

Solute in Plasma, Urine and Nephron

The data in Table 1 represent the results of tests which measured the amount of various solutes normally found in the blood. As you know, when blood passes through the kidneys, some solutes are removed while others remain. The data are relative to the formation of 1 L of urine.

Table 1 Amounts of solutes in blood and urine

Substance	Amount initially filtered out of blood	Amount returned to blood	Amount in urine	% reabsorbed into blood
Water	100 L	99.00 L		
chloride ion	370 g	364 g		
glucose	70 g	70 g		
urea	30 g	10 g		
uric acid	4 g	3.5 g		
calcium ion	10 g	9.85 g		

Questions

- For each substance, calculate the amount left in the urine.
Amount in urine = amount initially filtered out - amount returned to blood.
- For each substance, calculate the percent reabsorbed into the blood.
- On a percentage basis, which of these six substances is most efficiently removed from the blood?
 - On a percentage basis, which two substances are returned to the blood with the highest efficiency?
- What do the answers to question 3 suggest about the importance of these substances?
- How does the body benefit by reabsorbing so much water and so much glucose back into the bloodstream?
 - All glucose is normally returned by the kidneys to the bloodstream. Why, then, do you need to keep eating foods that are a source of new glucose?
- If you had data for someone on a low salt diet, explain the changes you would expect to see in the amount of reabsorption of certain substances.
 - If you had data for someone on a high protein diet, explain the changes you would expect to see in the amount of reabsorption of certain substances.
- What might the presence of glucose in the urine say about levels of glucose in the blood?
 - What disease could cause this condition?

Fluids from Bowman's capsule, the glomerulus, the loop of Henle, and the collecting duct were collected and tested for the presence of several solutes. The data are displayed in Table 2. Unfortunately, some of the data were not recorded, and those absences are indicated on the table by the words "no data."

Table 2 Amounts of various compounds in filtrate

Solute	Glomerulus	Bowman's	Loop of Henle	Collecting Duct

		Capsule		
Protein	8.0	0	0	0
Urea	0.05	0.05	1.50	2.00
Glucose	0.10	no data	0	0
Chloride	0.37	no data	no data	0.6
Substance X	9.15	0	0	0

Note: Quantities are recorded in g/100 mL.

Questions

8. Which of the solutes was/were not filtered into the nephron? Explain your answer.
9. Why is protein not found anywhere except the glomerulus?
10. Unfortunately, the test for glucose was not completed for the sample taken from Bowman's capsule. Predict whether or not glucose would be found in Bowman's capsule. Provide reasons for your prediction.
11. If the presence of amino acids had been checked, what would you expect to find?
12. Why does the urea level increase after filtration occurs?
13. Chloride ions (Cl^-) follow actively transported Na^+ ions from the nephron into the blood. You might expect the $[\text{Cl}^-]$ to decrease toward the collecting duct. Why is that not what we observe?
14. Suggest a possible identity for Substance X. Support your suggestion.