ANATOMY

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EMBRYOLOGY

EMBRYOLOGY

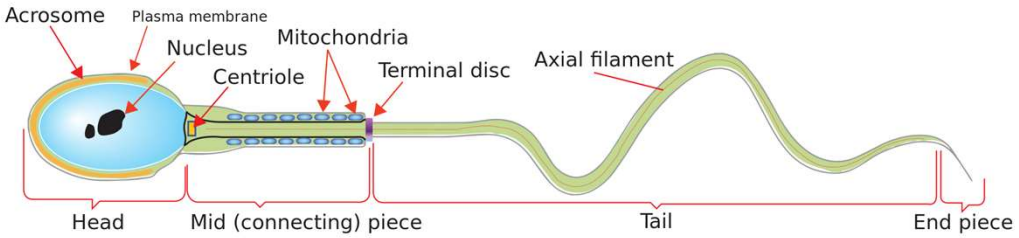
DEVLOPMENT OF URINARY SYSTEM

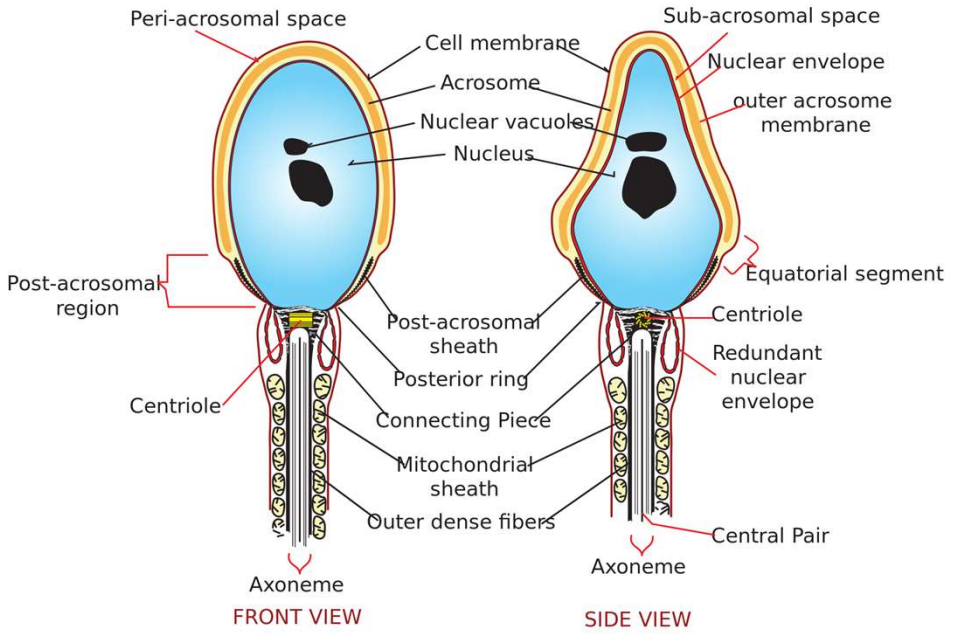
Development of Urinary System

- **Contents**

Development of Urinary System

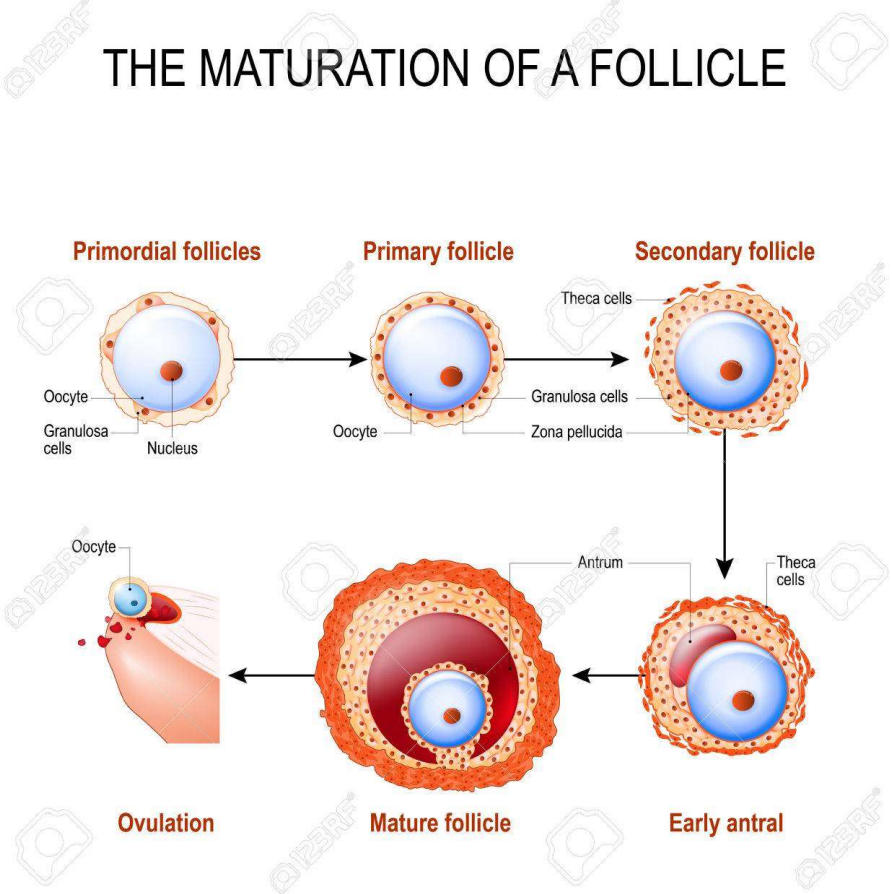
Sperm

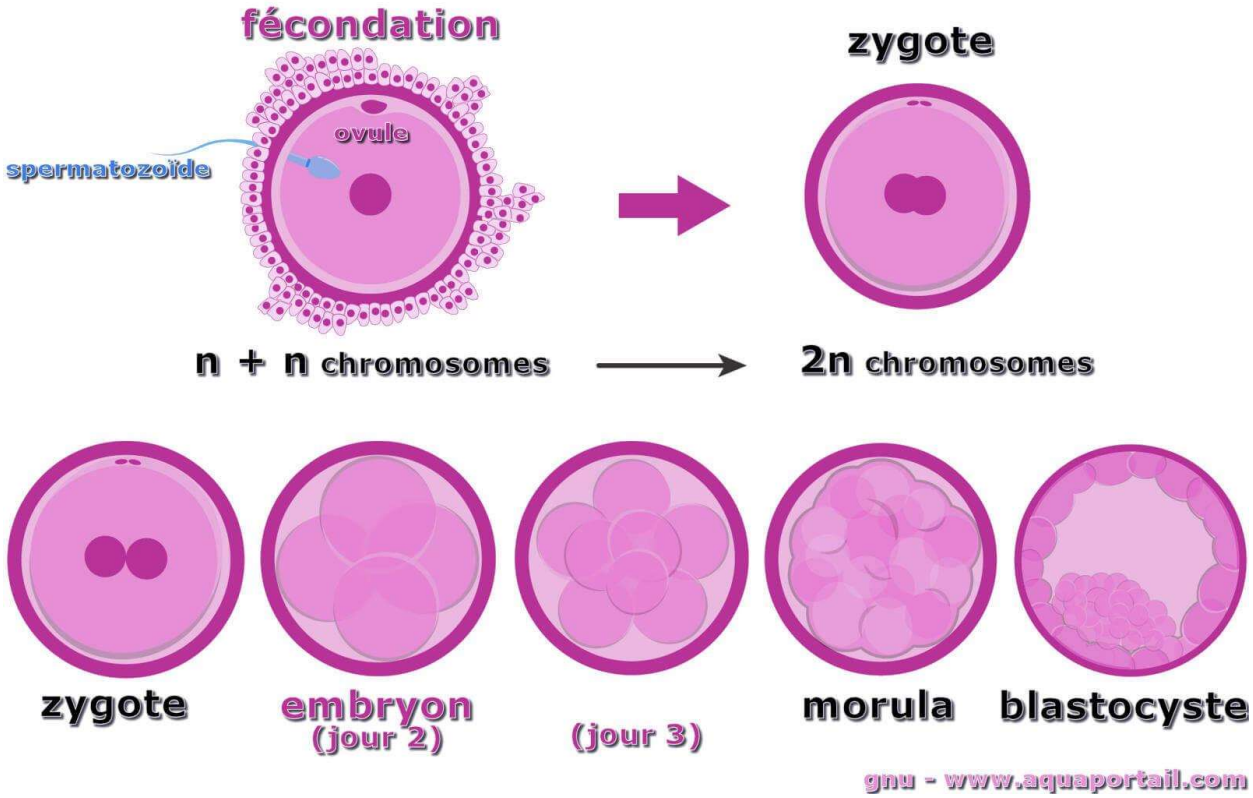




Development of Urinary System

Maturation of Ovum




fécondation
zygote
ovule
spermatozoïde
n + n chromosomes
2n chromosomes
zygote
embryon
(jour 2)
(jour 3)
morula
blastocyste
gnu - www.aquaportail.com

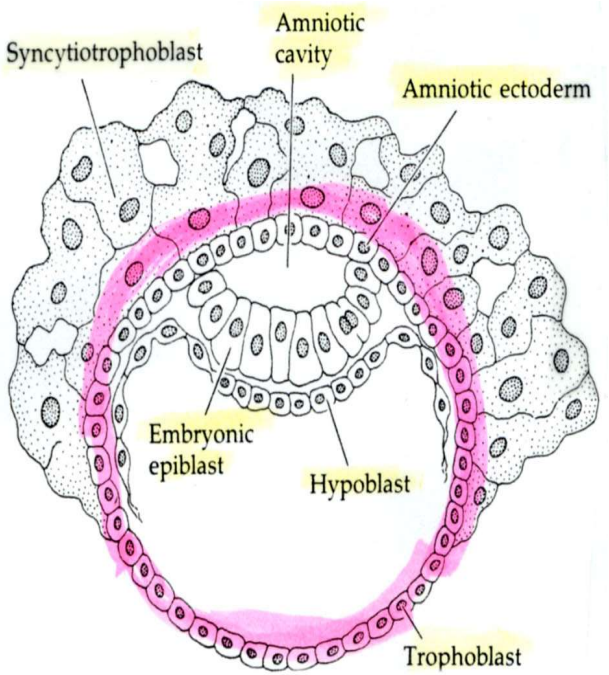
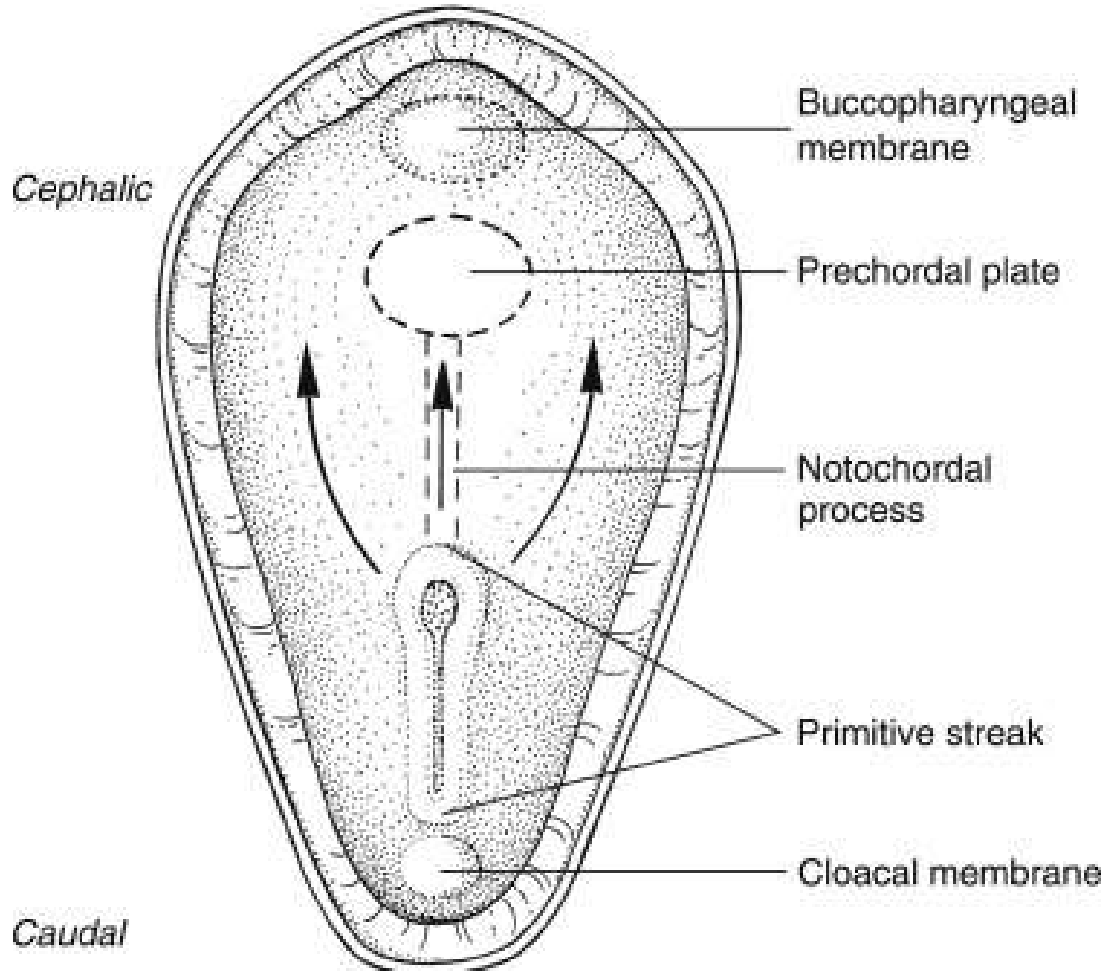


FIGURE 41
Formation of the amnion in human embryos. The hypoblast is complete near the site of the inner cell mass, and the trophoblast cells are dividing to form the syncytiotrophoblast, which will invade the uterus. Meanwhile, the epiblast has split into the amniotic ectoderm and the embryonic epiblast. All subsequent development of the embryo will focus on the embryonic epiblast. (After Carlson, 1981.)

