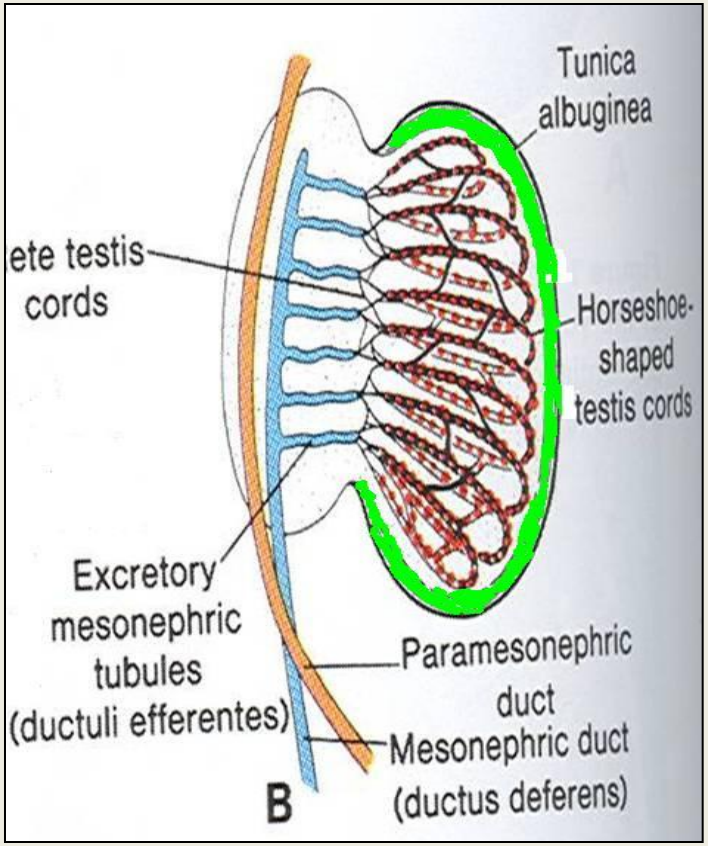
⇨***Secrete by the 8th Week*** ***Androgenic Hormones***

Development of Testes

- ***At Fourth Month :***

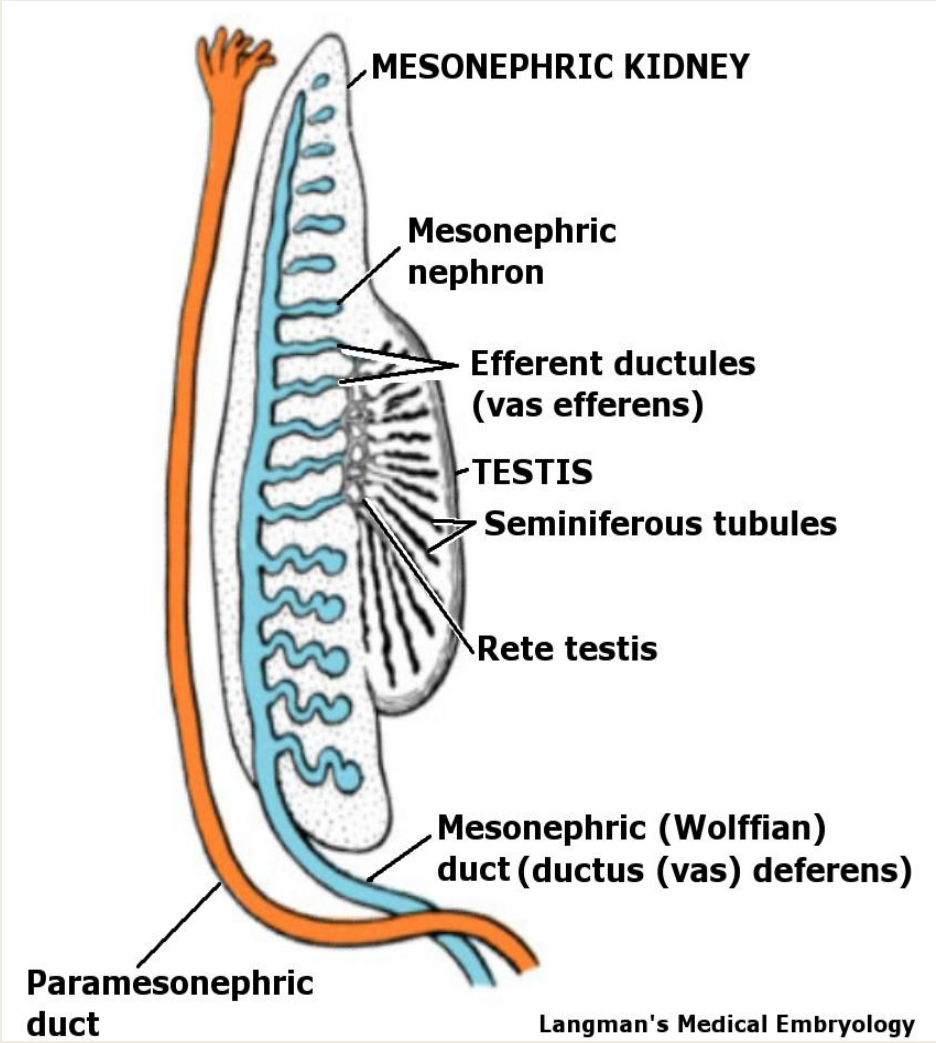
The cords become Horse Shoe Shaped.

- ***They Develop into :***
  - ***Seminiferous Tubules.***
  - ***Rete Testis.***



Maturation of the Testis

- Surface epithelium is flattened to form mesothelium on the external surface of the adult testis.
- Seminiferous Cords acquire a Lumen and become Tubules.
- Rete Testis canalized and Joined Seminiferous Tubules.
- Mesonephric Tubules (Efferent Ductules)(15 –20) link the rete testis to Mesonephric Duct.



Genital Ducts

- Indifferent stage: 4^{th} – 5^{th} week, two pair of ducts:

1. Mesonephric (Wolffian) Ducts:
Important for the Development of Male Genital System.

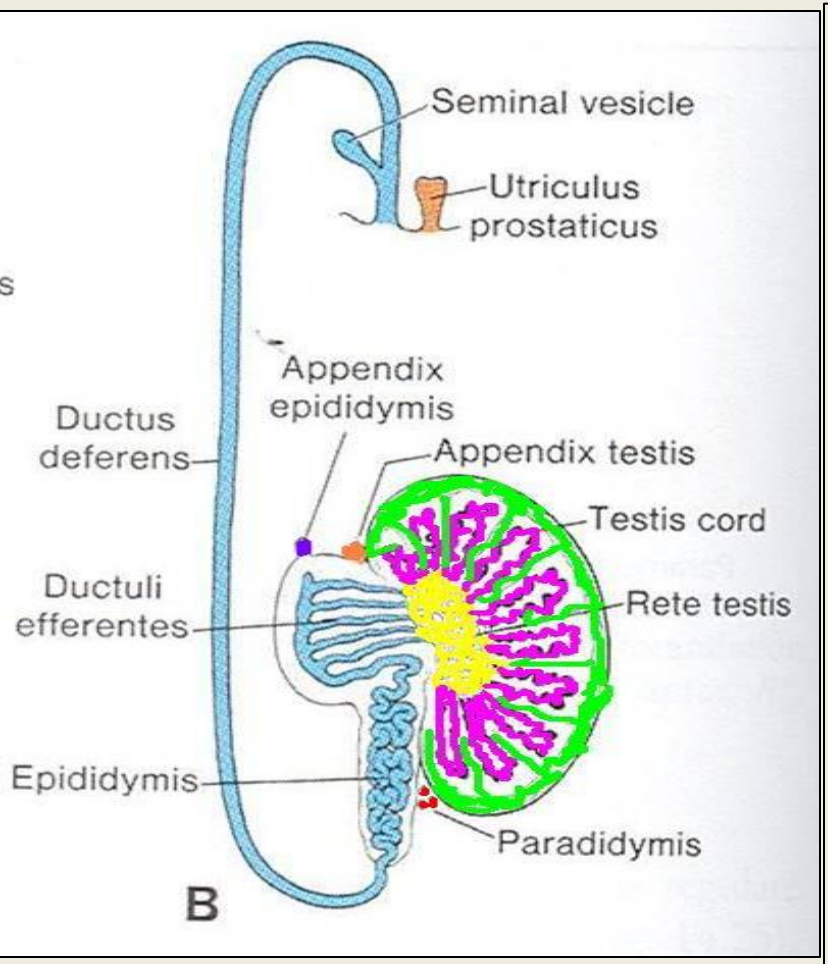
2. Paramesonephric (Mullerian) Ducts:
Important for the Development of Female Genital System.

