

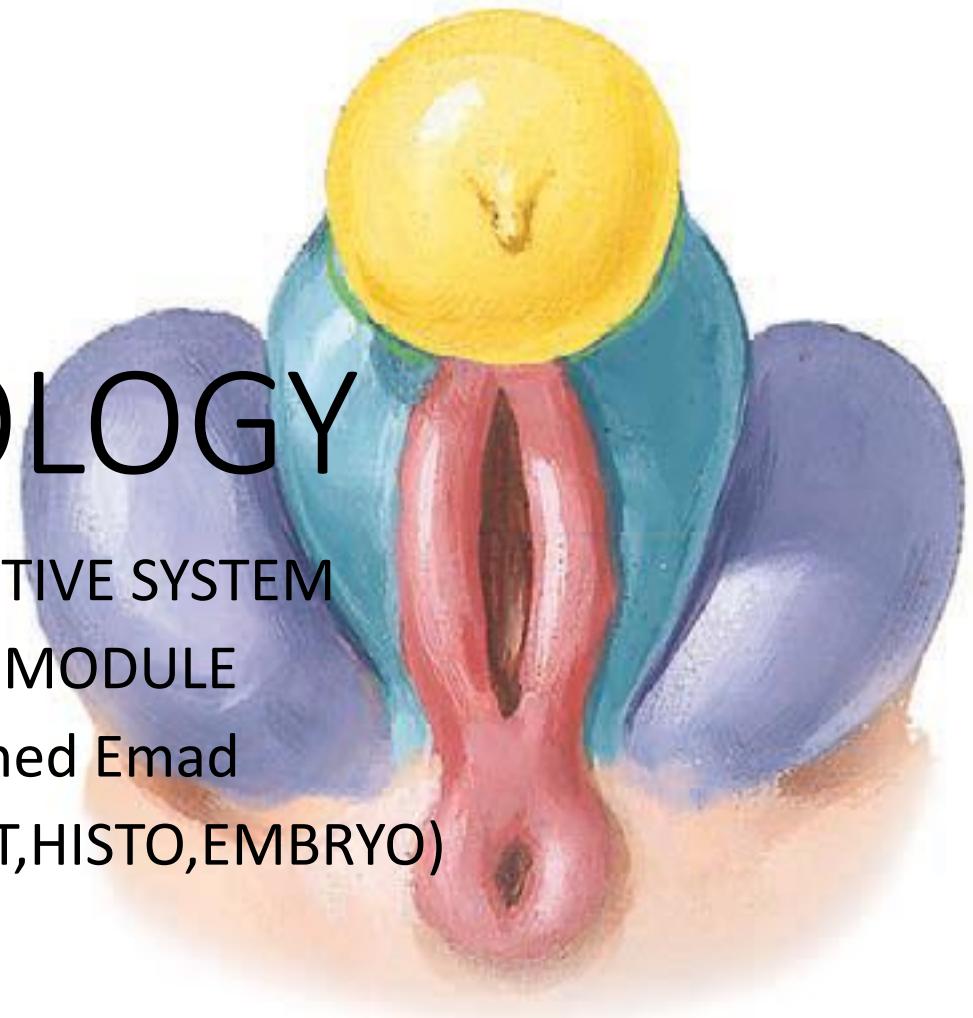
# EMBRYOLOGY

FEMALE REPRODUCTIVE SYSTEM

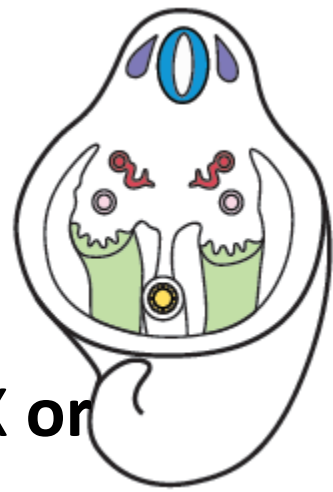
REPRODUCTIVE MODULE

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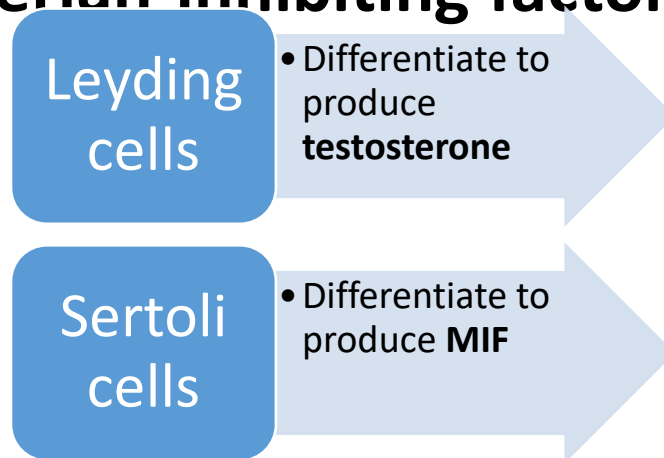
# I- THE INDIFFERENT EMBRYO



