



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

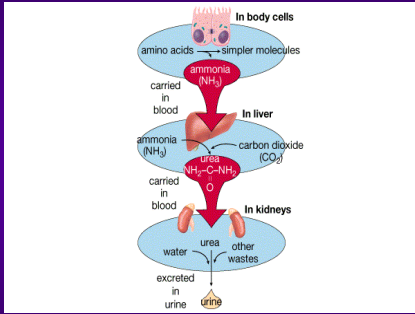


Key Concepts:

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.

CO₂ – aerobic respiration (not in kidney!)

NH₃ – ammonia (from protein breakdown)
ammonia → urea

B. Regulation of mineral ions, other chemicals
Na⁺, K⁺, etc.

C. Regulation of water balance

All of the A, B, C are the function of kidney (vertebrates)

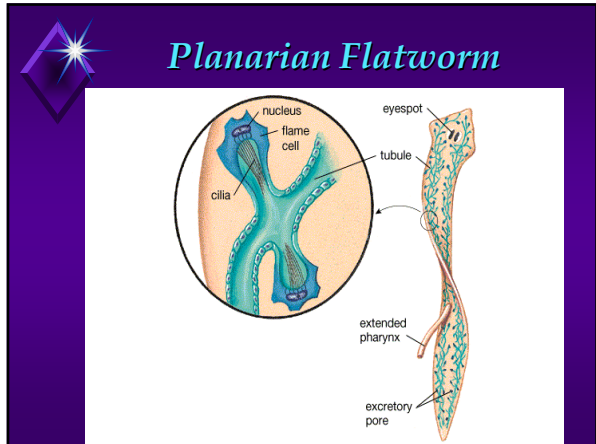


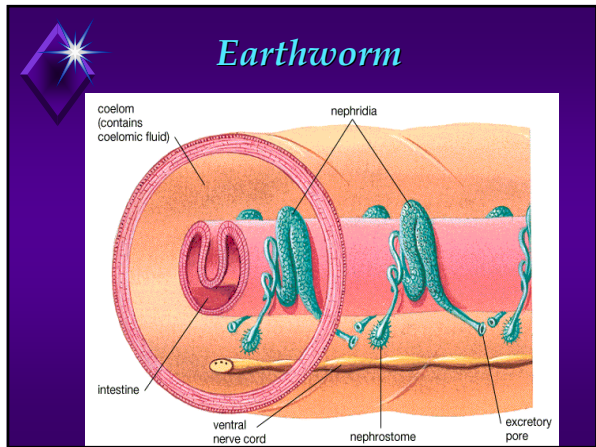
Excretory systems

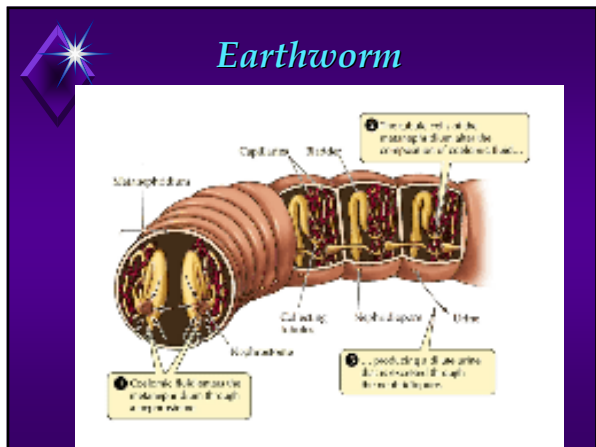
A. **Planarian flatworm:** network of fine tubules and cilia-lined flame cells → elimination of excess water.

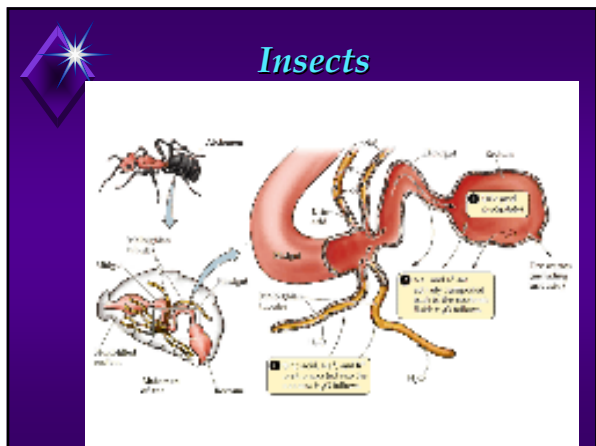
B. **Earthworm:** most body segments have a pair of nephridia (similar in structure and function to the nephron of the human kidney) → elimination of NH₃, conservation of water