Paramesonephric Ducts

- ***They Disappear by the effect of <u>mullerian inhibiting substance</u> (MIS) produced by Sertoli cells of the Testes.***

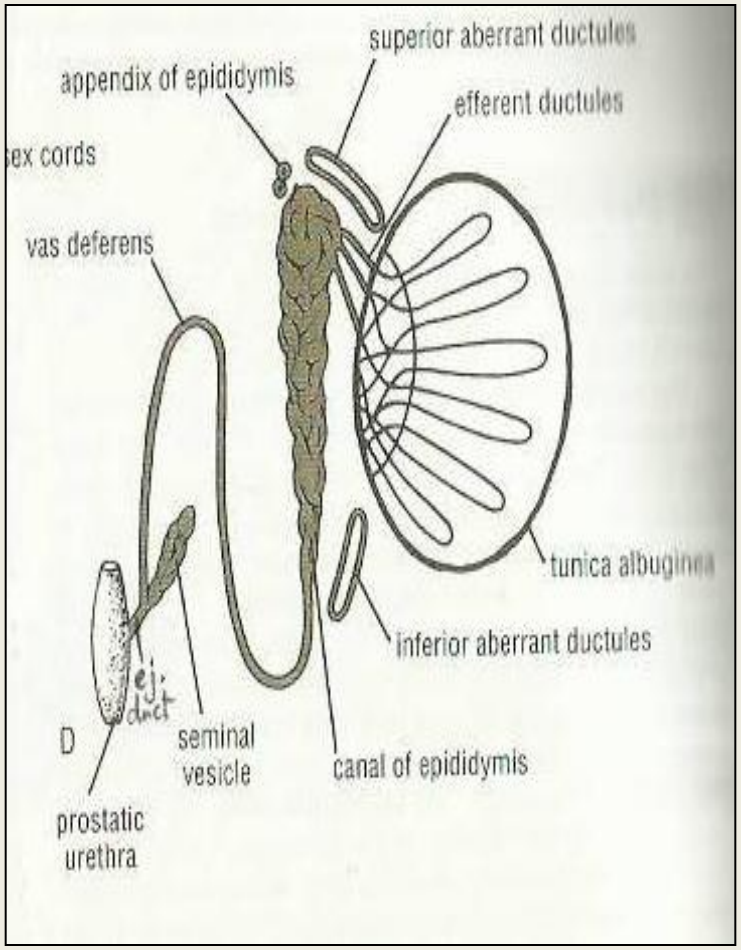
- ***Their Remnant is Appendix of Testis***

Mesonephric Ducts



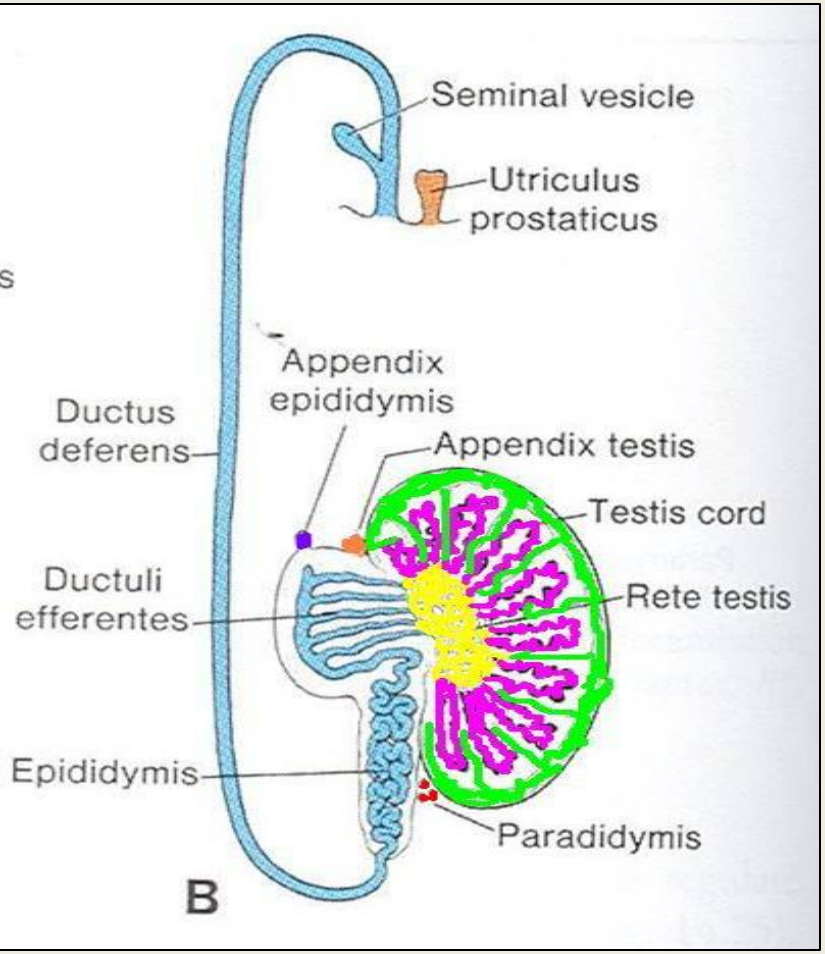
- ***Testosterone*** ***Differentiates*** ***<u>Mesonephric (Wolffian) duct</u>*** ***into :***
- ***1. Epidydimis :***
  - ***Proximal Highly Convoluted part of the duct.***
- ***2. Ductus Deferens :***
  - ***The part of the duct Distal to the Epididymis.***

MESONEPHRIC DUCTS (Cont.)



- ***3. Seminal Vesicles :***
  - ***Lateral Outgrowth from the <u>Caudal End of the mesonephric duct</u>.***
- ***4. Ejaculatory Duct :***
  - ***The part of the Mesonephric duct that lies Between the Duct of Seminal Vesicle and the Urethra.***

Embrylogic Remnants



- ***1. Appendix of Epididymis:***
  - ***Remnants of mesonephric duct.***
  - ***Lies at cranial pole.***
- ***2. Paradidymis***
  - ***Remnants of Tubules which do not join the Rete Testis.***
  - ***Lies at the Caudal Pole of the Testis.***
- ***Appendix of Testis.***
  - ***Remenant of paramesonephric duct***

Glands

- **Prostate:** develop from multiple **endodermal** outgrowths from **prostatic urethra**.

