

Human Physiology

Topic 11



11.3 The Kidney and Osmoregulation

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

Understandings:

- 11.3.U1 Animals are either osmoregulators or osmoconformers.
- 11.3.U2 The Malpighian tubule system in insects and the kidney carry out osmoregulation and removal of nitrogenous wastes.
- 11.3.U3 The composition of blood in the renal artery is different from that in the renal vein.
- 11.3.U4 The ultrastructure of the glomerulus and Bowman's capsule facilitate ultrafiltration.
- 11.3.U5 The proximal convoluted tubule selectively reabsorbs useful substances by active transport.
- 11.3.U6 The loop of Henlé maintains hypertonic conditions in the medulla.

Understandings:

- 11.3.U7 ADH controls reabsorption of water in the collecting duct.
- 11.3.U8 The length of the loop of Henlé is positively correlated with the need for water conservation in animals.
- 11.3.U9 The type of nitrogenous waste in animals is correlated with evolutionary history and habitat.

Applications:

- 11.3.A1 Consequences of dehydration and overhydration.
- 11.3.A2 Treatment of kidney failure by hemodialysis or kidney transplant.
- 11.3.A3 Blood cells, glucose, proteins and drugs are detected in urinary tests.

Skills:

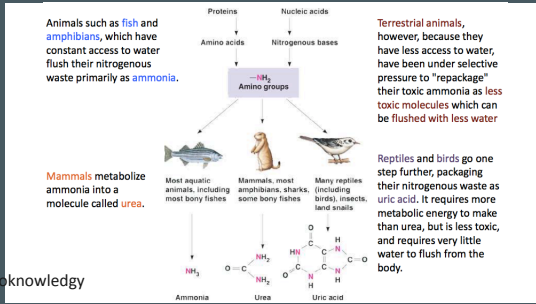
- 11.3.S1 Drawing and labeling a diagram of the human kidney.
- 11.3.S2 Annotation of diagrams of the nephron

I. Excretion of Wastes

A. Excretion is the removal of waste products of metabolism from the body.

Defecation of feces is not the waste product of metabolism, it is the removal of undigested food

1. Most metabolic waste is in the form of nitrogen.



Bioknowledgy

II. Different Responses to Changes in Osmolarity in the Environment

A. Animals are either osmoregulators or osmoconformers-

Osmoconformers maintain an internal conditions that are equal to osmolarity of their environment.

Minimizing the osmotic gradient minimizes the water movement in and out of cells. A disadvantage is that internal conditions may be sub-optimal.

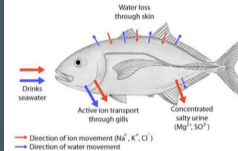
Most Osmoconformers are marine invertebrates, e.g. starfish.

Osmoregulators tightly regulate their body osmolarity, which always stays constant, irrespective of their environment.

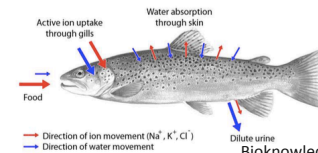
Kidneys play a large role in osmoregulation by regulating the amount of water reabsorbed. A disadvantage is that osmoregulation costs the animal ATP.

Osmoregulators are much more common in the animal kingdom, e.g. bony fish.

Osmoregulation in saltwater fish



Osmoregulation in freshwater fish

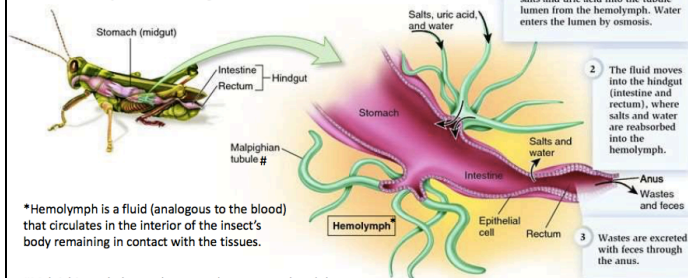


Bioknowledgy

III. The Malpighian Tubule System

A. The Malpighian tubule system in insects and the kidney carry out osmoregulation and removal of nitrogenous wastes-

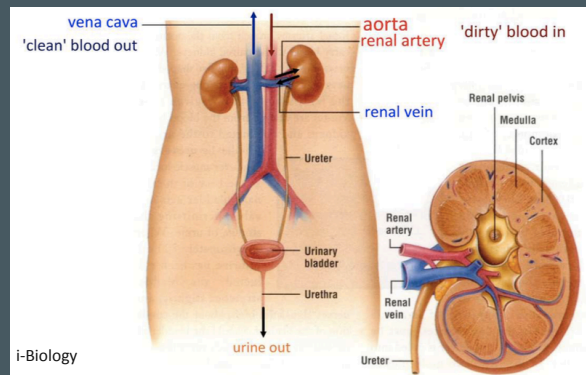
The removal of nitrogenous waste and osmoregulation in insects by the Malpighian tubule



Biology-Forums

III. Comparing the Composition of Blood in the Renal Artery to Vein

B. The urinary (excretory) system filters blood and produces urine-



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Drawing the Human Kidney

A. Drawing and labeling a diagram of the human kidney- Sketch and label the kidney (Draw it Neat)

III. Comparing the Composition of Blood in the Renal Artery to Vein

A. The composition of blood in the renal artery is different from that in the renal vein-

- The kidney's is blood's filtration and balancing system

Medulla
Reabsorption of water

renal vein (filtered blood)
Balanced blood

cortex
Ultrafiltration and selective reabsorption of blood contents

renal artery (unfiltered blood)
Unbalanced blood

ureter (urine)
Carries urine to bladder

pelvis
Collecting ducts deliver urine to the pelvis to be passed on the ureter

i-Biology
*Oxygen and glucose are used for cell respiration in the kidney and carbon dioxide is produced.

III. Comparing the Composition of Blood in the Renal Artery to Vein

- Balancing the blood

Cortex

- Ultrafiltration

2. Reabsorption of
- glucose
- salt
- water

Medulla

- Osmoregulation
- water
- salt

Pelvis

- Excretion
- urea
- toxins
- excess water
- excess salt
- excess ions

i-Biology

IV. The Nephron

A. The nephron is the functional unit of the kidney.

- There are around one million nephrons in each kidney

renal capsule ultrafiltration

proximal convoluted tubule selective reabsorption

distal convoluted tubule secretion of toxins into urine

blood in

blood out

glomerulus delivers blood

descending

ascending

Loop of Henle osmoregulation

collecting duct delivers urine to pelvis

urine

i-Biology

Drawing the Nephron

A. Annotation of Diagrams of the Nephron-
Sketch and label the nephron (Draw it Neat)

