

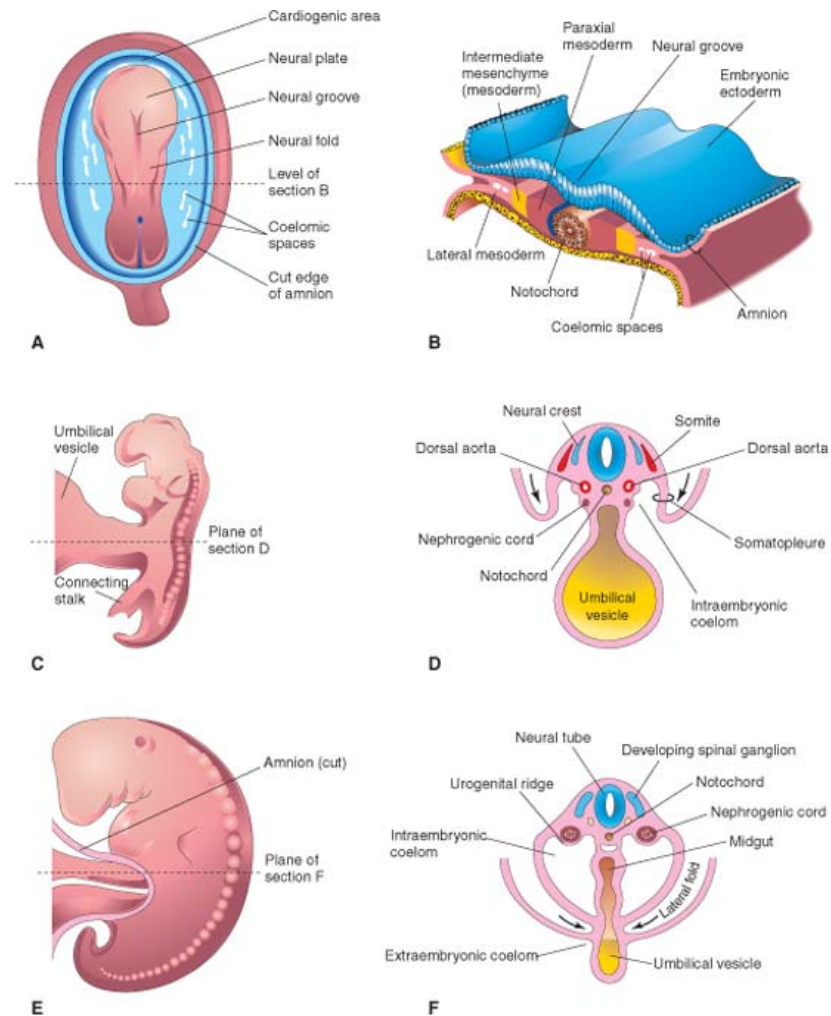
Development of Reproductive System

Lecture Objectives

- Describe the development of gonads (indifferent stage) and sex determination.
- Describe the development of testis and ovaries and the related structures.
- Describe the development of the genital ducts.
- Describe the development of male and female glands.
- Describe the development of the male and female external genitalia.
- Discuss the related developmental anomalies.

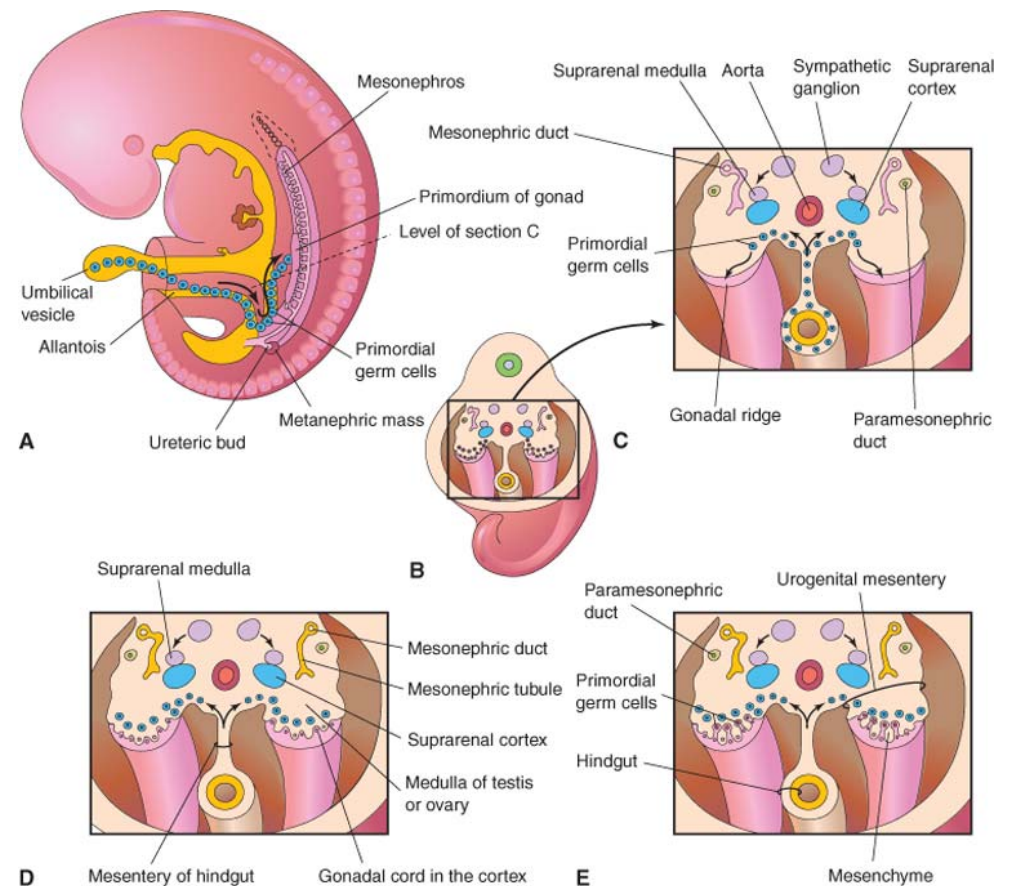
Development of Urogenital System

- Both the urinary & reproductive systems are closely related (structurally & developmentally)
- Urogenital system develop from the **intermediate mesoderm**
- **Urogenital ridge** is a longitudinal elevation of the mesoderm lateral to the dorsal aorta
- **Nephrogenic cord (ridge)** develop in the urogenital ridge
 - Gives rise to part of the urinary system
- **Genital (gonadal) ridge** develop close to the nephrogenic cord
 - Gives rise to part of the genital system



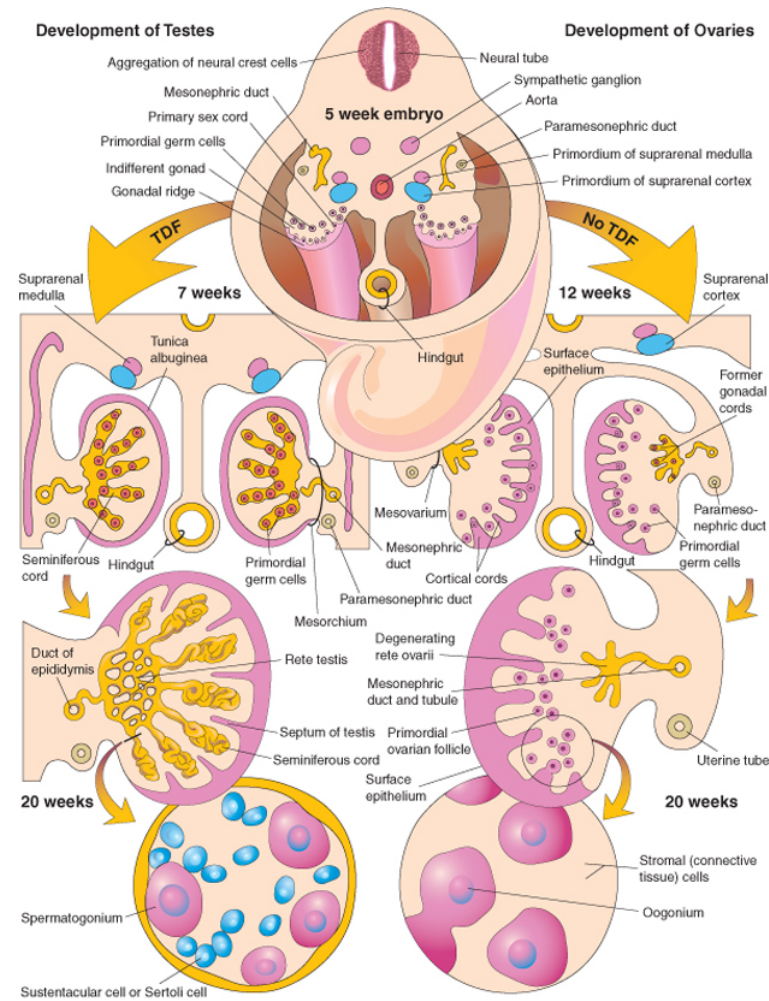
Development of Gonads

- Early development of male & female gonads are similar (**indifferent stage – indifferent gonads**)
- Development of gonads begin in the 5th week
- Source of gonadal development
 - Mesothelium of posterior abdominal wall – lateral somatic mesoderm – cortex
 - Proliferate and form gonadal ridge
 - Primary sex cords
 - In female form ovary
 - Underlying mesenchyme – intermediate mesoderm – medulla
 - In male form testis
 - Primordial germ cells – from the yolk sac
 - Migrate via mesentery & mesenchyme to the primary sex cords (6th week)