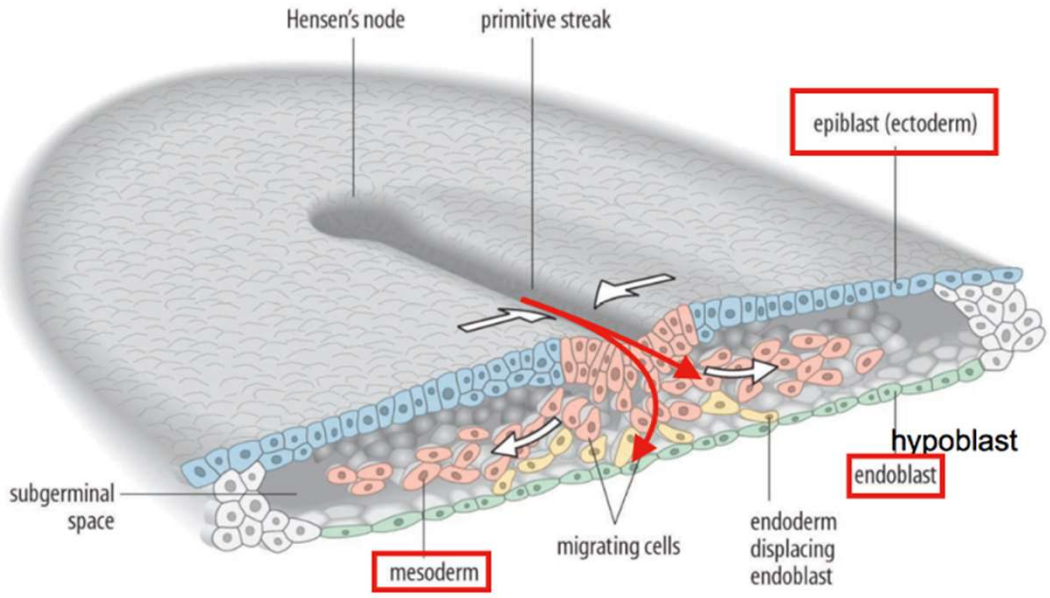
Formation of Bilaminar germ Layer

Formation of Bilaminar germ Layer



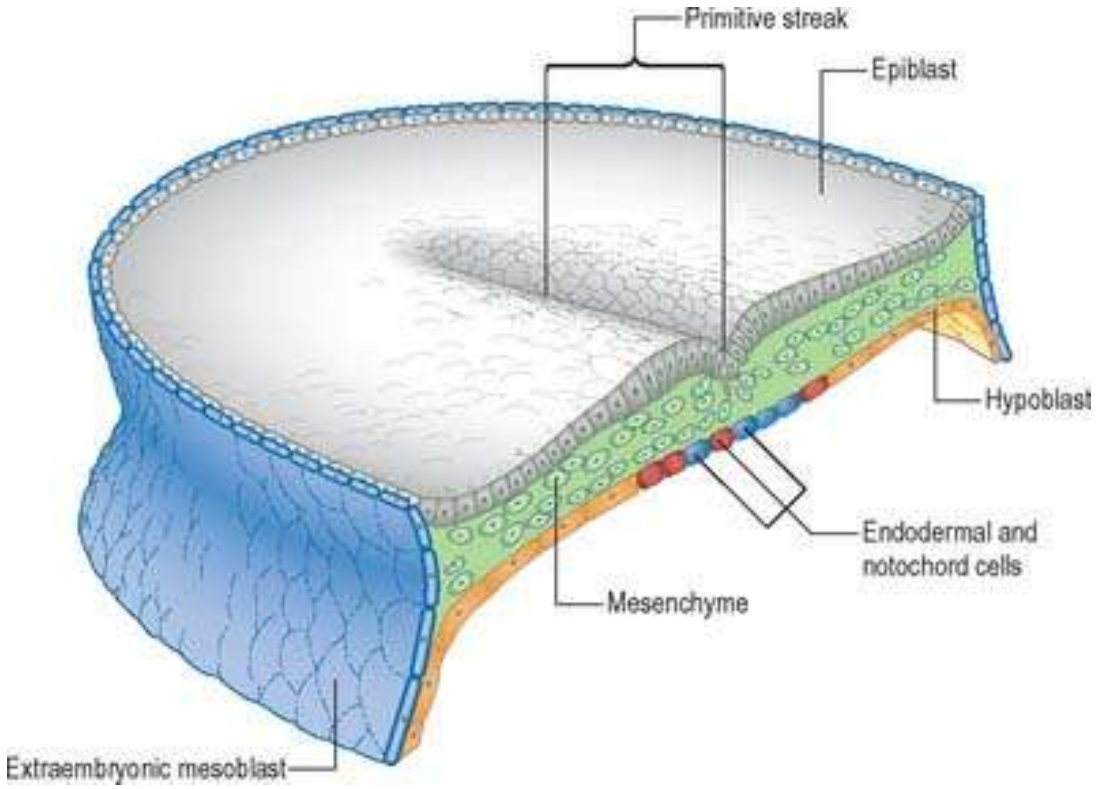
Development of Urinary System

Trilaminar Disc



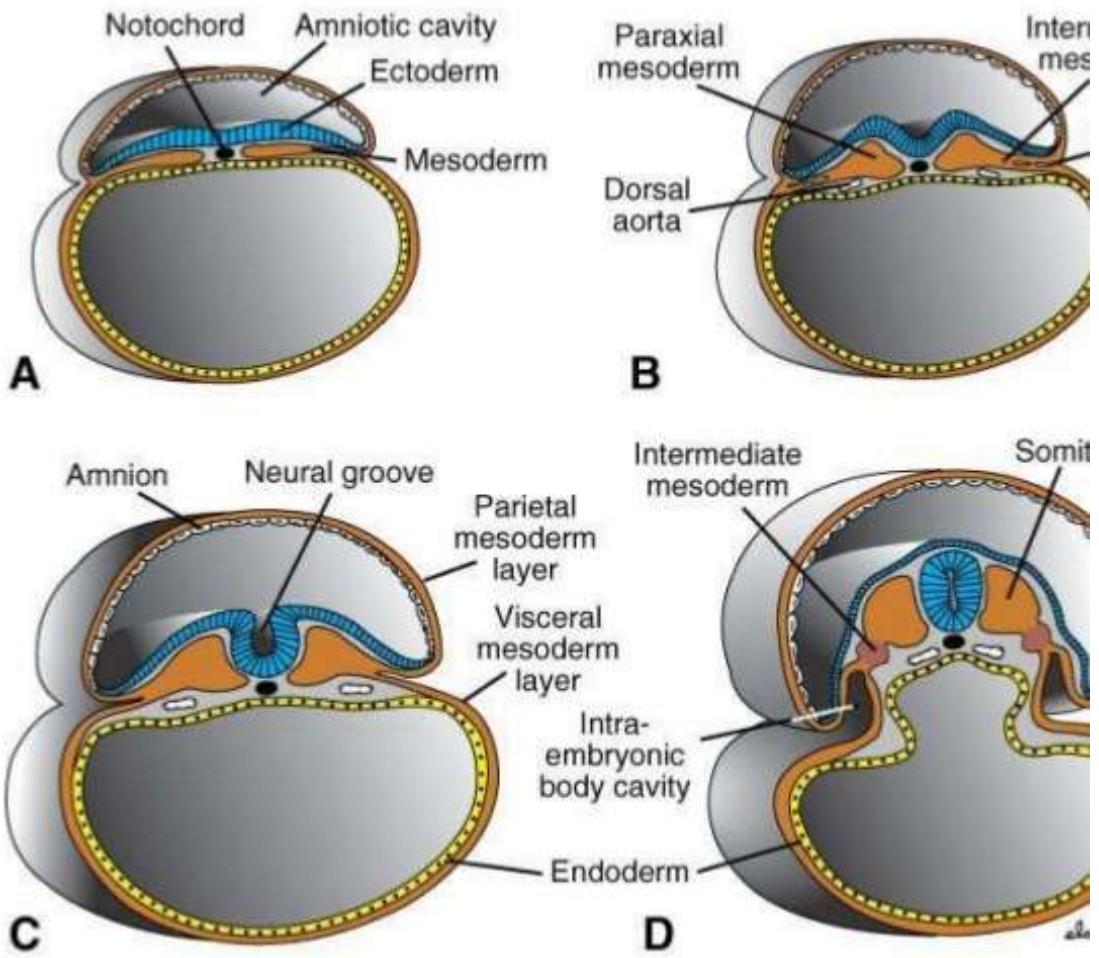
Development of Urinary System

Trilaminar Disc



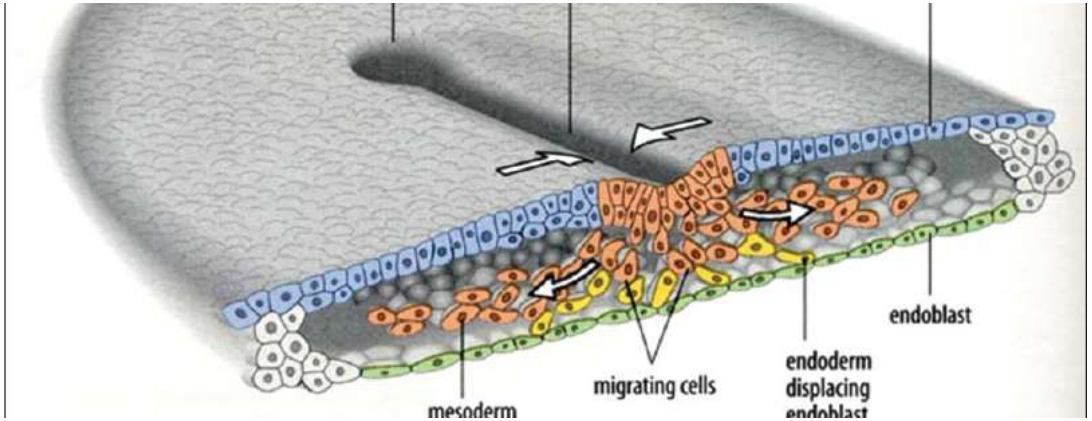
Real Embrology

Formation of Bilaminar germ Layer



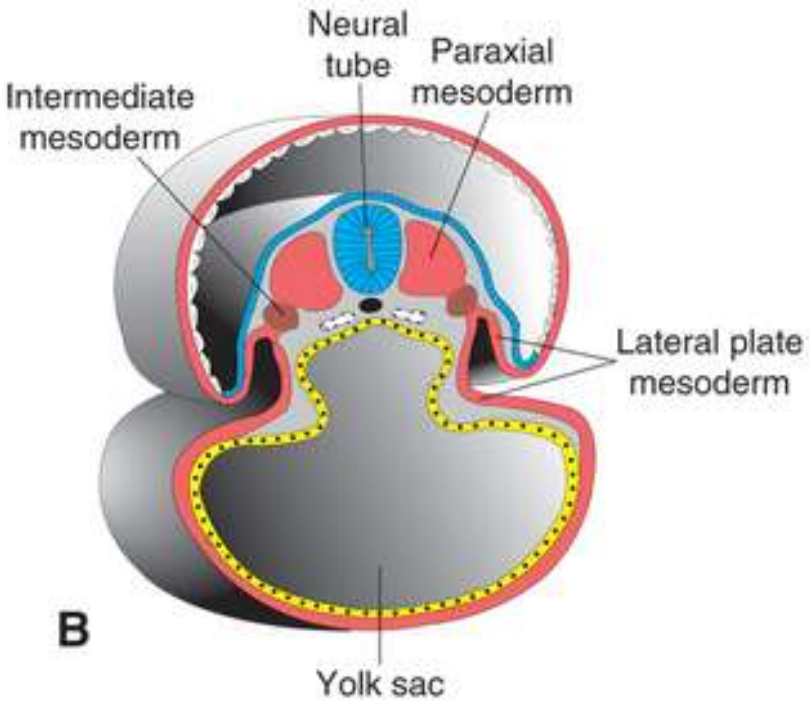
Development of Urinary System

Trilaminar Disc

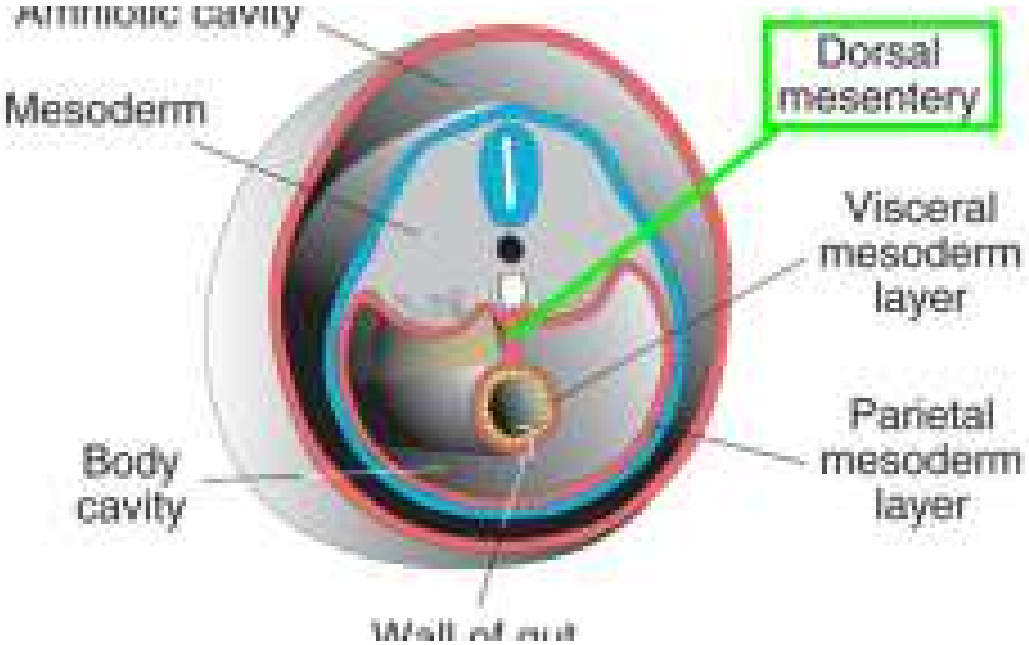


Development of Urinary System

Intermediate Mesoderm



Development of Urinary System

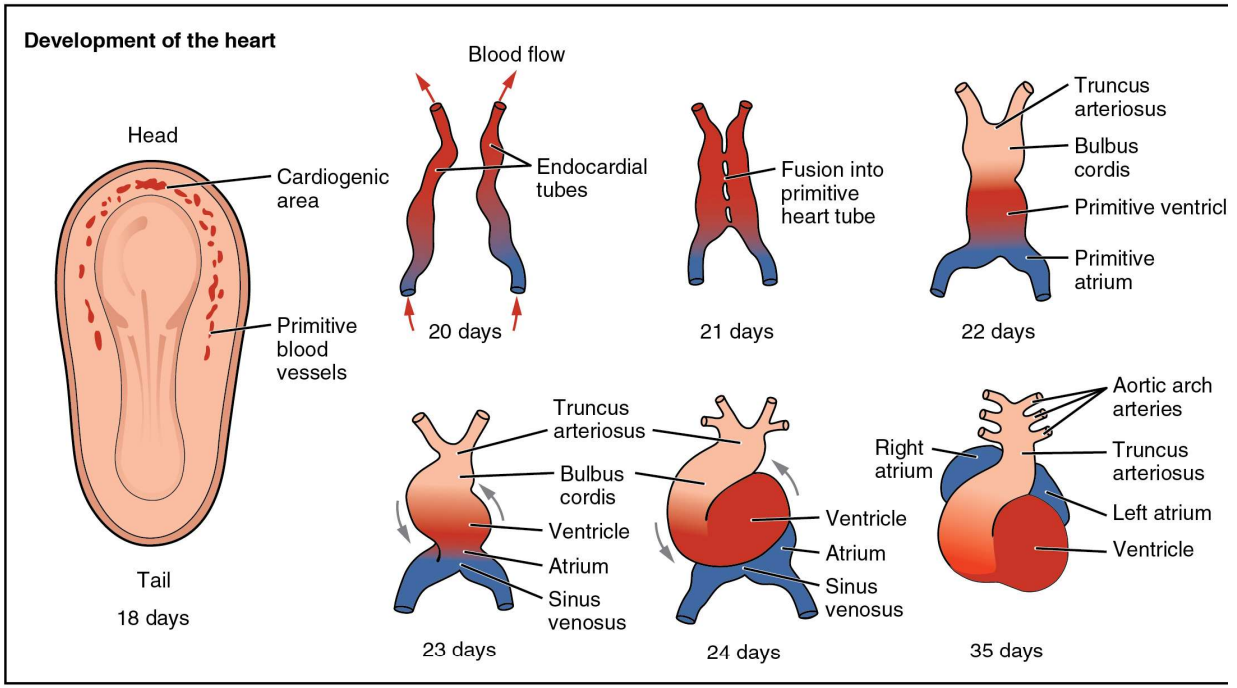