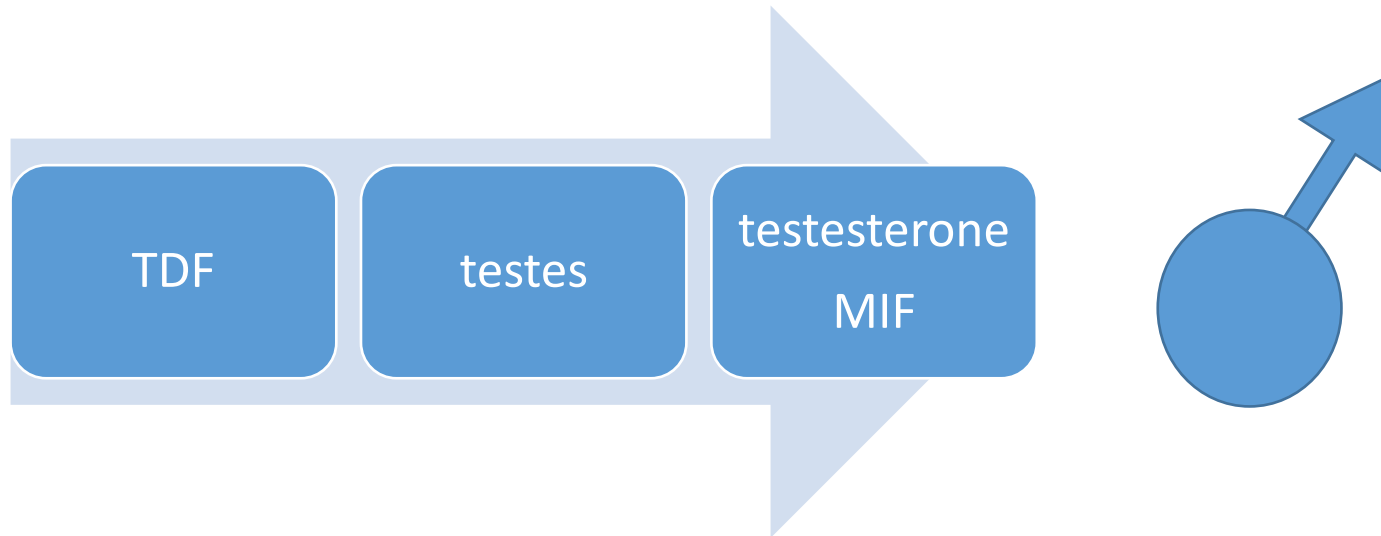
- At **fertilization**, the genotype of the embryo is established (46, XX or 46, XY)
- **During weeks 1–6**, the embryo remains in a sexually indifferent or undifferentiated stage. (This means= genetically female embryos and genetically male embryos are phenotypically indistinguishable.)
- **During week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

# By week 20, phenotypic differentiation is complete.

- And is determined by the *SRY* gene (sex-determining region Y) and may result in individuals with a **female phenotype**, an **intersex phenotype**, or a **male phenotype**.
- The *SRY* gene on chromosome Yp11.3 encodes for a **sex-determining region Y protein** (also called **testes-determining factor [TDF]**)
- As the indifferent gonad develops into the testes, **Leydig cells** differentiate to produce **testosterone** and **Sertoli cells** differentiate to produce **Müllerian-inhibiting factor (MIF)**.

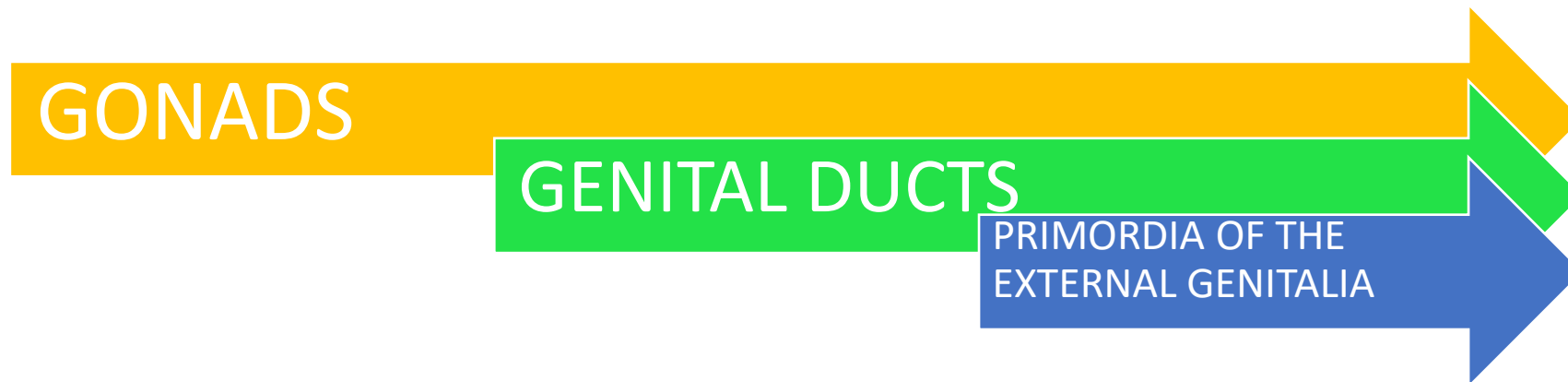


- **In the presence of TDF, testosterone, and MIF**, the indifferent embryo will be directed to the male phenotype.
- **In the absence of TDF, testosterone, and MIF**, the indifferent embryo will be directed to the female phenotype.