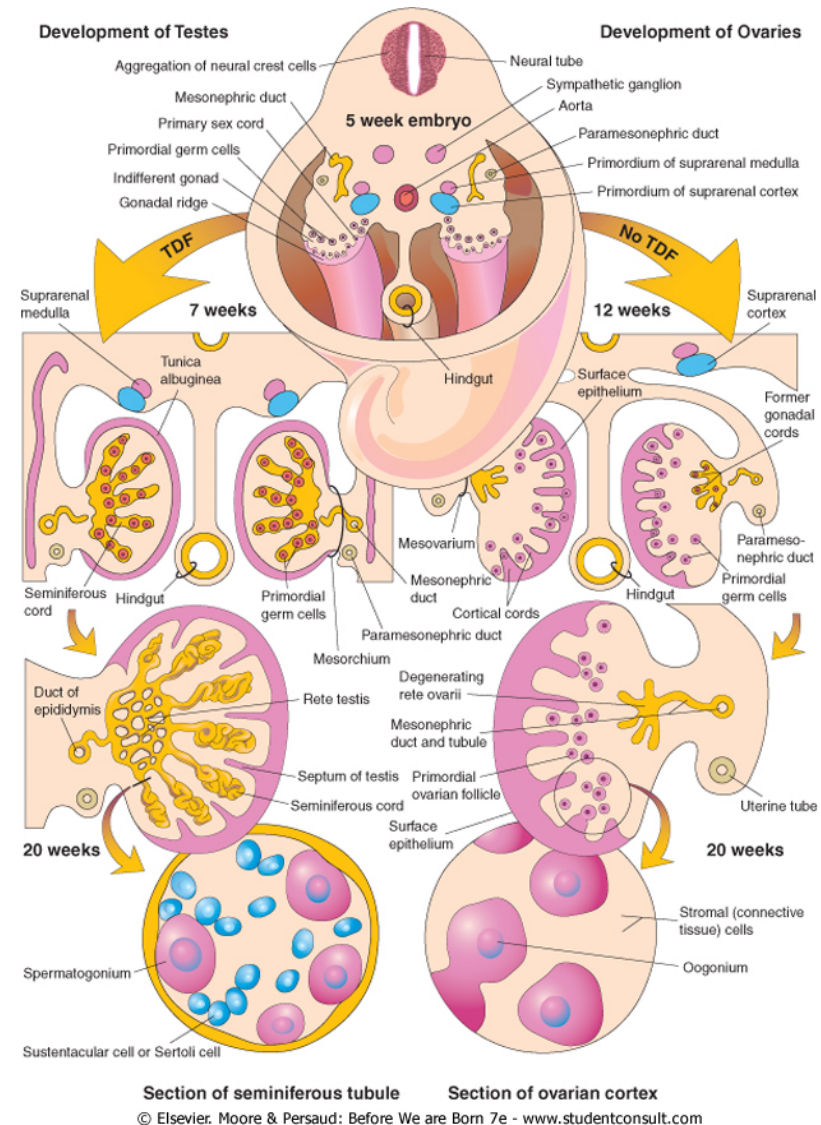
Sex Determination

- Y chromosome has SRY gene in the sex determining region for **testis determining factor (TDF)**
- Presence of TDF determines the differentiation of testis
 - Primary sex cords (in medulla) → seminiferous tubules
 - Absence of Y chromosome & TDF results in ovary formation
- Testosterone from fetal testis determines male characteristics
 - Female characteristics determined without hormonal effect



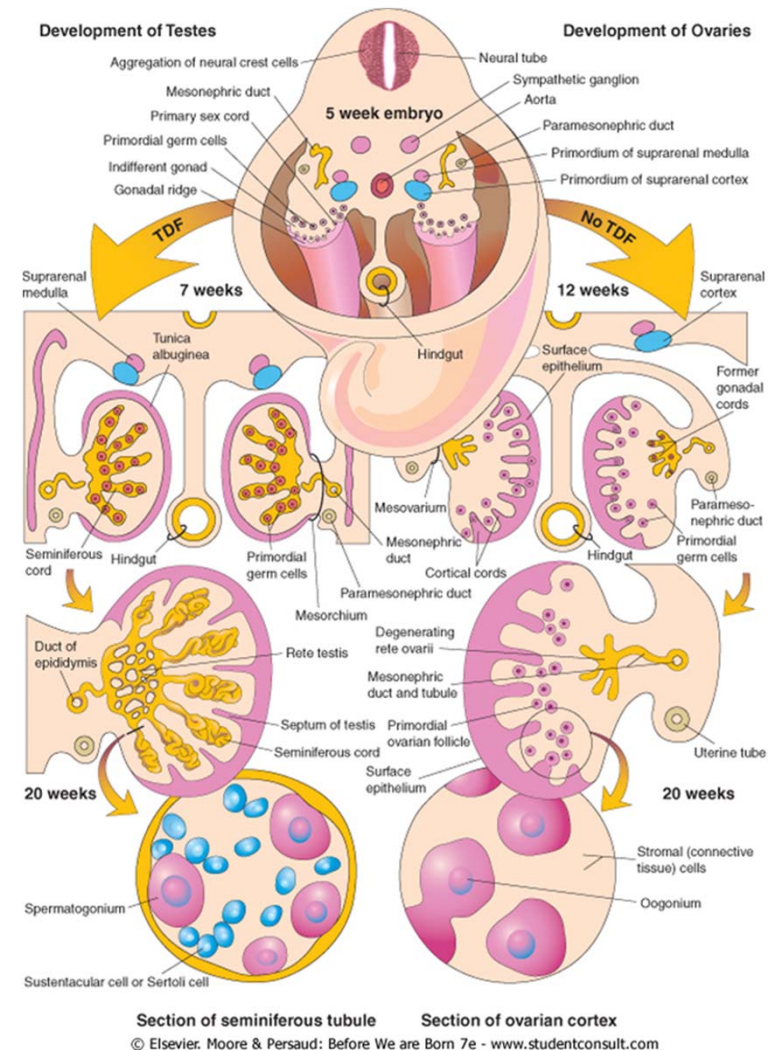
Development of Testes

- **Primary sex cords** extend into medulla and form **seminiferous cords** (obliterated tubules)
 - Lumen form on puberty
- **Seminiferous cords** Branch & connect to form **rete testis**
- Rete testis connect with 15-20 **mesonephric tubules** → **efferent ductules**
- **Mesonephric duct** becomes **ductus epididymis**



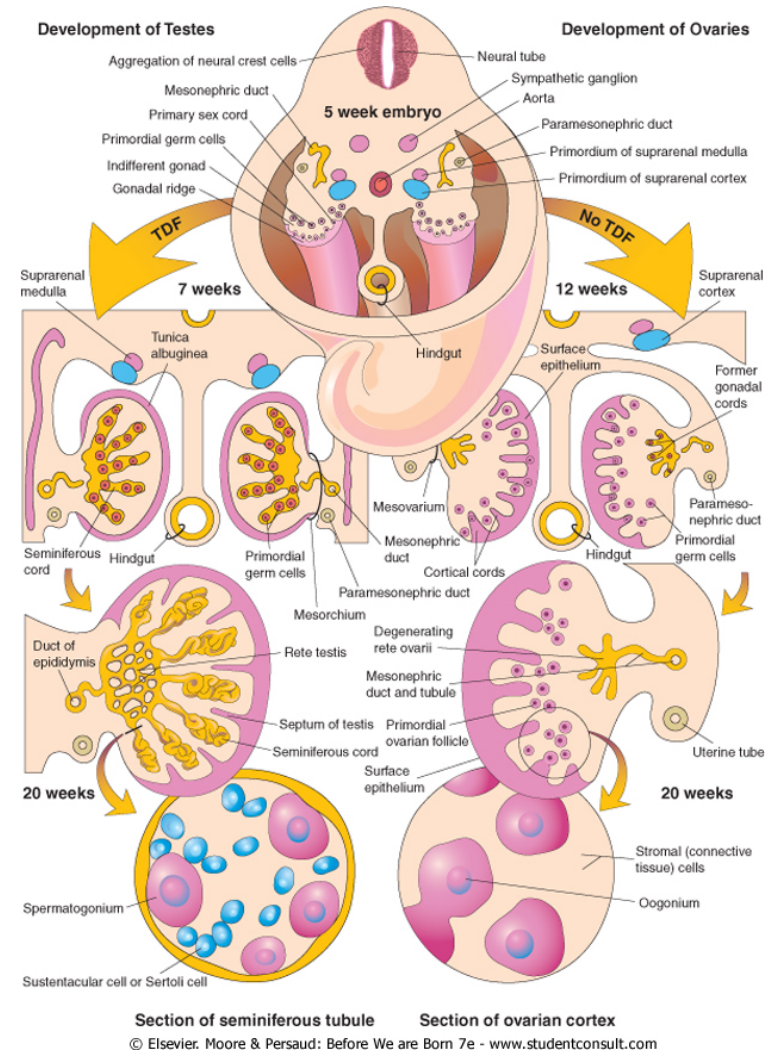
Development of Testes

- The fibrous **tunica albuginea** form
 - seminiferous cords loose connection with surface epithelium
- Testis enlarge & separate from the abdominal wall leaving a mesentery (**mesorchium**)



