

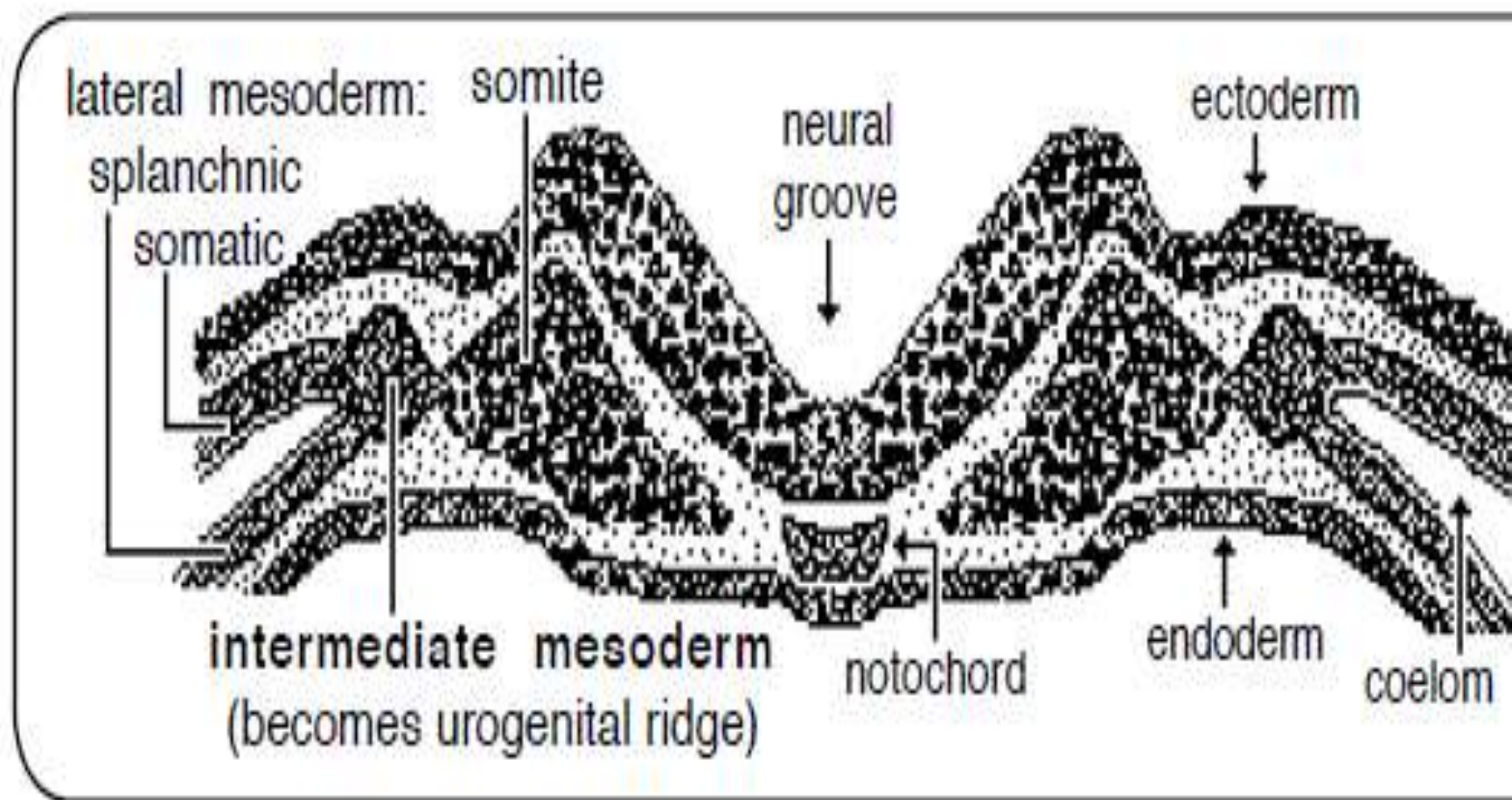
Embryology

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