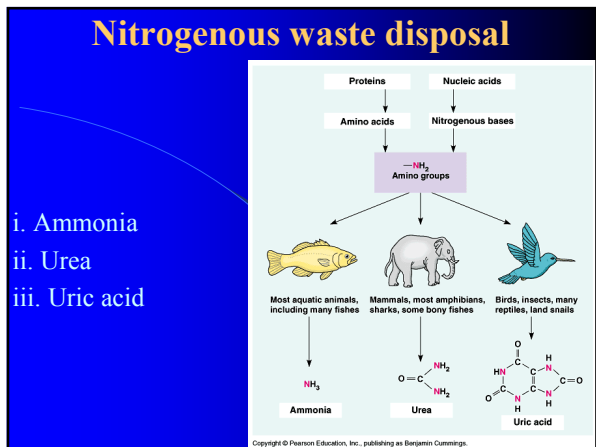
C. **Grasshopper:** Malpighian tubules – nitrogen waste products emptied into the hindgut and eliminated along with digestive wastes. (insects no liquid urine)

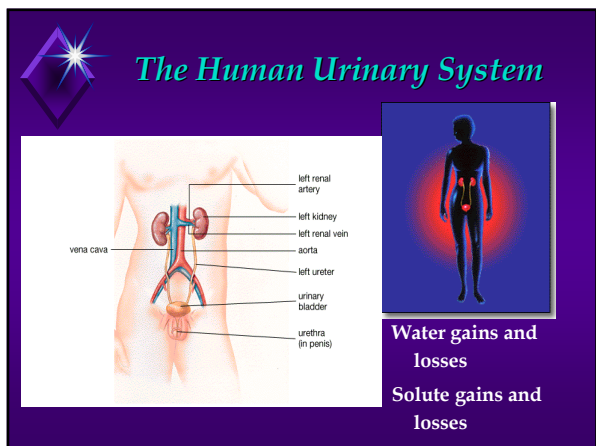






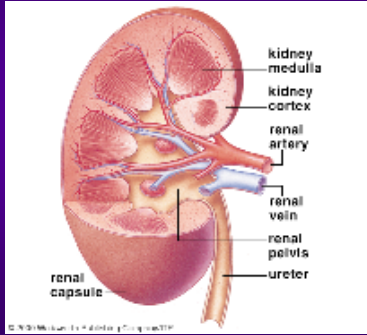






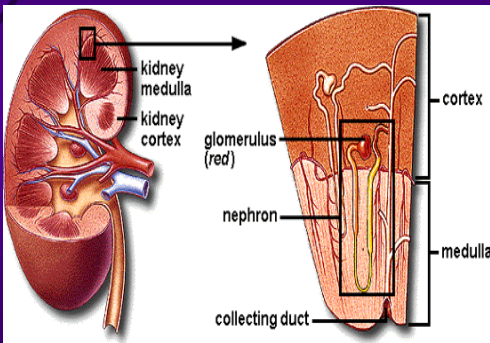


A Human Kidney and Blood Vessels





A Human Kidney

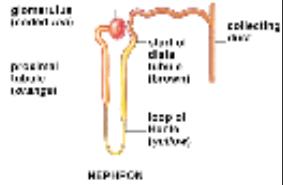




Functional Regions of a Nephron



orientation of nephrons relative to the kidney cortex and medulla

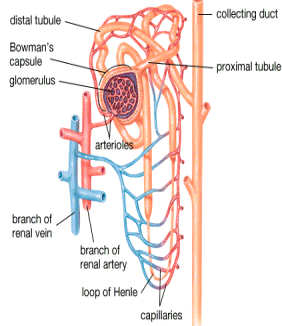


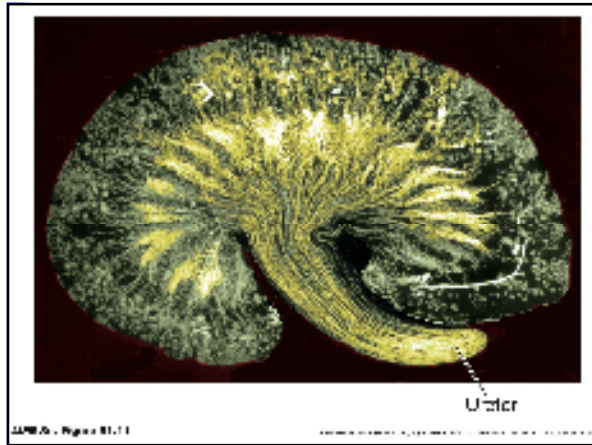
NEPHRON



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 \rightarrow 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) \rightarrow more water reabsorbed