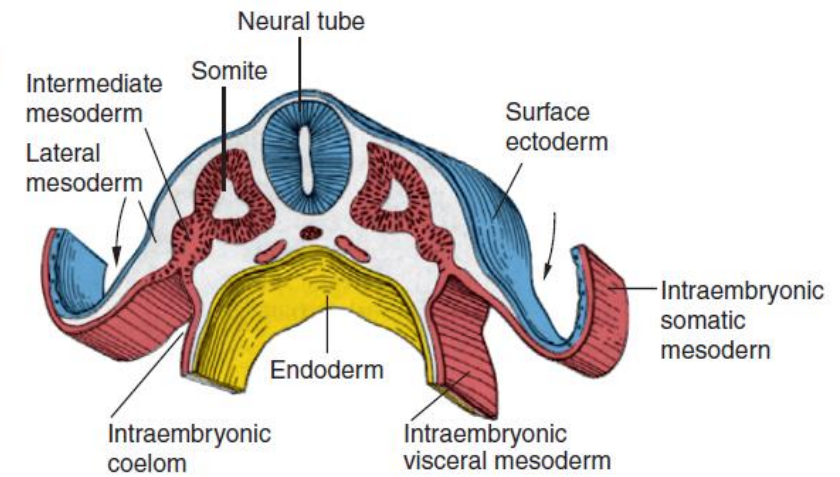


# Components of the indifferent embryo

- **gonads, genital ducts, and primordia of external genitalia.**
- Phenotypic sexual differentiation occurs in a sequence beginning with the gonads, then the genital ducts, and finally the primordia of external genitalia.



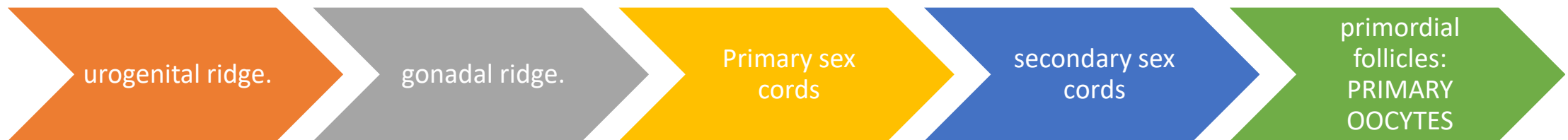
# II- DEVELOPMENT OF THE GONADS<sup>B</sup>



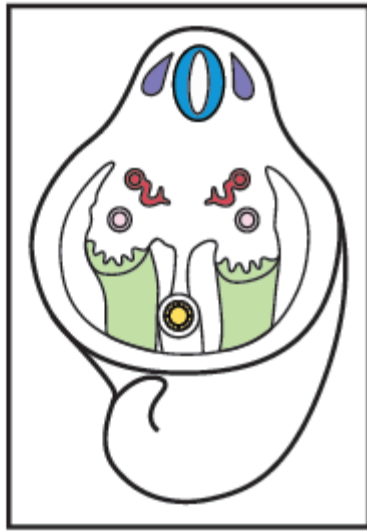
## A- THE OVARY:

- The **intermediate mesoderm** forms a longitudinal elevation along the dorsal body wall, the **urogenital ridge**.
- The coelomic epithelium and underlying mesoderm of the urogenital ridge proliferate to form the **gonadal ridge**.
- **Primary sex cords** develop from the gonadal ridge and incorporate primordial germ cells (XX 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.)

- Primary sex cords extend into the medulla and develop into the **rete ovarii**, which eventually degenerates. Later, **secondary sex cords** develop and incorporate primordial germ cells as a thin **tunica albuginea** forms.
- The secondary sex cords break apart and form isolated cell clusters called **primordial follicles**, which contain **primary oocytes** surrounded by a layer of **simple squamous cells**.
- The primary oocytes are derived from primordial germ cells. Whereas, the simple squamous cells of the primordial follicle and the ovarian connective tissue stroma are derived from **mesoderm**.

