

EMBRYOLOGY

MALE REPRODUCTIVE SYSTEM

REPRODUCTIVE MODULE

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THE INDIFFERENT EMBRYO

- The genotype of the embryo (46, XX or 46, XY) is established at fertilization.
- **B. During weeks 1–6**, the embryo remains in a sexually indifferent or undifferentiated stage. This means that genetically female embryos and genetically male embryos are phenotypically indistinguishable.
- **C. During week 7**, the indifferent embryo begins phenotypic sexual differentiation.
- **D. By week 12**, female or male characteristics of the external genitalia can be recognized.
- **E. By week 20**, phenotypic differentiation is complete.

Phenotypic sexual differentiation

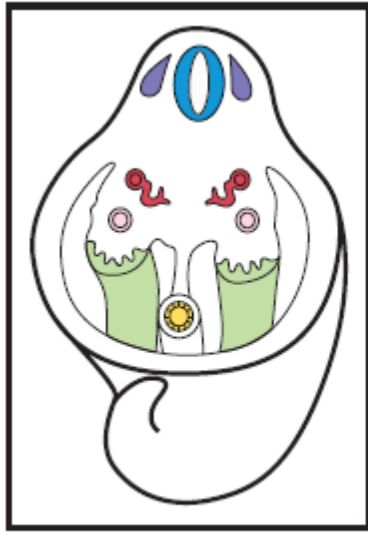
- a. Phenotypic sexual differentiation is determined by the *SRY* gene and may result in individuals with a **female phenotype**, an **intersex phenotype**, or a **male phenotype**.
- b. The *SRY* gene on chromosome Yp11.3 encodes for a **sex-determining region Y protein** (also called **testes-determining factor [TDF]**).
- c. As the indifferent gonad develops into the testes, **Leydig cells** differentiate to produce **testosterone** and **Sertoli cells** differentiate to produce **Müllerian-inhibiting factor (MIF)**.
- d. **In the presence of TDF, testosterone, and MIF**, the indifferent embryo will be directed to the male phenotype.
- e. **In the absence of TDF, testosterone, and MIF**, the indifferent embryo will be directed to the female phenotype.

DEVELOPMENT OF THE GONADS

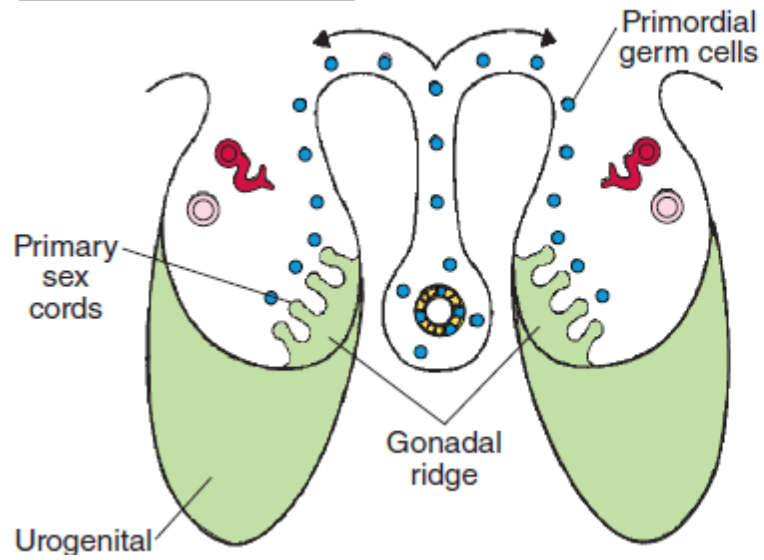
THE TESTES

- **1.** The **intermediate mesoderm** forms a longitudinal elevation along the dorsal body wall, the **urogenital ridge**.
- **2.** The coelomic epithelium and underlying mesoderm of the urogenital ridge proliferate to form the **gonadal ridge**.
- **3. Primary sex cords** develop from the gonadal ridge and incorporate primordial germ cells (XY genotype), which migrate into the gonad from the wall of the yolk sac. The primordial germ cells originate from the **epiblast** in week 2 of development and then migrate into the endoderm and mesoderm layers of the yolk sac.

