**Topic 11.3: Kidney and Osmoregulation**

**Essential Idea: All animals excrete nitrogenous waste products and some animals also balance water and solute concentrations.**

**Statements & Objectives:**

**11.3.U1 Animals are either osmoregulators or osmoconformers.**

Define osmoregulator and osmoconformer.

**(Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

List three example osmoregulator animals and three example osmoconformer animals.

(**List** Give a sequence of brief answers with no explanation.)

**11.3.U2 The Malphigian tubule system in insects and the kidney carry out osmoregulation and removal of nitrogenous wastes.**

Define osmoregulation.

**(Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

State the nitrogenous waste products found in insects and mammals.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

Outline the structure and function of the Malpighian tubule system.​

(**Outline** Give a brief account or summary.)

**11.3.U3 The composition of blood in the renal artery is different from that in the renal vein.**

**State the functions of the kidney.**

Distinguish between osmoregulation and excretion.

(**Distinguish** Make clear the differences between two or more concepts or items)

List 4 substances that are found in higher concentration in the renal artery than in the renal vein.

(**List** Give a sequence of brief answers with no explanation.)

Compare the relative glucose, oxygen and carbon dioxide concentrations between the renal artery and the renal vein.

(**Compare** Give an account of the similarities and differences between two (or more) items or situations, referring to both (all) of them throughout.)

State that plasma proteins are not filtered by the kidney so should be present in the same concentration in the renal artery and renal vein.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

**11.3.U4 The ultrastructure of the glomerulus and Bowman’s capsule facilitate ultrafiltration.**

Outline the cause and effect of high blood pressure in the kidney glomerulus.

(**Outline** Give a brief account or summary.)

List solutes found in glomerular filtrate.

(**List** Give a sequence of brief answers with no explanation.)

Define filtrate and ultrafiltration.

**(Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

Explain why plasma proteins and blood cells are not part of glomerular filtrate.

On a glomerulus diagram, label the basement membrane, fenestrations, podocyte foot processes, podocytes.

(**Explain**: Give a detailed account including reasons or causes)

Outline the role of fenestration, the basement membrane and podocytes in ultrafiltration.

(**Outline** Give a brief account or summary.)

Describe the relationship between the glomerulus and Bowman’s capsule.

(**Describe** Give a detailed account or picture of a situation, event, pattern or process.)

**11.3.U5 The proximal convoluted tubule selectively reabsorbs useful substances by active transport.**

List substances in the glomerular filtrate that are reabsorbed in the proximal convoluted tubule.

(**List** Give a sequence of brief answers with no explanation.)

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

(**Explain**: Give a detailed account including reasons or causes)

Outline the mechanism of selective reabsorption of sodium ions, chloride ions, glucose and water.

(**Outline** Give a brief account or summary.)

**11.3.U6 The loop Henle maintains hypertonic conditions in the medulla.**

State the overall function of the loop of Henle.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

Outline the role of interstitial fluid in osmoregulation.

(**Outline** Give a brief account or summary.)

Describe the structure and function of the descending limb of the loop of Henle.

(**Describe** Give a detailed account or picture of a situation, event, pattern or process.)

Describe the structure and function of the ascending limb of the loop of Henle.

(**Describe** Give a detailed account or picture of a situation, event, pattern or process.)

Describe why the loop of Henle is a countercurrent multiplier system.

(**Describe** Give a detailed account or picture of a situation, event, pattern or process.)

**11.3.U7 The length of the loop of Henle is positively correlated with the need for water conservation in animals.**

Outline the relationship between habitat and length of the loop of Henle.

(**Outline** Give a brief account or summary.)

Outline the relationship between habitat and relative medullary thickness.

(**Outline** Give a brief account or summary.)

**11.3.U8 ADH controls reabsorption of water in the collecting duct.**

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

(**Outline** Give a brief account or summary.)

Outline the of low blood solute concentration on the volume of urine produced, solute concentration in the urine, permeability of the distal convoluted tubule and collecting duct to water and volume of water reabsorbed.