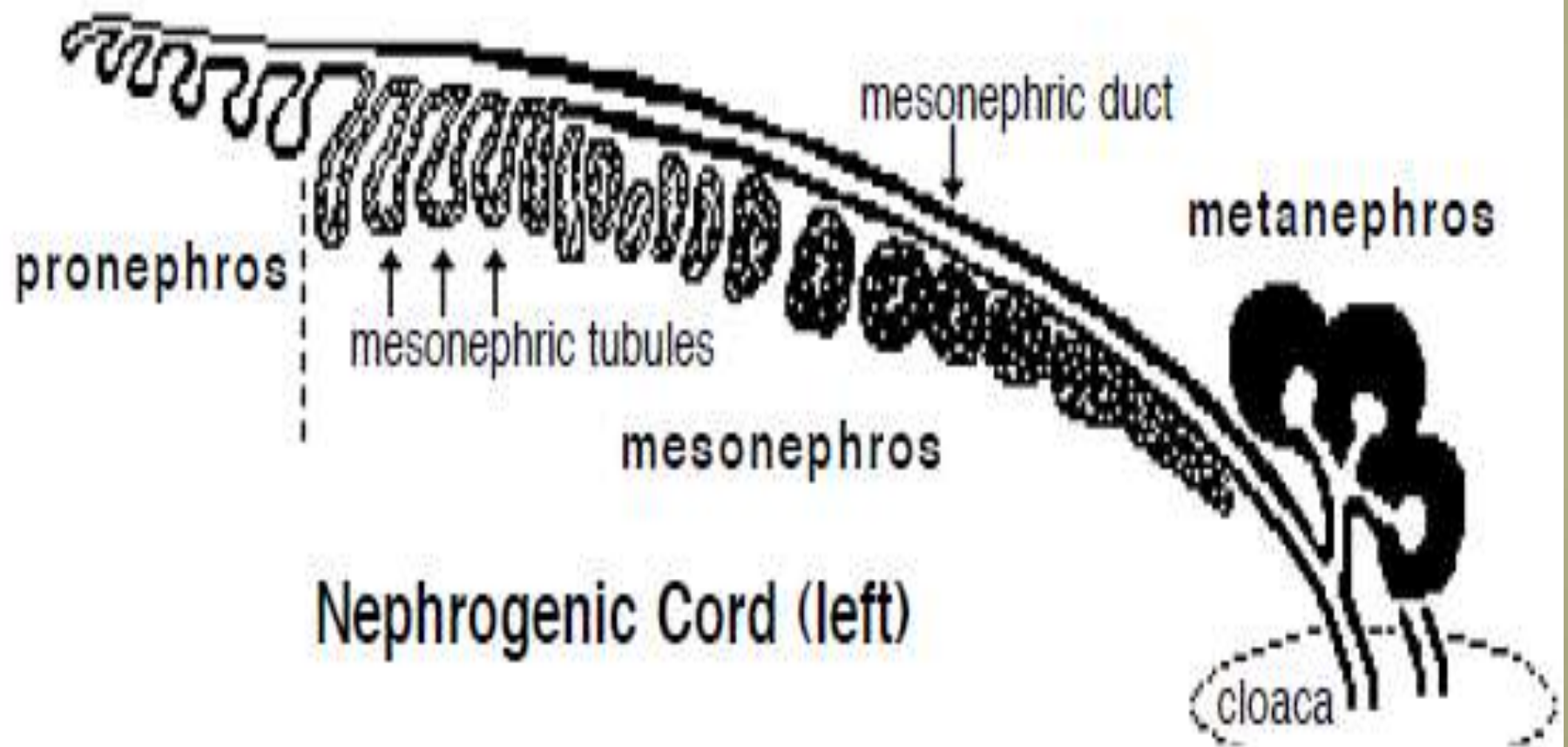
Urinary System