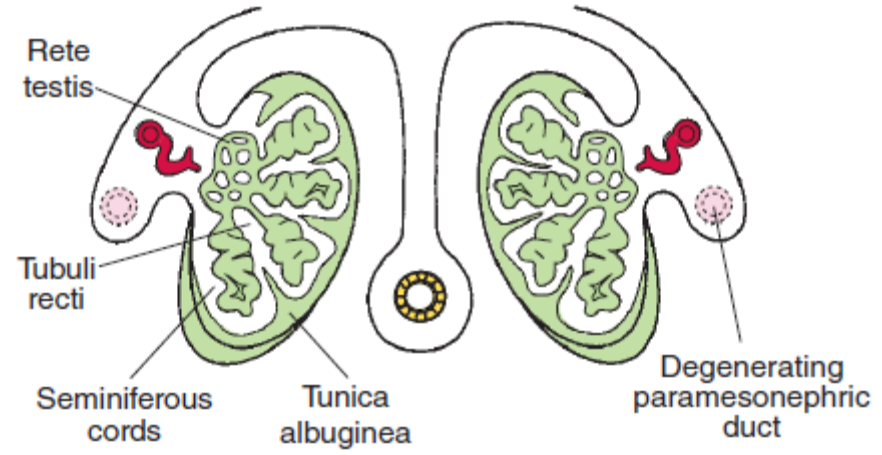
- **4.** The Y chromosome carries a gene on its short arm that codes for **TDF**, which is crucial to testes differentiation.
- **5.** The primary sex cords extend into the medulla of the gonad and lose their connection with the surface epithelium as the thick **tunica albuginea** forms.
- **6.** The primary sex cords form the **seminiferous cords, tubuli recti, and rete testes.**
- **7.** Seminiferous cords consist of **primordial germ cells** and **sustentacular (Sertoli) cells**, which secrete **Müllerian-inhibiting factor (MIF)**.
- **8.** The mesoderm between the seminiferous cords gives rise to the **interstitial (Leydig) cells**, which secrete **testosterone**.
- **9.** The primordial germ cells, sustentacular (Sertoli) cells, interstitial (Leydig) cells, and connective tissue stroma of the testes are derived from **mesoderm**.
- **10.** The seminiferous cords remain as solid cords until puberty, when they acquire a lumen and are then called **seminiferous tubules**.



