Animals: Urinary System

A urinary system is crucial to balancing the intake and output of water and solutes

Outline

1. Key concepts
2. Urinary system functions
3. Homeostasis
4. Excretory systems
5. Functions of Human kidney
6. Conclusions

Key Concepts:

1. A urinary system is crucial to balancing the intake and output of water and solutes
2. Kidneys are blood-filtering organs, and the urinary system of vertebrates has a pair of them
3. Nephrons receive water and solutes from capillaries
4. Water and solutes not returned to the blood leave the body as fluid called urine
Urinary system functions

1. Removal of wastes
2. Maintenance of homeostasis

Homeostasis

Homeostasis – maintaining constant internal condition.

Regulation of internal environment
A. Excretion of metabolic wastes – wastes of cellular activity.
\[ \text{CO}_2 \] – aerobic respiration (not in kidney!)
\[ \text{NH}_3 \] – ammonia (from protein breakdown)
Ammonia $\rightarrow$ urea
B. Regulation of mineral ions, other chemicals
\[ \text{Na}^+, \text{K}^+, \text{etc.} \]
C. Regulation of water balance
All of the A, B, C are the function of kidney (vertebrates)

Excretory systems

A. Planarian flatworm: network of fine tubules and cilia-lined flame cells $\rightarrow$ elimination of excess water.
B. Earthworm: most body segments have a pair of nephridia (similar in structure and function to the nephron of the human kidney) $\rightarrow$ elimination of \[ \text{NH}_3 \], conservation of water
C. Grasshopper: Malpighian tubules – nitrogen waste products emptied into the hindgut and eliminated along with digestive wastes. (insects no liquid urine)
Insects

Nitrogenous waste disposal

The Human Urinary System

Water gains and losses
Solute gains and losses
A Human Kidney and Blood Vessels

A Human Kidney

Functional Regions of a Nephron
Nephrons: Functional Units

1. Bowman’s capsule
2. Proximal tubule
3. Loop of Henle
4. Distal tubule
5. Collecting Duct
6. Capillaries

Functions of Human kidney

1. Kidney structure
   - Cortex, Medulla, and Renal Pelvis (collecting chamber)
2. Function
   - function unit = Nephron (more than 1 million)
   A. force filtration
      - RBC, WBC, large protein cannot move (forced) across the membrane enter the Bowman’s capsule.
      - AAs, glucose, NaCl, vitamins, H₂O... come out
   B. re-absorption
      - in the proximal tubule region, AAs, NaCl, glucose, vitamins, etc. active transported out of the tubule and back to blood vessels
   C and more next slide
Functions of Human kidney

C. Tubule secretion
in the distal tubule region, some wastes not initially filtered out are actively secreted from blood into the distal tubule for excretion such as K+, H+, ammonia, and many drugs (penicillin, for example)

D. Water back to circulatory system by osmosis
the osmotic concentration gradient of salts produced by the loop of Henle → water comes out of the tubule and into the capillary bed

E. Antidiuretic Hormone (ADH) circulates in blood
can increase the permeability to water (distal tubule and collecting duct region) → more water reabsorbed

Urine Formation

Three Processes

Filtration
At Glomerulus

Reabsorption
Most of water and solutes move back into blood

Secretion (at both Proximal tubule and Distal tubule regions)
Active transport of H+ and K+ into nephron
1. The vertebrate urinary system consists of 2 kidneys, 2 ureters, a bladder, and urethra.
2. Kidneys have many nephrons that filter blood and form urine.
3. Urine forms in the nephron by 3 processes: filtration, reabsorption, and secretion.

I am tired. Let’s call it a day!