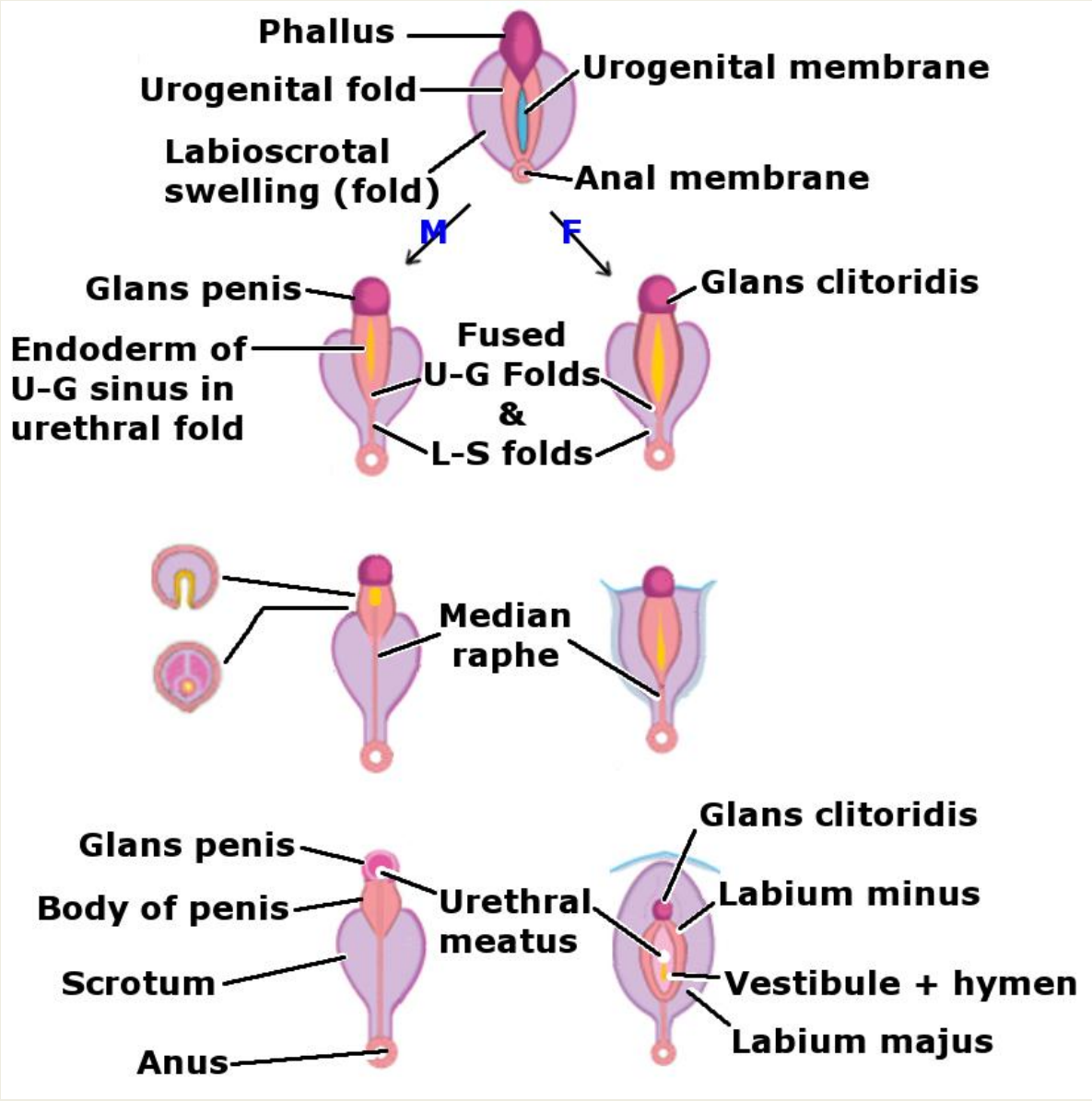
- **Bulbourethral gland:** **endoderm** of **spongy urethra**

- Adjacent **Mesenchyme** will form :

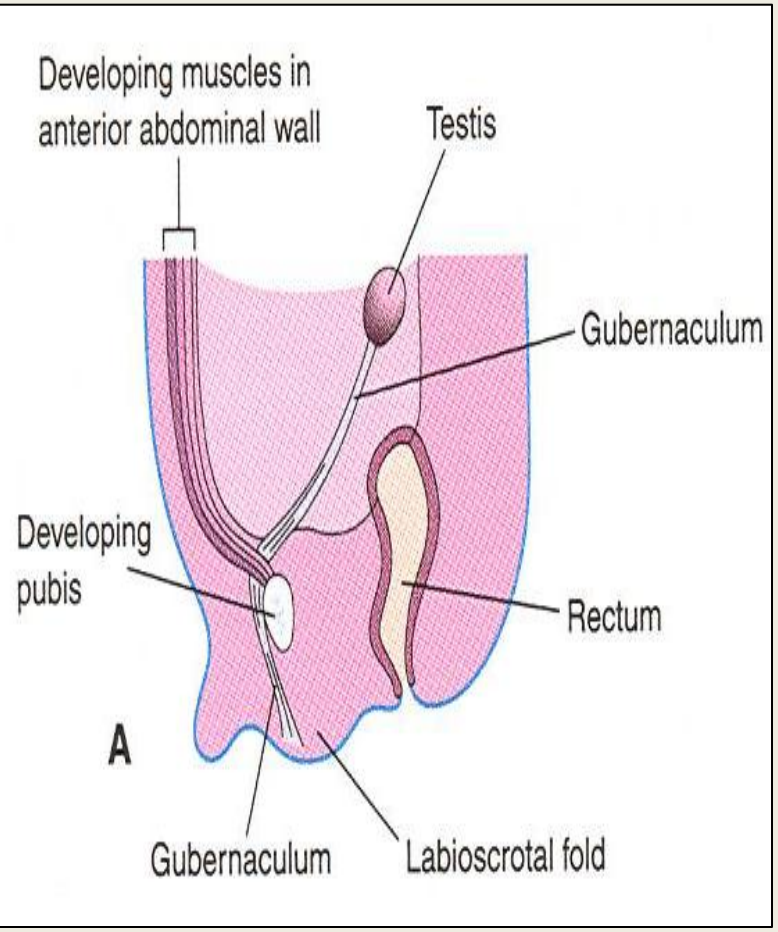
  Stroma and Smooth Muscle of the Glands.

Development Of External Genitalia

- It is stimulated by testosterone, and it is fully differentiated at 12th w.
- **It passes through 2 stages :**
- **Indifferent stage :**
- Genital tubercle develops from **mesenchyme** at the cranial end of cloacal membrane forming **the Phallus.**
- 2 inner urogenital folds develop.
- 2 outer labioscrotal folds develop.
- **Differentiation stage :**
- The phallus enlarges to form penis.
- The 2 urogenital folds fuse forming **Penile (spongy) urethra.**
- The 2 labioscrotal folds fuse to form **Scrotum.**


Phallus
Urogenital membrane
Urogenital fold
Labioscrotal swelling (fold)
Anal membrane
M
F
Glans penis
Glans clitoridis
Endoderm of U-G sinus in urethral fold
Fused U-G Folds & L-S folds
Median raphe
Glans penis
Body of penis
Scrotum
Anus
Urethral meatus
Glans clitoridis
Labium minus
Vestibule + hymen
Labium majus

Inguinal Canal

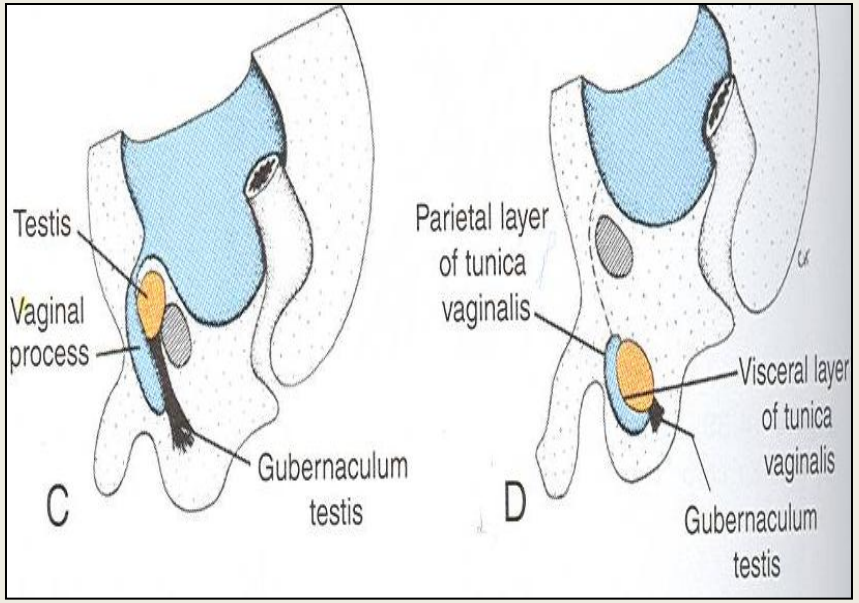


- **It is the pathway for the descend of the testis from the intra-abdominal position to the scrotum.**
- **A band of mesenchyme (Gubernaculum) extends from the inferior pole of the gonad to the labioscrotal swelling.**
- **This ligament passes obliquely through the site of the future inguinal canal.**

Descent Of Testes

- *Begins during the **26th week***
- *It takes (2 -3) days.*
- *About (97%) of Full Term New Born Boys have Both Testes in the Scrotum.*

- Within the scrotum, the testis projects into the distal end of the processus vaginalis.
- During the intrauterine life, the connecting stalk of process normally obliterates, isolating the tunica vaginalis.