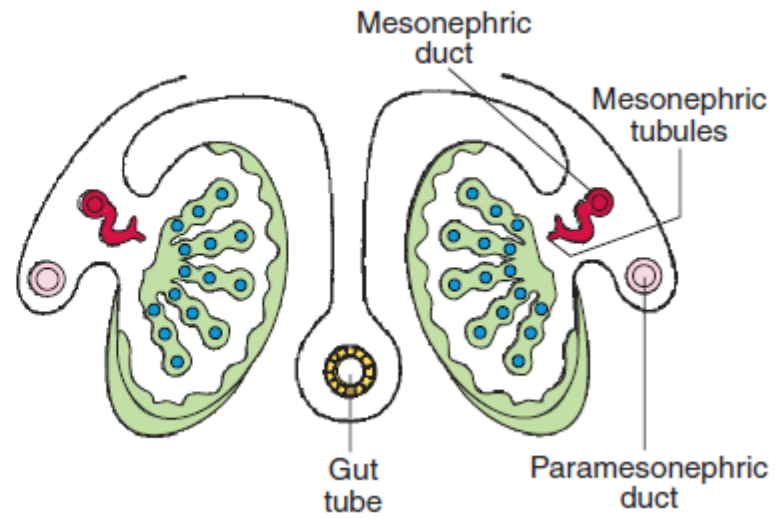
A Indifferent embryo

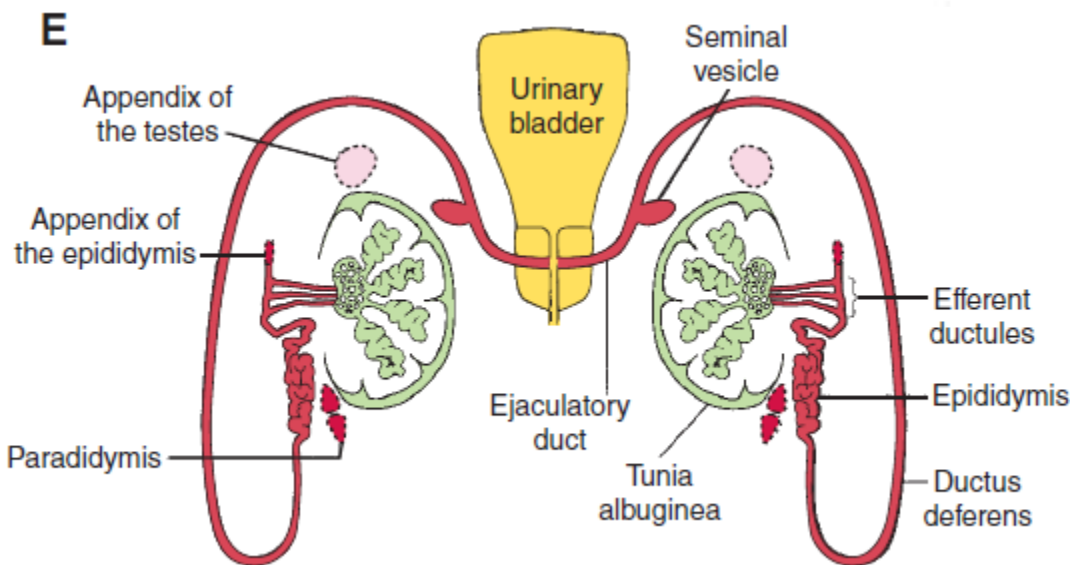
