

Excretion

I. Excretory Substances

A. End Products of Metabolism

1. Ammonia is the result of deamination (removal of the amino groups) from amino acids.
2. Urea - produced in liver when ammonia is altered;
3. Uric acid - produced when nucleotides are broken down;
4. Creatinine - result of muscles using the high phosphate stored in creatine;
5. Bile pigments - results from the breakdown of hemoglobin into bilirubin and biliverdin;
6. CO_2 - excreted by the lungs (kidneys excrete bicarbonate).

B. Ions are excreted to keep the proper concentration in blood of the pH, osmotic pressure and electrolyte balance.

1. Examples include: Na, K, Magnesium, Ca, Fe, Cl, P.

II. Organs of Excretion

A. Skin

1. Sweat glands secrete perspiration; contains H_2O , salt and urea;
2. Main purpose of sweating is to cool off; heat is lost during perspiration.

B. Liver

1. Excretes bile pigments into bile;

2. Bile passes into the intestine;
3. Bile comes from the breakdown of hemoglobin.

C. Lungs

1. Expiration - Removes CO_2 , H_2O vapor.

D. Intestine

1. Fe and Ca are excreted by cells of the intestine (passes out in wastes);
2. Defecation - refers to rejects of the body, substances that have never been a part of the body.

E. Kidneys - main organ of excretion

1. Excrete urine (a combination of the end products of metabolism).

III. Urinary System

A. Parts

1. Kidneys - removes wastes from blood;
2. Ureters - muscular tubes which convey the urine to bladder;
3. Urinary bladder - urine is stored here;
4. Urethra - leads from bladder to outside.

B. Urination

1. Bladder fills → stretch receptors send nerve impulses → spinal cord
2. Bladder contracts → sphincters relax → urination occurs.

C. Kidneys

<u>Macroscopic Parts</u>	<u>Microscopic Parts of Nephron</u>
A. Outer cortex	Bowman's capsule Convulated tubules
B. Medulla	Loop of henle Collecting duct
C. Pelvis	

1. **Microscopic parts of nephron (nephron - the functional unit of the kidney).**
 - a. **Bowman's capsule - blind end of tubule, cup-like;**
 - b. **Proximal (near) convoluted tubule - near Bowman's capsule;**
 - c. **Loop of henle - "U" portion of nephron;**
 - d. **Distal convoluted tubule - far from the capsule;**
 - e. **Collecting duct - collects urine.**

Urine Formation

A. Overview

1. **Filtration**
 - a. **Water nutrients and wastes move from glomerulus to inside of Bowman's capsule;**
 - b. **Large molecules remain in blood;**
 - c. **Small molecules glucose, urea, enter tubule.**
2. **Selective reabsorption**

- a. Nutrients and salt are reabsorbed from proximal convoluted tubule into blood;
 - b. H_2O reabsorbed all along but more at loop of henle.
3. Secretion - wastes are actively secreted into the distal convoluted tubule.

Result - small H_2O loss, wastes are removed, kidneys promote homeostasis.

B. Blood Supply

Aorta → Renal Artery → Small Arteries →
 Afferent → Glomerulus → Efferent
 Arteriole (capillary tuft) Arteriole

Peritubular → Venule → Vein →
 capillary network

Renal Vein → IVC

The peritubular capillary network surrounds convolutions, collecting duct and loop. It provides nourishment.

C. Bowman's Capsule

1. Whole blood enters in afferent arteriole going to Bowman's capsule (filtration occurs).
 - a. Glomerular filtrate - filterable substances H_2O , nitrogen wastes, food, salt, ions;
 - b. Formed elements and large proteins remain in blood vessel and leave by efferent arteriole.

D. Proximal convoluted tubule (close) passive and active reabsorption occurs along tubule.

1. Passive - Greater → Lesser

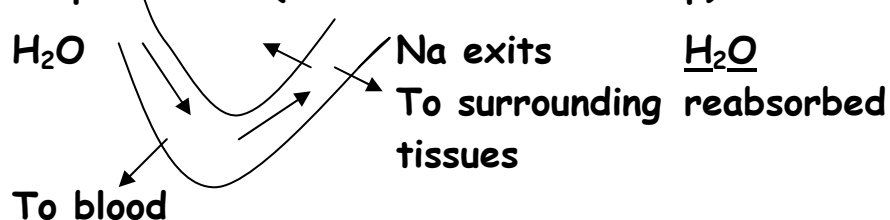
- filtrate blood
- a. Cl passively follows active transport of Na and H₂O.

2. Active reabsorption - carriers

Lesser Carrier Greater
tubule → blood

- a. Items actively reabsorbed
-H₂O, food Na⁺

E. Loop of henle (unabsorbed enters loop)



1. Na⁺ exits ascending portion causing:
2. H₂O exits descending portion.

F. Distal convoluted tubule

1. Na and H₂O are reabsorbed.
 - a. Na actively, H₂O passively
2. Secretion or augmentation substances added to urine by cells of tubule: creatinine, K, drug breakdown.

G. Collecting duct

1. H₂O diffuses out;
2. Urine → Collecting Duct → (Pelvis) → of Kidney
Ureters → Bladder → Urethra

Regulatory Functions of Kidney

A. Blood Volume

1. Blood volume controlled by amounts of H_2O in blood;
2. ADH (antidiuretic);
 - a. Secreted by posterior lobe of pituitary gland;
 - b. Controls amount of reabsorption of H_2O .

More ADH	Less urine	Increased H_2O reabsorption
Less ADH	More urine	Less reabsorption of H_2O

ALC. suppresses H_2O reabsorption

B. pH

1. H^+ and ammonia ions are excreted and Na and bicarbonate are reabsorbed to maintain pH.
2. If too acidic, H^+ exits; if basic, fewer are excreted
3. If too alkaline, fewer H^+ excreted and fewer Na^+ , CO_3^- reabsorbed.

ILLNESSES

Urinalysis - Examination of Urine

A. Diabetes

1. Sign: Glucose in urine;
2. Liver does not store glucose as glycogen, thus filtrate high in glucose.

B. Diabetes Mellitas

1. Cells of pancreas do not secrete insulin that promotes storage of glycogen.

C. Renal disease

1. **Sign: WBC, RBC in urine urinary tract;**
2. **Under attack by bacteria bladder.**

D. Uremia - urea in blood

1. **Kidney failure;**
2. **Swelling**