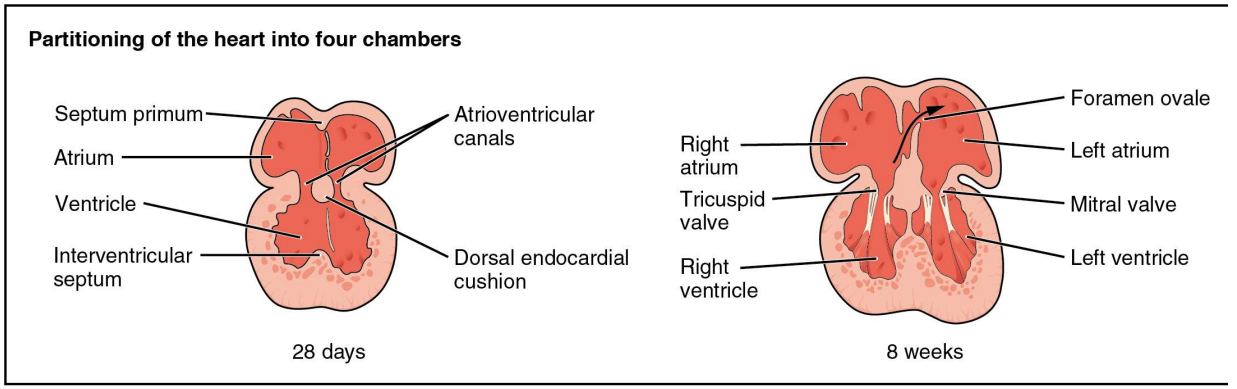
Intermediate Mesoderm

Development of Urinary System

Renal Embryology

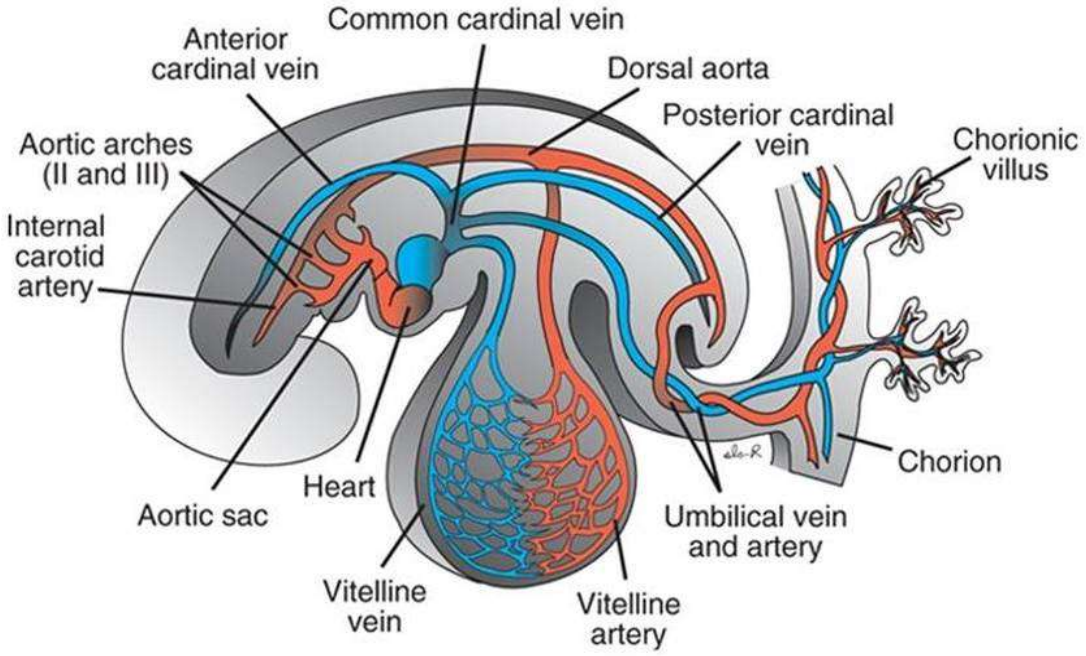
On going development of the heart.





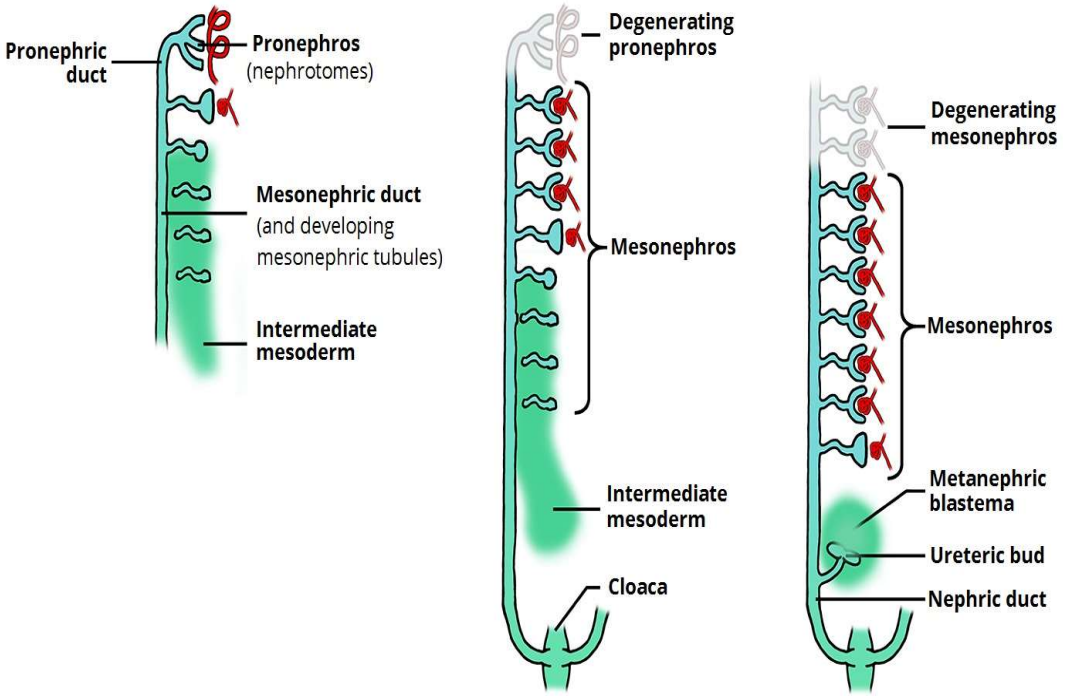
Development of Urinary System

Dorsal Aorta



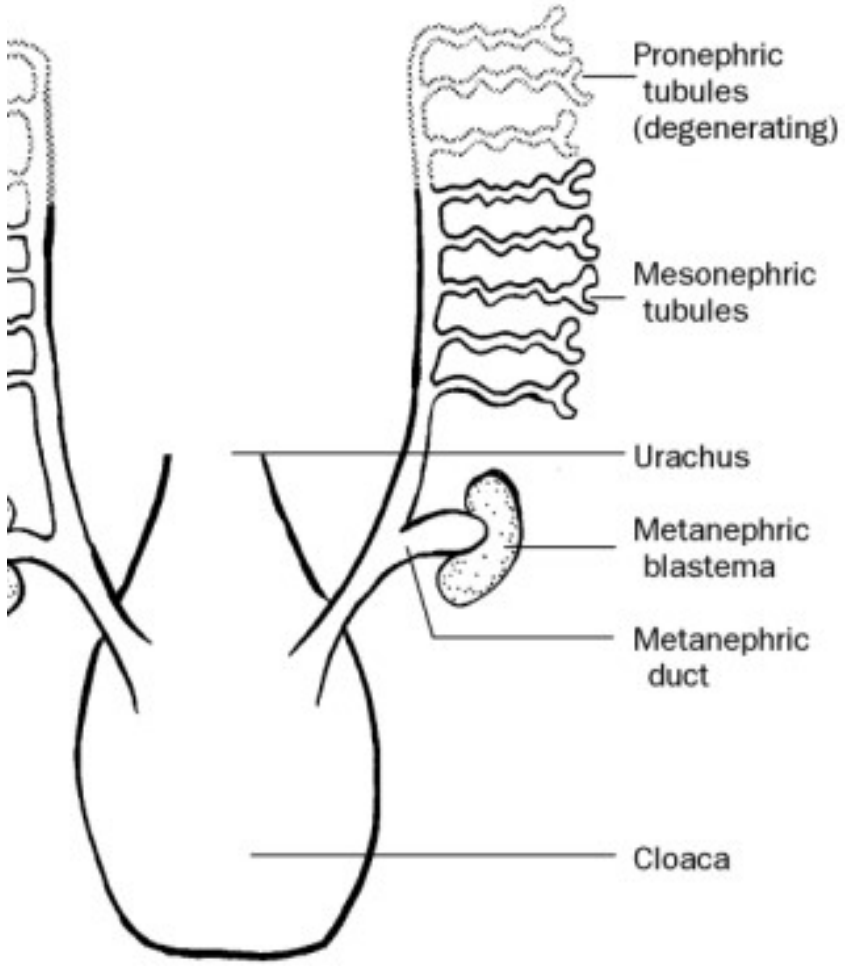
Development of Urinary System

Pronephros



Development of Urinary System

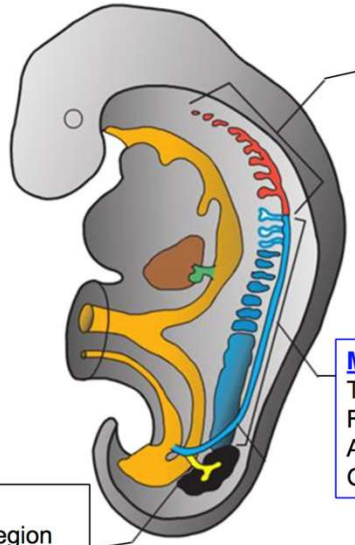
Pronephros



Development of Urinary System

Metanephros

3 components



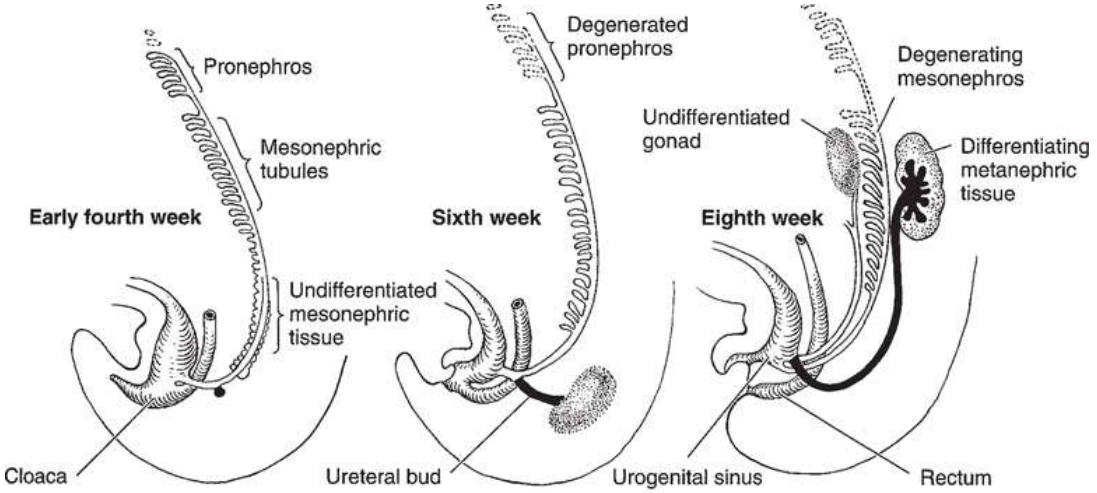
Pronephros
Cervical segments
Only present early week 4
Nonfunctional; no adult derivatives