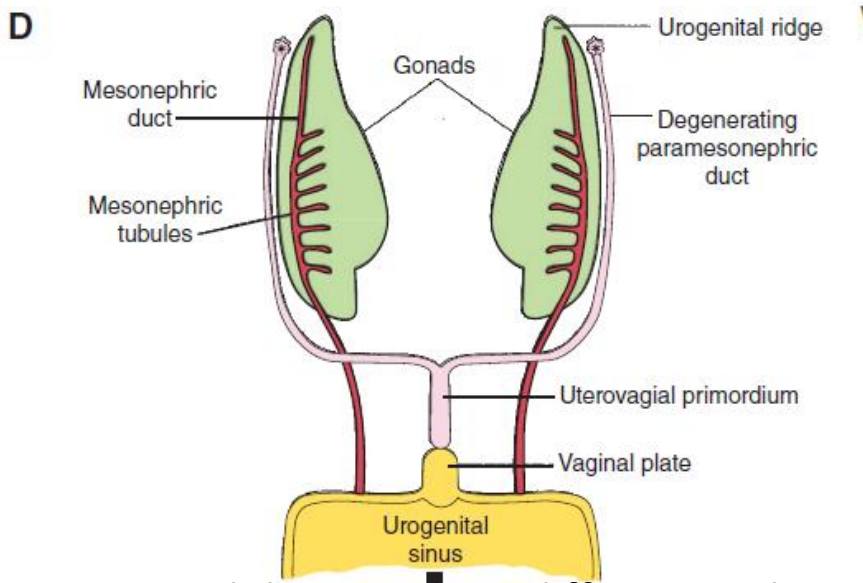
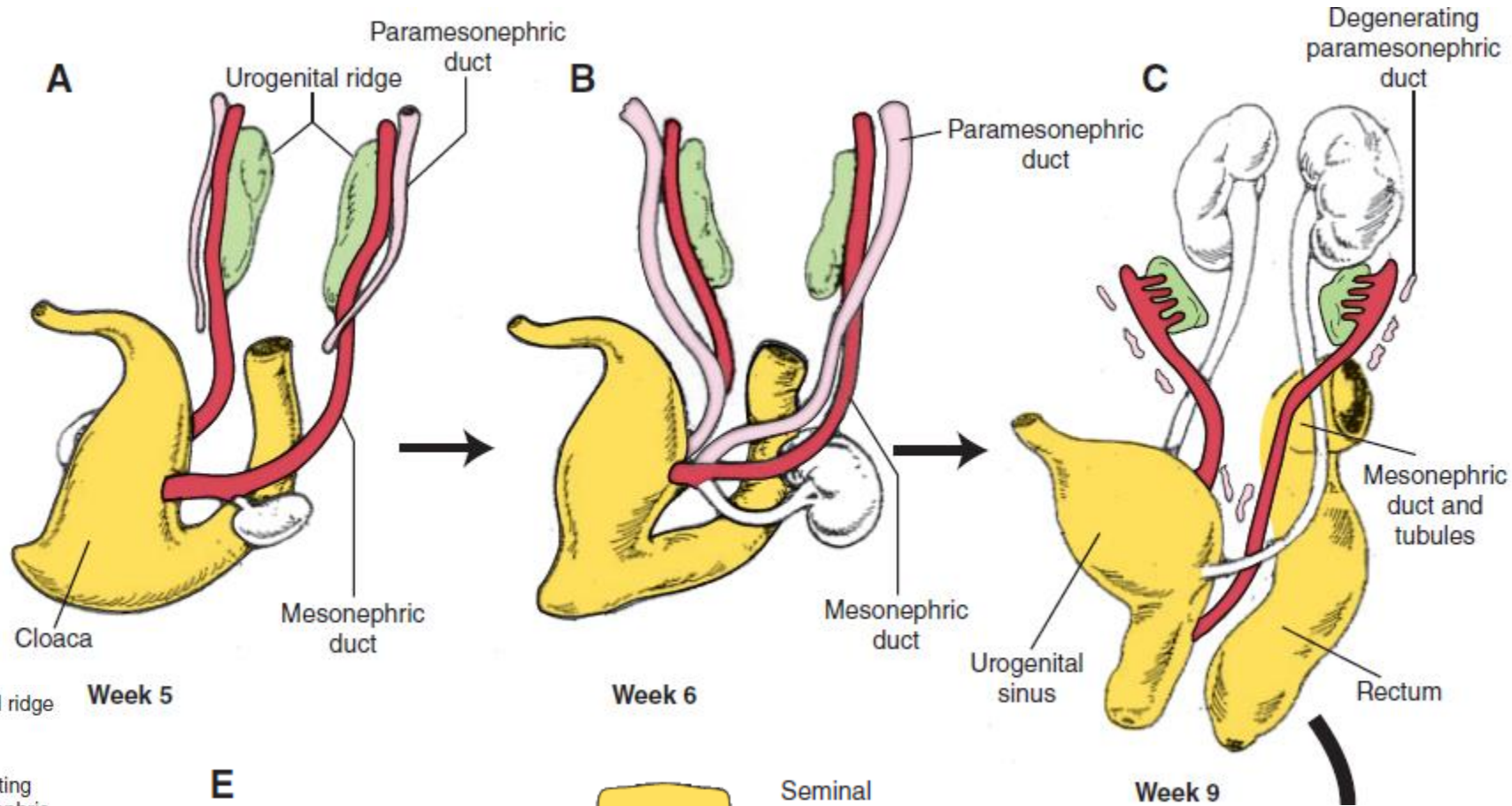