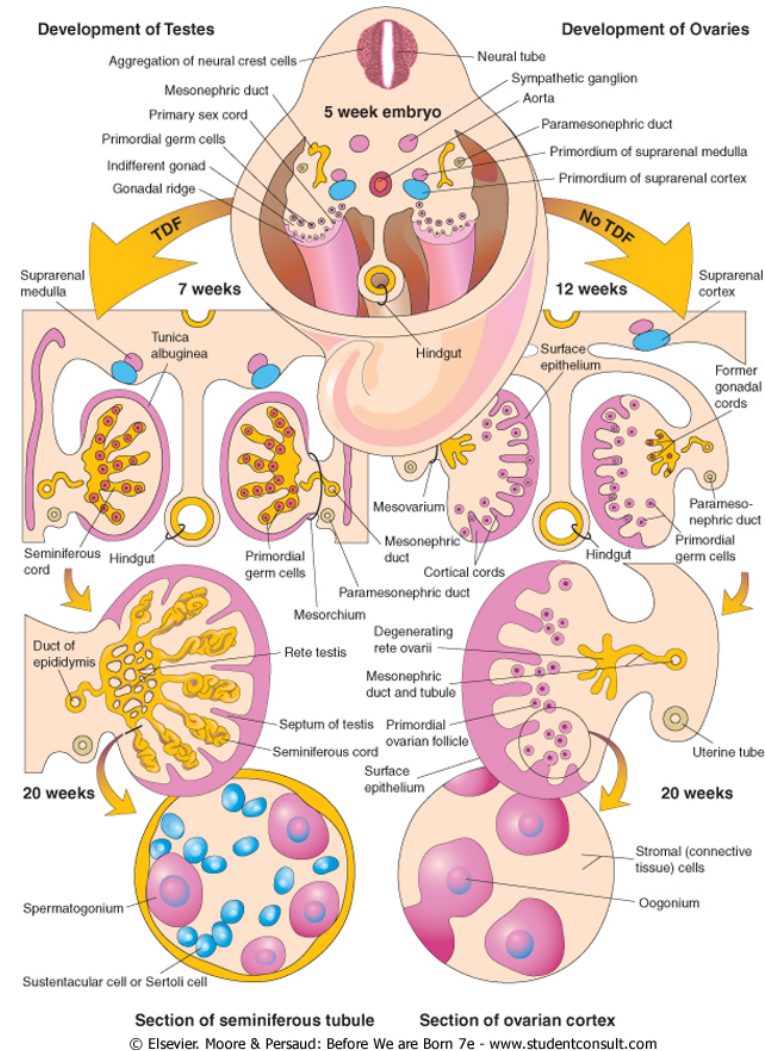
Development of Testes

- **Interstitial (Leydig) cells** form from the **mesenchyme** between seminiferous cords
 - By 8th week secrete testosterone under influence of hCG
 - Induce differentiation of mesonephric ducts & external genitalia
- **Sertoli cells** derived from **surface epithelium** of testis
 - Secrete antimüllerian hormone (AMH) at 6-7 week
 - Suppresses development of paramesonephric (müllerian) ducts
- **Spermatogonia** develop from **primordial germ cells**



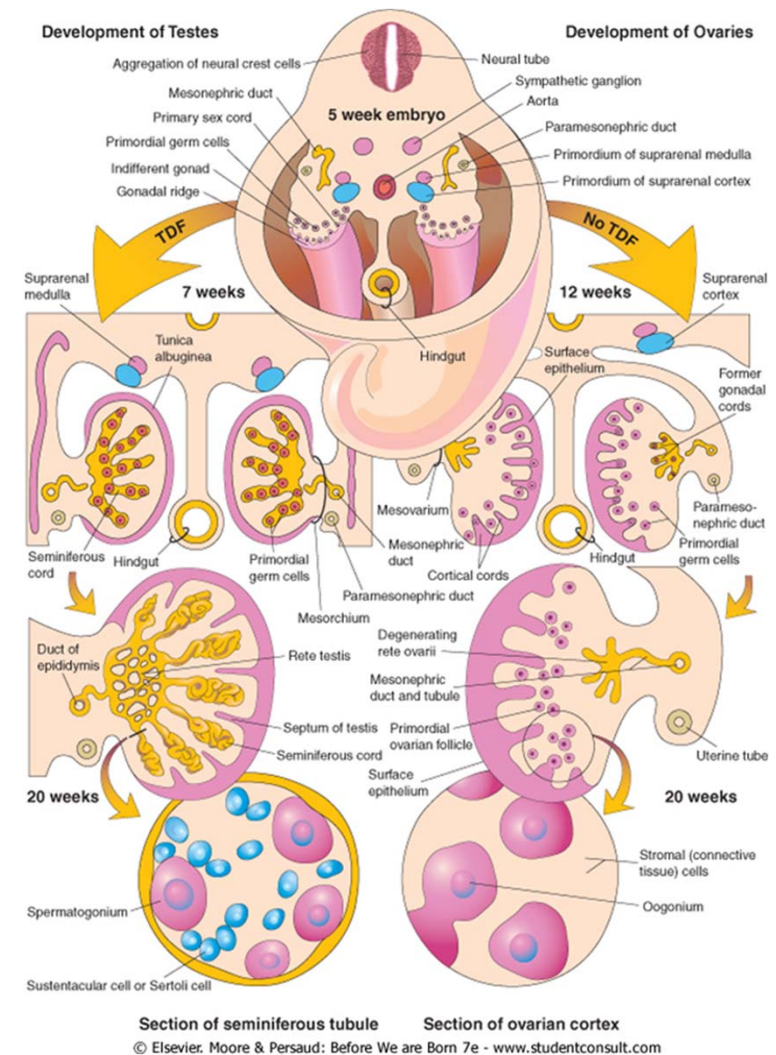
Development of Ovaries

- Primary sex cords → rete ovarii → degenerate
- Secondary sex cords (cortical cords)
 - Extend to underlying mesenchyme at early fetal life
 - Primordial germ cells incorporated in it
 - Disconnect and form **primordial follicles**
 - **Oogonium** surrounded by 1 layer of follicular cells



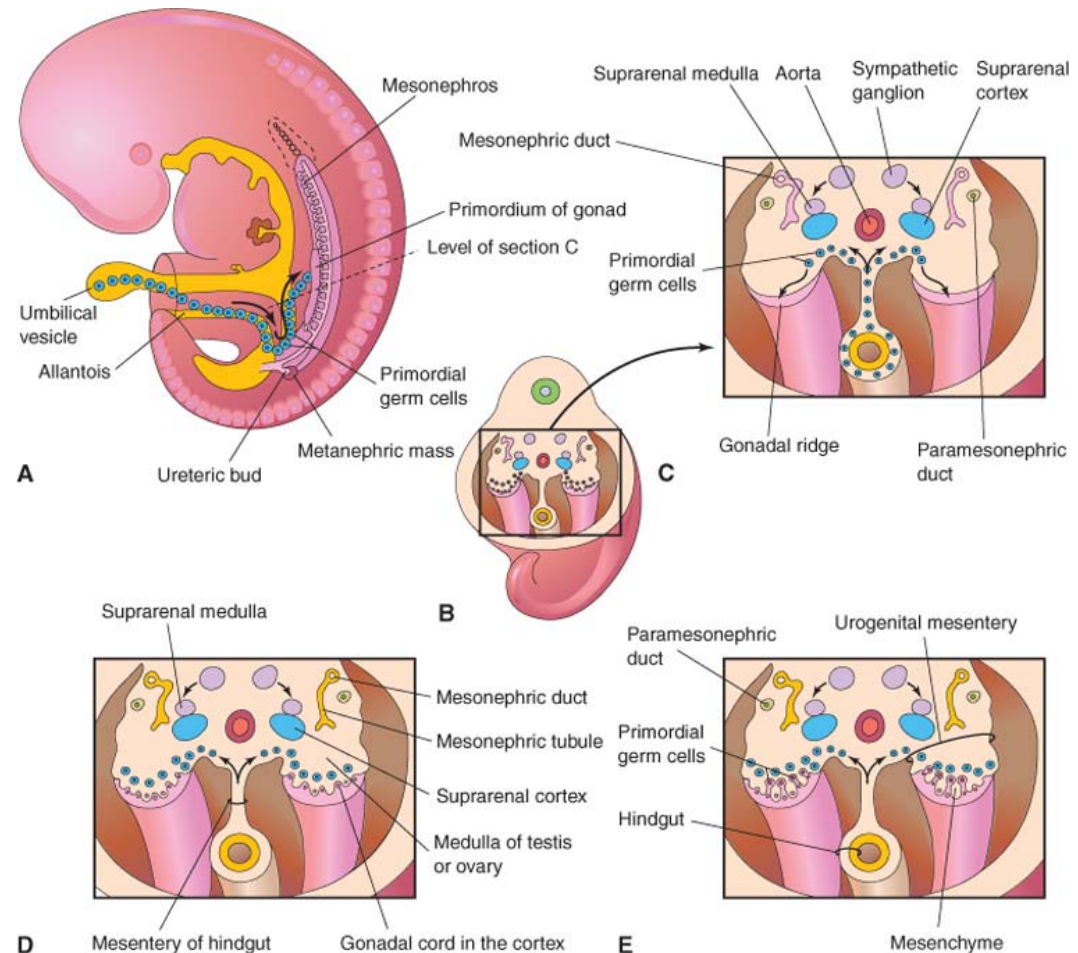
Development of Ovaries

- Surface epithelium form 1 layer of **germinal epithelium**
 - Separated from cortex by fibrous **tunica albuginea**
- Ovary separate from the abdominal wall leaving a mesentery (**mesovarium**)