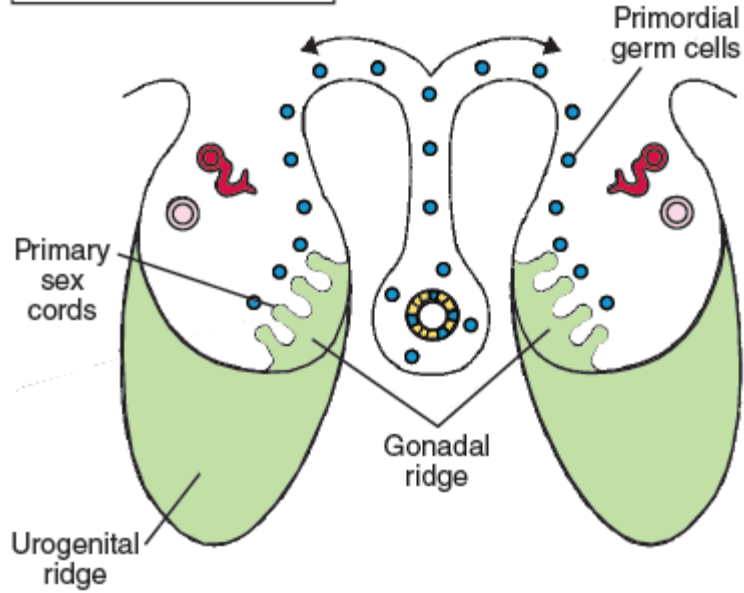






**A Indifferent embryo**

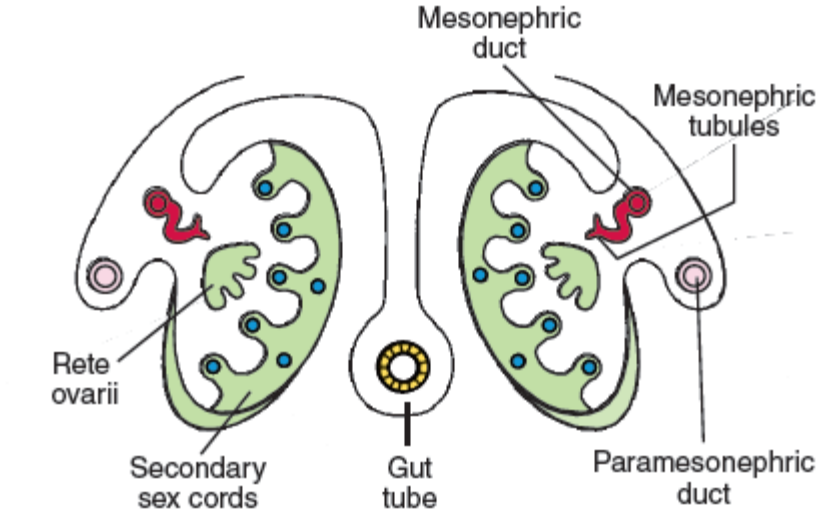
**A Indifferent embryo**



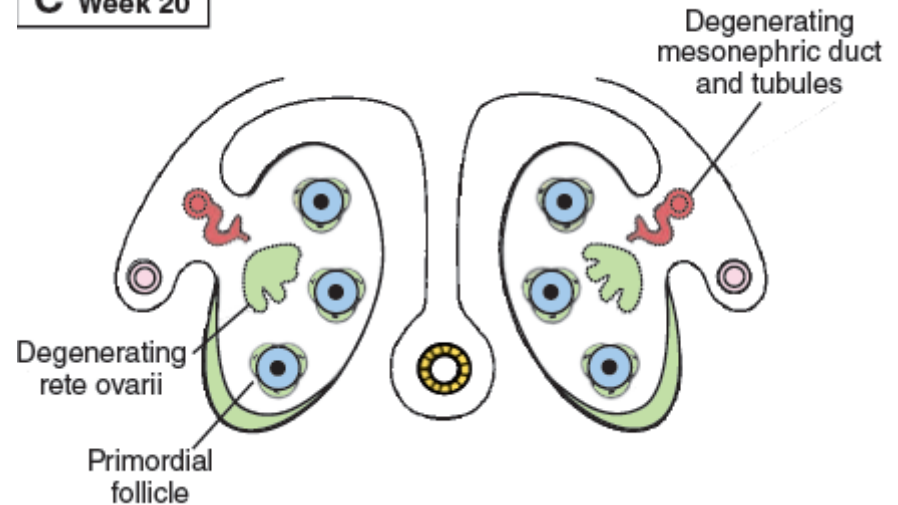
**C Week 20**

Degenerating

**B Week 12**



**C Week 20**





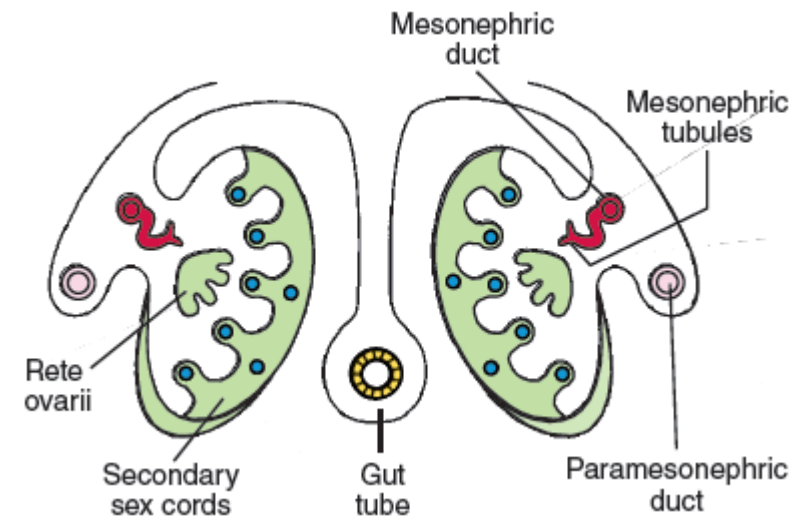
## B- RELATIVE DESCENT OF THE OVARIES

- The ovaries originally develop within the abdomen but later undergo a relative descent into the pelvis as a result of **disproportionate growth of the upper abdominal region away from the pelvic region.**
- Other factors: **gubernaculum:** is a band of fibrous tissue along the posterior wall that extends from the medial pole of the ovary to the uterus at the junction of the uterine tubes, forming the **ovarian ligament.** The gubernaculum then continues into the labia majora, forming the **round ligament of the uterus.** The peritoneum evaginates alongside the gubernaculum to form the **processus vaginalis,** which is obliterated in the female later in development.