C Week 20



B Week 7





Male genital ducts at birth

Relative descent of the testes

- **1.** The testes originally develop within the abdomen but later undergo a relative descent into the scrotum as a result of disproportionate growth of the upper abdominal region away from the pelvic region.
- **2.** Other factors involved in this movement are uncertain but probably include the **gubernaculum**, which is a band of fibrous tissue along the posterior wall that extends from the caudal pole of the testes to the scrotum. Remnants of the gubernaculum in the adult male serve to anchor the testes within the scrotum.
- The peritoneum evaginates alongside the gubernaculum to form the **processus vaginalis**.
- Later in development, most of the processus vaginalis is obliterated except at its distal end, which remains as a peritoneal sac called the **tunica vaginalis of the testes**.

DEVELOPMENT OF THE GENITAL DUCTS

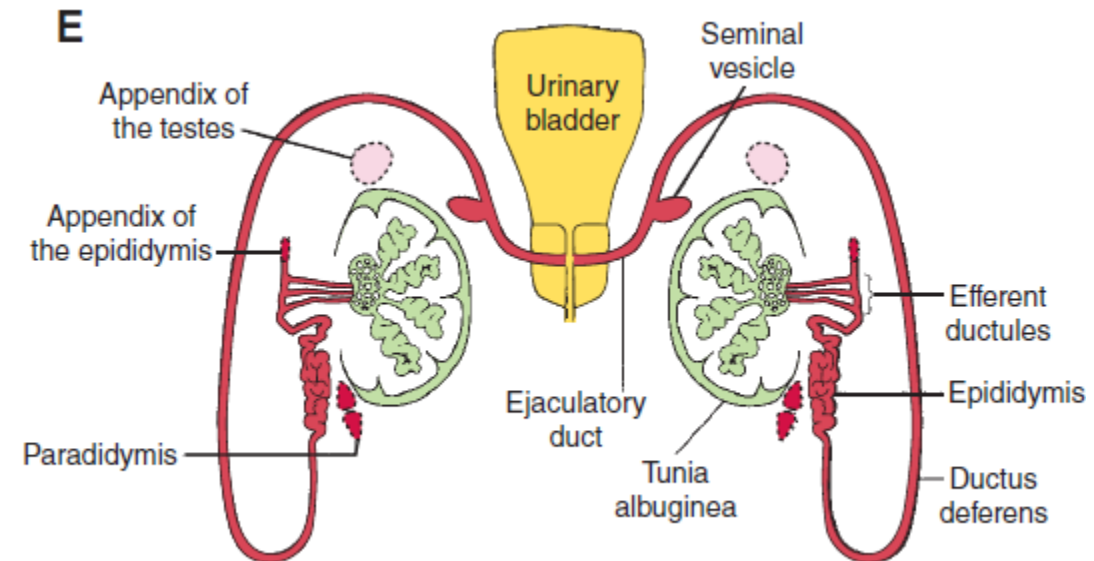
- **A. Paramesonephric (Müllerian) ducts:**
- The paramesonephric ducts develop as **mesodermal** invaginations of the lateral surface of the urogenital ridge. The cranial portions run parallel to the mesonephric ducts. The caudal portions fuse in the midline to form the **uterovaginal primordium**.
- Under the influence of MIF, the cranial portions of the paramesonephric ducts and the uterovaginal primordium regress.

B. Mesonephric (Wolffian) ducts and tubules

- The mesonephric ducts and tubules develop in the male as part of the urinary system because these ducts are critical in the formation of the definitive metanephric kidney.
- The mesonephric ducts then proceed to additionally form the **epididymis, ductus deferens, seminal vesicle, and ejaculatory duct.**
- A few mesonephric tubules in the region of the testes form the **efferent ductules** of the testes.