(**Outline** Give a brief account or summary.)

Outline the of high blood solute concentration on the volume of urine produced, solute concentration in the urine, permeability of the distal convoluted tubule and collecting duct to water and volume of water reabsorbed.

(**Outline** Give a brief account or summary.)

Outline the source and function of ADH in osmoregulation.

(**Outline** Give a brief account or summary.)

**1.3.U9 The type of nitrogenous waste in animals is correlates with evolutionary history and habitat.**

Outline the production and effect of ammonia in animals.

(**Outline** Give a brief account or summary.)

State the nitrogenous waste products released by: aquatic organisms, terrestrial organisms, marine mammals, amphibians, birds and insects.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

Compare urea and uric acid.

**(Compare** Give an account of the similarities and differences between two (or more) items or situations, referring to both (all) of them throughout.)

**11.3.A1 Consequences of dehydration and over-hydration.**

Outline the causes and consequences of dehydration.

(**Outline** Give a brief account or summary.)

Outline the causes and consequences of overhydration.

(**Outline** Give a brief account or summary.)

**11.3.A2 Treatment of kidney failure by hemodialysis or kidney transplant.**

List two common causes of kidney failure.

(**List** Give a sequence of brief answers with no explanation.)

Outline the process of hemodialysis.

(**Outline** Give a brief account or summary.)

Outline the process of kidney transplant.

(**Outline** Give a brief account or summary.)

Outline the treatment of kidney stones by ultrasound.​

(**Outline** Give a brief account or summary.)

**11.3.A3 Blood cells, glucose, proteins and drugs are detected in urinary tests.**

Define urinalysis.

**(Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

Outline the use of a urine test strip in detection of diabetes, kidney damage and drug use.

(**Outline** Give a brief account or summary.)

Outline the microscopic examination of urine for detection of infection, kidney stones or kidney tumors.

(**Outline** Give a brief account or summary.)

**11.3.S1 Drawing and labeling a diagram of the human kidney.**

Draw a diagram of a human kidney.

Label the renal artery, renal vein, cortex, medulla, renal pelvis and ureter on a diagram of the human kidney.

(**Label** Add title, labels or brief explanation(s) to a diagram or graph.)

**11.3.S2 Annotations of a diagram of the nephron.**

Define nephron.

**(Define** Give the precise meaning of a word, phrase, concept or physical quantity.)

Annotate a diagram of the nephron with the following structures and associated functions: Bowman’s capsule, proximal convoluted tubule, Loop of Henle,. distal convoluted tubule, collecting duct, afferent arteriole, glomerulus, efferent arteriole, peritubular capillaries, vasa recta and venules.

(**Annotate** Add brief notes to a diagram or graph.)

**11.3.NOS Curiosity about particular phenomena- investigations were carried out to determine how desert animals prevent water loss in their wastes.**

State that many scientific discoveries have come from simple curiosity about particular phenomena.

(**State** Give a specific name, value or other brief answer without explanation or calculation.)

**Key Terms**

Osmoconformer

​Kidney

Bowman’s capsule

basement membrane

podocyte foot processes

​proximal convoluted tubule

​loop of Henle

​ADH

​distal convoluted tubule

​dehydration

​kidney stone

cortex

nephron

peritubular capillaries

​osmoregulation

excretion

​glomerulus

ultrafiltrate

​renal artery

filtrate

fenestrations

​tonicity

​ammonia

overhydration

​ultrasound

medulla

collecting duct

vasa recta

​The Malphigian tubule

renal vein

​facilitate ultrafiltration

​podocytes

​reabsorption

​microvilli

​hyptertonic

​urine

​urea

​hemodialysis

​urinalysis

renal pelvis

​afferent arteriole

​venules.

selective reabsorption

​nitrogenous waste

​plasma proteins

​glomerular filtrate

active transport

​lumen

​interstitial fluid

permeability

uric acid

​transplant

​diabetes

​ureter

efferent arteriole