Development of Genital Ducts

- In the indifferent stage two ducts develop (5th-6th week)
 - Mesonephric (wolffian) ducts from mesonephrone
 - Important in male genital structures
 - Disappear in female
 - Paramesonephric (mullarian) ducts – develop lateral to the gonads & mesonephric ducts
 - Form from longitudinal invagination of the mesothelium
 - Important in female genital structures
 - Disappear in male



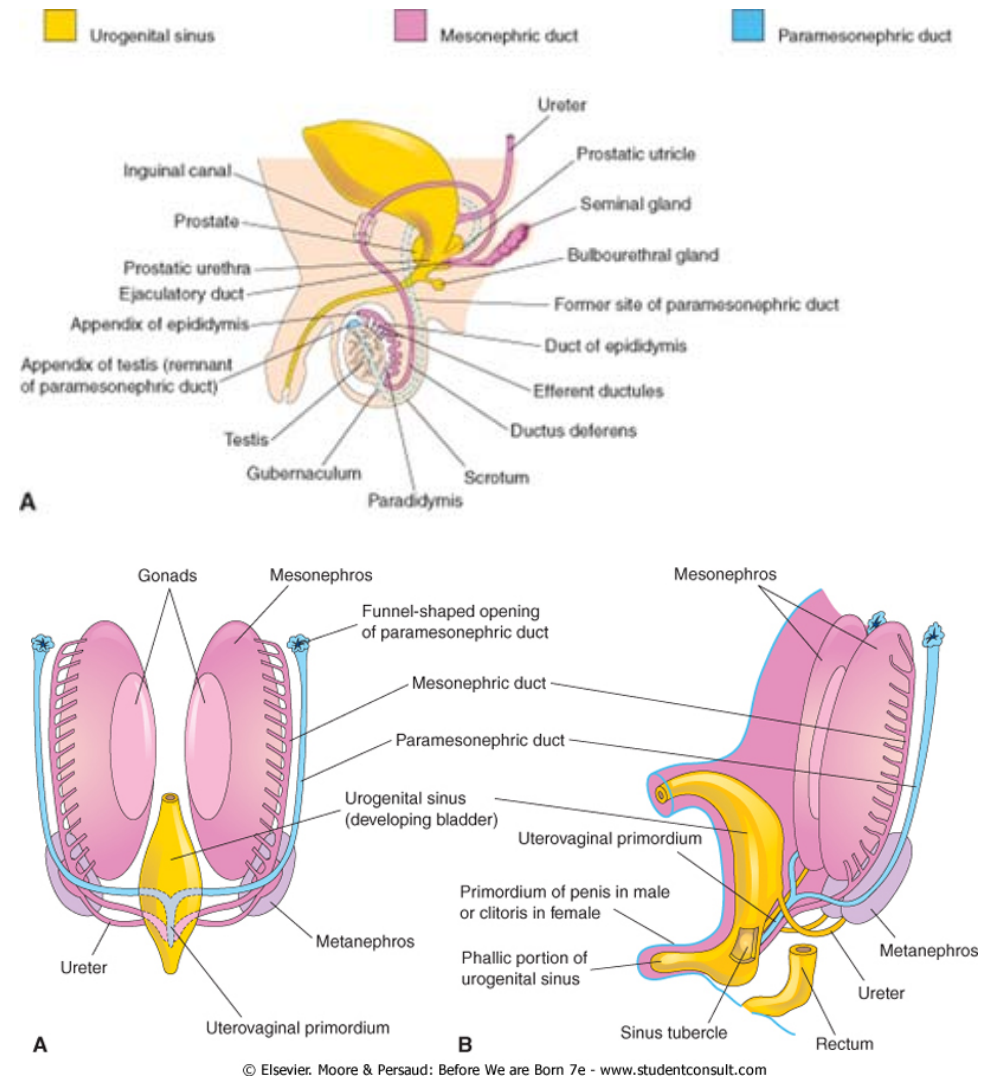
Development of Genital Ducts

- **Mesonephric ducts**

- Proximally – form **epididymis**
- Distally – form **ductus deferens & ejaculatory duct**
 - Lateral outgrowth give rise to **seminal vesicle**

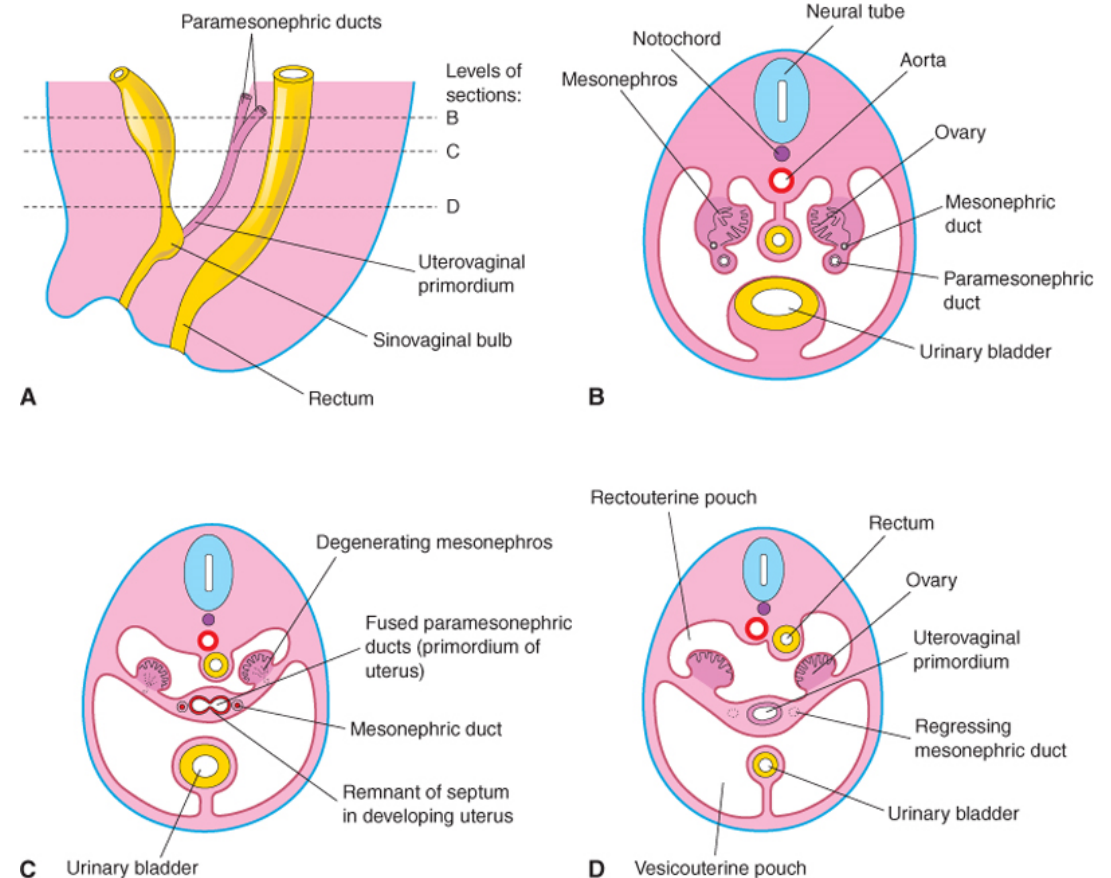
- **Paramesonephric ducts**

- Rostrally (with funnel shape opening into the abdomen)
- Caudally they cross anterior to mesonephric ducts & fuse together forming **uterovaginal primordium**
 - Ends at the posterior wall of the urogenital sinus
 - Results in an elevation called **sinus tubercle**