Causes Of Descent

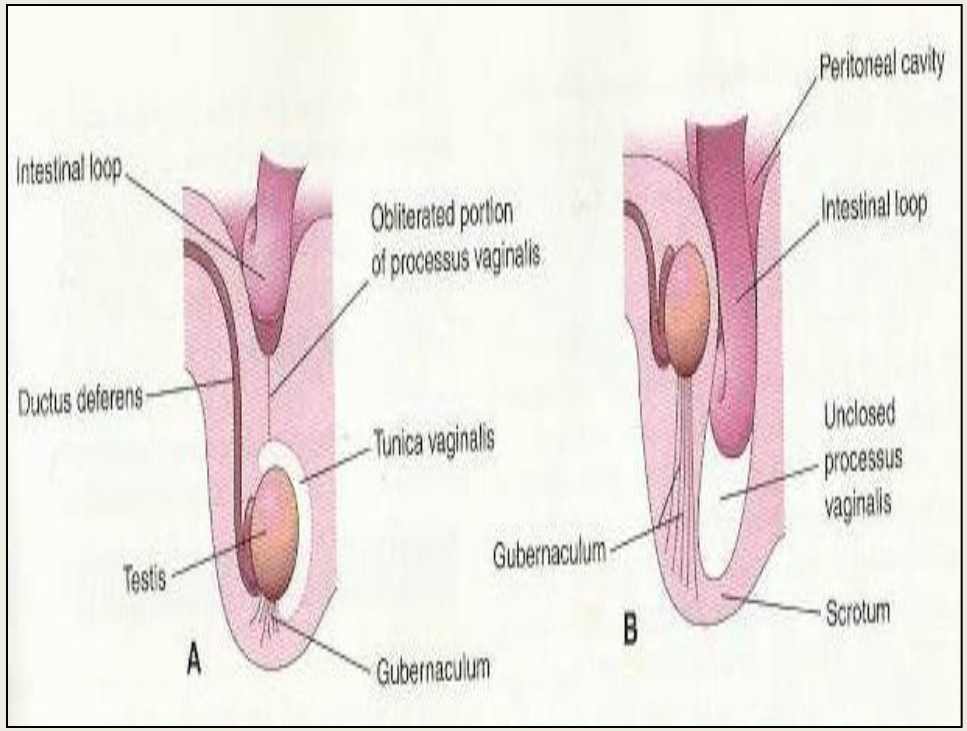
- *(1) Stimulating effect by Androgens* ***produced by the Fetal Testes.***
- *(2) Enlargement of the Testes* ***and Atrophy of the Mesonephric Kidney.***
- *(3) Atrophy of the Paramesonephric Ducts.*
- *(4) Processus Vaginalis.*
- ***An Evagination of Peritoneum.***
- ***It herniates through the abdominal wall along the path formed by gubernaculum.***

Cryptorchidism

- **Undescended Testis :**
- 30% of Premature and in 3 - 4 % of Full Term Males.
- It can be Unilateral or Bilateral.
- The cause is not well known but a Deficiency of Androgen production by the Fetal Testes is an important factor.
- **Common Sites :**
- **The Abdominal Cavity.**
- **Usually Along the path of the Testes in the Inguinal Canal.**
- **Complications :**
- **1. Sterility In Bilateral Undescended Testes.**
- **2. Testicular Cancer (20-44%).**

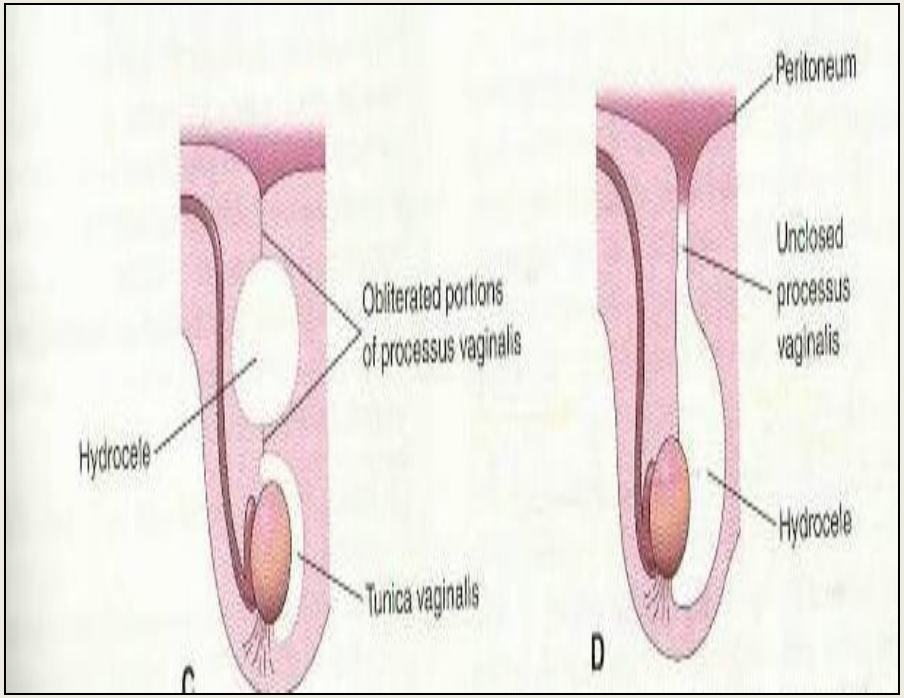
Congenital Inguinal Hernia

- **The processus vaginalis** remains in open communication with the peritoneal cavity.
- A loop of intestine may herniate through it into the scrotum.
  A (incomplete) & **B (complete).**



Hydrocele

- If the middle part of the processus vaginalis remains open, fluid may accumulate forming a **hydrocele of spermatic cord (C).**
- If the abdominal end of processus vaginalis remains open but is too small to permit herniation of intestine. Peritoneal fluid passes into patent processus vaginalis forming a **hydrocele of testis(D).**



