

Topic 11.3 The Kidney and Osmoregulation

Instructions: Read pages 485-498 in your biology textbook. Then define the below vocabulary words and address the below questions in a separate document.

Vocabulary words:

| | | |
|-------------------|----------------------------|----------------------------|
| Osmolarity | Ultrafiltration | Loop of Henlé |
| Osmoregulator | Podocytes | Medulla |
| Osmoconformer | Fenestrations | ADH (antidiuretic hormone) |
| Hemolymph | Basement Membrane | Dehydration |
| Malpighian tubule | Bowman's Capsule | Overhydration |
| Excretion | Proximal convoluted tubule | Dialysis |
| Glomerulus | Nephron | Urinalysis |

1.3.U1: Animals are either osmoregulators or osmoconformers (Oxford Biology Course Companion page 485).

1. Define osmoregulator and osmoconformer.
2. List three example osmoregulator animals and three example osmoconformer animals.

11.3.U2: The Malpighian tubule system in insects and the kidney carry out osmoregulation and removal of nitrogenous wastes (Oxford Biology Course Companion page 486).

1. Define osmoregulation.
2. State the nitrogenous waste products found in insects and mammals.
3. Outline the structure and function of the Malpighian tubule system.

11.3.U3: The composition of blood in the renal artery is different from that in the renal vein (Oxford Biology Course Companion page 487).

4. State the functions of the kidney.
5. Distinguish between osmoregulation and excretion.
6. List 4 substances that are found in higher concentration in the renal artery than in the renal vein.
7. Compare the relative glucose, oxygen and carbon dioxide concentrations between the renal artery and the renal vein.
8. Identify the plasma proteins concentrations in the renal artery and renal vein. Describe your findings.

11.3.U4: The utrastructure of the glomerulus and Bowman's capsule facilitate ultrafiltration (Oxford Biology Course Companion page 489).

9. Outline the cause and effect of high blood pressure in the kidney glomerulus.
10. List solutes found in glomerular filtrate.
11. Define filtrate and ultrafiltration.
12. Explain why plasma proteins and blood cells are not part of glomerular filtrate.
13. On the diagram of the glomerulus label the basement membrane, fenestrations, podocyte foot processes, podocytes.
14. Outline the role of fenestration, the basement membrane and podocytes in ultrafiltration.
15. Describe the relationship between the glomerulus and Bowman's capsule.



11.3.U5: The proximal convoluted tubule selectively reabsorbs useful substances by active transport (Oxford Biology Course Companion page 491).

16. Complete the table on the reabsorption of substances from the glomerular filtrate by the proximal convoluted tubule, and describe the mechanism that reabsorbs them.

| Substance | Mechanism |
|---------------|--|
| Sodium ions | |
| Chloride ions | |
| Glucose | |
| Amino acids | <i>Co-transported by co-transporter proteins in outer membrane of tubule; Amino acids are actively moved out of filtrate as sodium ions move down concentration gradient</i> |
| Water | |

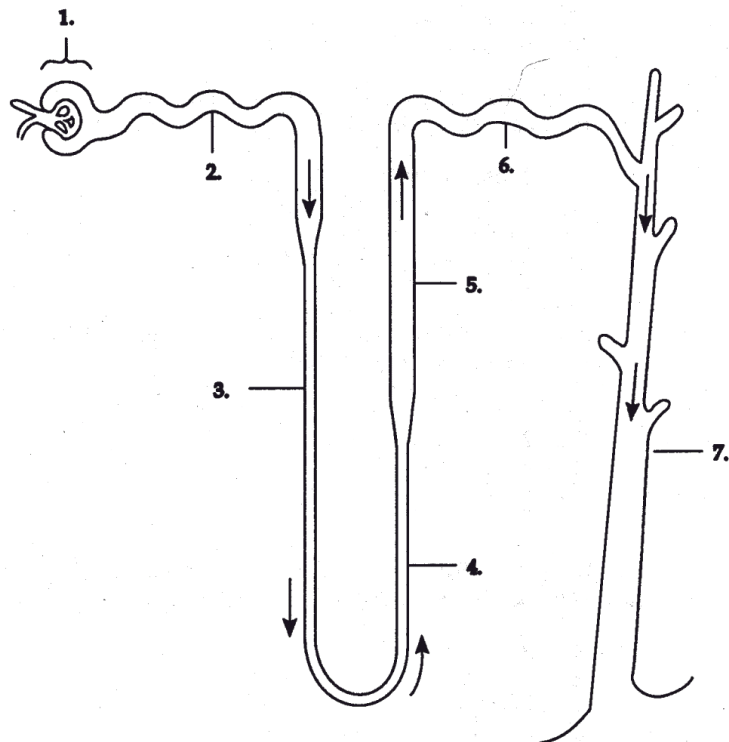
17. Explain why cells lining the lumen of the proximal convoluted tubule have microvilli and many mitochondria.

11.3.U6: The loop Henle maintains hypertonic conditions in the medulla (Oxford Biology Course Companion page 492).

18. State the overall function of the loop of Henlé.

19. Outline the role of interstitial fluid in osmoregulation.

20. Annotate the diagram to describe the structure and function of the descending **and** ascending limb of the loop of Henlé.



21. Describe why the loop of Henlé is a countercurrent multiplier system.

11.3.U7: The length of the loop of Henlé is positively correlated with the need for water conservation in animals (Oxford Biology Course Companion page 493).

22. Complete the DBQ: Medulla thickness and urine concentration on page 493.

11.3.U8: ADH controls reabsorption of water in the collecting duct (Oxford Biology Course Companion page 494).

23. Outline the tonicity of filtrate entering the distal convoluted tubule from the loop of Henlé.

24. Complete the table below on the affect of low blood solute concentration **and** high blood solute concentration on:

| | Low blood solute concentration | High blood solute concentration |
|---|---------------------------------------|--|
| The volume of urine produced | | |
| Solute concentration in the urine | | |
| Permeability of the distal convoluted tubule and collecting duct to water | | |
| Volume of water reabsorbed | | |

25. Outline the source and function of ADH in osmoregulation.

11.3.U9: The type of nitrogenous waste in animals is correlates with evolutionary history and habitat (Oxford Biology Course Companion page 495).

26. Outline the production and effect of ammonia in animals.

27. Outline the nitrogenous waste products released different organisms by completing the table:

| Organism | Primary Habitat | Waste Product |
|-----------------------|------------------------|----------------------|
| Aquatic organisms | | |
| Marine mammals | | |
| Amphibians | | |
| Terrestrial organisms | | |
| Birds and insects | | |

28. Compare urea and uric acid.