SCRUBS

STUDENT COLLABORATIVE RESOURCES FOR UNDERSTANDING AND BRODY SUCCESS

SCRUBS is a student driven initiative that aims to develop supplemental resources for current and future cohorts that will pass through Brody. Members of **SCRUBS** participate in a variety of sub-committees working to create resources for students, by students. These resources aim to offer unique perspectives from students who have walked in the same shoes and can develop resources that we wish we had been exposed to during our time in the course.

The hope is this organization will become a staple of the Brody student body, exemplifying the unique collaborative community that Brody offers. If this is a mission that aligns with your goals and you have the desire to help those that will come behind you, as well as a goal to leave your mark on Brody as a whole, we invite you to join the team!

Disclaimer:

The resources that are included in this document are made by students and not the faculty. As such, there is the possibility for errors in our development, although this is mitigated via a team approach to development with multiple stages of vetting. If there is a contradiction with the coursework presented within your course, please go by the course documents. Additionally, **SCRUBS** aims to supply ***supplemental resources***, however these are in no way replacements to the instruction of the Brody faculty. Use these resources as a supplement, but not as your primary source for course material.

Coursepack Practice Questions

Embryology Chapter 11 - Urinary System and Suprarenal Gland

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Quiz Level

1. During the development of the bladder, the middle pelvic part of the urogenital sinus corresponds to the development of which structure?

A) Presumptive urinary bladder
B) Allantois
C) Vestibule of the vagina
D) Entire male urethra
E) Entire female urethra

2. Which of the following structures is NOT derived from the ureteric bud (aka metanephric diverticulum)?

A) The ureter
B) Minor calyces
C) Distal convoluted tubule
D) Collecting tubule
E) Renal pelvis

3. Which of the following correctly pairs the germ layer with the derivative?

A) Ectoderm → Epithelial lining of female urethra
B) Intermediate Mesoderm → Suprarenal/Adrenal medulla
C) Endoderm → Epithelial lining of distal portion of male urethra
D) Splanchnic Mesoderm → Detrusor muscle of urinary bladder
E) Intermediate Mesoderm → Epithelial lining of urinary bladder

4. Which of the urethral components below has no correlation to the development/formation of the navicular fossa in males?

A) Ectodermal cord
B) Glandular plate
C) Penile (spongy) urethra
D) Endoderm of inferior urogenital sinus (phallic portion)
E) Intermediate/membranous urethra

5. Which of the following clinical embryology pathologies is NOT typically benign/asymptomatic?

A) Urachal cysts
B) Ectopic Ureter
C) Unilateral Renal Agenesis
D) Posteriorly facing kidney
E) Horseshoe Kidney

Test Level

6. A pregnant woman goes to her OBGYN appointment, where her physician advises her that they see less amniotic fluid than expected for her gestational age. It is later discovered that there is an issue with the fetus' kidney development, and no urine is being contributed to the amniotic fluid. Unfortunately, the infant dies shortly after birth. What embryologic defect did the infant have?

A) Ectopic Ureter
B) Accessory Renal Arteries
C) Bilateral Renal Agenesis
D) Exstrophy of the Bladder
E) Unilateral Renal Agenesis

7. The mesonephric kidneys produce small amounts of urine throughout the first trimester (until about the 3rd month of development). In order to produce urine, they must have functional mesonephric units, functioning similar to nephrons in the adult. Which answer choice correctly describes the constitution of a mesonephric unit?

A) Renal corpuscle consisting of Bowman's capsule with invaginated glomerulus on the medial end of the mesonephric tubule. The glomerulus is connected to the aorta, and each mesonephric tubule connects to a mesonephric duct.
B) Renal corpuscle consisting of Bowman's capsule with invaginated glomerulus on the lateral end of the mesonephric tubule. The glomerulus is connected to the aorta, and each mesonephric tubule connects to a mesonephric duct.
C) Renal corpuscle consisting of Bowman's capsule with invaginated glomerulus on the medial end of the mesonephric tubule. The glomerulus is connected to the vena cava, and each mesonephric tubule connects to a mesonephric duct.
D) Renal corpuscle consisting of Bowman's capsule with invaginated glomerulus on the lateral end of the mesonephric tubule. The glomerulus is connected to the vena cava, and each mesonephric tubule connects to a mesonephric duct.