Mesonephros
Thoracic and lumbar segments
Forms later in week 4, after pronephros
Acts as "interim kidney" until week 9
Gives rise to reproductive structures

Metanephros
Forms within pelvic region
Appears week 5
Definitive kidney at week 10

Development of Urinary System

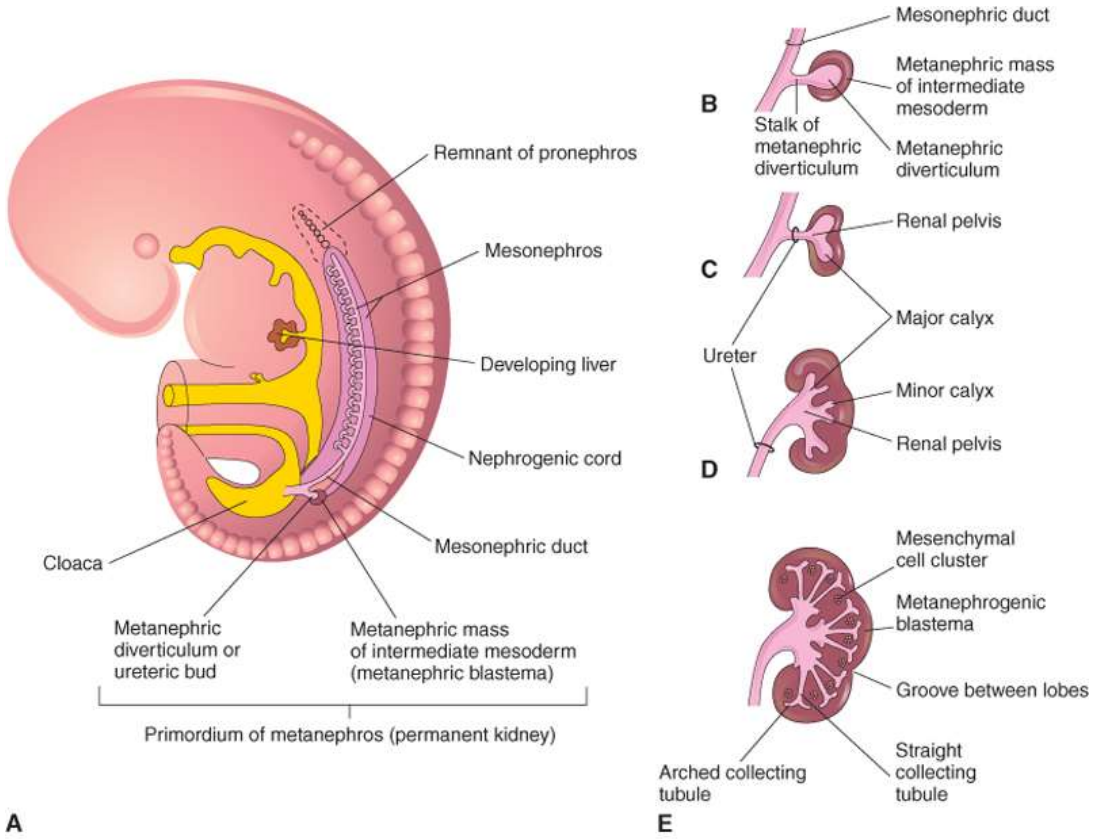
Ureteric Bud



Source: McAninch JW, Lue TF: *Smith & Tanagho's General Urology*, 18th Edition: www.accessmedicine.com