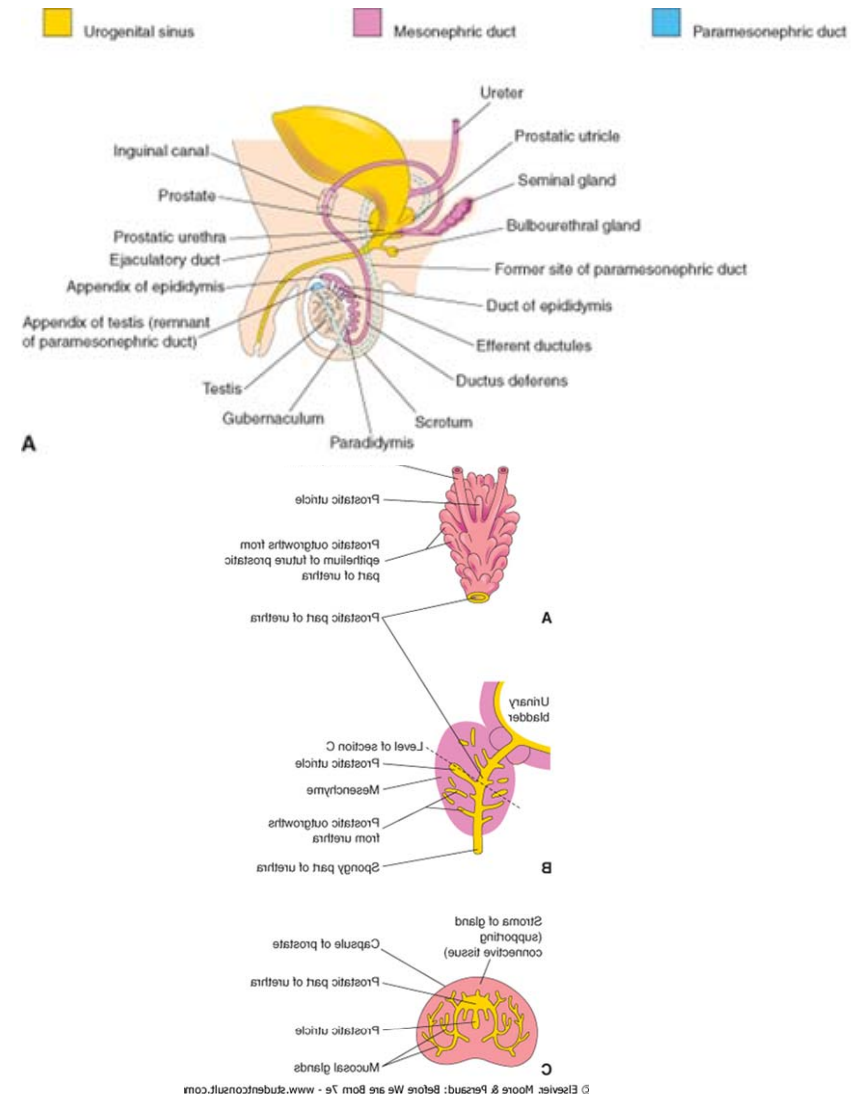
Formation of the Peritoneal Structures

- The fusion of the distal parts of the paramesonephric ducts extend parts of the peritoneum towards the midline
- The extended peritoneum forms the **broad ligament**
- Anterior to it forms the **vesicouterine pouch**
- Posterior to it forms the **rectouterine pouch**



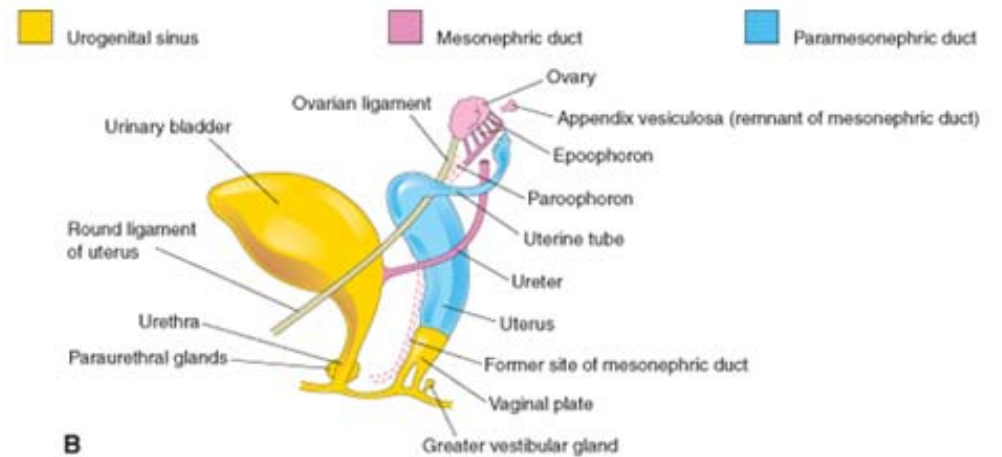
Development of Male Glands

- **Seminal vesicle** develop from a Lateral outgrowth of the distal part of the **mesonephric duct**
- **Prostate gland** develop from endodermal outgrowth of the **prostatic urethra** into the surrounding mesenchyme
- **Bulbourethral glands** develop from outgrowths of the **penile urethra**

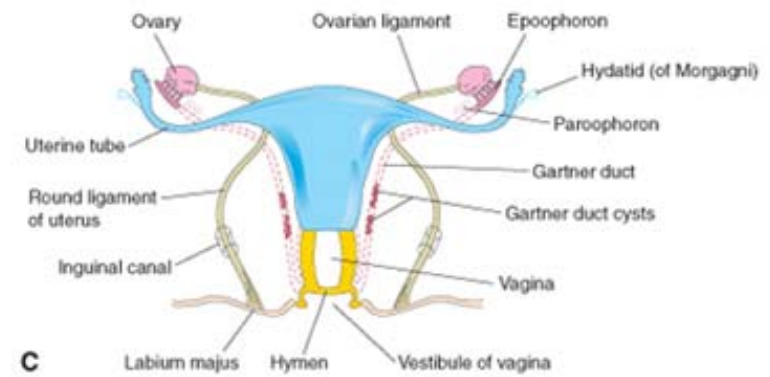


Development of Female Genital Organs

- **Uterine tubes** develop from proximal part of **paramesonephric ducts**
- **Uterus** develops from the **uterovaginal primordium**



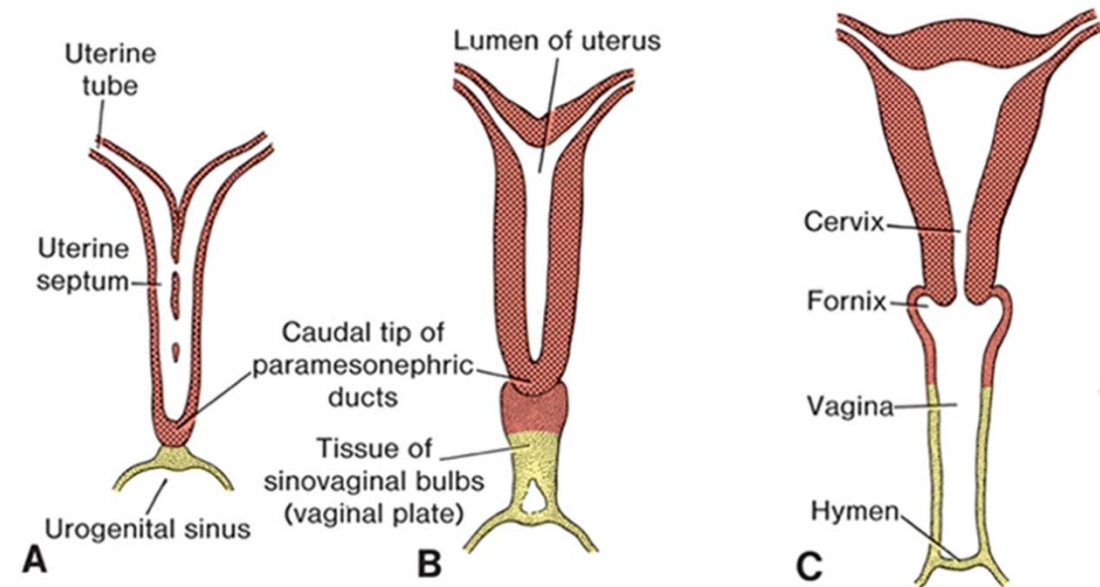
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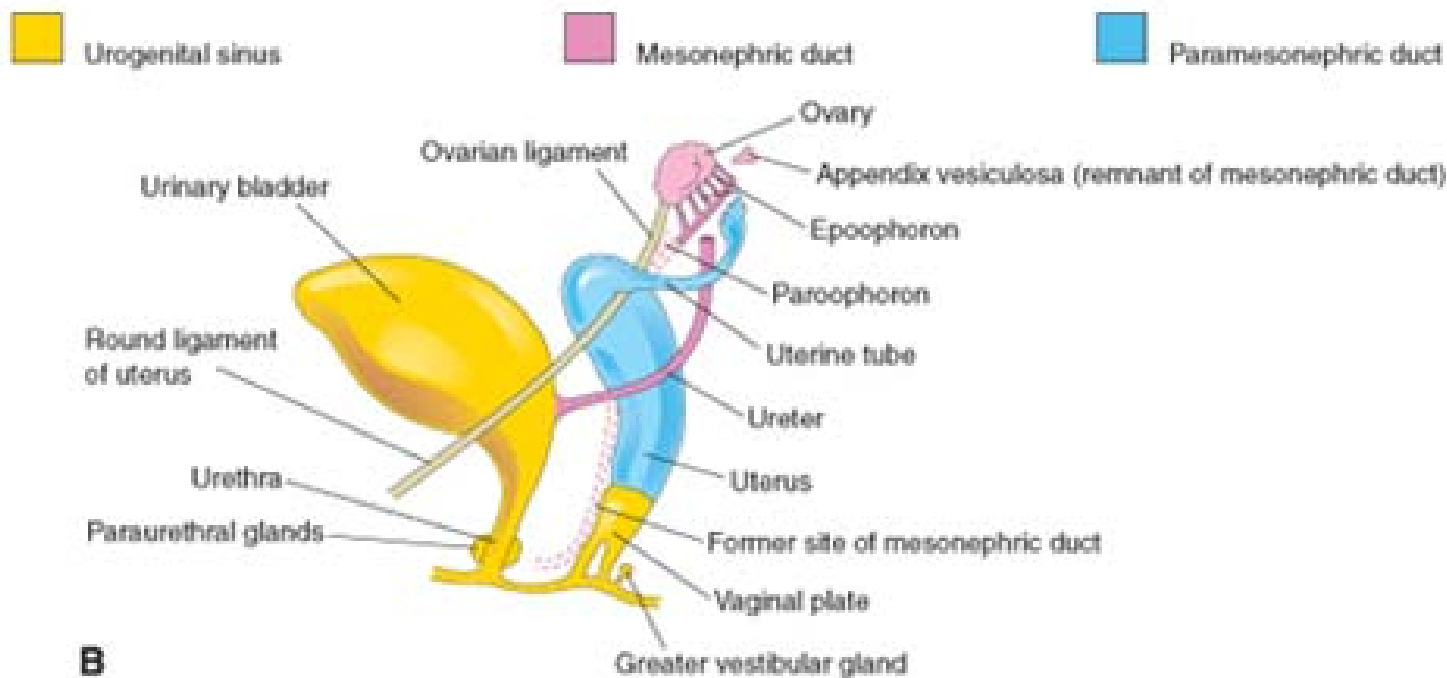
Development of Female Genital Organs