8. Which statement below is incorrect regarding positional changes of the kidneys?

A) The kidneys will “ascend” laterally to a lumbar site just caudal to the suprarenal glands (as the body caudal to the kidneys elongates)
B) The kidneys will rotate laterally 90 degrees as they ascend and will each end up being located at the same lumbar level in the adult.
C) The kidneys are initially positioned with the hilum/renal vessels facing anteriorly. After their ascent, the hilum/renal vessels face the midline.
D) The kidneys have changes in blood supply as they ascend. They initially receive branches from the common iliac artery, but the definitive renal arteries should form directly from the aorta.
E) If renal arteries formed during the kidneys’ ascent do not degrade after the kidney has reached its definitive location, they may persist as accessory renal arteries.

9. The posterior body wall of the bladder incorporates each mesonephric duct with its attached caudal end of the ureter. Which statement below is true about this process?

A) The mesonephric ducts contribute mesoderm to the trigone of the bladder, which is then overtaken by bladder endoderm
B) As the mesonephric ducts are incorporated into the bladder, the ureters come together and enter the bladder at one ureteric orifice (the bottom “point” of the trigone)
C) The ureters enter the bladder directly (i.e. at a perpendicular angle) at the fundus of the bladder
D) The mesonephric ducts degrade in males, but are incorporated as the fallopian tubes in females
E) The mesonephric duct fuses and is incorporated into the ureter, becoming one tube that is then incorporated into the bladder.

10. The adrenal glands have 3 main precursors: mesothelium, mesenchyme, and neural crest cells. Match these precursors correctly with their adrenal gland location and products:

A) Mesothelium – cortex, steroids; Mesenchyme – cortex, catecholamines; Neural Crest Cells – medulla, catecholamines
B) Mesothelium – medulla, catecholamines; Mesenchyme – medulla, catecholamines; Neural Crest Cells – cortex, steroids
C) Mesothelium – cortex, steroids; Mesenchyme – cortex, steroids; Neural Crest Cells – medulla, catecholamines
D) Mesothelium – cortex, catecholamines; Mesenchyme – cortex, catecholamines; Neural Crest Cells – medulla, steroids
E) Mesothelium – medulla, steroids; Mesenchyme – cortex, catecholamines; Neural Crest Cells – cortex, catecholamines

Answers

1. The correct answer is E – The entire female urethra.
The pelvic/middle portion of the urogenital sinus forms the entire female urethra, and the intermediate and prostatic urethra in males. The presumptive urinary bladder (A) and the allantois (B) are derivatives of the vesical portion of the urogenital sinus, the vestibule of the vagina (C) is a derivative of the phallic portion of the urogenital sinus, and D – the entire male urethra – is incorrect as it is only the intermediate and prostatic portions of the male urethra which are derived from the pelvic portion. Most of the penile (spongy) urethra in males comes from the phallic portion of the urogenital sinus.

2. The correct answer is C – The distal convoluted tubule.
The distal convoluted tubule is associated with the nephron, which means it would be a derivative of the metanephrogenic blastema. It is also the last component of the nephron that is correlated with the metanephrogenic blastema – it connects with the arched collecting tubule, which is a ureteric bud/metanephric diverticulum derivative. The other answer choices – ureter (A), minor calyces (B), Collecting tubule (D), and Renal Pelvis (E) – are all derivatives of the ureteric bud.

SUMMARY OF KIDNEY AND URETER EMBRYONIC STRUCTURES AND DERIVATIVES

Embryonic Structure	Derivatives
Metanephric diverticulum (Ureteric bud)	Collecting tubules, collecting ducts, minor calyces, major calyces, renal pelvis, ureter
Metanephrogenic blastema	Renal glomerulus (capillaries), Bowman's capsule, proximal convoluted tubule, loop of Henle, distal convoluted tubule

3. The correct answer is D - Splanchnic Mesoderm → Detrusor muscle of urinary bladder.
All other answer choices incorrectly correlate the germ layer with the derivative (see chart).