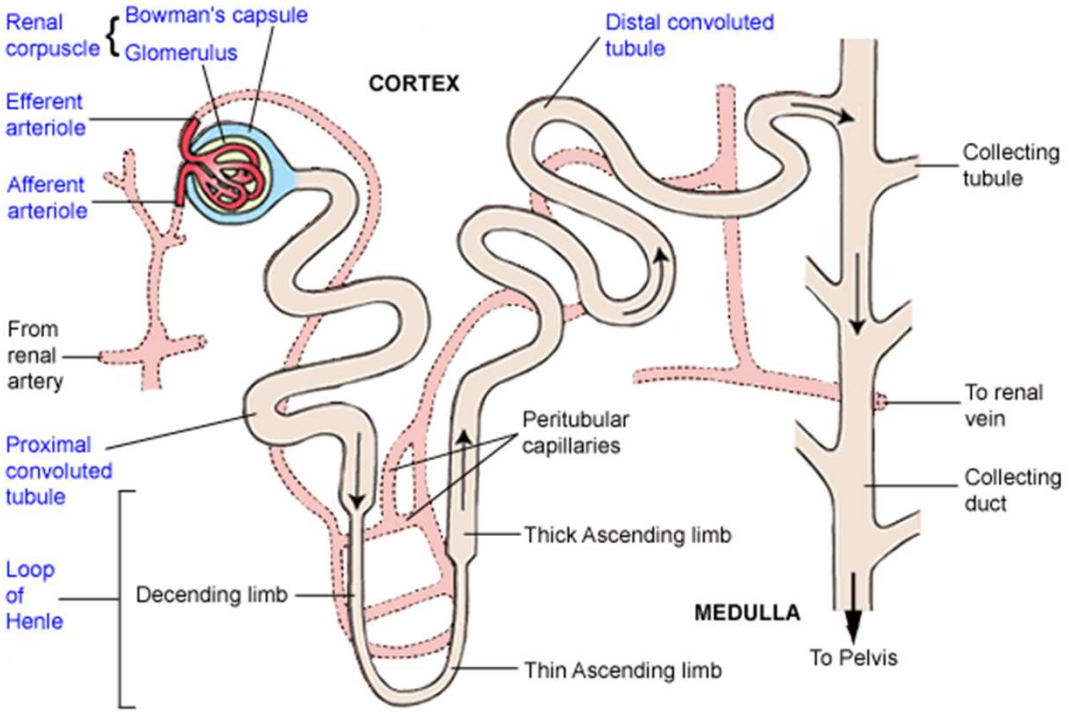
Development of Urinary System

Metanephric Blastema



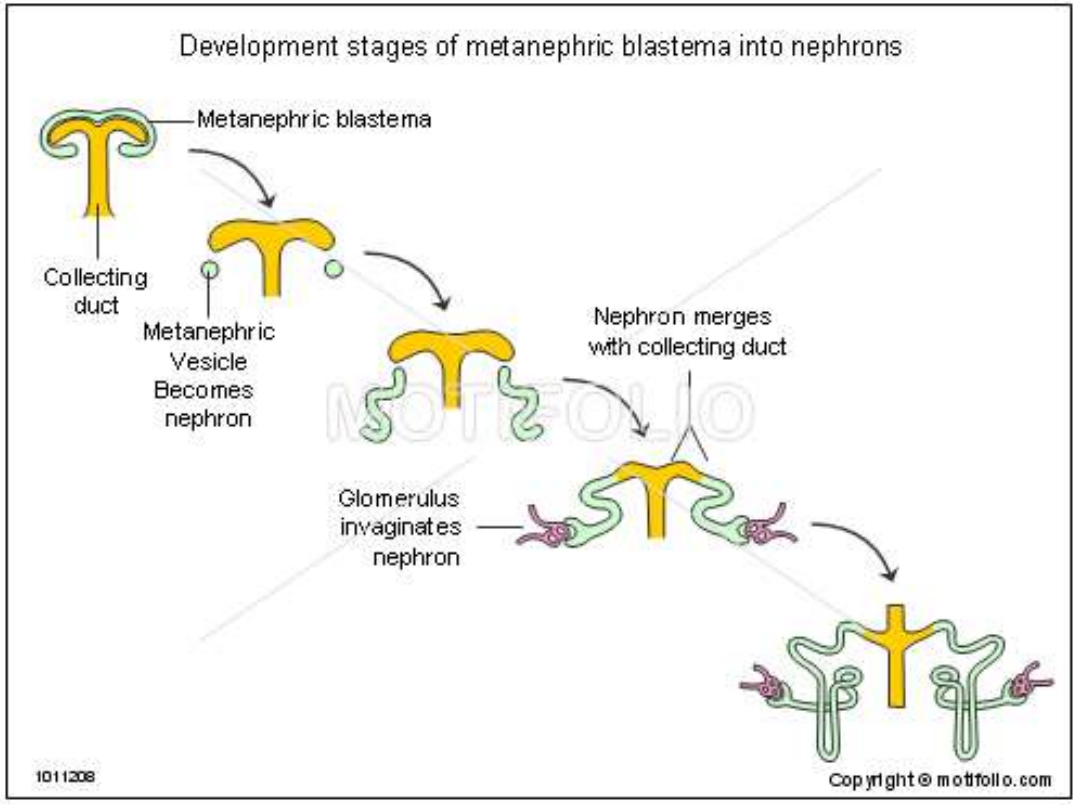
Development of Urinary System

Nephrons



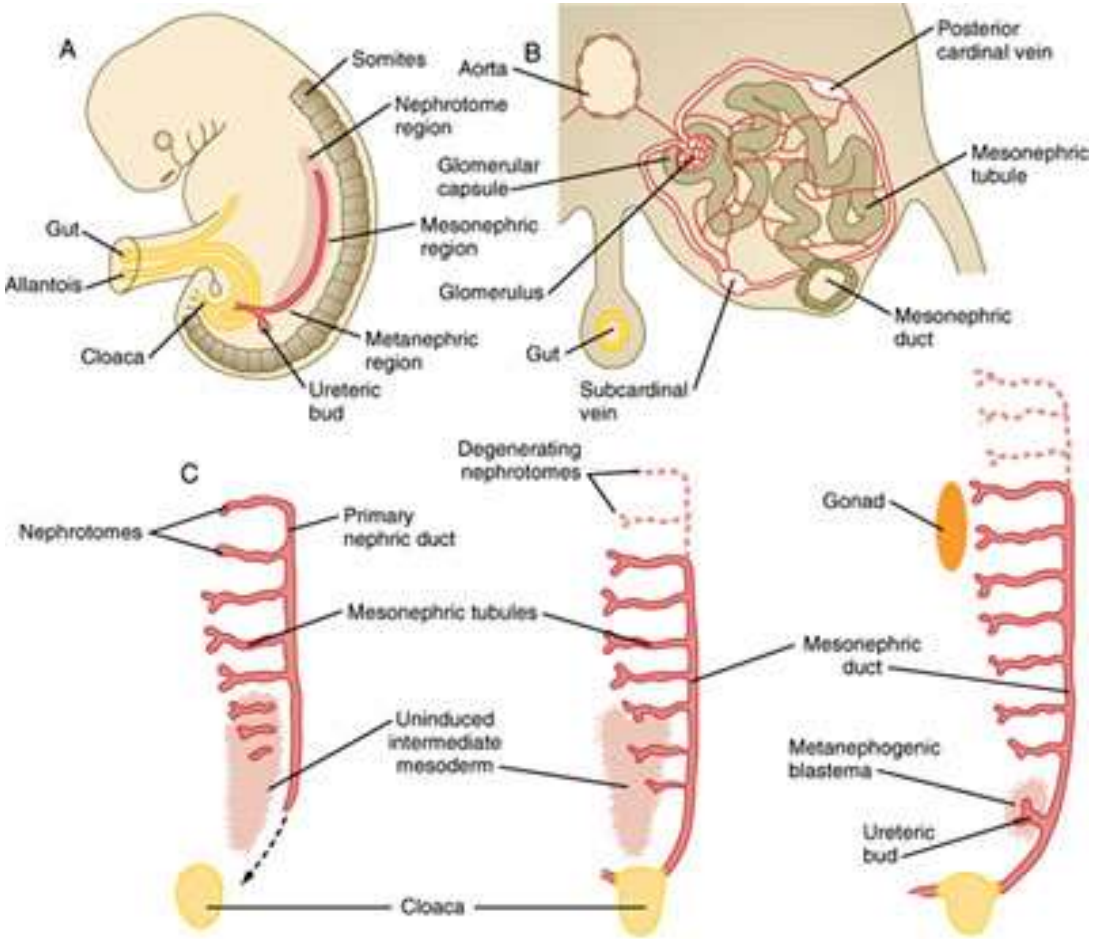
Development of Urinary System

Bowmen's Capsule



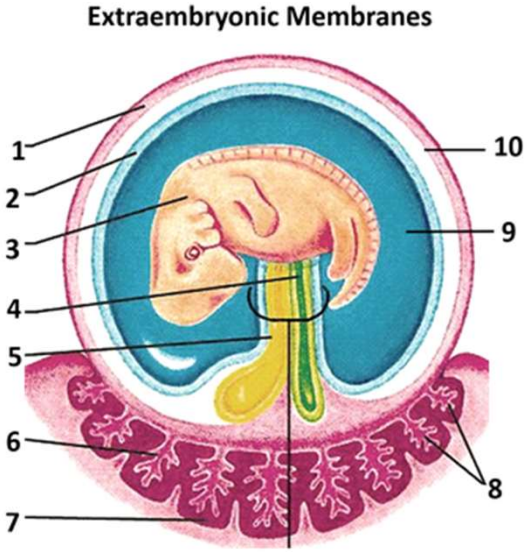
Development of Urinary System

Metanephric Blastema



Development of Urinary System

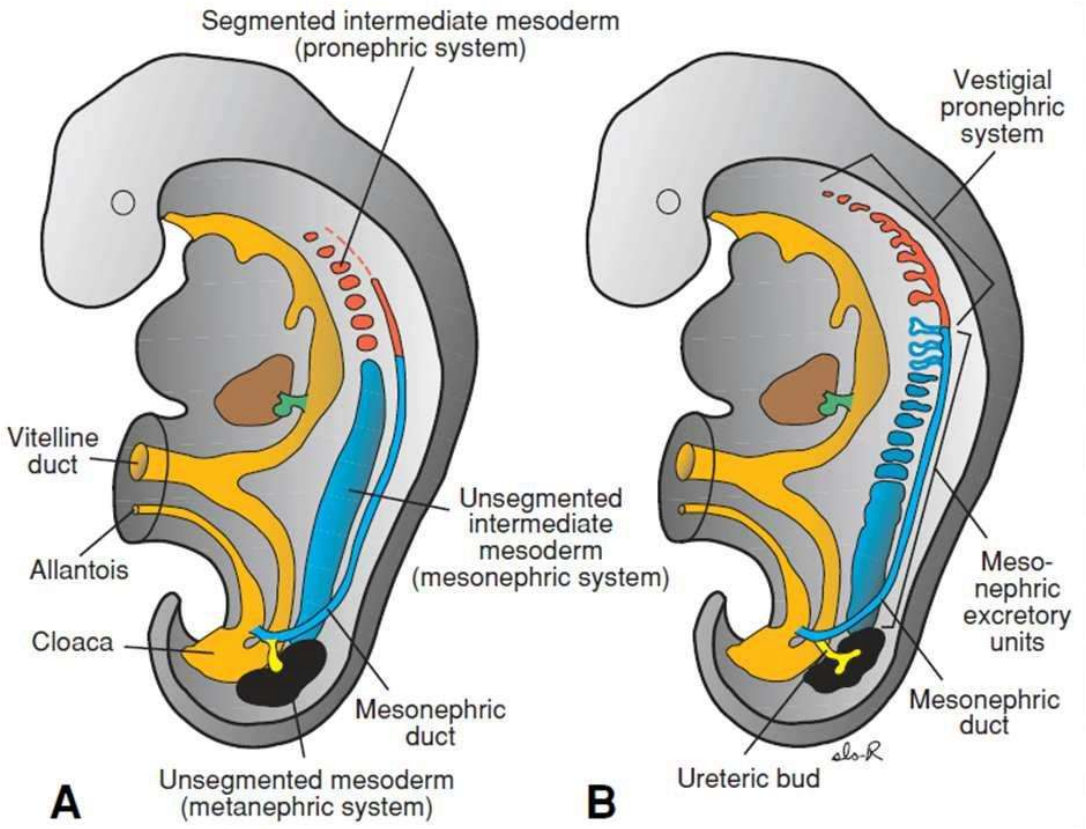
Allantois



1. Chorion
2. Amnion
3. Embryo
4. Allantois
5. Yolk sac
6. Fetal part of placenta (Chorion frondosum)
7. Maternal part of placenta (Decidua basalis)
8. Chorionic villi
9. Amniotic cavity
10. Chorionic cavity