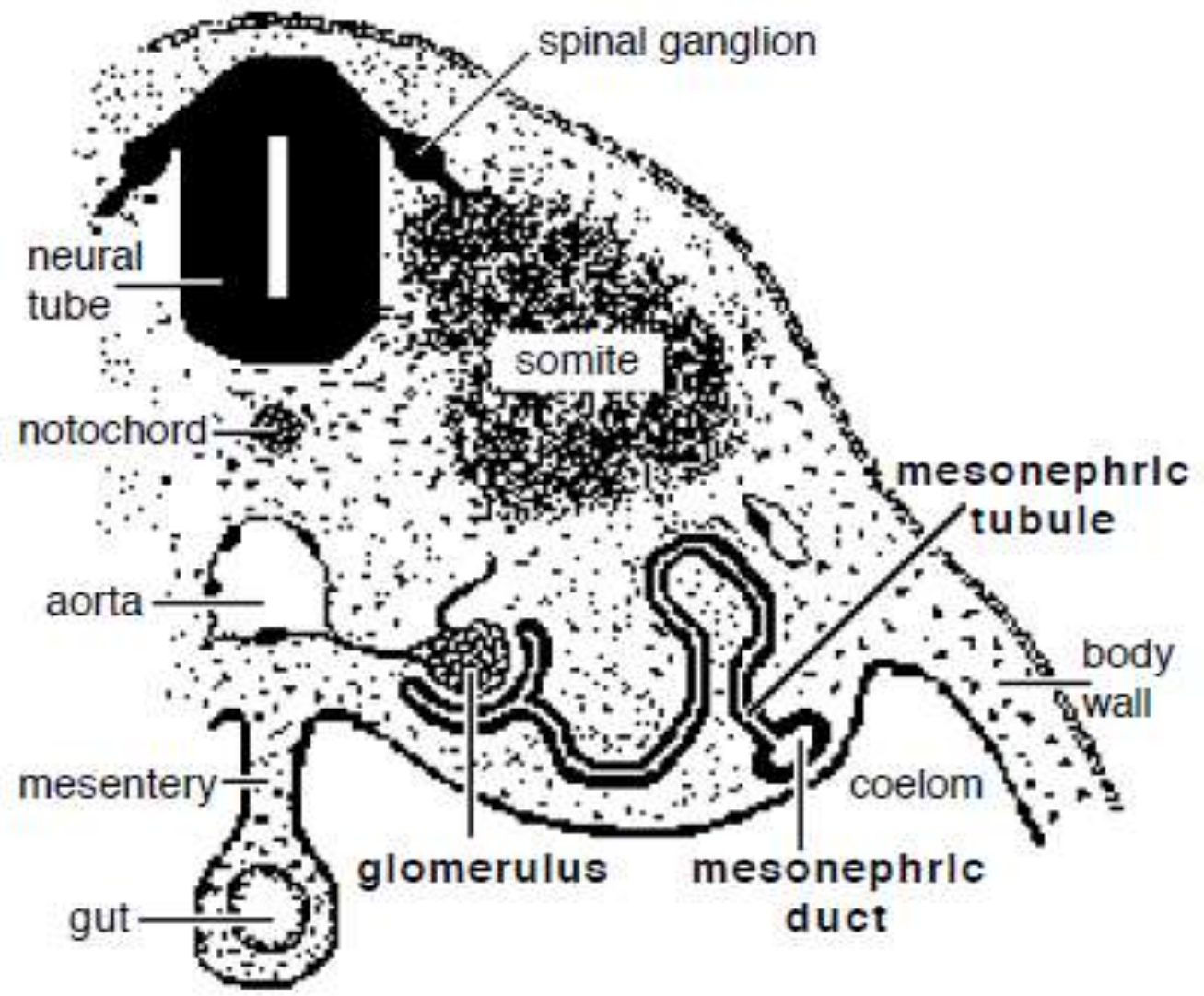
- *Intermediate mesoderm forms a urogenital ridge, which consists of a laterally-positioned nephrogenic cord (that forms kidneys & ureter) and a medially-positioned gonadal ridge (for ovary/testis & female/male genital tract formation). Thus urinary & genital systems have a common embryonic origin; also, they share common ducts.*
- **NOTE:** *Intermediate mesoderm is situated between somites and lateral mesoderm (somatic and splanchnic mesoderm bordering the coelom)*



Kidneys:

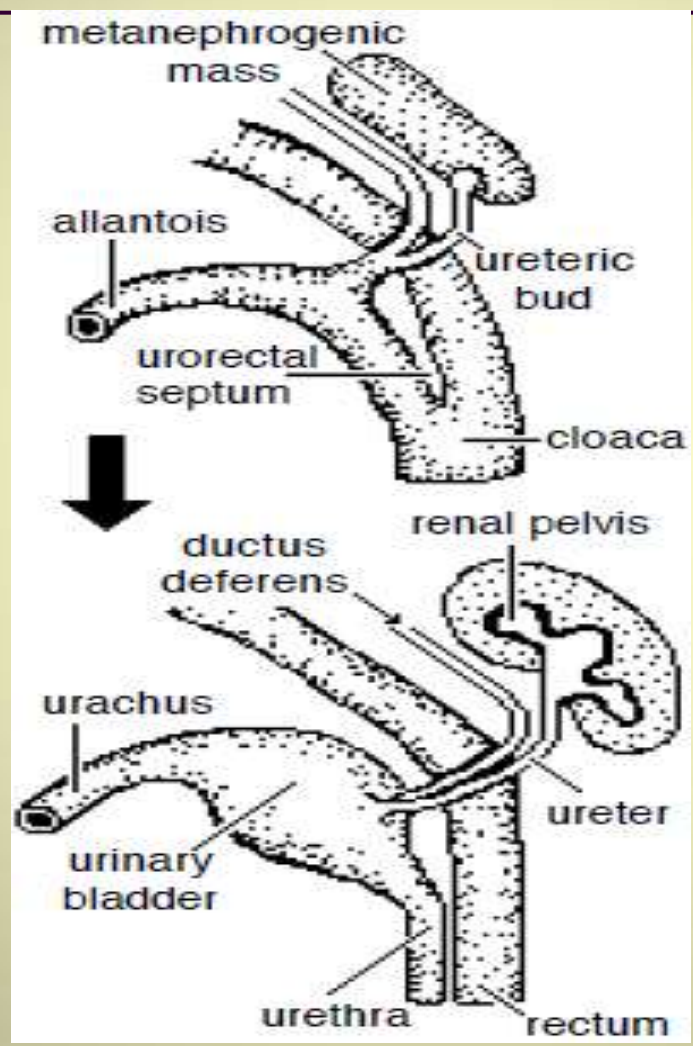
- *Bilaterally, three kidneys develop from the nephrogenic cord. They develop in cranial caudal sequence, and are designated pro—, meso—, and metanephros respectively.*
- *The pronephros and mesonephros develop similarly:*
- *the nephrogenic cord undergoes segmentation,*
- *segments become tubules, tubules drain into a duct & eventually tubules disintegrate*
- *1-**Pronephros**—consists of (7-8) primitive tubules and a pronephric duct that grows caudally and terminates in the cloaca. The tubules soon degenerate, but the pronephric duct persists as the mesonephric duct. (The pronephros is not functional, except in sheep.)*