Vestigial remnants

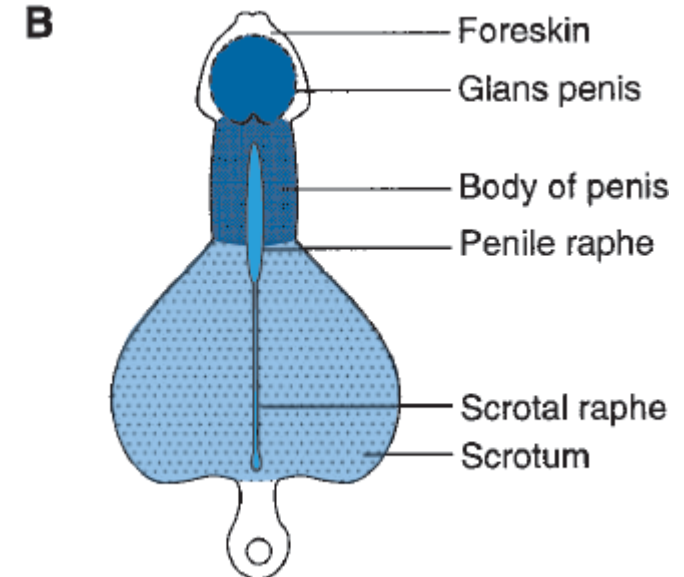
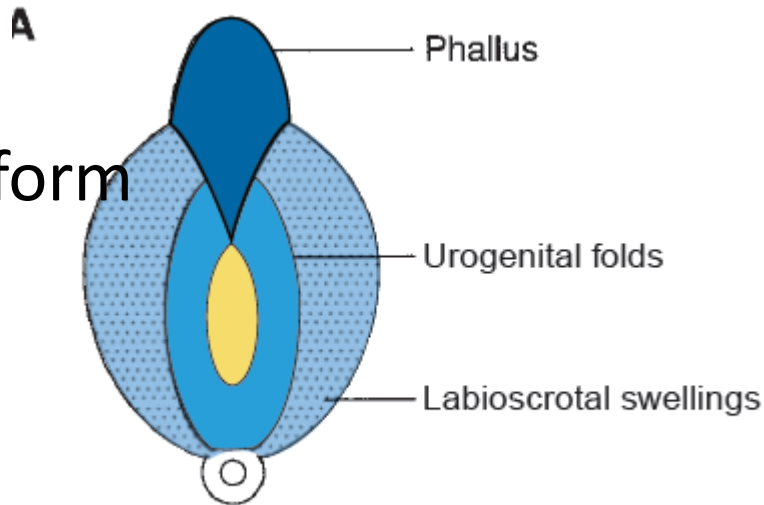
- 1. Vestigial remnants of the paramesonephric duct (called the **appendix testis**) may be found in the adult male.
- 2. Vestigial remnants of the mesonephric duct (called the **appendix epididymis**) may be found in
- the adult male.
- 3. Vestigial remnants of mesonephric tubules (called the **paradidymis**) may be found in the adult male.



DEVELOPMENT OF THE PRIMORDIA OF THE EXTERNAL GENITALIA

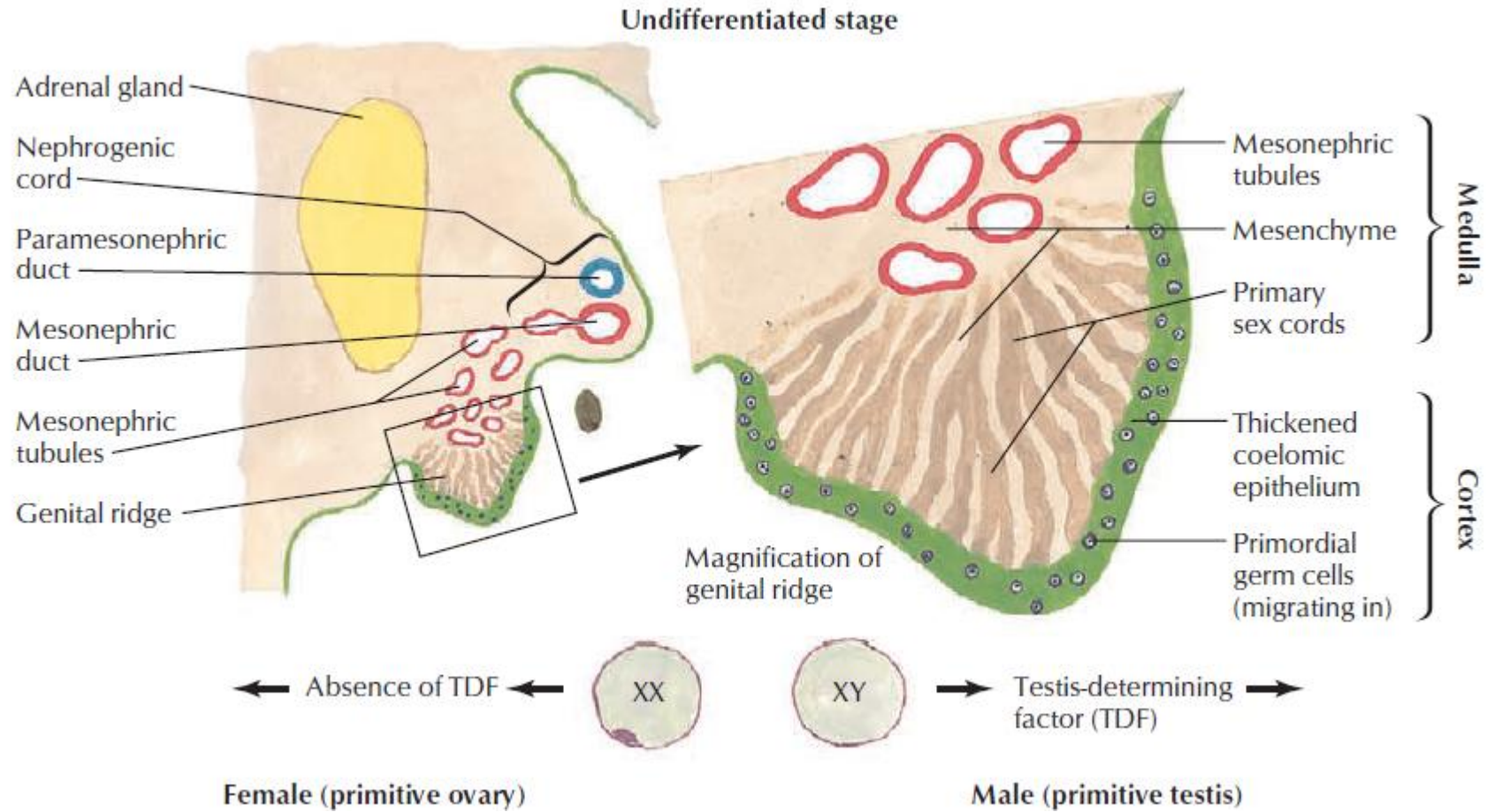
- **A.** A proliferation of **mesoderm** around the cloacal membrane causes the overlying **ectoderm** to rise up so that three structures are visible externally: the **phallus**, **urogenital folds**, and **labioscrotal swellings**.
- **B.** The phallus forms the **penis (glans penis, corpora cavernosa penis, and corpus spongiosum penis)**.
- **C.** The urogenital folds form the **ventral aspect of the penis (i.e., penile raphe)**.