Female System

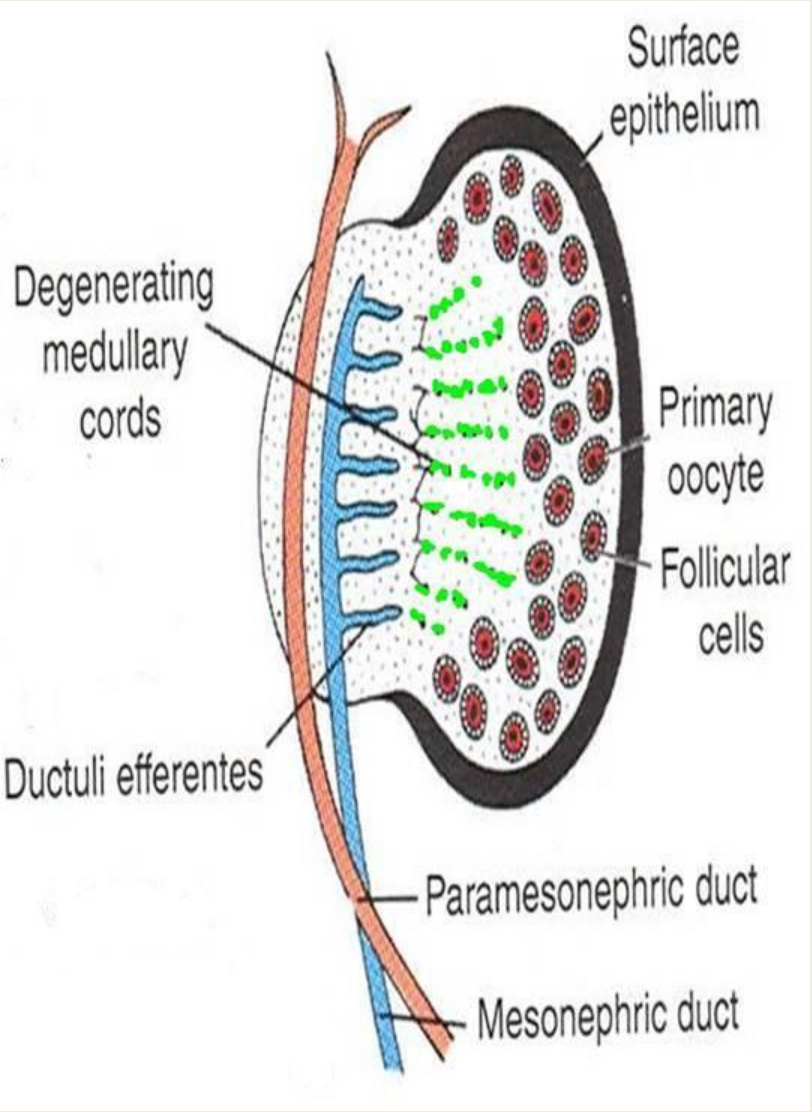
Review

- 4^{th} week:
- 5^{th} week:
- 6^{th} week:
- 7^{th} week:
- 10^{th} week:

Differentiation of the Ovary (10th week)

- ***The Primary sex cords dissociate into irregular cell clusters (Rete ovarii).***
- ***Which extend into the Medulla and form (Medullary Cords)***
- ***Both the medullary cords and rete ovarii degenerate and disappear.***
- ***Cortical Cords: [secondary sex cords]***
- ***Formed from proliferating surface epithelium.***
- ***They penetrate the mesenchyme.***

Primary Oocytes



- ***Isolated cell clusters.***
- ***Formed in the 4th month (16 weeks)***
- ***From splitting of secondary sex cords.***
- ***They contain oogonia (derived from the primitive germ cells).***
- ***They are surrounded by follicular cells (derived from the sex cords).***
- ***Their number increases up to thousands by active mitosis of oogonia.***

Changes of the Ovary After Birth

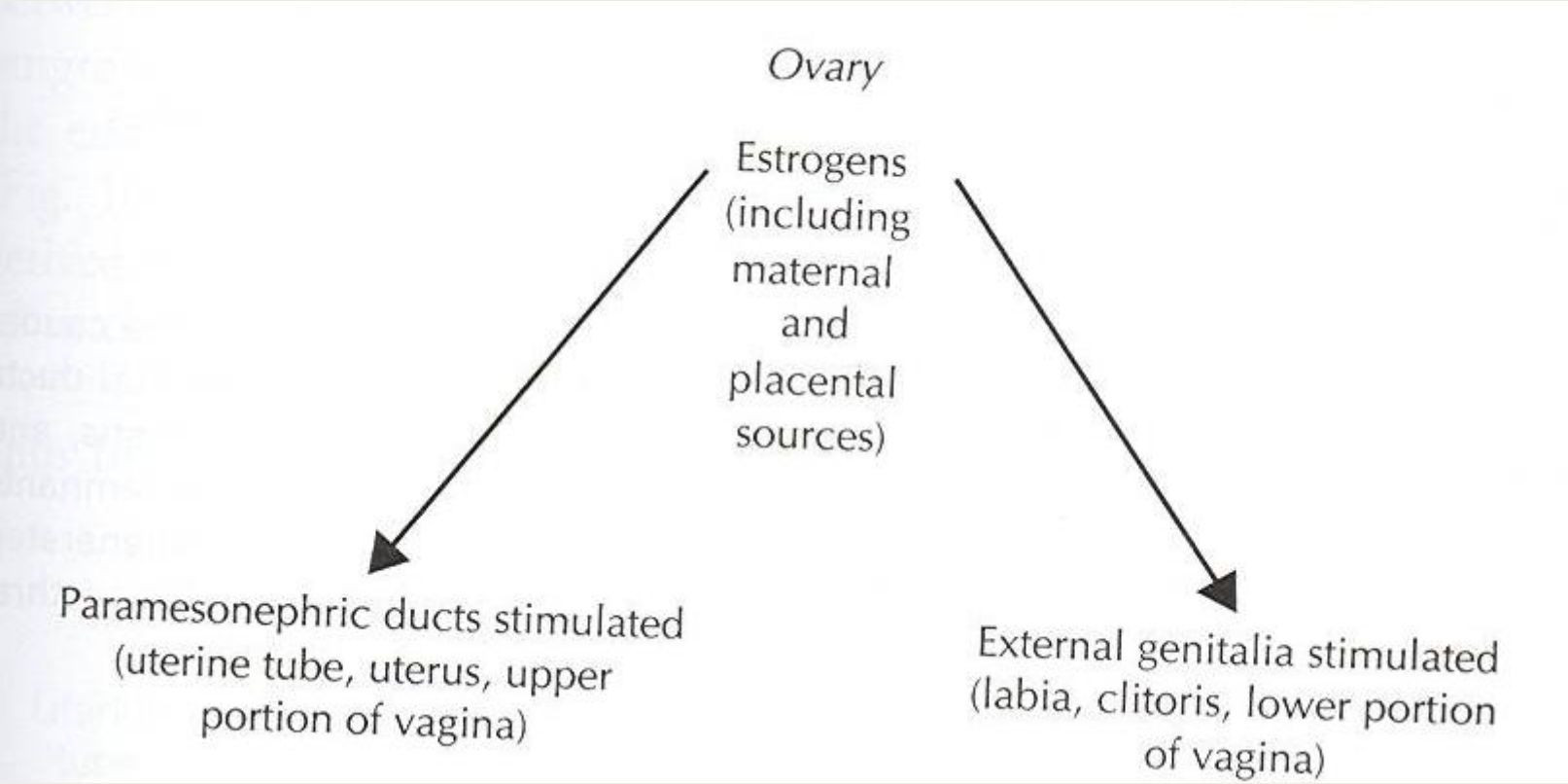
- ***Surface Epithelium:***
- ***Flattened into a single layer and***

Separated from follicles in the cortex by

A thin tunica albuginea.

- ***No new oogonia are formed***
- ***The ovaries descend from the posterior abdominal wall into the pelvis;*** just inferior to the pelvic brim.