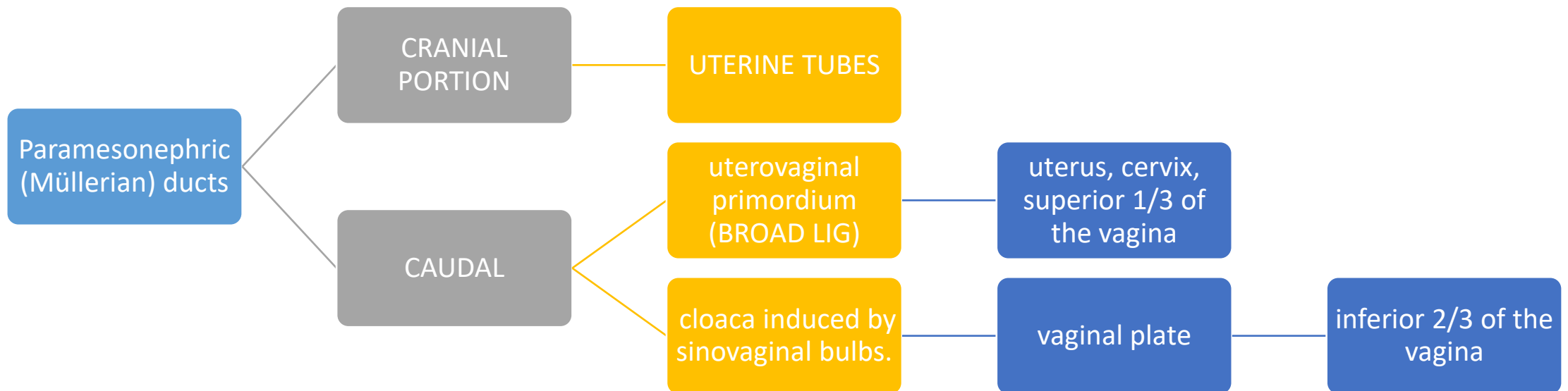
# III- DEVELOPMENT OF THE GENITAL DUCTS

## 1- Paramesonephric (Müllerian) ducts:

- develop as **mesodermal** invaginations of the lateral surface of the urogenital ridge.
- The cranial portions of the paramesonephric ducts develop into the **uterine tubes**.
- The caudal portions fuse in the midline to form the **uterovaginal primordium**, and thereby bring together two peritoneal folds called the **broad ligament**



- The uterovaginal primordium develops into the **uterus, cervix, and superior one third of the vagina.**
- The paramesonephric ducts project into the dorsal wall of the cloaca and induce the formation of the **sinovaginal bulbs.**
- The sinovaginal bulbs fuse to form the solid **vaginal plate**, which canalizes and develops into the **inferior two thirds of the vagina.**
- Although the vagina has a dual origin, BUT the epithelial lining of the entire vagina is of **endodermal** origin.