D. The labioscrotal swellings form the **scrotum**.

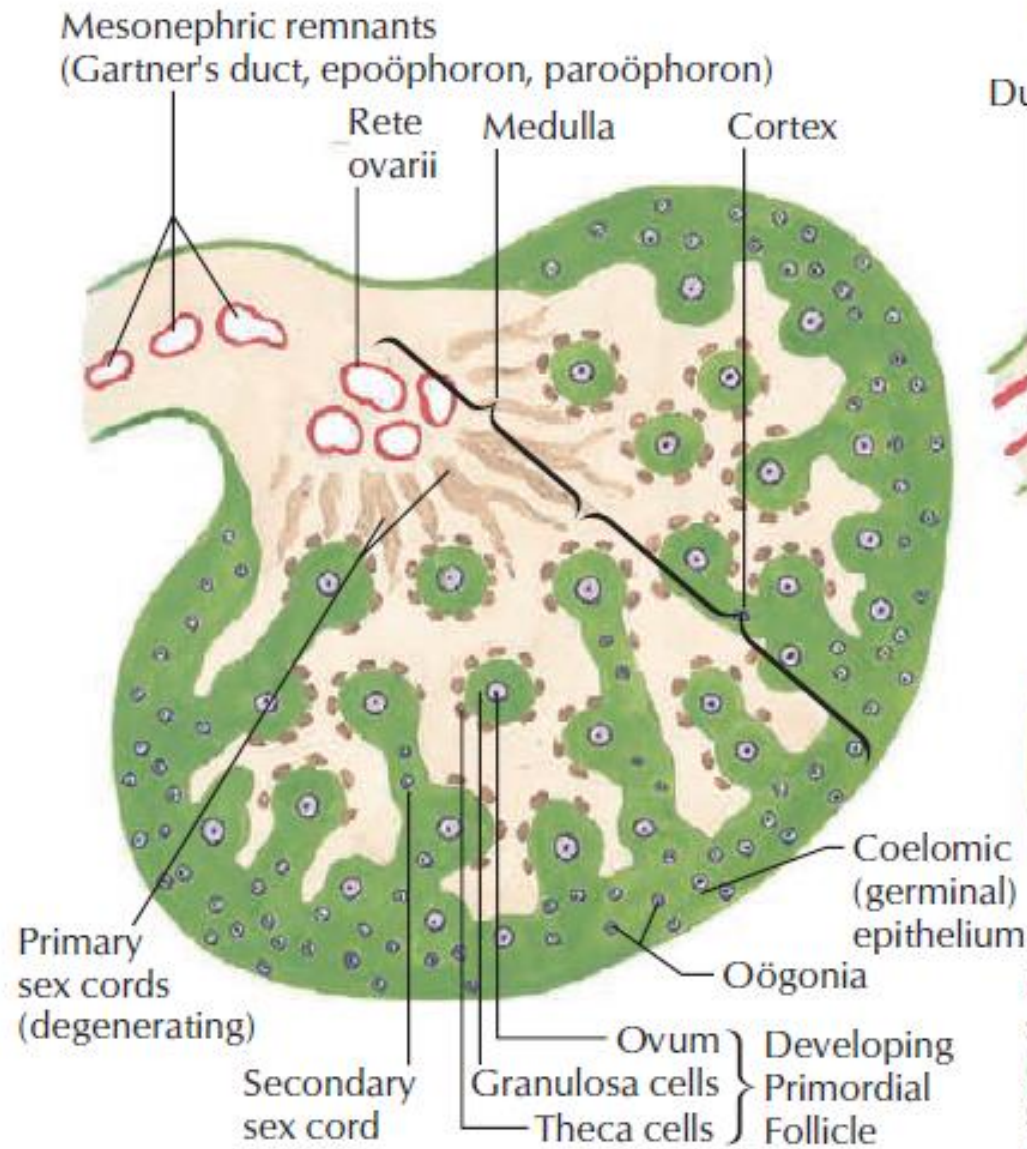


Adult Female	Indifferent Embryo	Adult Male
Ovary, ovarian follicles, rete ovarii	Gonads	Testes, seminiferous tubules, tubuli recti, rete testes, Leydig cells, Sertoli cells
Uterine tubes, uterus, cervix, superior one third of vagina <i>Hydatid of Morgagni</i>	Paramesonephric duct	<i>Appendix testes</i>
<i>Appendix vesiculosa, Gartner duct</i>	Mesonephric duct	Epididymis, ductus deferens, seminal vesicle, ejaculatory duct <i>Appendix epididymis</i>
<i>Epoophoron, paroophoron</i>	Mesonephric tubules	Efferent ductules <i>Paradidymis</i>
Glans clitoridis, corpora cavernosa clitoridis, vestibular bulbs	Phallus	Glans penis, corpora cavernosa penis, corpus spongiosum
Labia minora	Urogenital folds	Ventral aspect of penis
Labia majora, mons pubis	Labioscrotal swellings	Scrotum
Ovarian ligament, round ligament of uterus	Gubernaculum	Gubernaculum testes
	Processus vaginalis	Tunica vaginalis

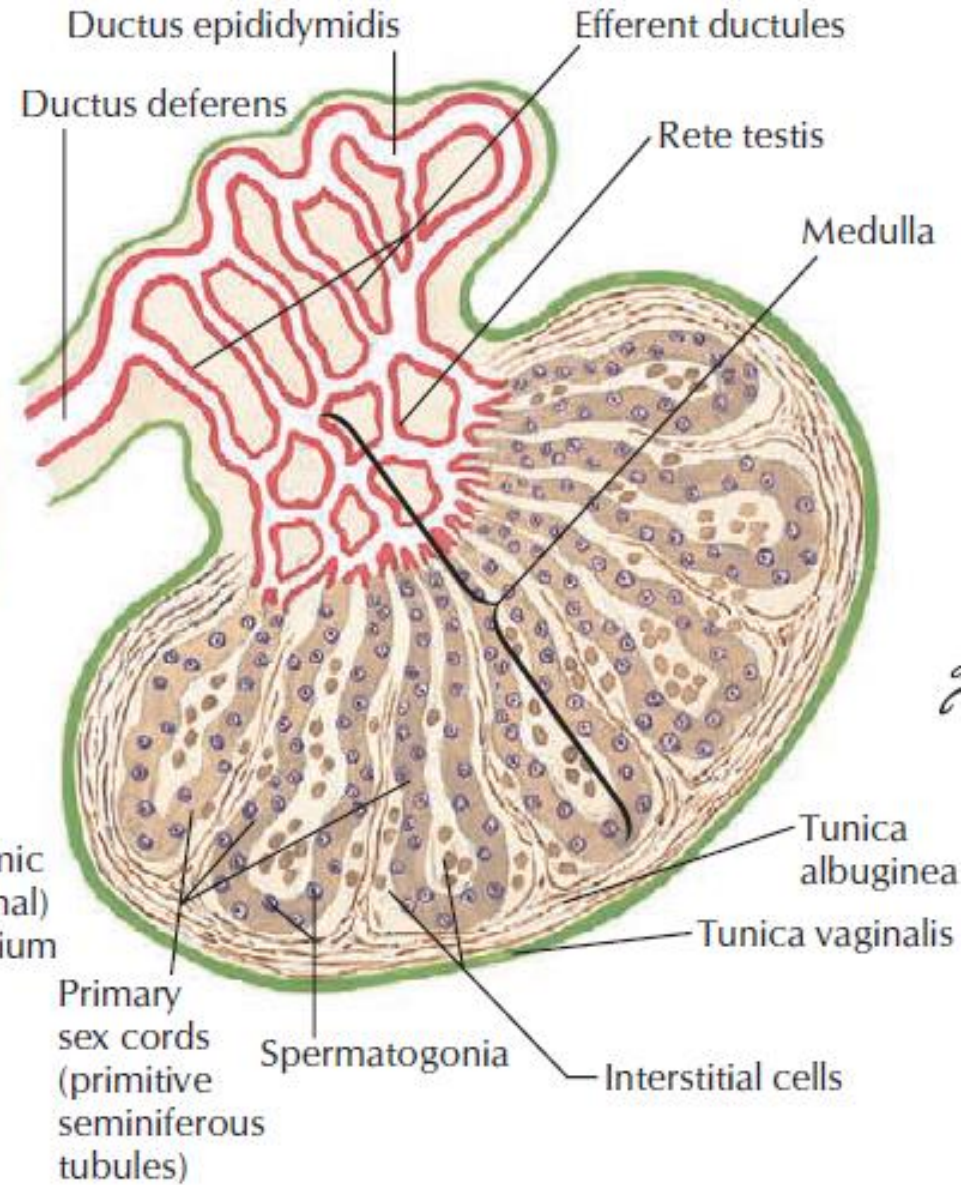
Italics indicate a vestigial structure.

