



Excretory System

Biology 2201



Excretory System

✳️ **How does the excretory system maintain homeostasis?**

– **It regulates:**

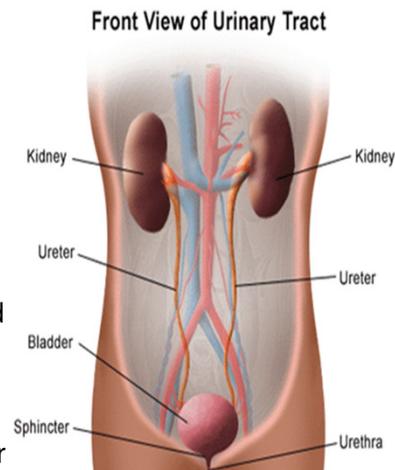
- Body heat
- Water-salt concentrations
- Acid-base concentrations
- Metabolite concentrations

ORGANS OF EXCRETION

- ✦ **Skin and associated glands**
 - Removes heat and salts
- ✦ **Lungs**
 - Removes carbon dioxide
- ✦ **Kidneys**
 - Primary excretory organs that excrete metabolic wastes, regulate water-salt balance and acid-base balance.
- ✦ **Liver**
 - Removes metabolic wastes

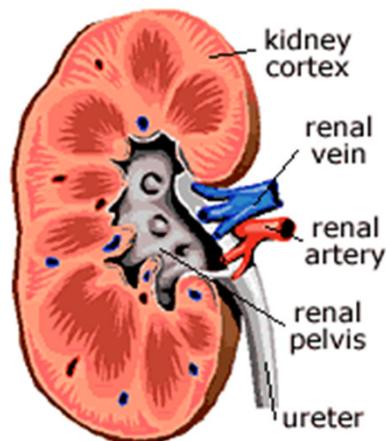
PARTS OF THE URINARY SYSTEM (pg. 374)

- ✦ **Kidneys:** filter blood to produce urine.
- ✦ **Ureters:** carry urine from the kidneys to the urinary bladder
- ✦ **Urinary Bladder:** stores urine.
- ✦ **Urethra:** carries urine from the bladder to the outside of the body.
- ✦ **Renal Artery:** carries contaminated blood into the kidney.
- ✦ **Renal Vein:** carries purified blood from the kidney and returns it back into circulation by way of the inferior vena cava.



KIDNEY PARTS (pg. 375)

- ✦ **Cortex:** the outer part
- ✦ **Medulla:** the middle part
- ✦ **Pelvis:** the inner cavity where urine collects



Major Kidney Functions

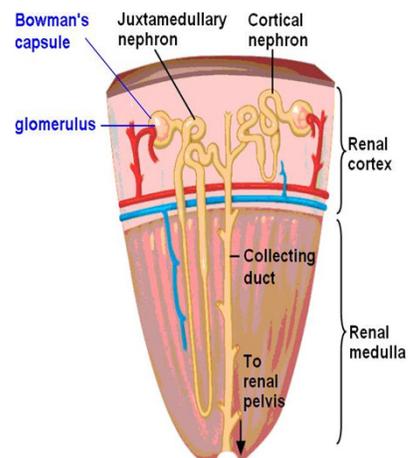
- ✦ Filters the following out of the blood
 - Urea – formed in the liver from the breakdown of ammonia
 - Creatinine – formed in the muscles
 - Uric Acid – formed as a result of the breakdown of nucleic acids (DNA and RNA)
- ✦ Controls water balance in our body
- ✦ Regulates pH of the blood

More Kidney Functions

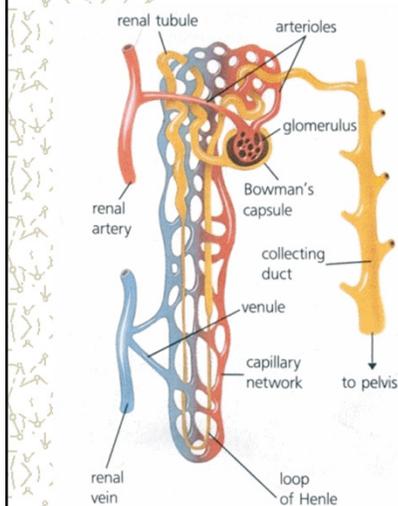
- ✦ Regulates the concentration of dissolved ions and other materials in the blood.
- ✦ Secretes a hormone that causes a production of red blood cells
- ✦ Activates Vitamin D production in the skin

The Nephron

- ✦ Tiny filtering units called *nephrons* fill the cortex and medulla of the kidney.
- ✦ Each kidney contains 1 to 1.25 million nephrons.