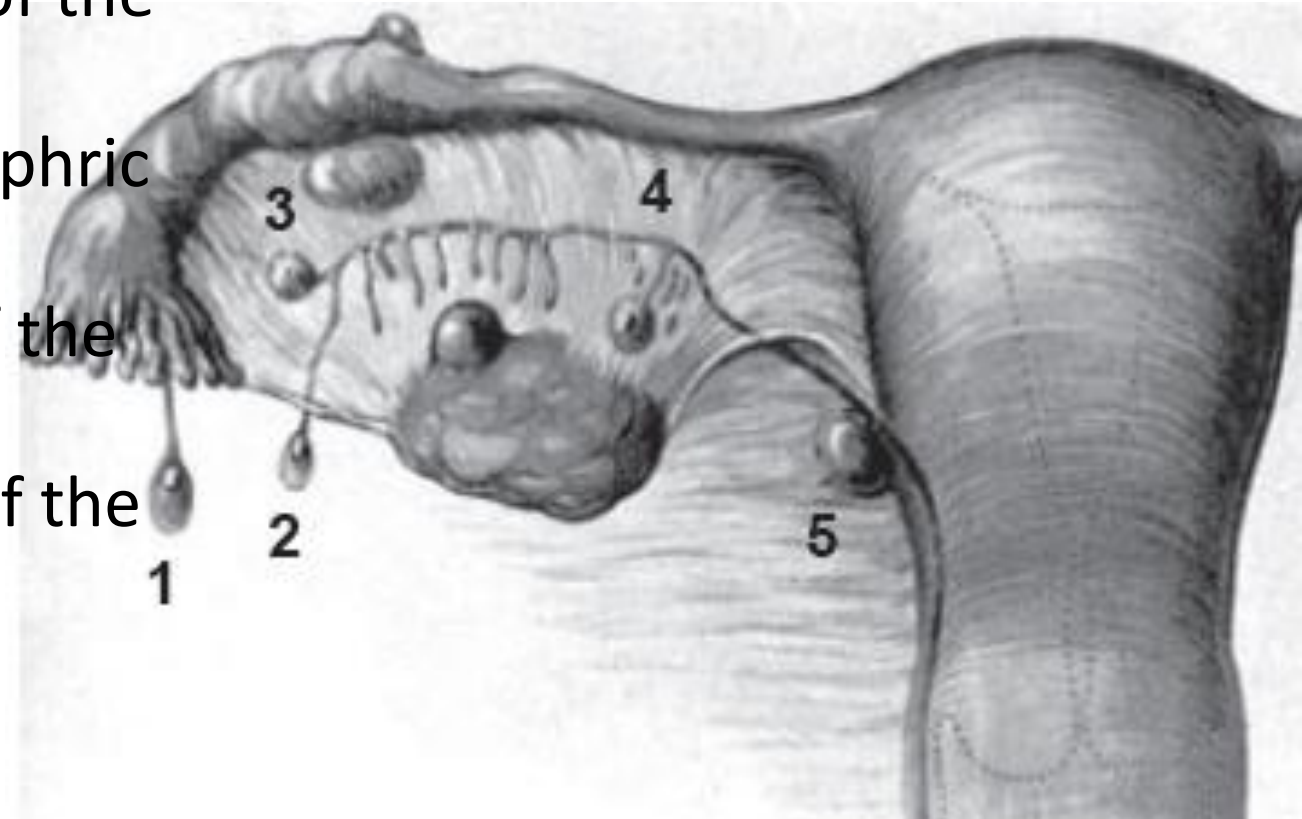


## 2- MESONEPHRIC (WOLFFIAN) DUCTS:

develop in the female as part of the urinary system because these ducts are **critical** in the formation of the definitive metanephric kidney. **However, they degenerate** in the female after formation of the metanephric kidney.

## 3- VESTIGEAL REMNENTS:CYSTS FORMATION:

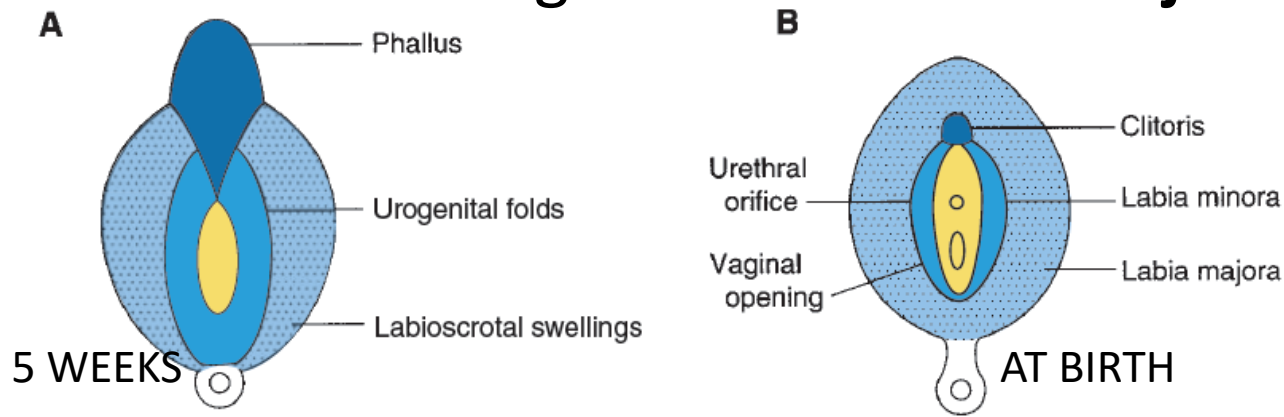
- hydatid cyst of Morgagni (1) (remnant of the paramesonephric duct).
- Kobelt cyst (2) (remnant of the mesonephric duct)
- cyst of the epooophoron (3) (remnant of the mesonephric tubules).
- cyst of the paroophoron (4) (remnant of the mesonephric tubules).
- Gartner duct cyst (5) (remnant of the mesonephric duct).



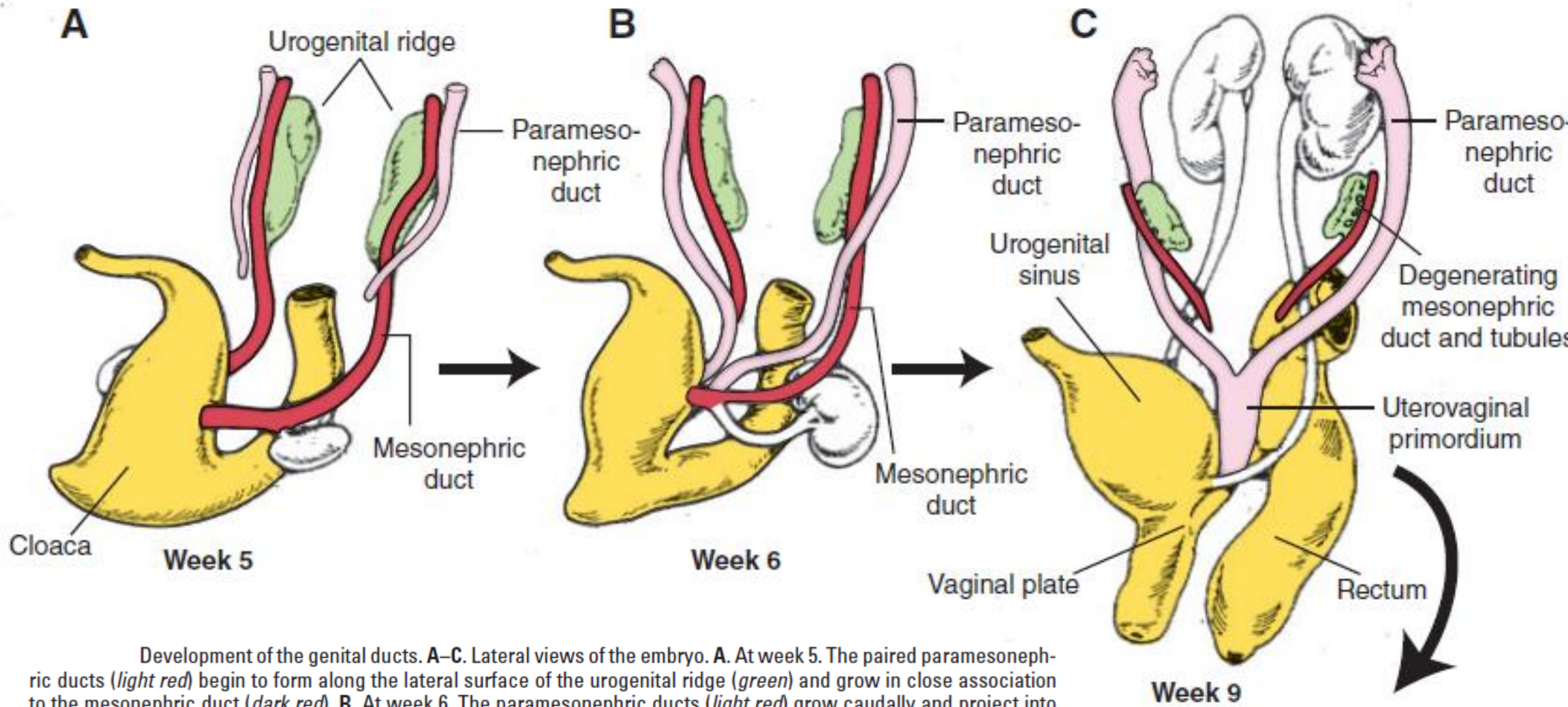
# IV- DEVELOPMENT OF THE PRIMORDIA OF THE EXTERNAL GENITALIA:

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**.

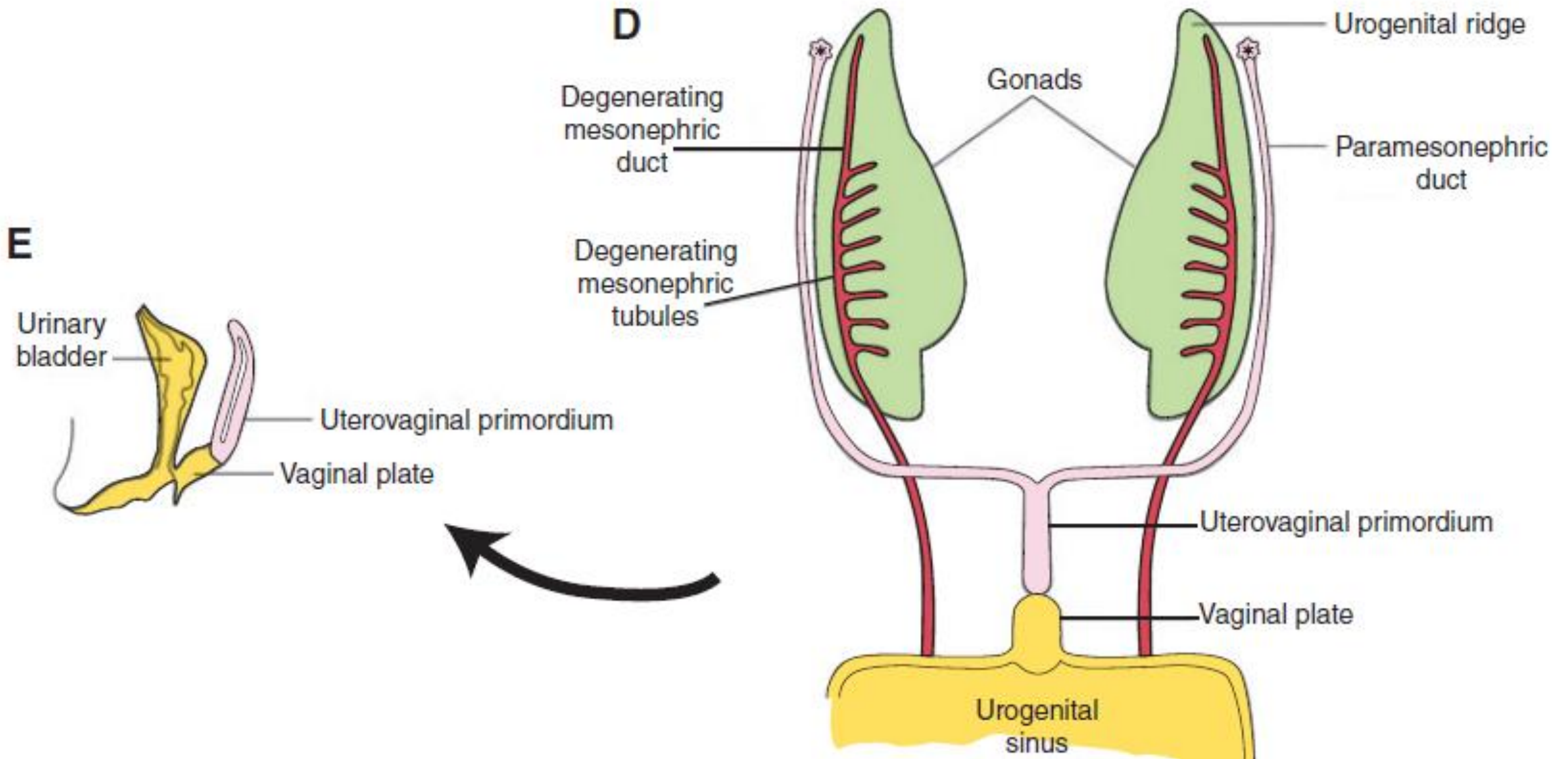
1. The phallus forms the **clitoris (glans clitoris, corpora cavernosa clitoris, and vestibular bulbs)**.
2. The urogenital folds form the **labia minora**.
3. The labioscrotal swellings form the **labia majora** and **mons pubis**.