Germ Layer	Derivatives
Ectoderm	Epithelial lining of distal portion of male urethra
Neuroectoderm (neural crest)	Suprarenal medulla
Mesoderm (intermediate)	Kidneys, ureters, suprarenal cortex
Mesoderm (splanchnic)	Detrusor muscle of urinary bladder
Endoderm	Epithelial lining of urinary bladder, epithelial lining of female urethra, epithelial lining of most of male urethra

4. The correct answer is E – Intermediate/membranous urethra.
This portion of the urethra does not correlate with the formation of the navicular fossa. The ectodermal cord (A) and glandular plate (B) are different names for the same thing: the solid ingrowth of ectodermal cells from the glans of the penis. The penile/spongy urethra (C) and "endoderm of the inferior portion of the urogenital sinus (phallic portion)" (D) both refer to the portion of the penile urethra that will end up meeting with the ingrowth of ectodermal cells, which

allows for the formation of the navicular fossa. The intermediate/membranous urethra is not correlated with the navicular fossa in any way.

5. The correct answer is B – Ectopic Ureter.
Ectopic ureter refers to when the ureter opens anywhere except into the urinary bladder. It is commonly associated with the symptom of incontinence as urine is not carried to the bladder. Urine continually dribbles from the urethra in males, and either the urethra or vagina in females (depending on the location of the ectopic ureter). Urachal cysts (A) are typically asymptomatic unless infected. Unilateral renal agenesis (C) is typically asymptomatic. Posteriorly facing kidney (D) occurs when the kidney rotates too far medially and is associated with ectopic kidneys. No associated symptoms are listed. Horseshoe kidney (E) is also usually asymptomatic.

6. The Correct answer is C – Bilateral Renal Agenesis.
This pathology corresponds to no renal development at all (no kidneys), leading to oligohydramnios (decreased amniotic fluid) from little to no urine development. This is different from unilateral renal agenesis (E), where one kidney does develop – this condition is typically asymptomatic. Ectopic Ureter (A), Accessory Renal Artery (B), and Exstrophy of the Bladder (D) are not correlated with any of these symptoms.

7. The correct answer is A – Renal corpuscle consisting of Bowman's capsule with invaginated glomerulus on the medial end of the mesonephric tubule.
The glomerulus is connected to the aorta, and each mesonephric tubule connects to a mesonephric duct. C and D are wrong because the glomerulus does not connect to the vena cava, but instead gets its blood supply for filtration from the aorta. B is wrong because the renal corpuscle (with Bowman's capsule and the glomerulus) is located on the medial end of the mesonephric tubule, not the lateral end.

8. The correct answer is B – The kidneys will rotate laterally 90 degrees as they ascend and will each end up being located at the same lumbar level in the adult.
This statement is false; the kidneys will MEDIALLY rotate 90 degrees during their ascent, and they will also not end up at the same lumbar level. The right kidney is slightly lower due to the presence of the liver. All other answer choices are correct.

9. The correct answer is A – the mesonephric ducts contribute mesoderm to the trigone of the bladder, which is then overtaken by bladder endoderm.
B is wrong as the ureters enter the bladder separately in two distinct ureteric orifices → these are the top two points of the trigone. C is wrong because the ureters enter the bladder obliquely at its base. D is wrong because the mesonephric ducts degrade in females, not males; in males, they become the ejaculatory ducts and enter the prostatic urethra. E is wrong because the ureter and mesonephric duct stay separate from each other, they do not become one tube before incorporation into the bladder.

10. The correct answer is C – Mesothelium – cortex, steroids; Mesenchyme – cortex, steroids; Neural Crest Cells – medulla, catecholamines.
All other answer choices incorrectly pair one or more of the structures listed. The mesothelium and mesenchyme both contribute to the development of the cortex of the adrenal gland, which

produces steroids. The invading neural crest cells contribute to the development of the medulla of the adrenal gland, which produces catecholamines.