- **Vagina** develops from the **urogenital sinus**
 - Sinus tubercle induces the outgrowth of sinovaginal bulbs → vaginal plate → vagina
- Separation between urogenital sinus & vagina → **hymen**



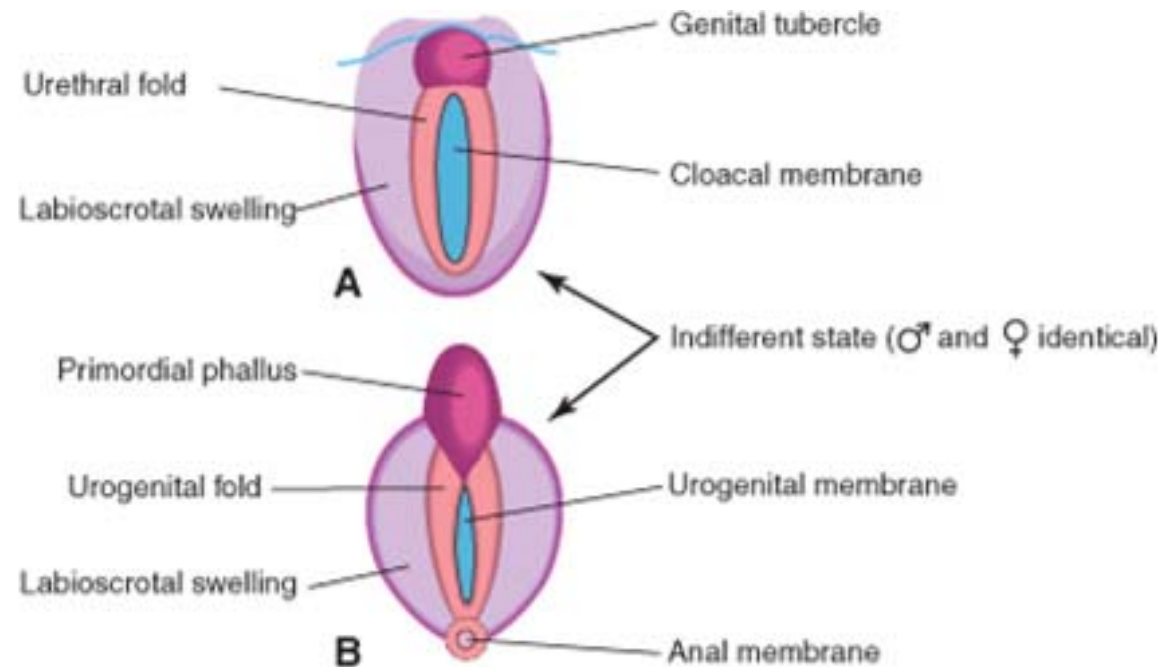
Development of Female Glands

- Urethral & paraurethral glands develop as buds from urethra
- Greater vestibular glands develop from outgrowth of urogenital sinus



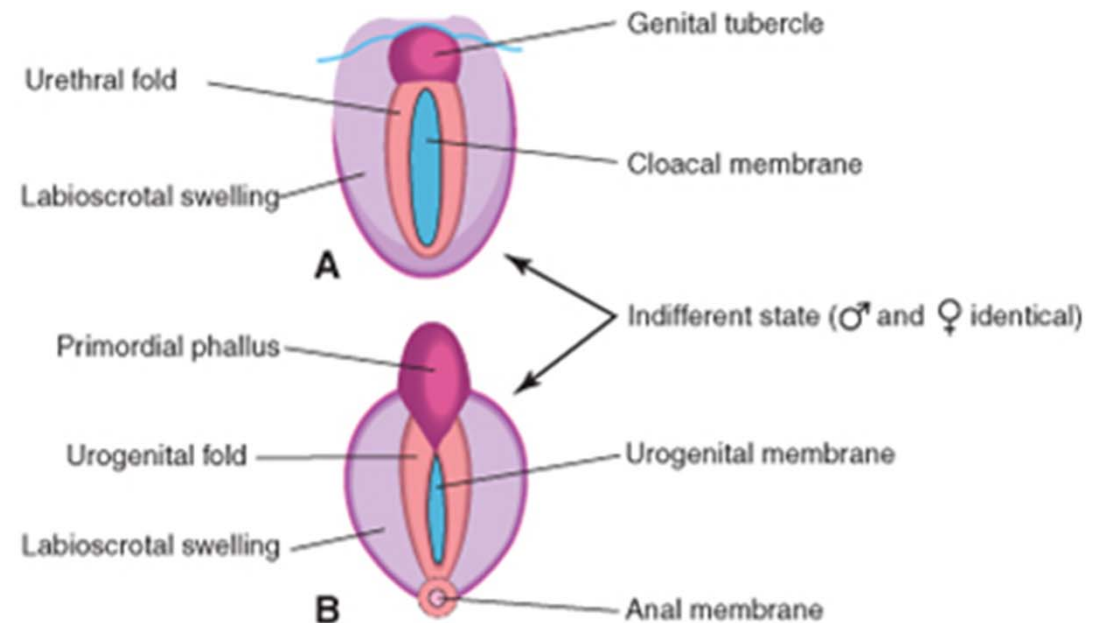
Development of External Genitalia Indifferent Stage (4th-7th weeks)

- **Genital tubercle** formed from mesenchymal proliferation at the cranial end of the cloacal membrane
 - **Phallus** is an elongated genital tubercle
- **Urogenital (urethral) & labioscrotal folds** develop on sides of the cloacal membrane



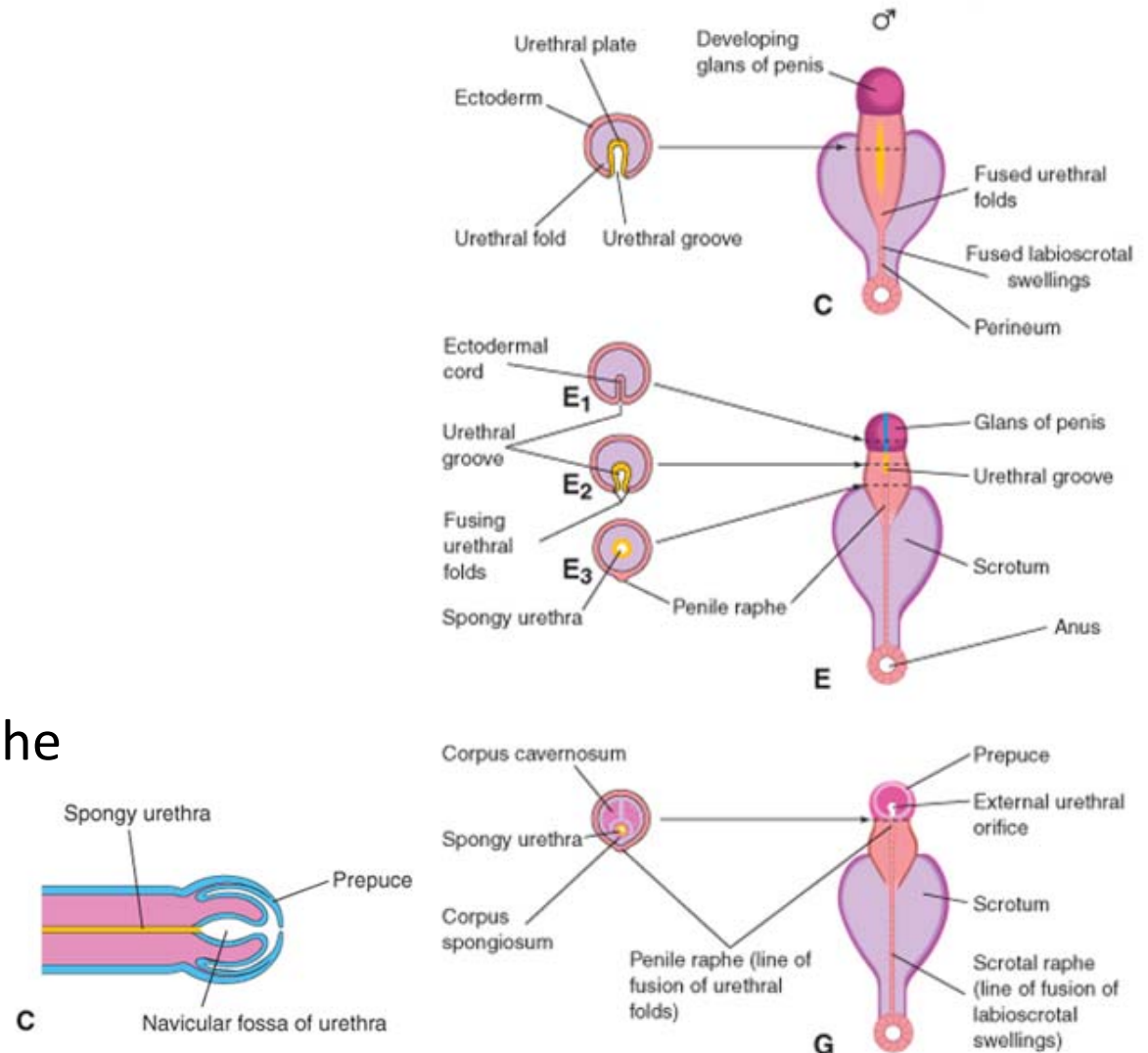
Development of External Genitalia Indifferent Stage (4th-7th weeks)