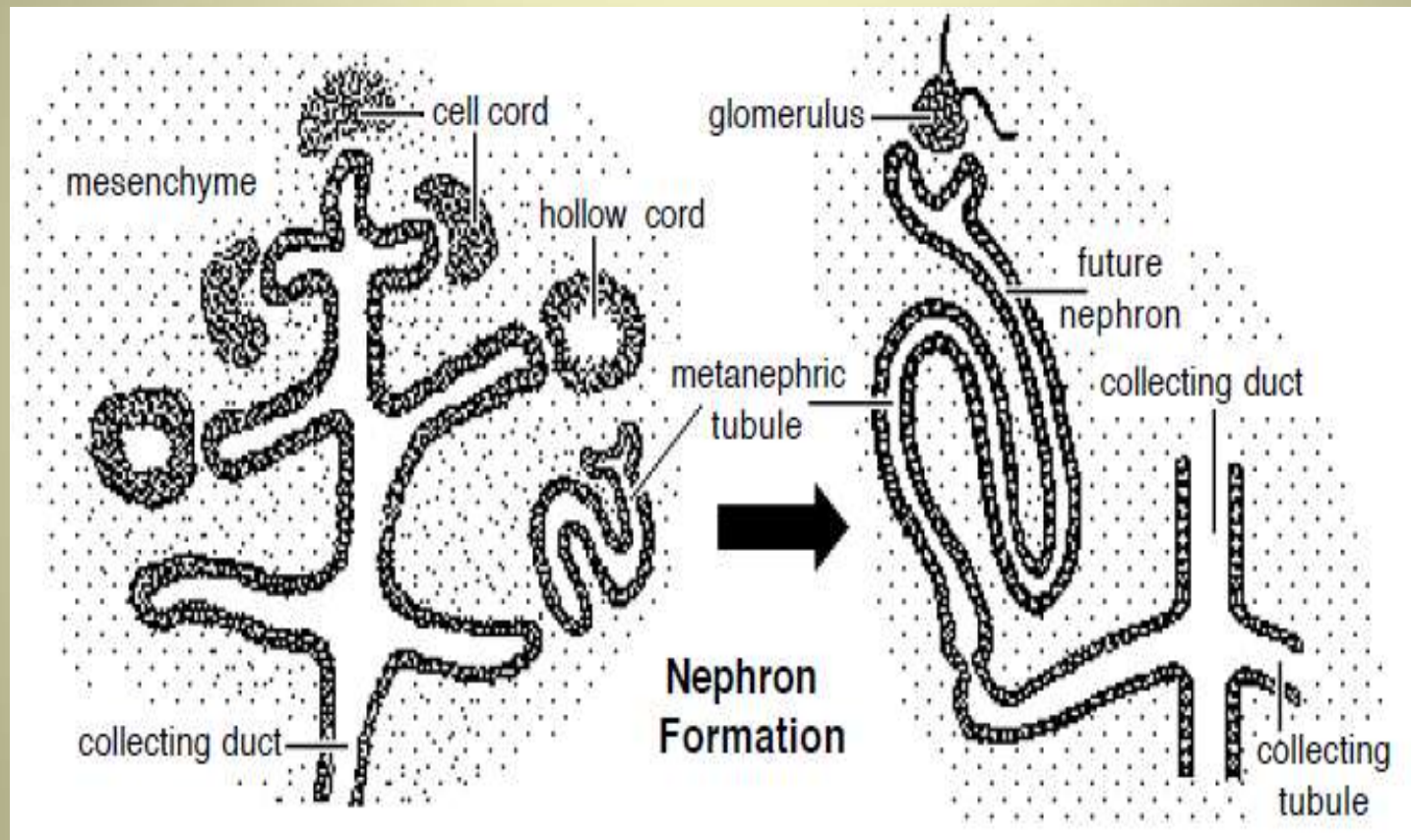


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- **2- Mesonephros**—consists of (70-80) tubules induced to form by the mesonephric duct (former pronephric duct). One end of each tubule surrounds a vascular proliferation (glomerulus) produced by a branch of dorsal aorta. The other end of the tubule communicates with the mesonephric duct. The mesonephros eventually degenerates, but a few tubules that become incorporated within the testis and the mesonephric duct becomes epididymis ductus deferens in the male. (Functional development of the mesonephros is inversely related to the numbers of tissue layers in the placenta, among species.)

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- **3 -Metanephros**—becomes the adult kidney and ureter of mammals, birds, and reptiles. The metanephros originates in the pelvic region and “ascends” cranially into the abdomen by differential growth. The kidney is lobulated initially and subsequently becomes smooth in most species. The metanephros originates from two sources:
 - — a ureteric bud : grows out of the mesonephric duct in the region of the cloaca; the bud eventually develops into the ureter, renal pelvis, and numerous collecting ducts;
 - — metanephrogenic mass, which is the caudal region of the nephrogenic cord.
 - *Note: When the ureteric bud grows into the mesoderm, it induces the metanephrogenic mass to develop; in turn, the mass induces the cranial end of the ureteric bud to differentiate into renal pelvis and collecting tubules—these, in turn, induce the metanephrogenic mass cells to form nephrons.*



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- ***The metanephrogenic mass forms nephrons in the following manner:***
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 - • *adjacent to collecting tubules, mesodermal cells proliferate to form cell cords; the cords canalize and elongate, becoming S-shaped metanephric tubules and eventually nephrons;*
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 - • *one end of each metanephric tubule establishes communication with a collecting tubule; the other end of the tubule expands to surround a capillary glomerulus (forming a glomerular capsule);*
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 - • *between the two ends, each metanephric tubule differentiates into the regions characteristic of a nephron (proximal segment, thin loop, & distal segment)*



Urinary Bladder and Urethra

- *A urorectal septum divides the cloaca into, dorsally, a rectum & anal canal and, ventrally, a **urogenital sinus**. The urorectal septum also divides the cloacal membrane into an anal membrane and a urogenital membrane. The membranes subsequently degenerate, resulting in an anus and urogenital orifice, respectively. Cranially, the urogenital sinus connects to the **urachus**,*
- *which is the intra-embryonic stalk of the allantois.*
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- ***Urinary bladder** develops from expansion of the cranial end of the urogenital sinus, including the adjacent portion of the urachus. The expansion incorporates both the mesonephric duct (future ductus deferens) and ureter into the dorsal wall of the urogenital sinus, each with a separate opening. Differential growth of the dorsal wall results in mesonephric duct and ureter openings being switched cranio-caudally, creating a trigone region that anchors the ureters to the bladder & urethra. (The bladder trigone region originates from mesoderm. The rest of the bladder is derived from endoderm.)*

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- **Urethra** develops from the urogenital sinus. The development is gender specific:
 - In females, the mid region of the urogenital sinus becomes urethra. (The caudal region of the urogenital sinus become vestibule. The vagina arises as an outgrowth of the vestibule.)
 - In males, the pelvic urethra develops from the mid region of the urogenital sinus and the penile urethra develops from elongation of the caudal end of the urogenital sinus.
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 - **NOTE:** In the fetus, urine is discharged into the allantoic cavity through the urachus and into the amniotic cavity through the urogenital orifice.