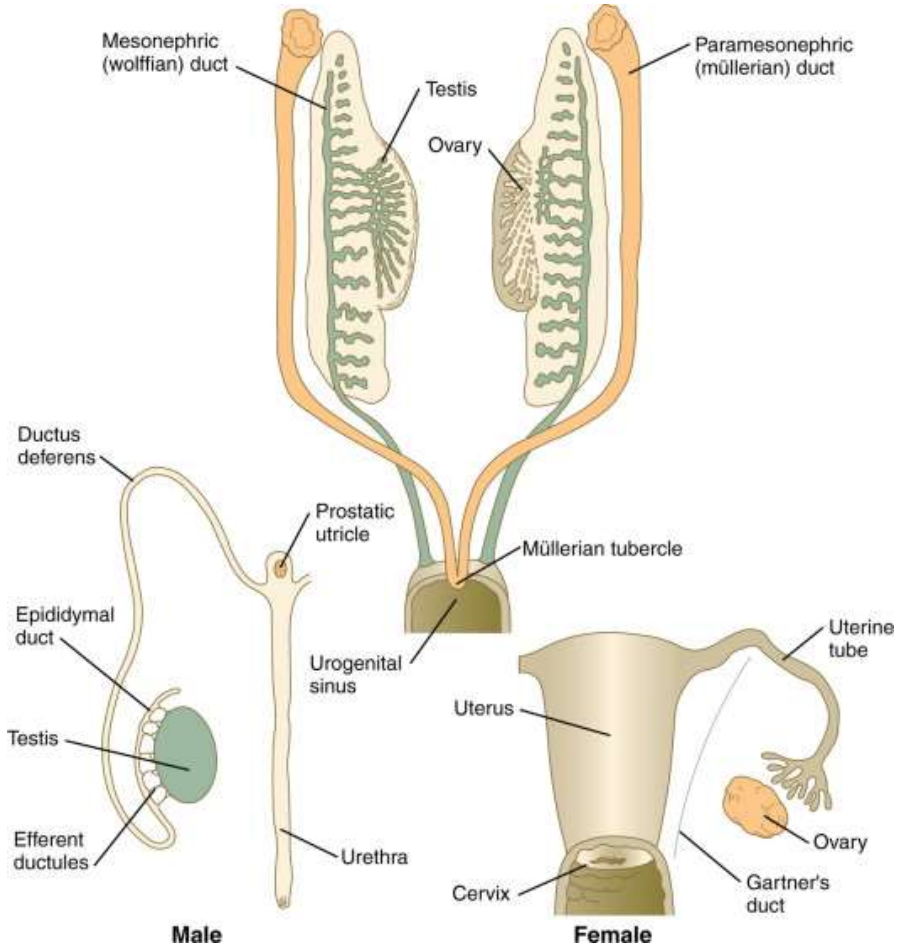
Development of Urinary System

Allantois



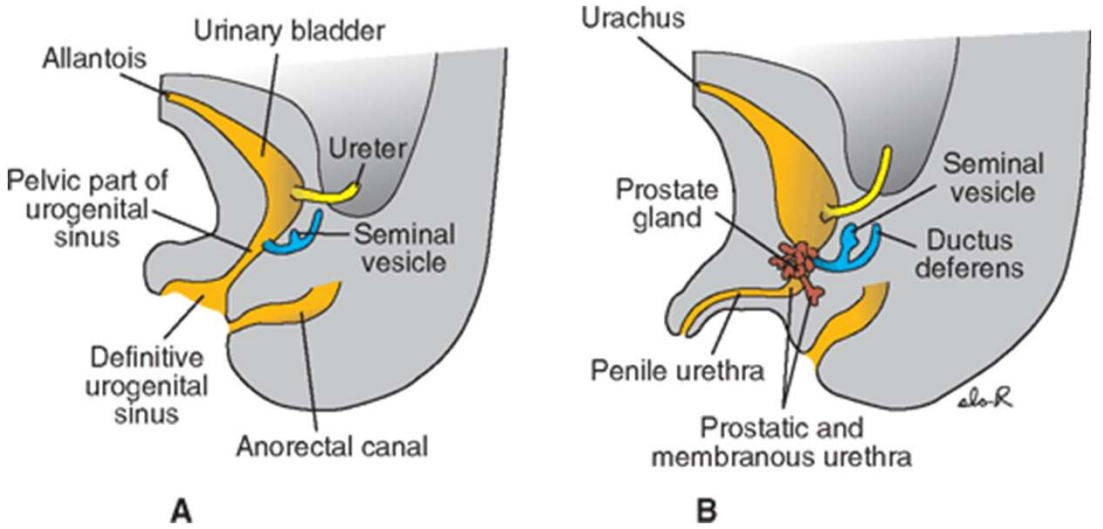
Development of Urinary System

Paramesonephric Duct



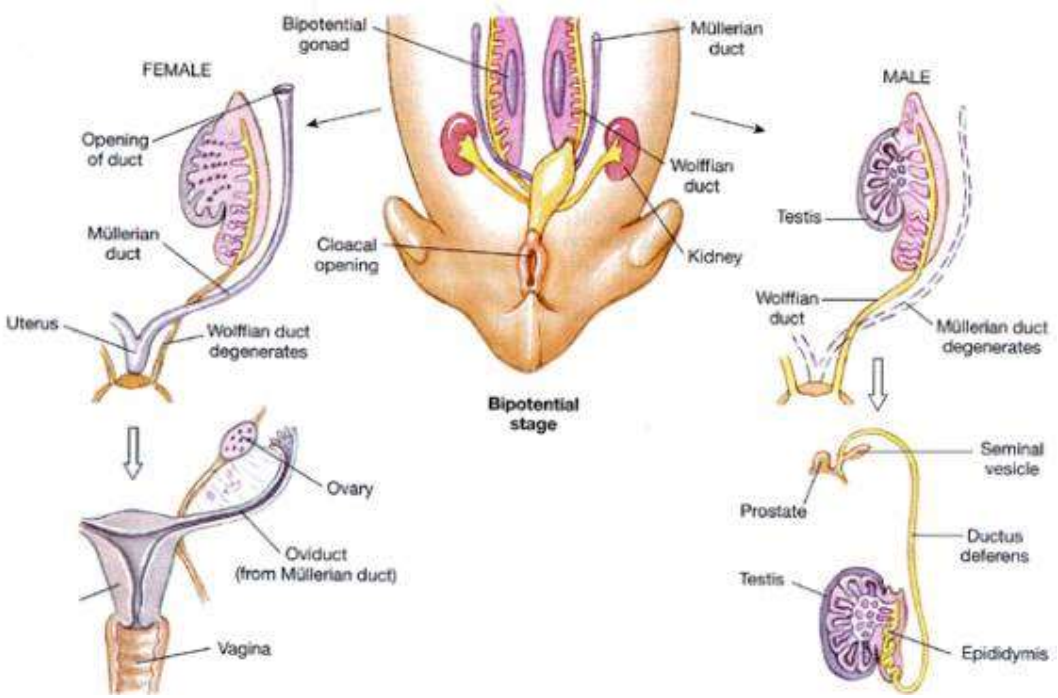
Development of Urinary System

Urogenital Sinus



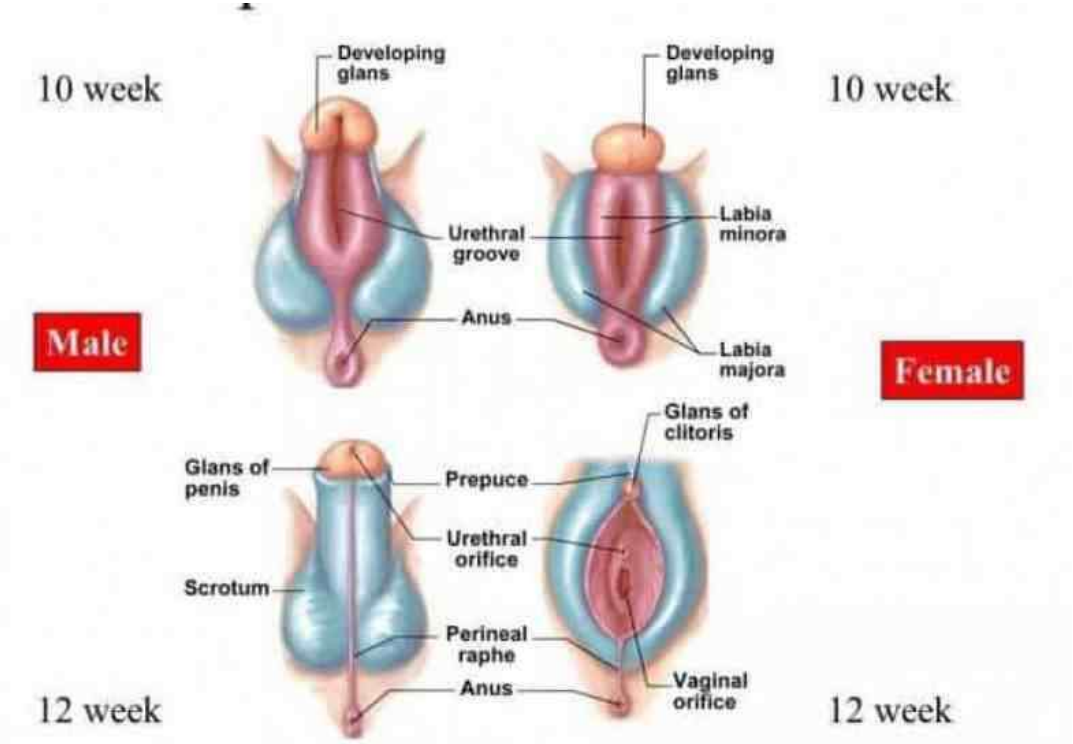
Development of Urinary System

Paramesonephric Duct



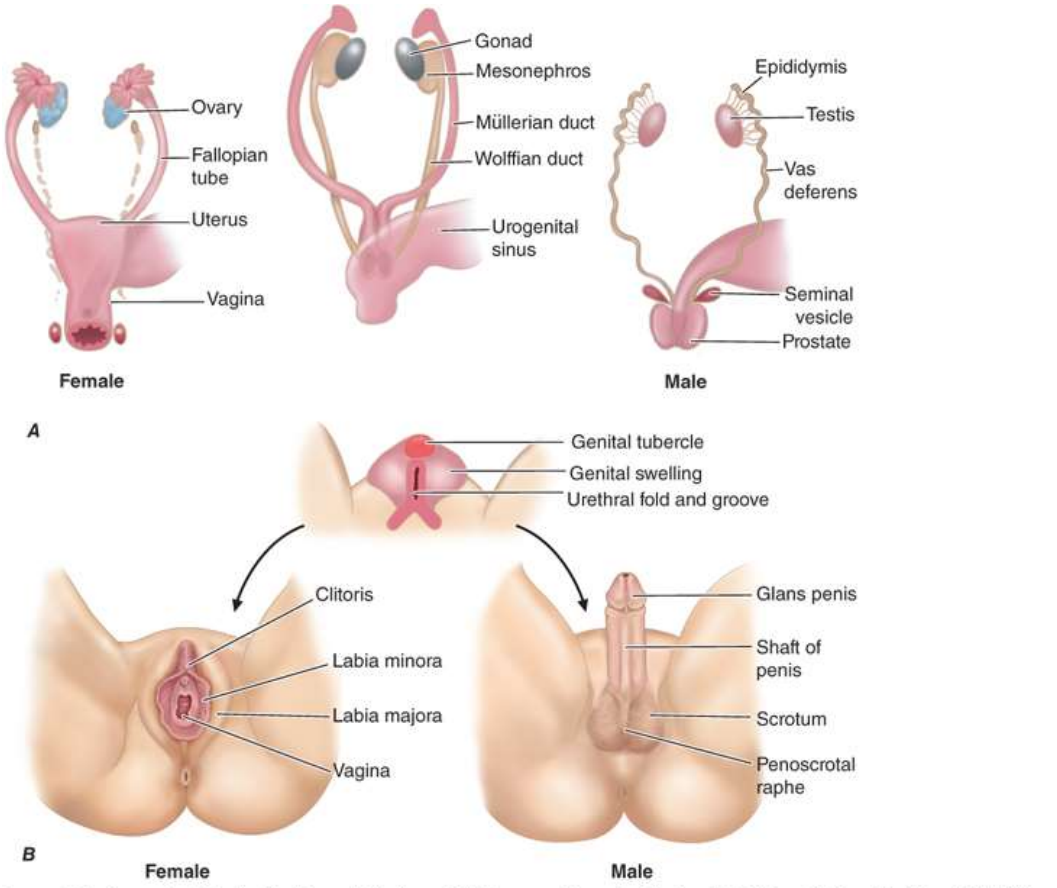
Development of Urinary System

External Genitalia



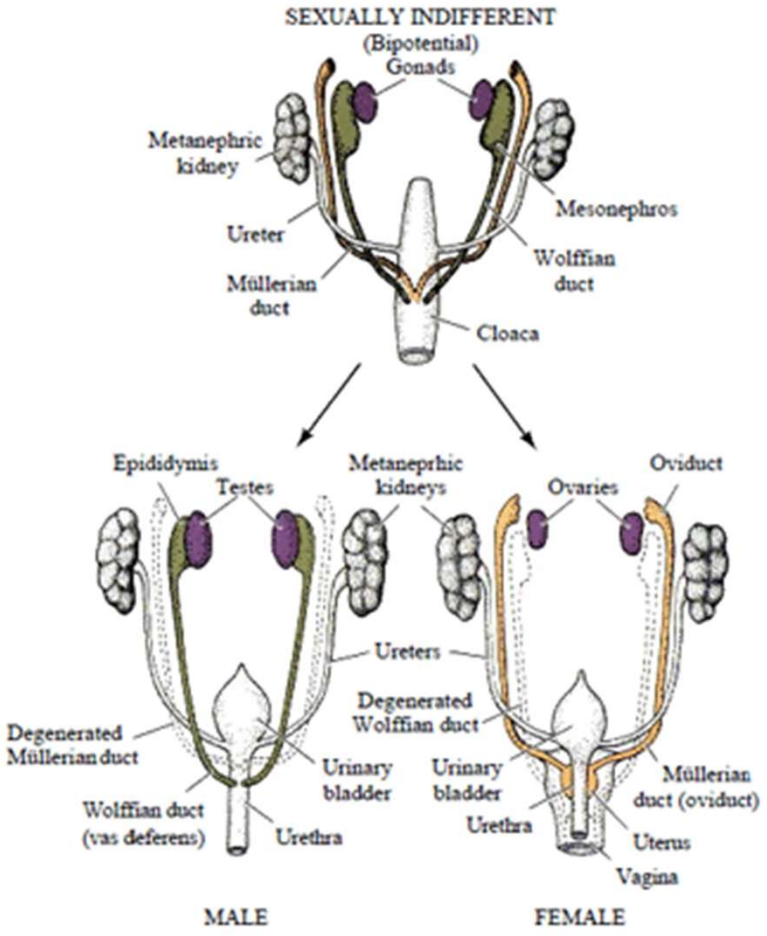
Development of Urinary System

External Genitalia



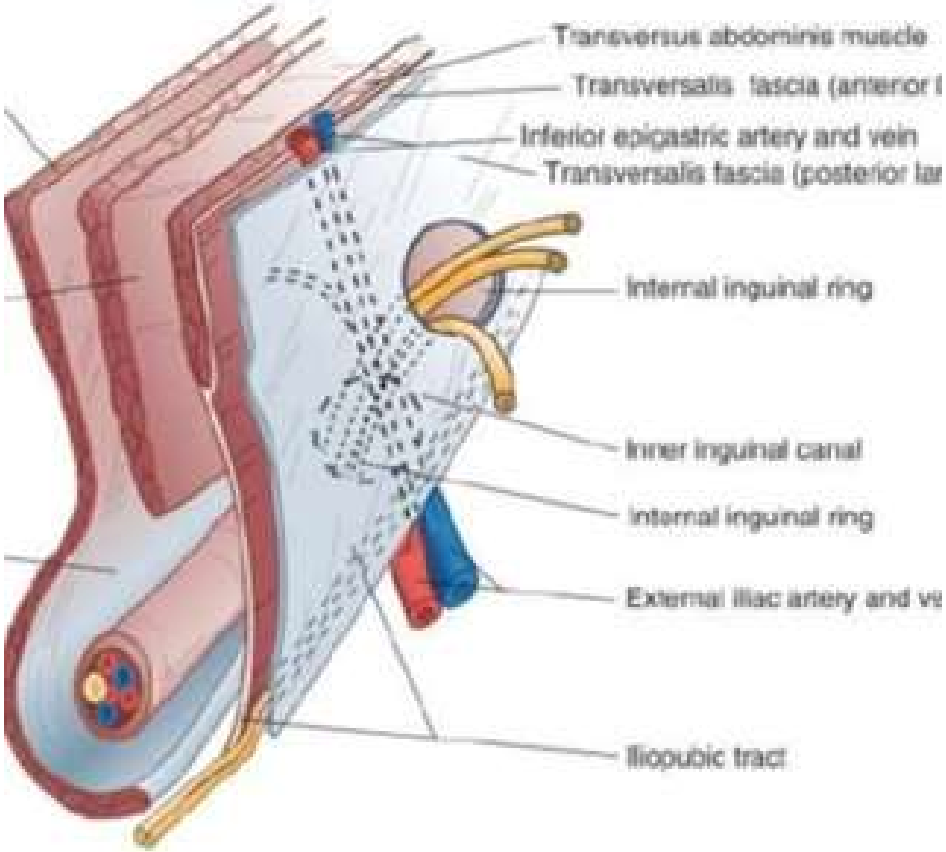
Development of Urinary System

Paramesonephric Duct



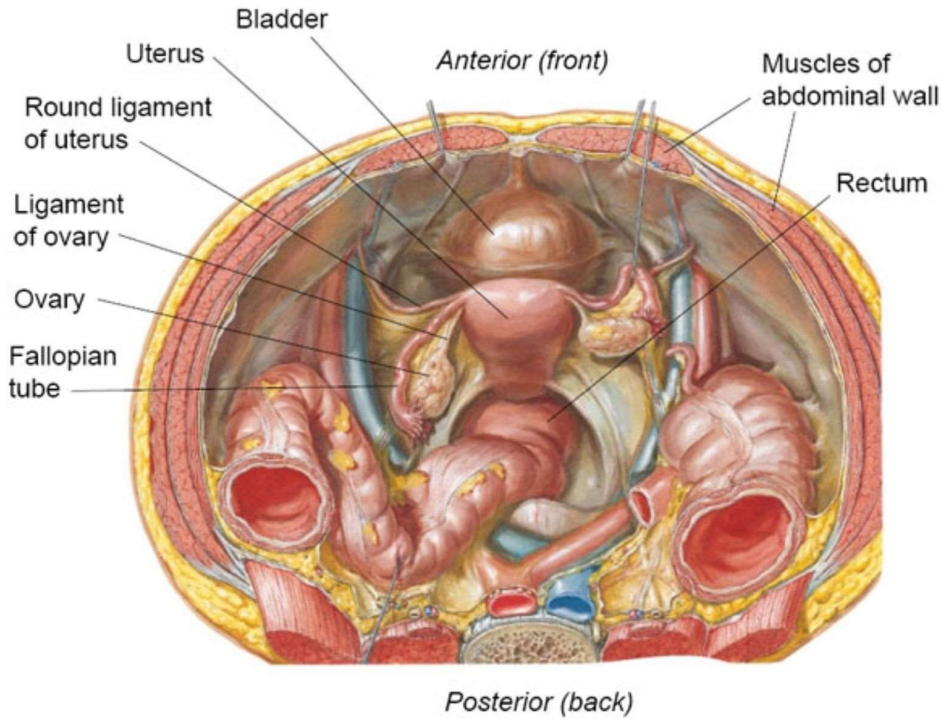
Development of Urinary System

Inguinal canal



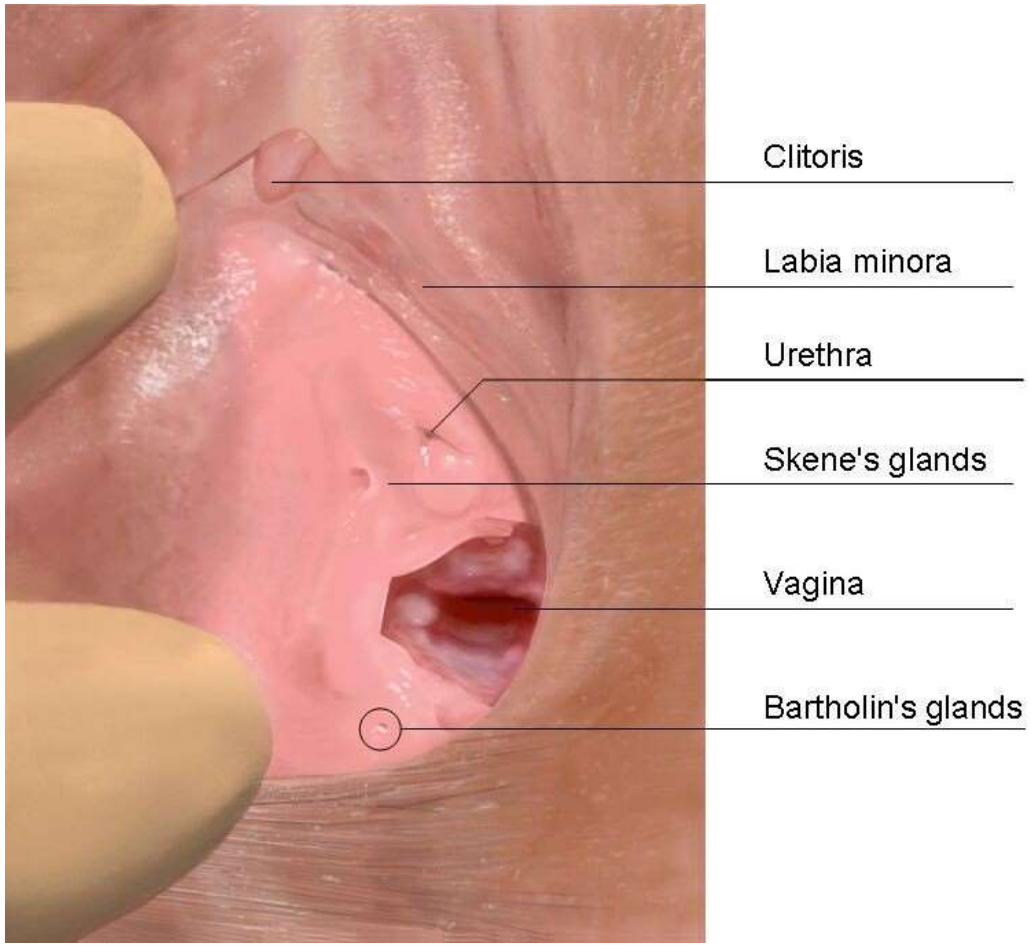
Development of Urinary System

Gubernaculum



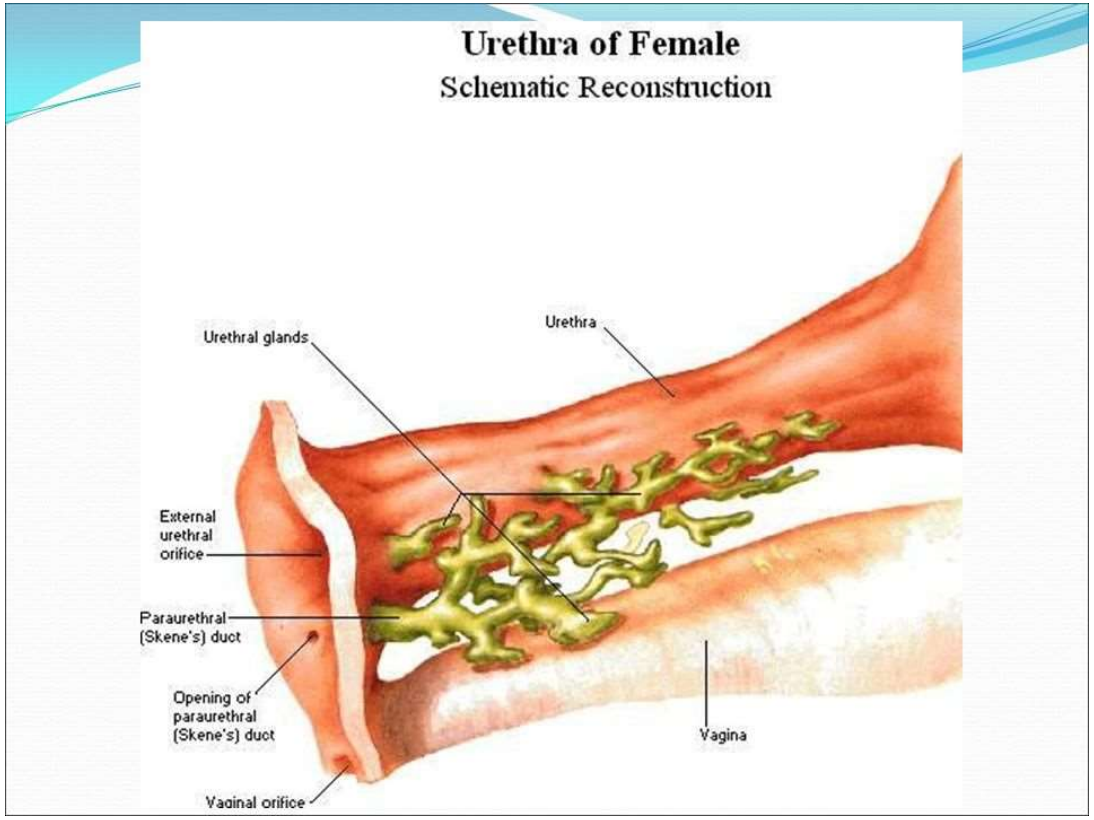
Development of Urinary System

Skene Gland



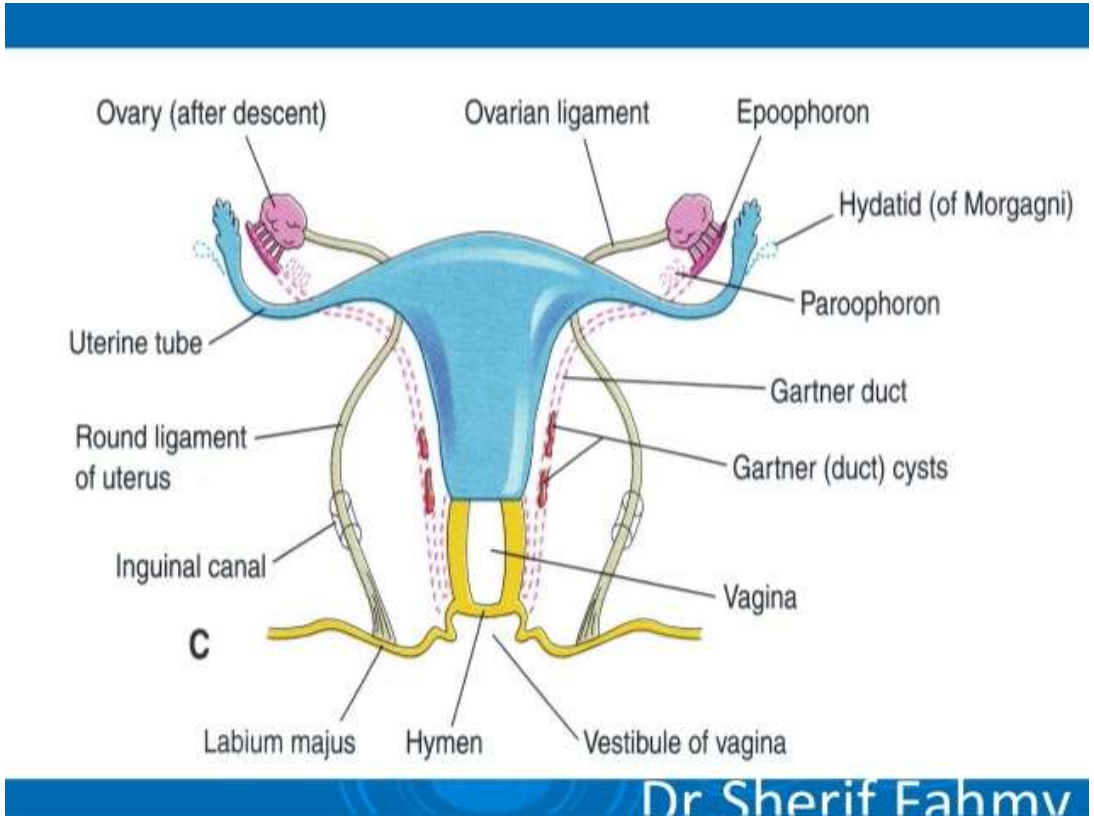
Development of Urinary System

Skene Duct/ Gland

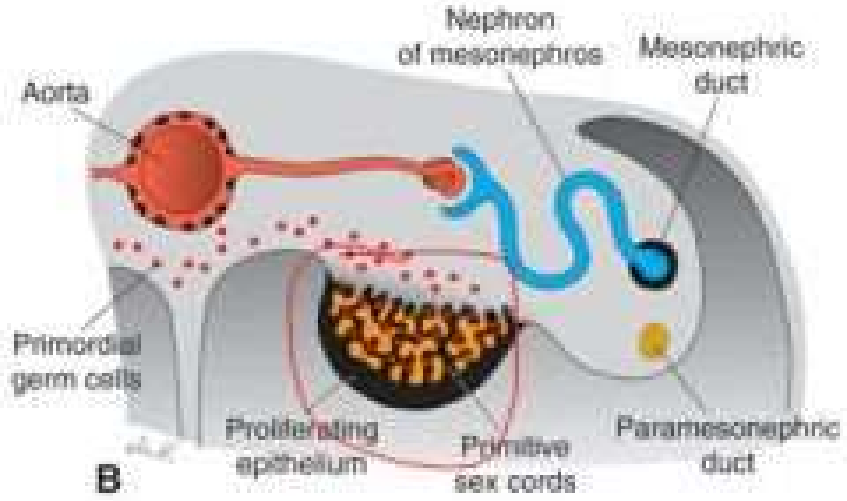


Development of Urinary System

Gartenr’ s Duct