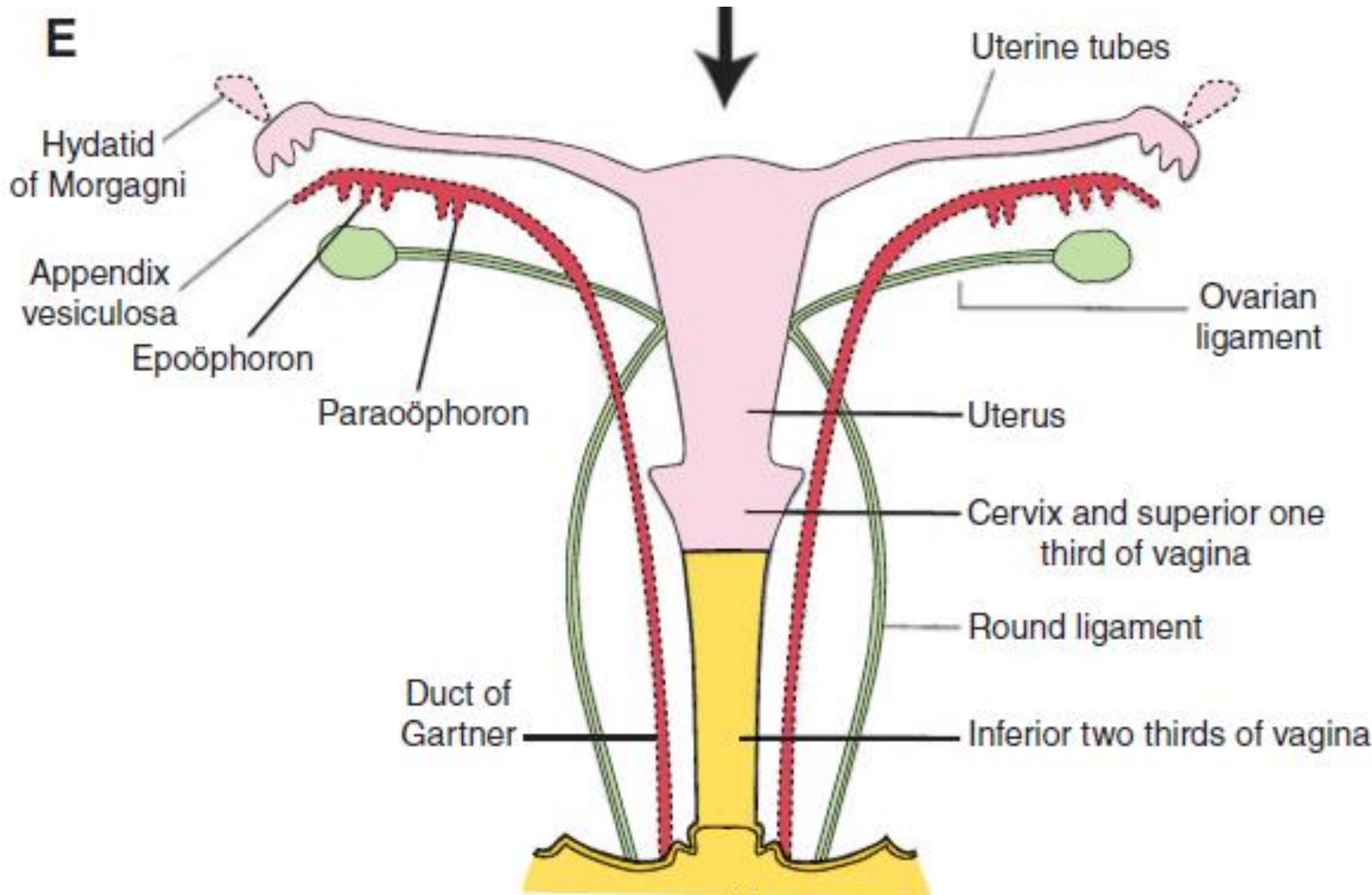
Development of the genital ducts. **A–C.** Lateral views of the embryo. **A.** At week 5. The paired paramesonephric ducts (*light red*) begin to form along the lateral surface of the urogenital ridge (*green*) and grow in close association to the mesonephric duct (*dark red*). **B.** At week 6. The paramesonephric ducts (*light red*) grow caudally and project into the dorsal wall of the cloaca (*yellow*) and induce the formation of the sinovaginal bulbs (not shown). The mesonephric ducts (*dark red*) continue to prosper. **C.** At week 9. The caudal portions of the paramesonephric ducts (*light red*) fuse in the midline to form the uterovaginal primordium (*light red*), and the sinovaginal bulbs fuse to form the vaginal plate (*yellow*) at the urogenital sinus (*yellow*). During this time period, the mesonephric duct (*dark red*) and mesonephric tubules (*dark red*) both degenerate in the female.



**D.** Genital ducts in the indifferent embryo. **E.** Lateral view showing the dual origin of

the vagina.





F. Female components and vestigial remnants (*dotted lines*) at birth.