Urine Formation

Three Processes

Filtration

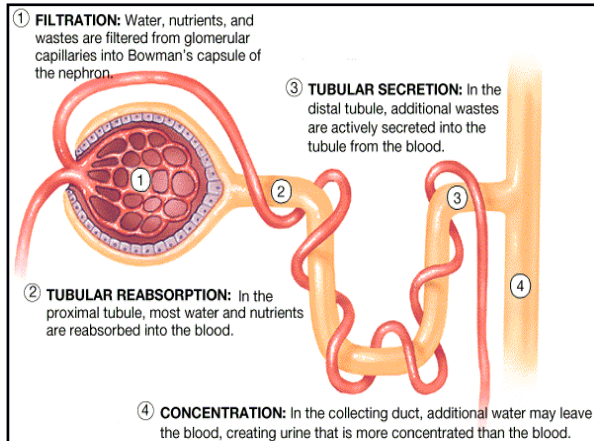
At Glomerulus

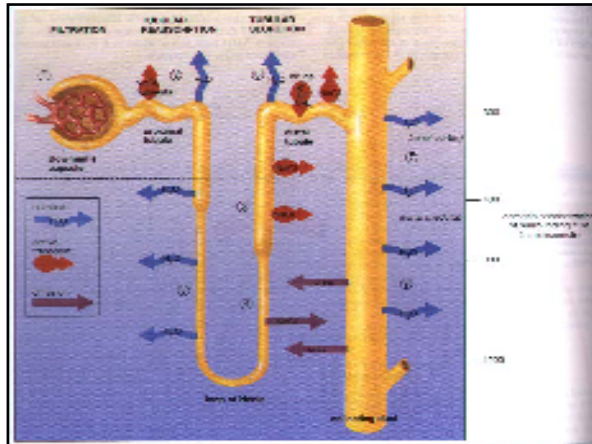
Reabsorption

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

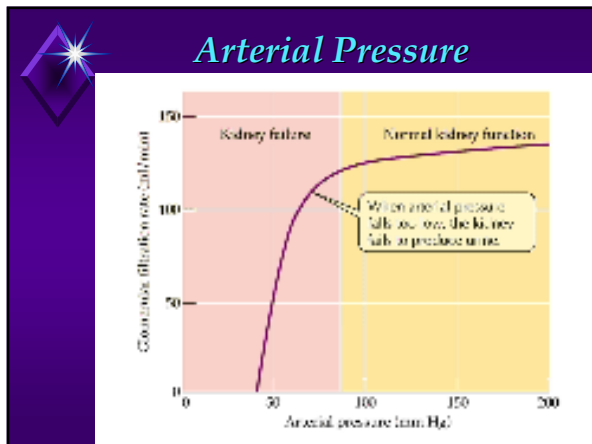


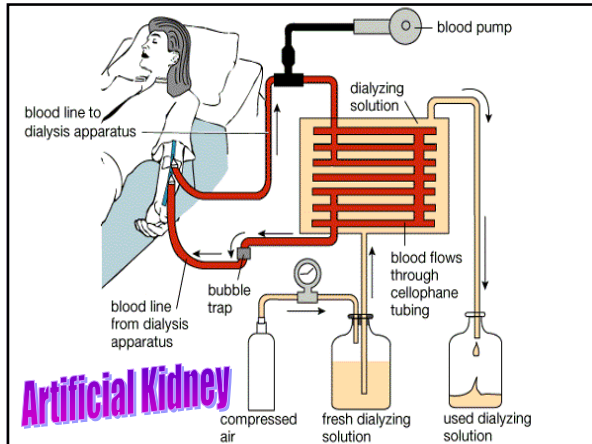


Reabsorption

Table 41.2 Average Daily Reabsorption Values for a Few Substances

	Filtered	Excreted	Proportion Reabsorbed
Water	180 liters	1.8 liters	99%
Glucose	180 grams	None, normally	100%
Sodium ions	690 grams	3.7 grams	99.5%
Urea	54 grams	30 grams	44%





In Conclusion

- 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!