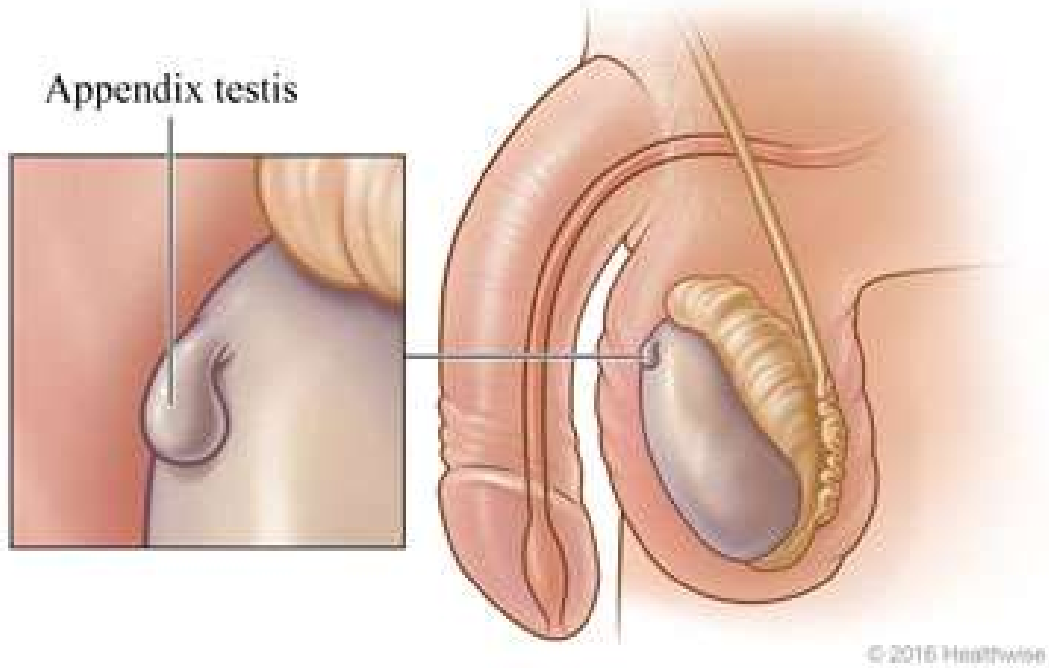
Development of Urinary System



Development of Gonads

Development of Urinary System

Appendix of testis



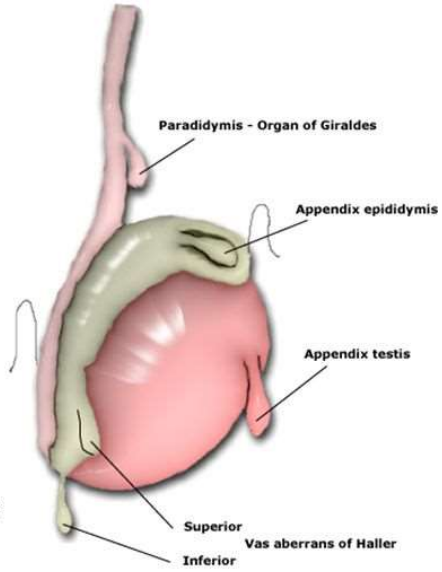
Development of Urinary System

Torsion of Appendicular Testis

Torsion of Appendix Testis

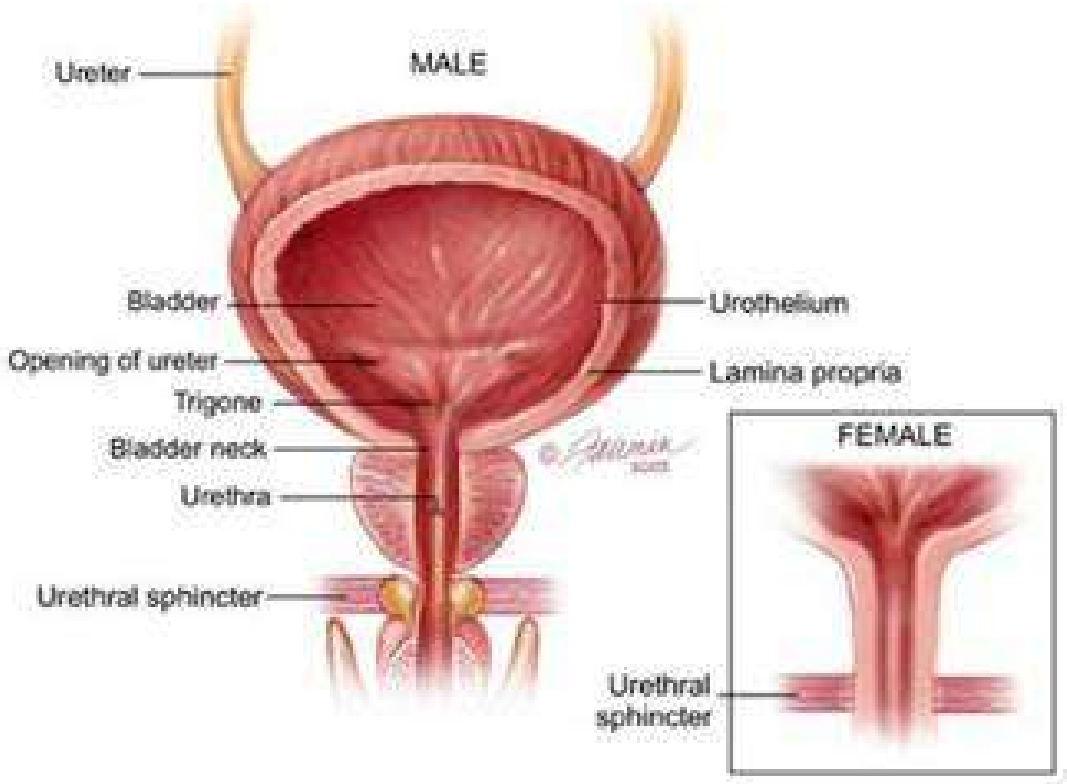
- Appendix testis
  - Small vestigial structure, remnant of Mullerium duct
  - Pedunculated, 0.3cm long
- Other appendix structures

- Prepubertal estrogen may enlarge appendix and cause torsion



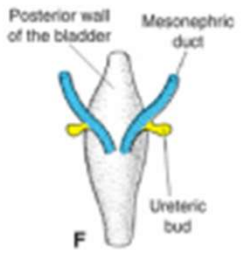
Development of Urinary System

Trigone of Bladder

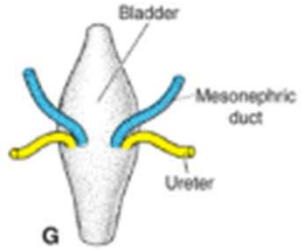


Development of Urinary System

Trigone of Bladder



Incorporation of the Mesonephric Ducts into the Posterior Bladder Wall



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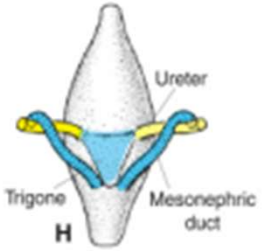
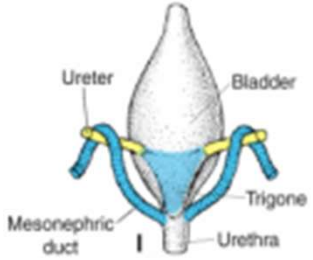


Incorporation of the Mesonephric Ducts into the Posterior Bladder Wall



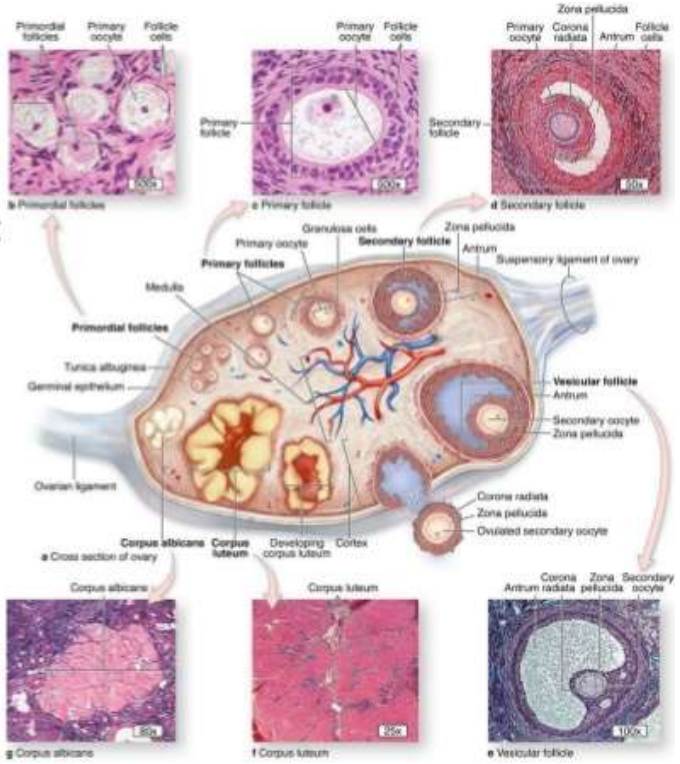
Incorporation of the Mesonephric Ducts into the Posterior Bladder Wall