Nephron Continued



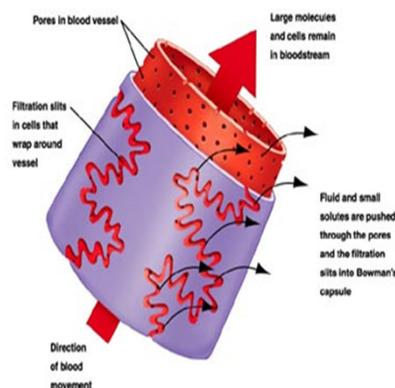
- Each nephron is composed of 5 main parts:
 - Bowman's Capsule
 - Proximal Tubule
 - Loop of Henle
 - Distal Tubule
 - Collecting Duct

Nephron Function: FILTRATION

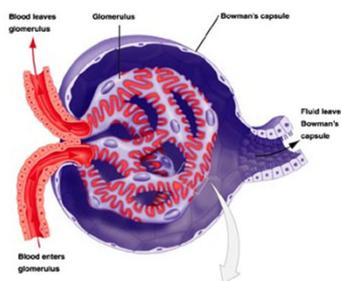
- Blood travels from the renal artery, to an arteriole and then into the *glomerulus*, a mass of capillaries surrounded by the *Bowman's capsule*.

Filtration Continued

- ✦ Blood pressure forces some plasma of the blood, containing both waste and useful material into the Bowman's capsule.
- ✦ This material is called the **nephric filtrate**.



- ✦ The filtrate contains such things as:
 - *water, urea, uric acid,*
 - *salt, glucose,*
 - *amino acids,*
 - *ions and vitamins.*

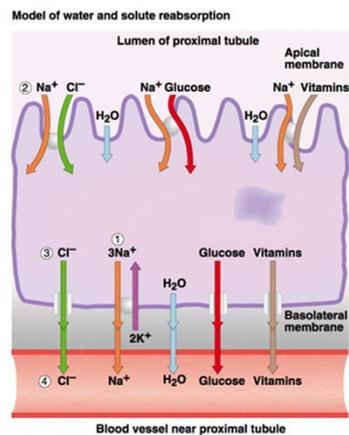


Nephron Function: REABSORPTION

- From the Bowman's capsule the filtrate is pushed into the proximal tubule.
- The process of re-absorption of useful materials within the filtrate, into the capillary network that surrounds the nephron than begins.

Reabsorption Continued

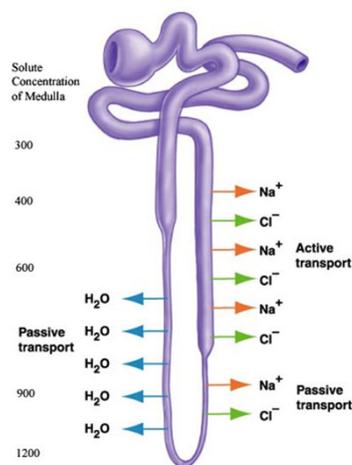
- Reabsorption occurs by osmosis, diffusion, and active transport
- Reabsorbed materials include water, glucose, amino acids, ions and vitamins
- When the filtrate reaches the end of the proximal tubule the solution is isotonic (the filtrate and the surrounding cells have the same concentration of water and solutes).



Getting Rid of Water

- ✦ The filtrate then moves down the descending loop of Henle
- ✦ As the loop descends further into the inner medulla, sodium concentrations in the surrounding tissue increase which draws water out of the filtrate (by osmosis).
- ✦ At the bottom of the loop sodium ions in the filtrate are at high concentration and therefore diffuse out of the tubule.