Internal Genital Organs

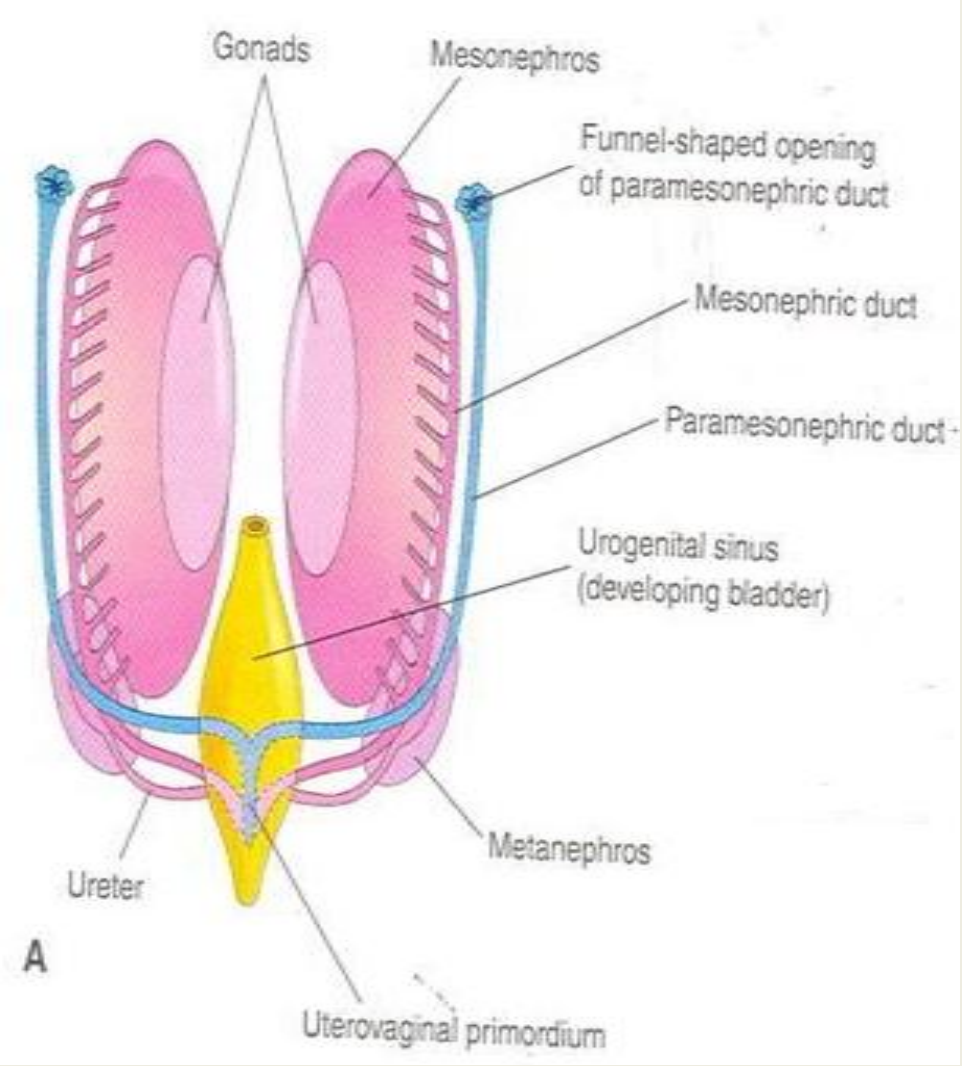


Paramesonephric Ducts

- Absence of **Mellurian Inhibiting Substance** (MIS)

→ Paramesonephric ducts ***are formed from longitudinal invagination of epithelium lateral to the mesonephroi.***

Paramesonephric Ducts



- **Cranially; their funnel shaped ends open into the peritoneal cavity.**
- **Caudally; they run lateral to the mesonephric ducts, crossing them ventrally.**
- ***They descend caudo medially and approach each other in the median plane.***
- ***They form the y- shaped Uterovaginal Primordium:***
- ***It opens in the dorsal wall of the Urogenital Sinus (developing urinary bladder)***

Derivatives Of Paramesonephric Ducts

- ***Uterine Tubes***
- ***from the cranial un fused parts of the ducts.***

- ***Uterus*** ***(body and cervix)***
- ***Superior*** ***portion of the*** ***vagina*****.**

} ***UteroVaginal Primordium***

- ***lower portion of vagina*** ***from the Urogenital sinus.***

Development of Vagina

- Upper part from Urovaginal Primmordium
- Lower part:
- ***The site of enterance of the paramesonephric ducts to the urogenital sinus produces two solid evaginations (SinoVaginal Bulbs); they grow out from the pelvic part of the sinus.***
- ***The bulbs proliferate and fuse to form a solid Vaginal Plate.***
- ***The Proliferation continues and it increases the distance between the urogenital sinus and the uterus.***

Development of Vagina

- ***The central cells of the vaginal plate break down to form the lumen of the vagina. [canalization]***

- ***The lining of the entire vagina is derived from the vaginal plate.***

Summary of Female Development

OVARY

Urogenital sinus

Female external genitalia
. Lower part of vagina

Absence of androgen exposure

Mullerian ducts

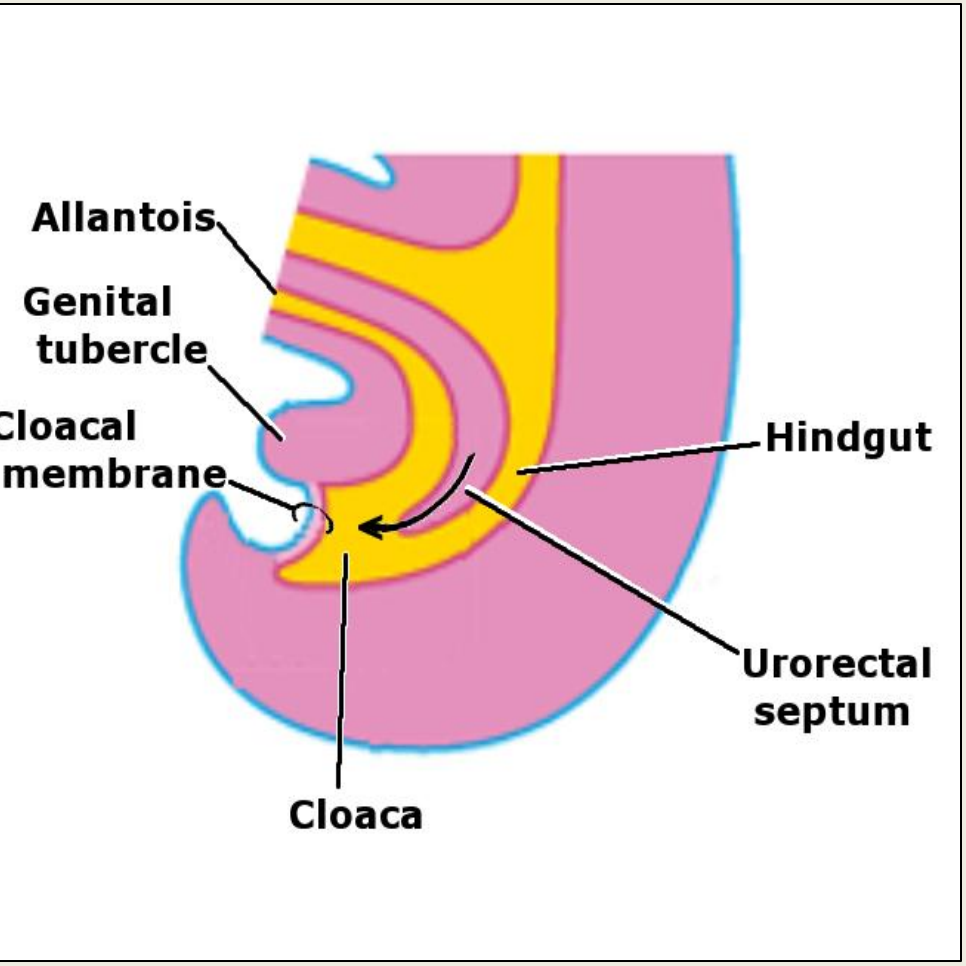
Female internal genital Organs
. Most of upper vagina
. Cervix and uterus . Fallopian tubes