- Cloacal membrane separated into **urogenital membrane** (anteriorly) and **anal membrane** (posteriorly) by the urorectal septum
- The end of the **urorectal septum** form the **perineal body**
- After a week the membranes rupture and form anus & urogenital orifice



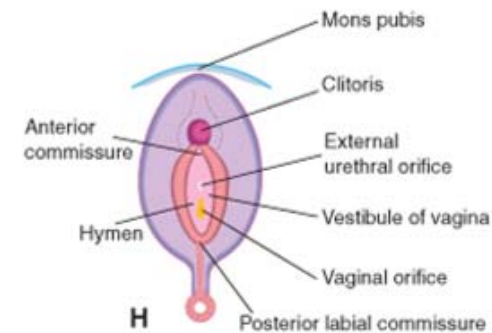
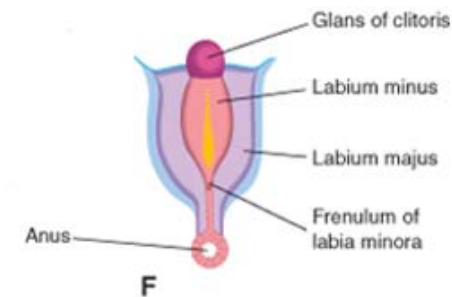
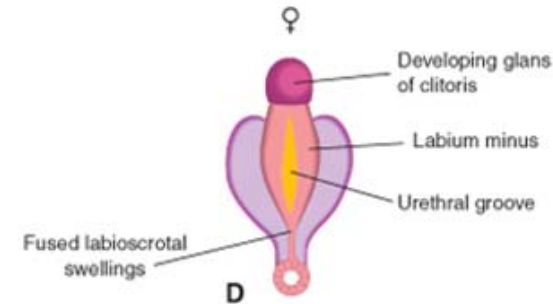
Development of Male External Genitalia

- **Phallus** enlarge to form **penis**
- **Penile corpora** formed by **phallus mesenchyme**
- Urogenital folds fuse & close the urethral groove forming **spongy urethra**
 - Site of fusion – **penile raphe**
- **Prepuce** formed by circular ectodermal ingrowth around the glans
- **Scrotum** formed by the fusion of the labioscrotal folds
 - Site of fusion is the **scrotal raphe**



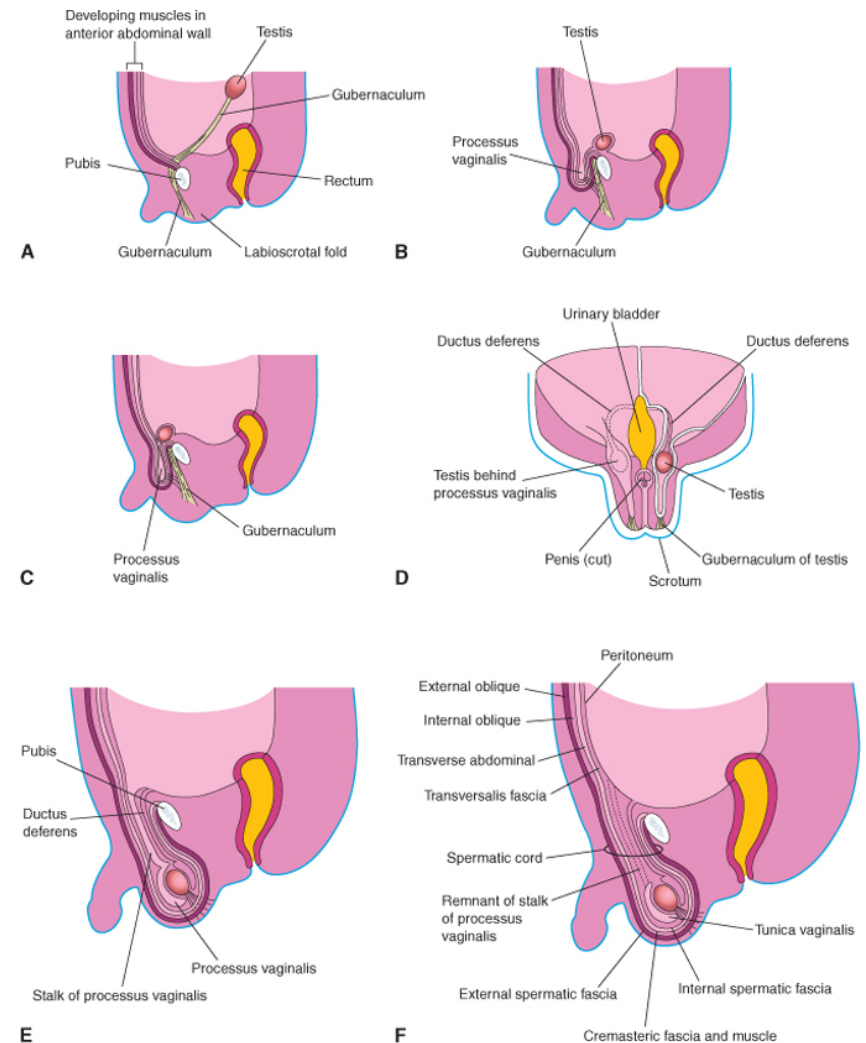
Development of Female External Genitalia

- Phallus become the **clitoris**
- Urogenital folds form the **labia minora**
 - Fuse posteriorly to form **frenulum of the labia minora**
- **Labioscrotal folds** form the labia majora
 - Fuse posteriorly & anteriorly to form **posterior & anterior labial commissures**



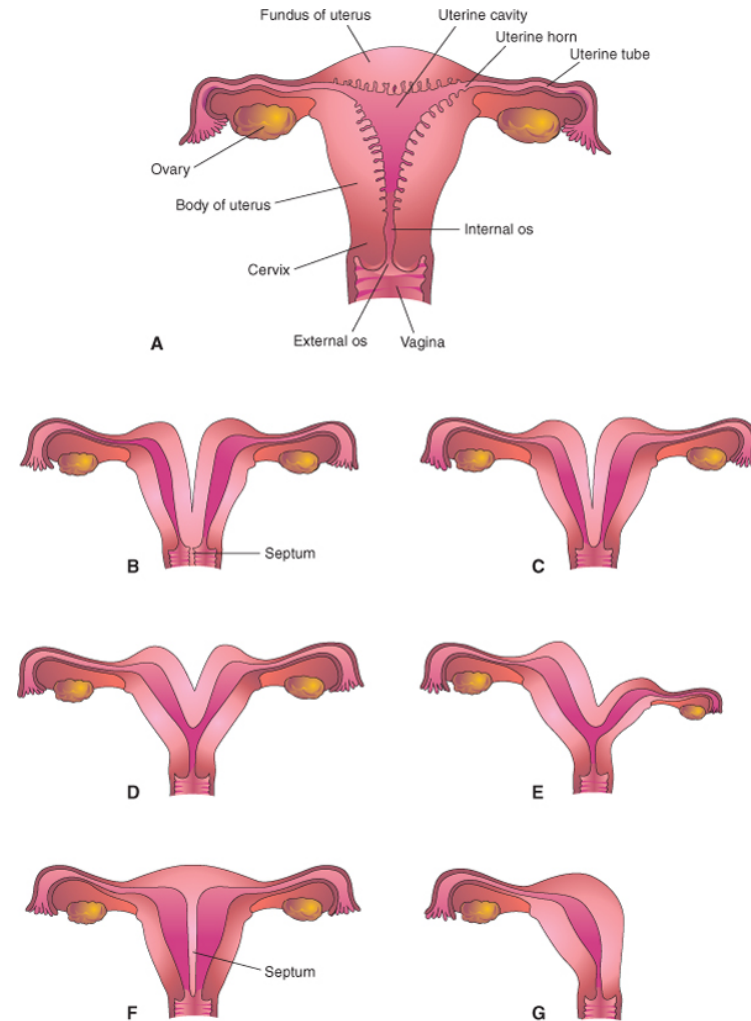
Development of Inguinal Canal

- While mesonephric duct degenerates, a ligament (gubernaculum) appears
- **Gubernaculum** connects the gonads with the labioscrotal swellings through the abdominal wall
- Peritoneal evagination (**processus vaginalis**) follow the gubernaculum taking the layers of the abdominal wall in front of it forming the **inguinal canal**
- **Processus vaginalis** guide the descent of testis through inguinal canal
- Gubernaculum in females
 - Cranially – ovarian ligament
 - Caudally – round ligament



