

- **Kidney development:**

- Intermediate mesoderm origin, forms the urogenital ridge at 3 week.
- Urogenital ridge forms clumps rostral-caudal called nephrotomes, which form nephric tubules
- Nephric tubules form in rostral-caudal order:
  - Pronephric tubules (C5-C7)
  - Mesonephric tubules (T1-L3)
  - Metanephros (L3-L5)
- Nephric tubules first drain into an early common archinephric duct, which then becomes the Wolffian duct.
- Wolffian duct grow a ureteric bud branch into the metanephros
  - Metanephros signalling induce ureteric bud branching forming calyx (calyces), collecting duct
  - Ureteric bud signalling induce metanephros cell proliferation and nephron formation
  - Ureteric bud branching can be disrupted with extreme levels of vitamin A or high glucose
- During development gonads migrate down from thoracic region while kidneys move up from pelvic region
  - Originally located below the common iliac artery, the kidneys move up gradually , bringing urethra along, blood vessel undergo a series of degeneration and reformation. Until kidneys reach its position against supradrenal glands.
- Developmental anomalies:
  - Horseshoe kidney: two metanephros fused together, failed to bypass inferior mesentery artery to migrate upwards.
  - Pelvic kidney where one kidney fails to migrate upwards

- **Bladder development**

- Initially, allantois from the yolk sac and primitive hindgut merge into the cloaca
- Inferior extension of the urorectal fold induce separation between superior urogenital sinus and inferior primitive rectum (occurs at 4-6 weeks)
- Upper urogenital sinus further develop into the bladder while lower urogenital sinus develop into urethra
- Genital tubercle dorsal to the urogenital sinus develop into the penis/clitoris
- Mesonephric (Wolffian) duct joins the urogenital sinus - forming the ureter and Vas Deferens
  - Mesonephric duct join primitive bladder at the superior portion, gradually incorporating the duct into bladder wall.
  - Merging of duct up to the branching point of ureteric bud, separation of entry points between two set of ducts
  - Mesonephric Wolffian duct continue to merge and move downwards to join the urethra - eventually becomes the vas deferens, forming the trigone region along the way
  - Ureteric bud becomes the ureter.

- **Reproductive system development**

- Superior part of the Wolffian duct joins the testes, allow the duct to become vas deferens
- Inferior part joins the urogenital sinus, later joins the urethra
- Mullerian duct forms during development, also joins the urogenital sinus
- Sex-determining Region on Y chromosome (SRY gene) induce degeneration of the mullerian duct in males, in absence of SRY, Wolffian duct degenerates.
- Mullerian duct becomes oviduct, with inferior part merging to form the uterus, upper vagina.