THE EXCRETORY SYSTEM

Premedical Biology
Pair of kidneys
Pair of urethers
Urinary bladder
Urethra
The **urethers** are tubes that carry urine from the pelvis of the kidneys to the urinary bladder.

The **urinary bladder** temporarily stores urine until it is released from the body.

The **urethra** is the tube that carries urine from the urinary bladder to the outside of the body.

The outer end of the urethra is controlled by a **circular muscle called a sphincter**.
Kidney

Each kidney is composed of three sections:

(renal) cortex,

(renal) medulla (middle part) and

(renal) pelvis.
The **cortex** is where the blood is filtered.

The **medulla** contains the collecting ducts which carry filtrate (filtered substances) to the pelvis.

The **pelvis** is a hollow cavity where urine accumulates and drains into the urether.
Kidney

- essential part of the **urinary system**
- **nephrons** are filtration units of the kidneys

Normal kidney contains **800,000 to one million nephrons:**

- **renal corpuscle** is filtering component
- **renal tubule** is specialized for reabsorption and secretion
Renal corpuscle

- Renal corpuscle is composed of a glomerulus and Bowman's capsule.

- The glomerulus is a capillary tuft, that receives blood supply from an afferent arteriole.

The glomerular blood pressure provides the driving force for water and solutes to be filtered out into the space made by Bowman's capsule.
Renal Corpuscle
Renal Corpuscle
The **Bowman’s capsule** is a double-walled, cup-shaped structure. Blood is filtered through the glomerular wall into Bowman's capsule, passes into the **efferent arteriole**.

- **visceral inner layer** formed by **podocytes**
- **parietal outer layer** composed of a single layer of flat cells called **simple squamous epithelium**
Renal tubule

The renal tubule contains the tubular fluid filtered through the glomerulus.

After passing through the renal tubule, the filtrate continues to the collecting duct system, which is not part of the nephron.
Tubules
Renal tubule

The **proximal tubule** leads from the Bowman’s capsule to the Loop of Henle.

The **loop of Henle** is a long loop which extends into the medulla.

Descending limb of loop of Henle

Ascending limb of loop of Henle

The **distal tubule** connects the loop of Henle to the collecting duct.
Function of Tubules

Most of these functions concern the **reabsorption and secretion** of various solutes such as ions (**sodium**), **carbohydrates** (**glucose**), and **amino acids** (**glutamate**). Each segment of the nephron has highly specialized functions.

- reabsorption of glucose
- reabsorption of water
- reabsorption of salts
- reabsorption of urea
Counter current multiplier system of loop of Henle
Collecting duct system

• It participates in **electrolyte and fluid balance** through reabsorption and excretion

• The collecting duct system participates in the regulation of other electrolytes, including **chloride**, **potassium**, **hydrogen ions**, and **bicarbonate**.
Serve homeostatic functions - the regulation of electrolytes and the reabsorption of water, glucose, and amino acids

Counter current multiplier system of loop of Henle

Excretion of wastes - include the nitrogenous wastes urea (ammonium) from protein catabolism, and uric acid from nucleic acid metabolism
Hormone secretion - produce hormones including calcitriol, renin, and erythropoietin

Functions are regulated by antidiuretic hormone, aldosterone, and parathyroid hormone

**Aldosterone** is a hormone that increases the reabsorption of sodium and water and the release (secretion) of potassium in the kidneys

**Antidiuretic hormone**=**Vasopressin** controls the reabsorption of water in the tubules of the kidneys by affecting the tissue's permeability. It plays a key role in homeostasis, and the regulation of water, glucose, and salts in the blood.
Osmolality regulation - Any significant rise or drop in plasma osmolality is detected by the hypothalamus, it is secreted antidiuretic hormone (ADH), resulting in water reabsorption by the kidney.

Acido-base homeostasis - the kidneys and lungs maintain pH around a relatively stable value. The kidneys contribute to acid-base homeostasis by regulating bicarbonate (HCO$_3^-$) concentration – bicarbonate reabsorption (increased pH) - bicarbonate production (excretion of H$^+$) - bicarbonate secretion (decreased pH)
Bicarbonate reabsorption
Blood pressure regulation - juxtaglomerular apparatus changes in the delivery of sodium and chloride to the distal part of the nephron alter the kidney's secretion of the enzyme renin. renin - angiotensin – aldosterone system
Renin-angiotensin-aldosterone system (RAAS)
When blood volume is low, the juxtaglomerular cells of kidney, modified smooth cells, secrete renin. Renin converts angiotensinogen (synthesized in the liver) to angiotensin I. Angiotensin-converting enzyme (ACE) converts angiotensin I to angiotensin II which acts on AT1 receptors in the adrenal cortex, blood vessels and brain. Angiotensin II causes blood vessels to constrict resulting in increased blood pressure. Angiotensin also stimulates the secretion of the hormone aldosterone from the adrenal cortex. Aldosterone causes the tubules of the kidneys to increase the reabsorption of sodium and water. This increases the volume of fluid in the body, which also increases blood pressure.
Thank you for your attention