- ✦ Positive sodium ions are followed by negative chloride ions
- ✦ Water cannot re-enter the *ascending loop* because this loop is impermeable to water



Nephron Function: SECRETION

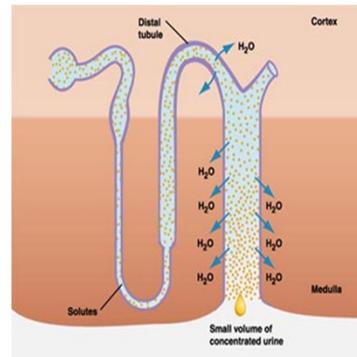
- ✚ Occurs in the *distal tubule*
- ✚ Involves active transport (pumping) of substances from the capillaries into the tubule
- ✚ Substances need to be forcibly removed from blood include hydrogen ions, creatinine and drugs

Nephron Function: ELIMINATION

- ✚ The fluid then enters the *collecting duct* as *urine*.
- ✚ Urine passes through the pelvis into the ureter.
- ✚ Most of the water, ions and useful nutrients (glucose, amino acids) have been reabsorbed.
- ✚ Reabsorption and urine production is regulated by the productions of anti-diuretic hormone (ADH)

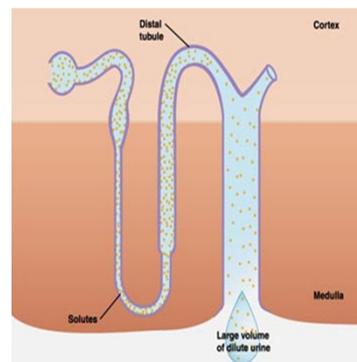
When Blood-water levels are too low

- ☀ Osmoreceptors and baroreceptors to detect low water/salt balance or low blood pressure
- ☀ The hypothalamus of the brain stimulates the pituitary gland to secrete anti-diuretic hormone.
- ☀ ADH travels to the kidneys where it increases the permeability of the tubules and collecting ducts
- ☀ **Result**
 - More water is reabsorbed into the blood
 - Blood volume, and thus blood pressure increases
 - More concentrated urine is produce



When Blood-water levels are too high

- ☀ Osmoreceptors and baroreceptors to detect low water/salt balance or high blood pressure
- ☀ The hypothalamus of the brain does not stimulate the pituitary gland to secrete anti-diuretic hormone.
- ☀ Permeability of collecting ducts and tubules is un-affected since no ADH was produced
- ☀ **Result**
 - Less water is reabsorbed into the blood, and more in urine is produced
 - Blood volume, and thus blood pressure decreases
 - More dilute urine is produce



Disorders of the Excretory System

- ✦ **Urinary Tract infection (UTI)**
 - Typically caused by bacterial infections from other sources
 - Cystitis – if on the bladder is infected
 - Urethritis – if only the urethra is infected
 - More common in females than males because of anatomical differences
- ✦ **Symptoms**
 - Painful urination (burning sensation), urge to urinate when there is no urine present,
 - discolored urine
 - Typical infection symptoms: fever, nausea, vomiting, chills
 - May result in pyelonephritis if infections reaches kidneys.
- ✦ **Treatments:**
 - Antibiotics or surgery
- ✦ **Prevention:**
 - Personal hygiene (wiping front to back)
 - Drinking lots of water

More on Disorders

- ✦ **Kidney Stones**
 - Chemicals in the urine precipitate out and form stones
 - Typically: Calcium oxalate, uric acid or cystine crystals
 - More common in men than women
 - Often are recurring in people
- ✦ **Causes:**
 - Recurring UTI's, insufficient water consumption, low activity levels, too much vitamin C and D
- ✦ **Symptoms:**
 - Severe pain in lower back/ abdomen, blood in urine, vomiting and nausea
- ✦ **Treatment and Diagnosis:**
 - X-rays & urine testing
 - Medications to break down stones and drinking plenty of water to pass stones
 - Small stones may be treated by ultrasound (**Lithotripsy**) to disintegrate the stones.
 - Surgery may be needed in small stones