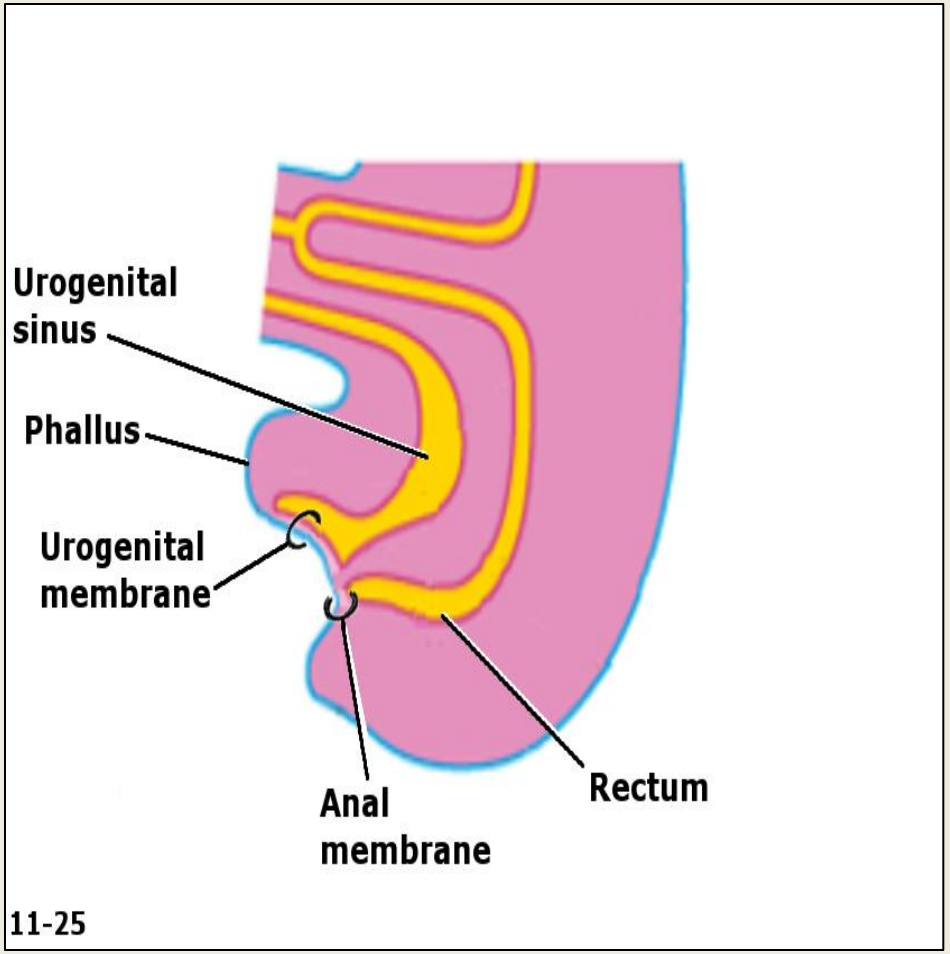
Indifferent Ext. Genitalia

- They are similar in both sexes up to the 7th week. They are fully differentiated by the 12th week.

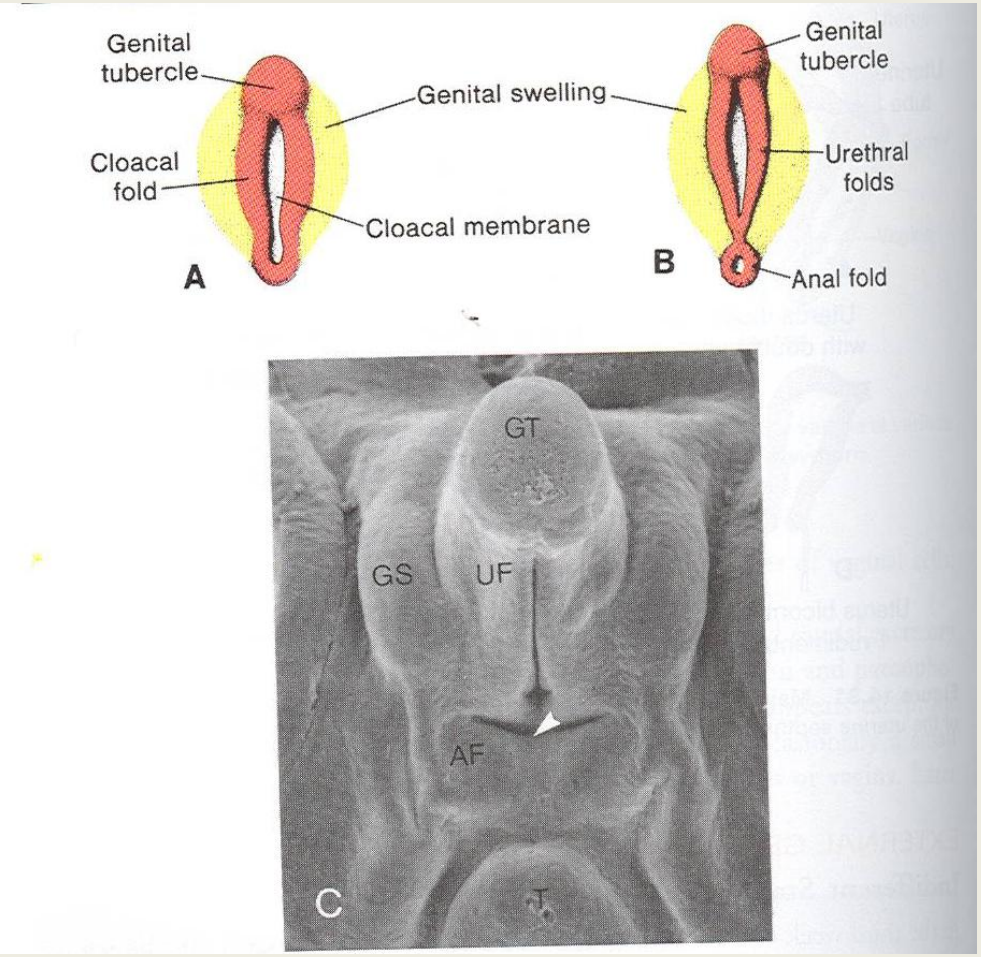
- **Mesenchyme cranial to the cloacal membrane proliferates to form Genital Tubercle**
- **The genital tubercle elongates to form the phallus.**

- **Urorectal septum fuses with the cloacal membrane, it divides the cloacal membrane into,**
  a. Dorsal anal membrane.
  b. Ventral urogenital membrane.
- **The urogenital and cloacal membranes rupture about the 7th week to form the urogenital orifice and the anus.**