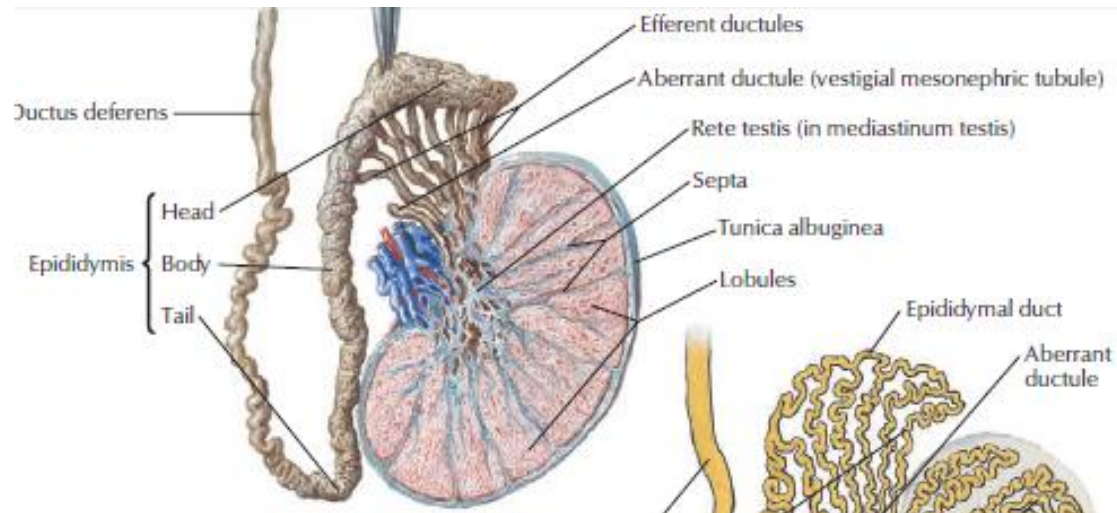


Female (primitive ovary)



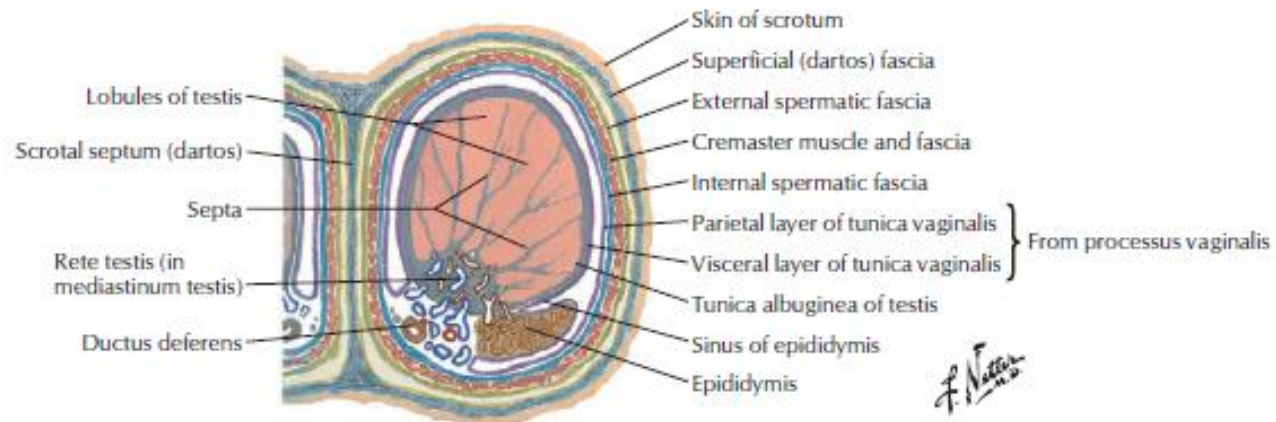
Male (primitive testis)





Frontal section

Schema



Cross section through scrotum and testis