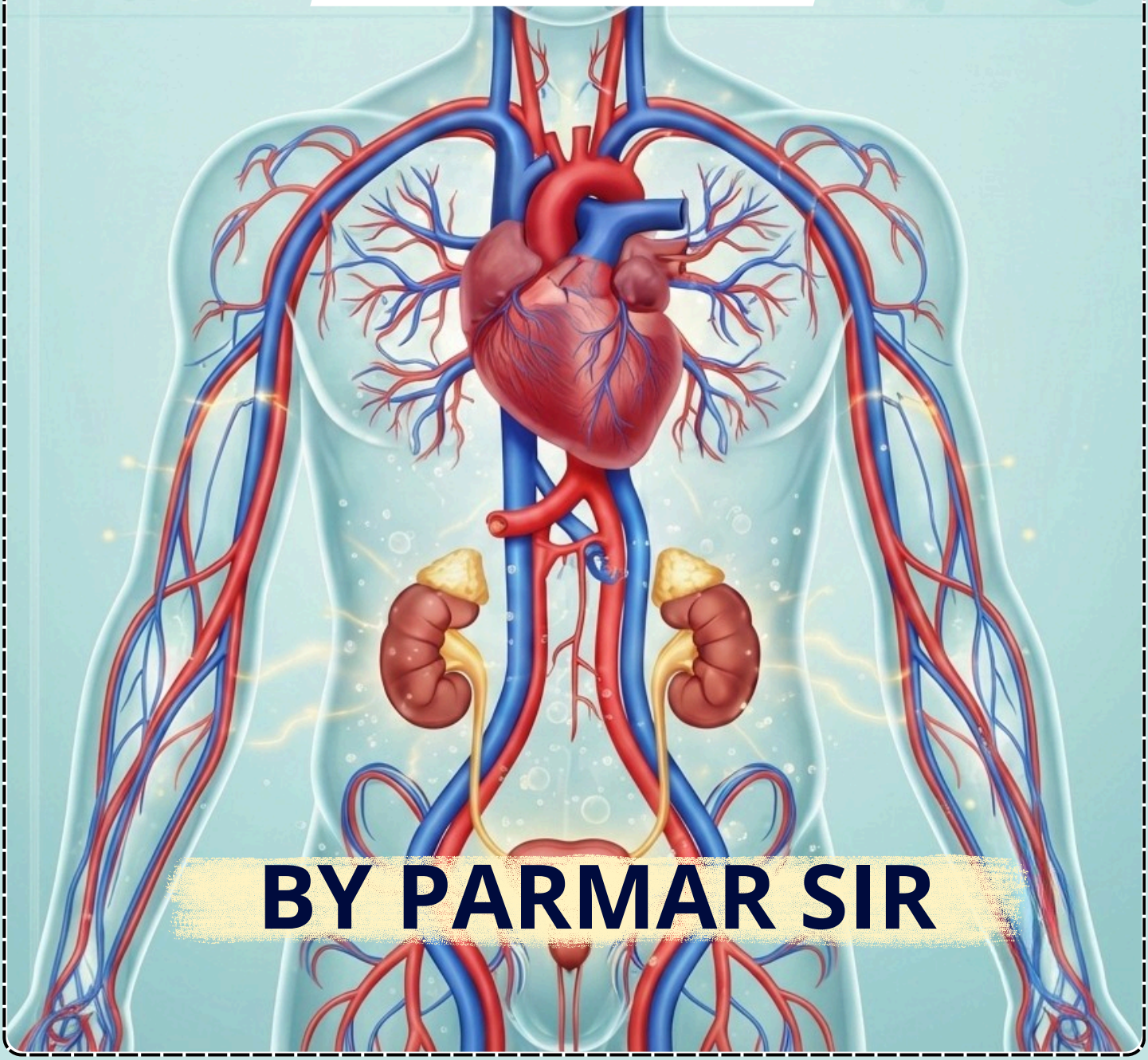
PARMAR SSC

CIRCULATORY AND EXCRETORY SYSTEM

Lecture - 10



BY PARMAR SIR

THE CIRCULATORY SYSTEM

HUMAN HEART

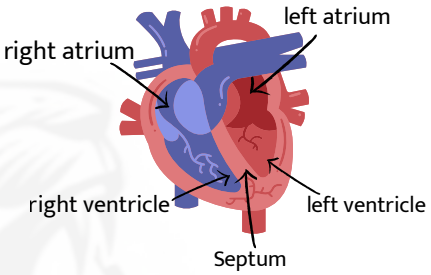
- The heart is a fist-sized organ that pumps oxygenated blood throughout the body.
- It controls the rhythm and speed of heart rate and maintains blood pressure.

ANATOMY OF HUMAN HEART

Human heart has four chambers:

- The heart's top two chambers (left and right) are known as atrium.
- The heart's bottom two chambers (left and right) are known as ventricles
- The wall of the heart comprises three layers:

1. The heart wall's outer layer is known as the epicardium
2. The heart wall's middle layer is known as the myocardium.
3. The heart wall's inner layer is known as the endocardium.



Heart Beat

- The rhythmic contraction and relaxation of the heart, which includes one systole (contraction phase / Ventricular Contraction) and one diastole (relaxation phase / Ventricular relaxation) of the heart.
- Heart beat count of healthy person is around 72 times per minute.
- **Sound of heart:** Lub-Dub.
  - **Lub:** The sound of the mitral and tricuspid valves closing.
  - **Dub:** The sound of the aortic and pulmonary valves closing.

Cardiac Output

- The amount of blood pumped by heart per minute is called cardiac or heart output.
- The value of cardiac output of a normal person is about