Allantois
Genital tubercle
Cloacal membrane
Hindgut
Urorectal septum
Cloaca

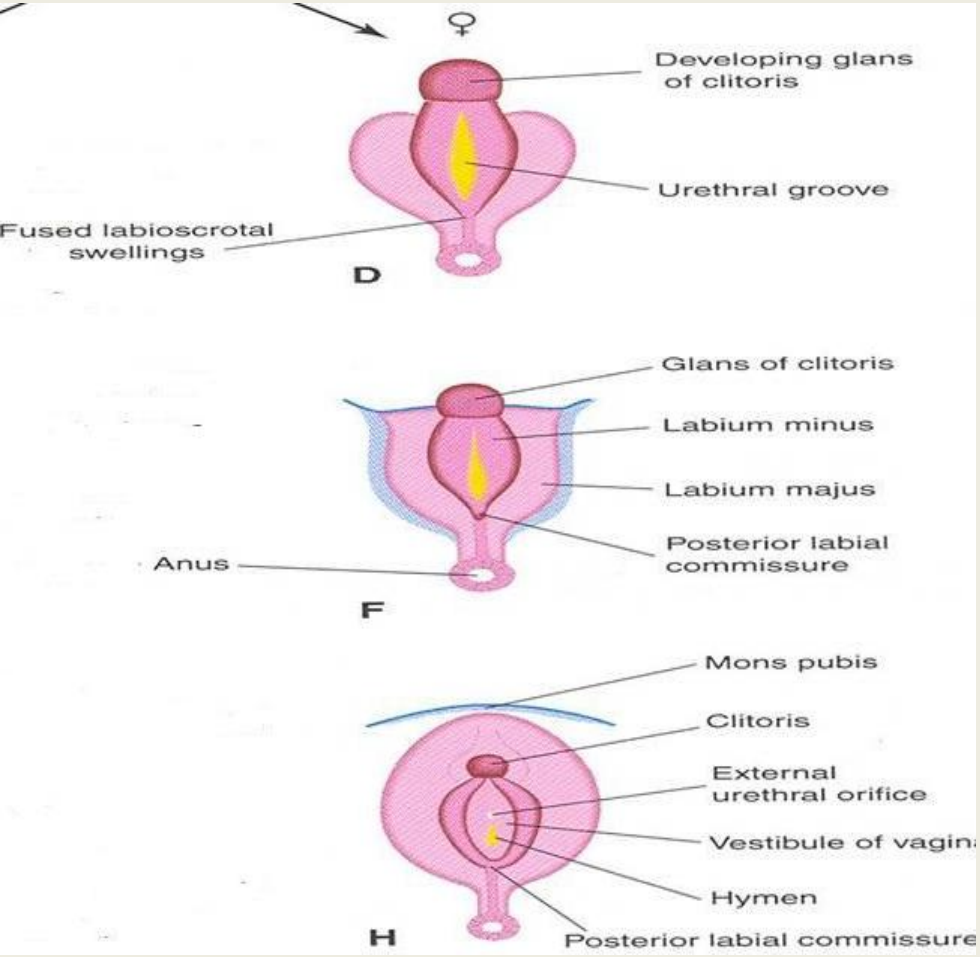

Urogenital sinus
Phallus
Urogenital membrane
Anal membrane
Rectum
11-25

Development Of External Genitalia



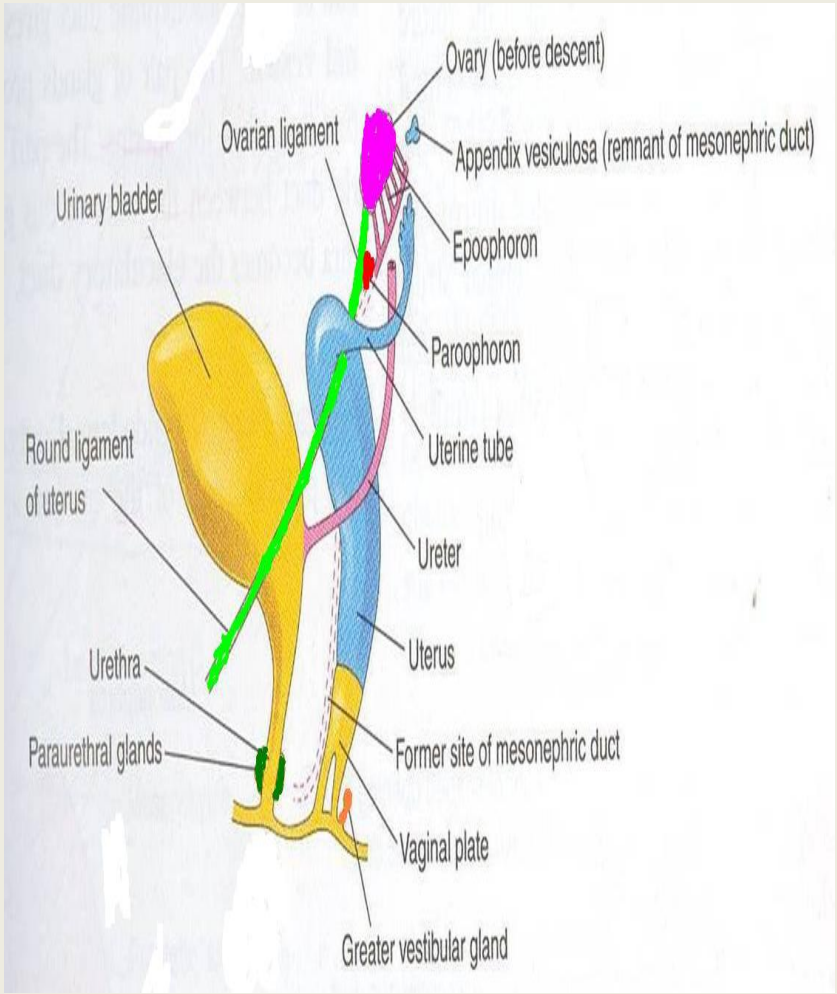
- On each side **of the cloacal membrane, it proliferates to form**
  - **Labioscrotal swellings (Genital Swellings).**
  - **Urogenital Folds (Urethral Folds).**

Development Of External Genitalia



- Genital tubercle elongates only slightly to form the Clitoris
- The Urethral Folds do not fuse and form the Labia Minora.
- The Labioscrotal Folds form the Labia Majora, they fuse to form the posterior labial commissure and the anterior labial commissure.

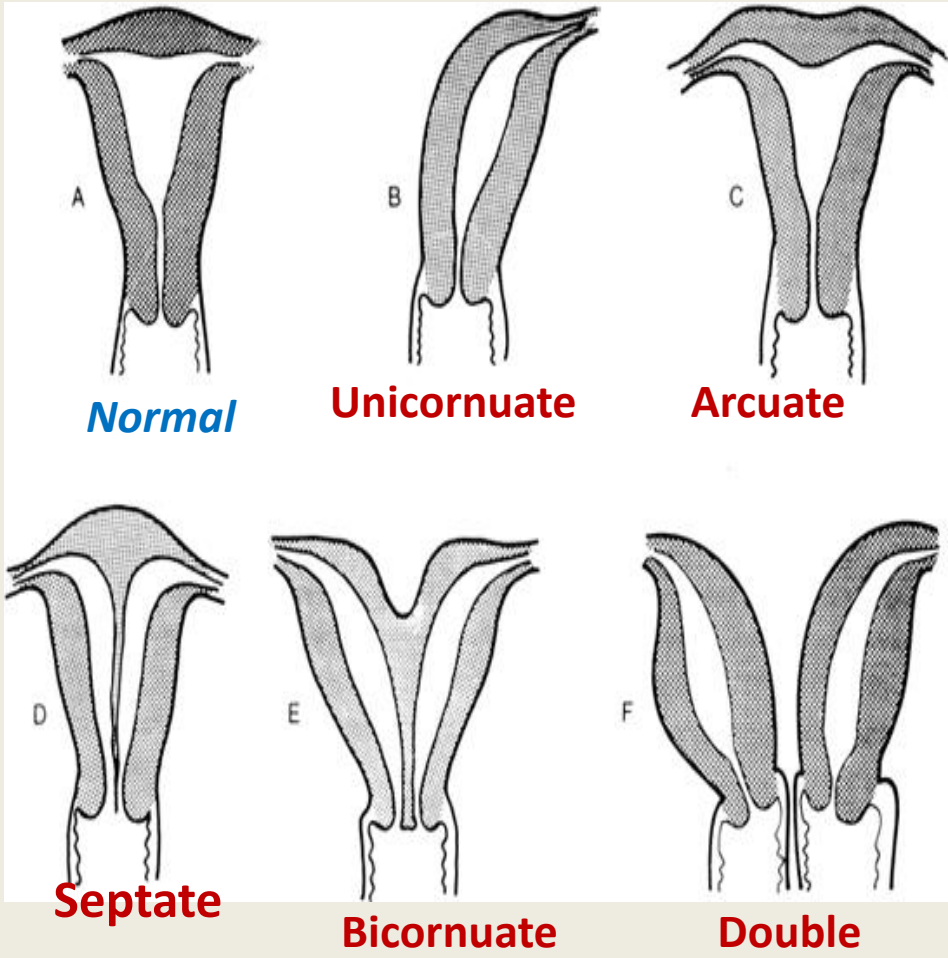
Glands



- ***Urethral & Paraurethral Glands:***
- ***They grow from the urethra.***
- ***They are corresponding to the Prostate Gland of the male.***
- ***Greater vestibular glands:***
- ***They are outgrowths of the urogenital sinus.***
- ***They are corresponding to the Bulbourethral Glands of the male.***

Uterine Malformations

- Double uterus (Uterus Didelphys).
  - Due to failure of fusion of inferior parts of the paramesonephric ducts.
  - May associated with double or single vagina.
- Bicornuate uterus.
  - The duoblication involves the superior segment.
- Unicornuate Uterus.
  - One paramesonephric ducts fails to develop.
- Arcuate Uterus.



❑***Cervical Atresia***.

- This may be combined with incomplete development of the upper vagina or lower uterus.
- ***Vaginal Anomalies***
- ***Atresia*** *(*Partial or complete).

❑***Double vagina***.

❑***Transversely septate vagina***.

- Results from faulty canalization of the fused müllerian ducts.