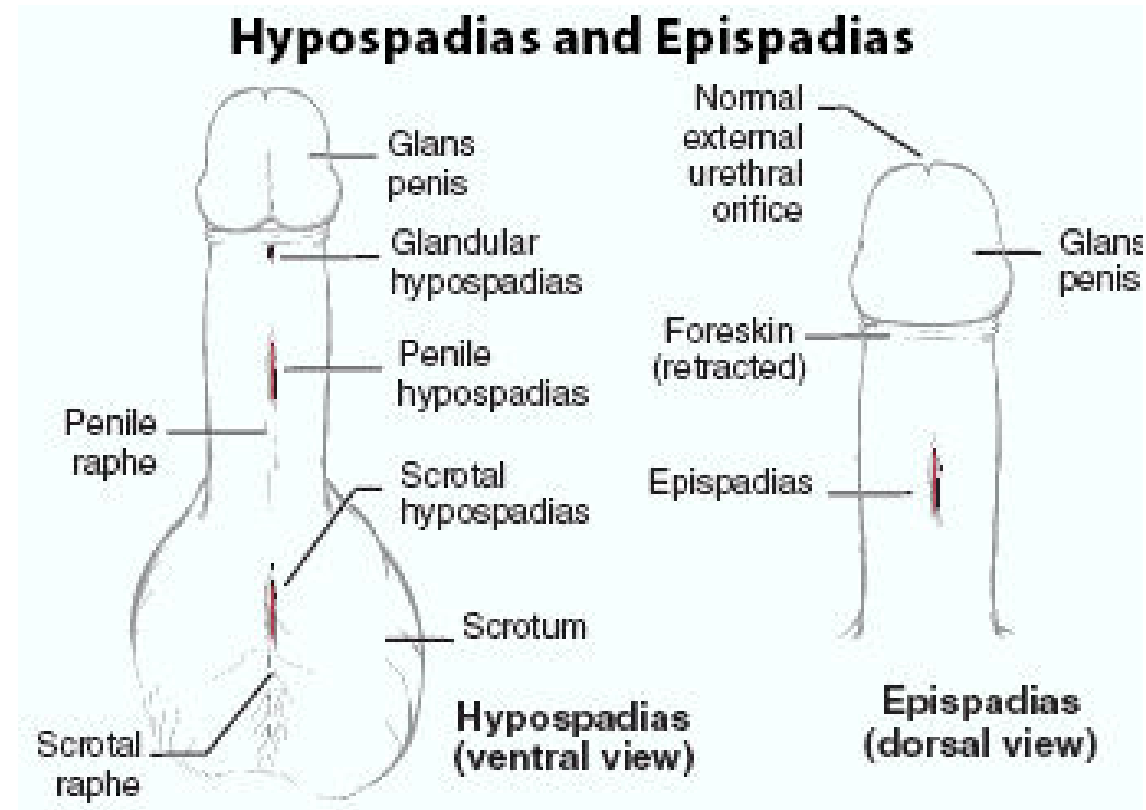
Female Genital Malformation

- Double uterus
 - Failure of fusion of inferior part of paramesonephric ducts
- Bicornuate uterus
 - Failure of fusion in the superior part
- Unicornuate uterus
 - Failure of development of one paramesonephric duct



Male Genital Malformation

- Hypospadias
 - 1/300
 - External urethral orifice in the ventral side of:
 - ❖ Glans (**glandular hypospadias**)
 - Failure of canalization of glandular plate
 - ❖ Body of penis (**penile hypospadias**)
 - Failure of fusion of urogenital folds
- Epispadias
 - Orifice opens dorsally at the root of the penis
 - Dorsal development of genital tubercle



Male Genital Malformation

- Testicular anomalies
 - Cryptorchidism (undescended testes)
 - 3-4% of full term men
 - Found in its path
 - Ectopic testes
 - Deviate from its path
 - Abnormal location of gubernaculum

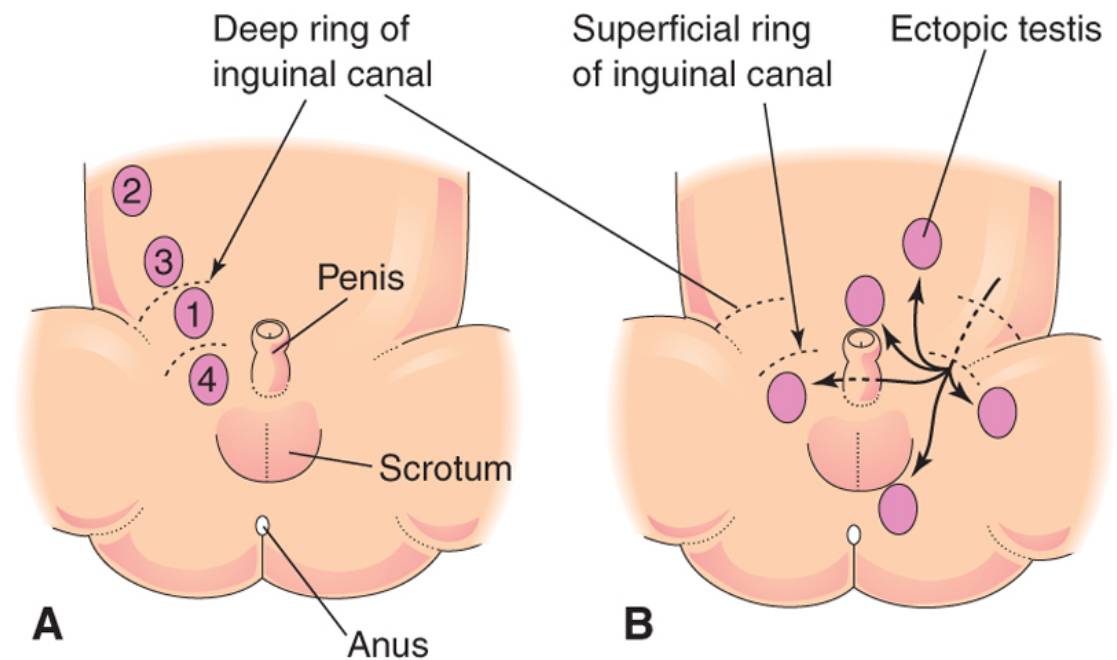


Table 12–1
Derivatives and Vestigial Remnants of Embryonic Urogenital Structures *

MALE	EMBRYONIC STRUCTURE	FEMALE
<i>Testis</i>	Indifferent gonad	<i>Ovary</i>
<i>Seminiferous tubules</i>	Cortex	<i>Ovarian follicles</i>
<i>Rete testis</i>	Medulla	<i>Rete ovarii</i>
<i>Gubernaculum testis</i>	Gubernaculum	<i>Ovarian ligament</i> <i>Round ligament of uterus</i>
<i>Efferent ductules of testis</i>	Mesonephric tubules	Epoophoron
<i>Paradidymis</i>		Paroophoron
<i>Appendix of epididymis</i>	Mesonephric duct	Appendix vesiculosa
<i>Duct of epididymis</i>		Duct of epoophoron
<i>Ductus deferens</i>		Longitudinal duct (Gartner duct)
<i>Ejaculatory duct and seminal gland</i>		
<i>Ureter, pelvis, calices, and collecting tubules</i>	Stalk of ureteric bud	<i>Ureter, pelvis, calices, and collecting tubules</i>
<i>Appendix of testis</i>	Paramesonephric duct	Hydatid (of Morgagni)
		<i>Uterine tube</i>
		<i>Uterus</i>
<i>Urinary bladder</i>	Urogenital sinus	<i>Urinary bladder</i>
<i>Urethra (except navicular fossa)</i>		<i>Urethra</i>
<i>Prostatic utricle</i>		<i>Vagina</i>
<i>Prostate</i>		<i>Urethral and paraurethral glands</i>
<i>Bulbourethral glands</i>		<i>Greater vestibular glands</i>
<i>Seminal colliculus</i>	Sinus tubercle	Hymen
<i>Penis</i>	Primordial phallus	<i>Clitoris</i>
<i>Glans penis</i>		<i>Glans clitoris</i>
<i>Corpora cavernosa of penis</i>		<i>Corpora cavernosa of clitoris</i>
<i>Corpus spongiosum of penis</i>		<i>Bulb of vestibule</i>
<i>Ventral aspect of penis</i>	Urogenital folds	<i>Labia minora</i>
<i>Scrotum</i>	Labioscrotal swellings	<i>Labia majora</i>

* Functional derivatives are in italics.