

Name _____

Course/Section _____

Date _____

Professor/TA _____



Activity 44.1 What is nitrogenous waste, and how is it removed from the body?

In the space below, draw a longitudinal section of a mammalian kidney. Next to this, draw a blowup of a nephron (including Bowman's capsule and the loop of Henle) and its associated collecting duct. Be sure to include the afferent arteriole, glomerulus, and efferent arteriole that are associated with this nephron.

You may do your drawing in chalk on a tabletop or blackboard if they are available.

Use your drawing and your understanding of the operation of the kidney to answer the questions.

1. Define excretion, and indicate how it differs from elimination?

2. The removal of nitrogenous wastes (excess nitrogen) is a special problem in most animals.

a. Where does the nitrogenous waste come from?

b. What is it about the chemistry of nitrogen that makes it difficult for most animals to deal with?

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3. Work through parts a and b, and then use the information you gather there to answer the question in part c.

a. Describe the composition of the newly filtered solution that enters Bowman's capsule. Then compare it to the composition of the blood entering and leaving the glomerulus.

b. Starting with the solution that escapes into Bowman's capsule from the glomerulus, describe the changes that occur in its composition as it moves through each of these regions:

i. Proximal convoluted tubule

ii. Loop of Henle

iii. Distal convoluted tubule

iv. Collecting duct

v. Urinary bladder

c. Now explain how the general function of the kidney enables it to "remove" (a better expression would be "let out") from the body a wide variety of unfamiliar substances (drugs, inorganic molecules, or ions of many kinds) that the body has never encountered before. After answering this, explain why "let out" from the body is a better expression than "remove."

4. It is useful to consider the excretory system (along with the digestive and gas-exchange systems) as primarily involved in bulk exchange with the external environment. The excretory system could also be interpreted as a specialized part of the external surface of the organism, which in its own way encloses and modifies part of the environment. Describe how this is true for the human kidney. For example:

- a. Where in the kidney does the organism end and the environment begin?
- b. Are changes in the glomerular filtrate changes in the organism, changes in the environment, or both?
- c. What do your answers in parts a and b indicate about the possible evolutionary origins of the kidney?

5. a. What is the difference between hydrostatic pressure and osmotic pressure?

b. Where in the human excretory system is hydrostatic pressure responsible for moving water across a membrane or layer of cells?

c. Where in the excretory system is osmotic pressure responsible?

6. a. You examine the kidney structure and function of a two species of mice, one from the desert and another from a meadow or grassland. What differences would you expect to find? Explain your reasoning.

b. Would you expect the excretory systems of organisms that live in the sea to resemble more closely those of animals that live in deserts or those that live in fresh water? Explain.

7. Many medicines are taken parenterally—that is, swallowed and absorbed from the digestive system. Aspirin and many antibiotics are examples. Even though these drugs may be very different chemically, the instructions for taking them often say “Repeat dose every 4 to 6 hours.” What is the reasoning behind this dose rate? In other words, why do you need to take the medicine every 4 to 6 hours?