

## Mastery Series: Nephron Physiology and Urine Formation

1. What are the three processes involved in filtration?
  - a. In which part (or parts) of the nephron are these processes occurring?
  - b. Which capillary bed is associated with filtration?
  - c. Which capillary bed is associated with reabsorption and secretion?
  - d. If creatinine is "secreted", is it going from the peritubular caps→tubule; or the other way around?
2. What happens at the PCT (and what does it stand for and why does that name make sense)?
3. The DCT is MOST sensitive to the hormone \_\_\_\_\_.
4. The collecting duct is MOST sensitive to the hormone \_\_\_\_\_.
5. What is the primary substance that IS filtered but should always be reabsorbed fully by the kidney?
  - a. Why might this substance end up in the urine?
6. What are the primary substances that are NOT supposed to be filtered at the glomerulus?
  - a. Why might one of these substances end up in the urine?
7. Define renal clearance and transport maximum.
  - a. Give an example of a substance that has FULL renal clearance, and one that should have 0 clearance.
  - b. Why is glucose spilled in the urine if blood sugar is high?
  - c. Why is serum creatinine a good way to judge kidney function?
8. The thick ascending limb of the loop of Henle actively reabsorbs \_\_\_\_\_.
9. Salt reabsorption in the DCT is increased by \_\_\_\_\_.
10. Water reabsorption in the collecting duct is increased by \_\_\_\_\_.
11. Compare the amount of ADH secretion in a dehydrated person and a well-hydrated person (assuming his/her hypothalamus and pituitary gland are properly functioning).
12. As people age, they may stop making and releasing as much ADH. How might this affect their ability to concentrate their urine?
13. Compare the amount of aldosterone secretion in a dehydrated person and a well-hydrated person.
14. Describe the structure of JGA (and what does it stand for)?
  - a. Cells from which two parts of the nephron interact here?
  - b. What does it monitor?
  - c. How does it respond if blood volume is low?
  - d. What is the target and effect of EPO?
  - e. Describe each step in the RAAS system.
  - f. Which of the two hormones/enzymes released from the JGA has the quicker effect? Why?
15. What would you say is the purpose of the loop of Henle (why do we need that part)?
16. If you could only have Bowman's capsule and one other part of the nephron, which would you pick and why?

## Nephron Physiology ; Urine Formation Mastery Series Answers

1. a) Bowman's capsule; b) glomerular capillaries; c) peritubular capillaries; d) capillaries→tubule
2. proximal convoluted tubule is proximal to the glomerulus and it's twisty (convoluted); reabsorption of 80% of the filtrate occurs here. Lots of active transport of glucose, salt, water, H<sup>+</sup> or HCO<sub>3</sub><sup>-</sup> (depending on whether the blood is acidic or alkaline)
3. aldosterone
4. ADH
5. Glucose. They can end up in the urine if there are simply too much of them. There is a transport maximum for glucose.
6. Proteins; RBCs; WBCs. They can end up in the urine if the glomerular capillaries are damaged (by trauma, hyperglycemia, or hypertension)
7. **Renal Clearance**—amount of substance that ends up in the urine (“clears the kidney”) compared with how much was in the arterial blood entering the kidneys. **Transport Maximum**—the maximum amount of a substance that be reabsorbed as it passes through the tubules. a) creatinine should have full renal clearance; and glucose should have zero. b) Glucose is spilled in the urine during hyperglycemia because the amount coming through the nephron is greater than the ability of the nephron to pump it (reabsorb it) back into the blood. c) because it should have 100% renal clearance if the kidneys are able to secrete as they should. Anything less than that reveals that the kidneys are not performing at a normal level.
8. Na<sup>+</sup>
9. Aldosterone
10. ADH
11. Higher ADH levels during dehydration
12. They will be less able to concentrate their urine.
13. More aldo in dehydration
14. Juxtaglomerular apparatus---found at the junction of the glomerulus and the DCT. a) DCT and glomerular/Bowman's capsule cells b) blood volume and blood oxygen; c) releases erythropoietin and renin; d) bone marrow, increases RBC production; e) renin converts angiotensinogen into angiotensin I; angiotensin converting enzyme converts AI into Angiotensin II. AII causes vasoconstriction, aldo secretion, ADH secretion. f) renin, because AII is ready to go in a few minutes. RBC production takes weeks.
15. Gives us the ability to concentrate urine.
16. PCT, it does the MOST amount of work....for sure.