Development of Urinary System

Histology of Ovaries

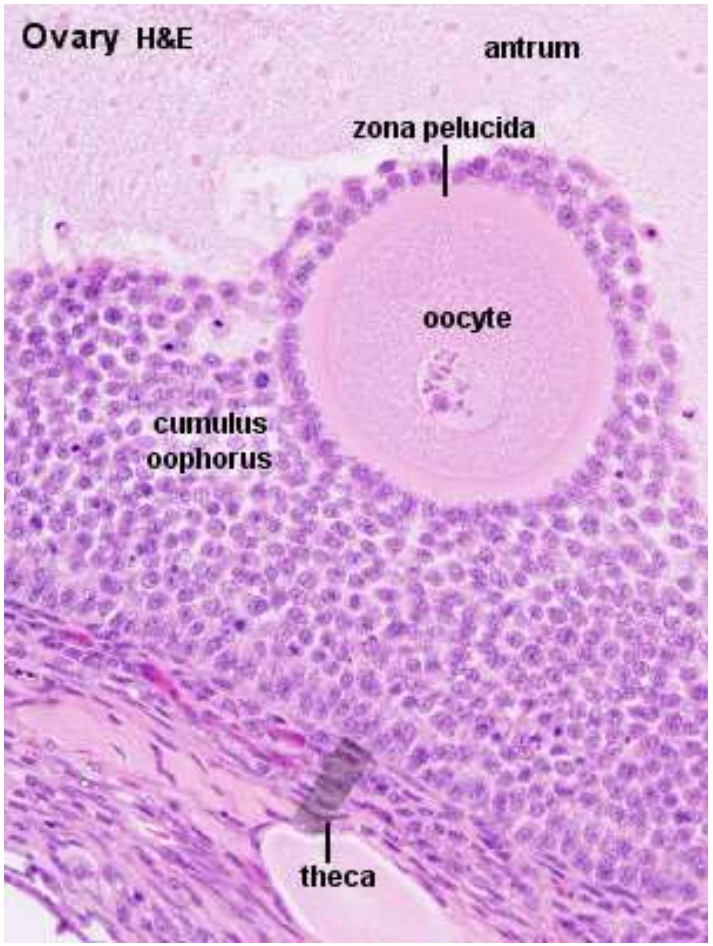
Ovary

- Cortex: outer part consists of:
- Stroma: connective tissue & stromal cells
- Paranchyma: different phases of ovarian follicles



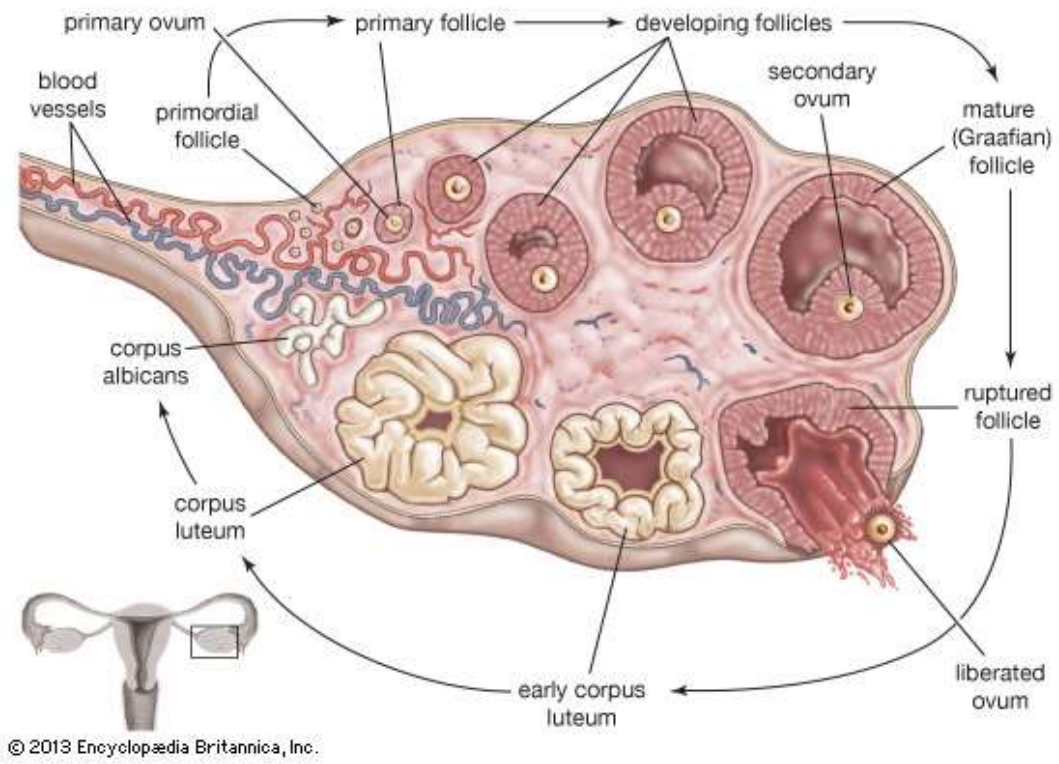
Development of Urinary System

Oocyte



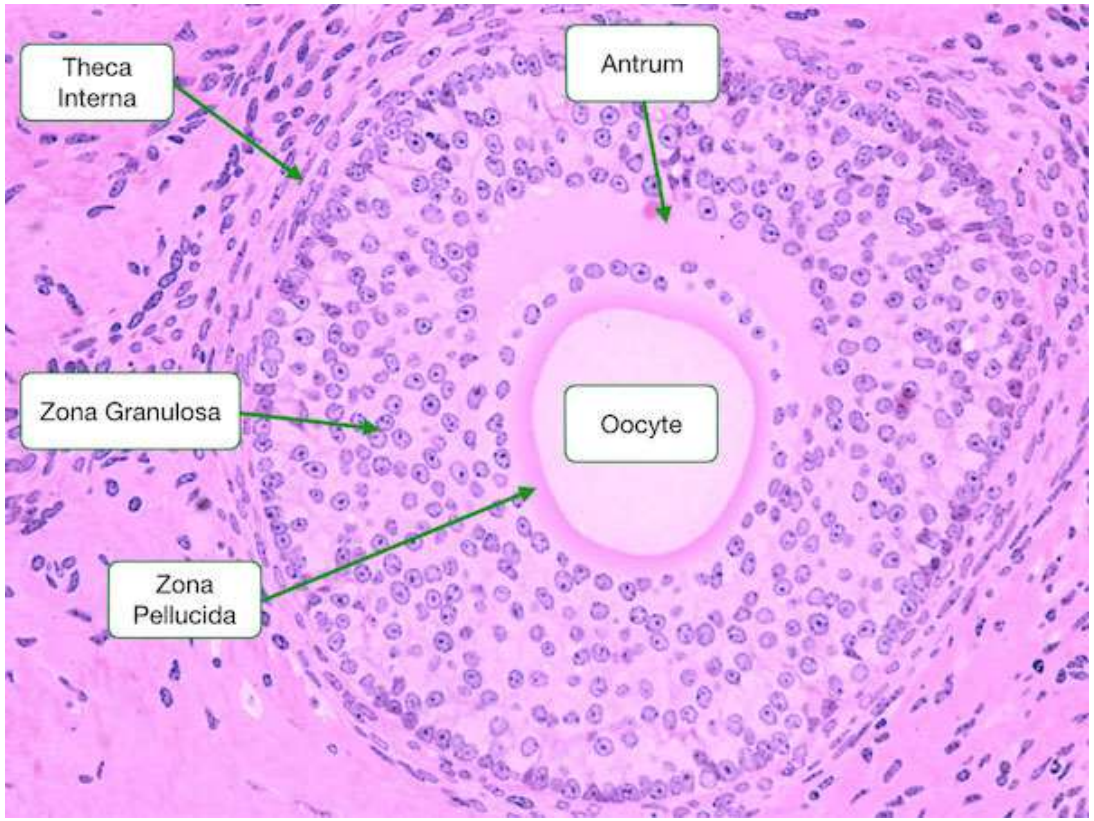
Development of Urinary System

Corpus Luteum



Development of Urinary System

Theca Cell



Development of Urinary System

The main functions of the **urinary system** include:

- Removal of metabolic waste products such as uric acid, urea and creatinine.
- Maintain electrolyte, water and pH balance.
- Regulation of blood pressure, blood volume and erythropoiesis, and vitamin D production.
- Development of the urinary system is closely related to the development of the **reproductive system**; particularly during the earlier stages – where they develop from the same origin. However, the urinary system develops ahead of the reproductive system.
- The urinary system consists of the kidneys, ureters, bladder and urethra. A region of **intermediate mesoderm**, known as the urogenital ridge, gives rise to these structures.
- In this article, we will look at the **embryology of the urinary system** and its clinical correlations.

Development of Urinary System

Development of the Kidneys

- In the embryo, the kidneys develop from three overlapping sequential systems; the pronephros, the mesonephros, and the metanephros. They are all derived from the **urogenital ridge**.

Development of Urinary System

Pronephros

- The **pronephros** appears in the 4th week of development.
- Its development begins in the **cervical region** of the embryo. Segmented divisions of intermediate mesoderm form tubules, known as nephrotomes. In total, 6-10 pairs of nephrotomes are formed.
- These tubules join into the **pronephric duct**, which is a duct that extends from the cervical region to the cloaca (distal end) of the embryo. This early system is non-functional and regresses completely by the end of week 4.

Development of Urinary System

Mesonephros

- The **mesonephros** develops caudally (inferiorly) to the pronephros. First, the presence of the pronephric duct induces nearby intermediate mesoderm in the thoracolumbar region to form **mesonephric tubules**.
- These tubules receive a tuft of capillaries from the dorsal aorta – allowing for the filtration of blood – and they drain into the **mesonephric duct** (a continuation of the pronephric duct). They act as a primitive excretory system in the embryo, with most tubules regressing by the end of the 2nd month.
- Additionally, the mesonephric duct sprouts the **ureteric bud** caudally, which induces the development of the definitive kidney.

Development of Urinary System

Metanephros

- The **metanephros** forms the definitive kidney. It appears in the 5th week of development and becomes functional around the 12th week.
- The ureteric bud from the mesonephric duct makes contact with a caudal region of intermediate mesoderm – the **metanephric blastema (Fig 2)**. Collectively, these blastema form the metanephric system, which has two components:
- **Collecting system** – derived from the ureteric bud.
  - It dilates to create the ureter, renal pelvis, major and minor calyces and collecting tubules – terminating at the distal convoluted tubule.
  - If the uretic bud splits too early, two ureters, or two renal pelvices connecting to one ureter may result.

Development of Urinary System

- **Excretory system** – derived from the metanephric blastema.Each collecting tubule from the collecting system is covered by a metanephric tissue cap which gives rise to the excretory tubules.
- These excretory tubules (along with the developing glomeruli) form the kidney's functional units – the nephron.
- The proximal end of the excretory tubule forms the Bowman's capsule around a glomerulus, while the distal end elongates to form the proximal convoluted tubule, loop of Henle and distal convoluted tubule

Development of Urinary System

The definitive kidney initially develops in the **pelvic region** before ascending into the abdomen. In the pelvis, the kidney receives its blood supply from a pelvic branch of the abdominal aorta and as it ascends, new arteries from the abdominal aorta supply the kidney. The pelvic vessels usually regress but can persist as accessory renal arteries.

Development of Urinary System

Clinical Relevance: Horseshoe Kidney

- A **horseshoe kidney** (also known as a cake kidney or fused kidney) is where the two developing kidneys fuse into a single horseshoe-shaped structure.
- This occurs if the kidneys become too close together during their ascent from the pelvis to the abdomen – they become fused and consequently 'stuck' underneath the **inferior mesenteric artery**.
- This type of kidney is still drained by two ureters, and is usually asymptomatic, although it can be prone to **obstruction**.

Development of Urinary System

Development of the Bladder and Urethra

- The bladder and urethra of the urinary system are ultimately derived from the **cloaca** – a hindgut structure that is a common chamber for gastrointestinal and urinary waste.

Development of Urinary System

- In the 4th-7th weeks of development, the cloaca is divided into two parts by the **uro-rectal septum**:
- **Urogenital sinus** (anterior) – divided into three parts:
  - The upper part of the urogenital sinus forms the bladder.
  - The pelvic part forms the entire urethra and some of the reproductive tract in females, and the prostatic and membranous urethra in males.
  - The phallic/caudal part forms part of the female reproductive tract, and the spongy urethra in males.

Development of Urinary System

Anal canal (posterior)

- The urinary bladder is initially drained by the **allantois**. However, this is obliterated during fetal development and becomes a fibrous cord – the urachus. A remnant of the urachus can be found in adults; the median umbilical ligament, which connects the apex of the bladder to the umbilicus.
- As the bladder develops from the urogenital sinus, it absorbs the caudal parts of the **mesonephric ducts** (also known as the Wolffian ducts), becoming the trigone of the bladder. The ureters, which have formed as outgrowths of the mesonephric ducts, enter the bladder at the base of the trigone. The final structure varies between sexes:

Development of Urinary System

Gender Difference

	Male	**Female**
Bladder	•As the kidneys ascend into the abdomen, the ureteric openings move cranially. •The mesonephric ducts (Wolffian ducts) move caudally and closer together, entering the prostatic urethra to become the ejaculatory ducts.	•As the kidneys ascend into the abdomen, the ureteric openings move cranially. •The mesonephric ducts degenerate due to a lack of testicular androgens.
Urethra	•The pre-prostatic, prostatic and membranous urethra is formed from the pelvic part of the urogenital sinus. •The spongy urethra is formed from the phallic part of the urogenital sinus.	•Urethra is formed from the pelvic part of the urogenital sinus