- 72 bpm x 70 mL per beat-5040 mL or about 5L per minute.

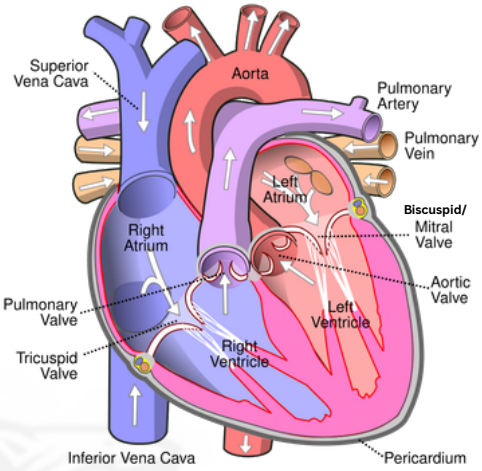
Sphygomanometer is used to measure blood pressure.

Electrocardiogram (ECG)

- An electrocardiogram (ECG) is a test that records the electrical activity of the heart.
- It produces a graph of voltage versus time using electrodes placed on the skin.
- This graph helps in detecting abnormal heart rhythms and conditions related to heart function.

STRUCTURE AND FUNCTIONS OF HEART

Right Atrium



- **Location:** Upper right side of the heart.
- **Function:** It receives deoxygenated blood from different parts of body through:
  - Superior vena cava (from upper body)
  - Inferior vena cava (from lower body)
- Oxygenated blood is usually carried by arteries, which are thick-walled and carry blood from the heart to different parts of the body through high pressure.
- **Exception:** the pulmonary artery carries deoxygenated blood from the heart to the lungs.
- Deoxygenated blood is usually carried by veins, which carry blood from different parts of the body back to the heart.
- **Exception**: The pulmonary vein carries oxygenated blood from the lungs to the heart.
- Blood passes into the right ventricle through the tricuspid valve.

Artery → Thick-walled
Vein → Thin-walled (valves present to prevent backflow of blood)

Right ventricle

- **Location:** Lower right side of the heart.
- **Function:** It receives blood from the right atrium.
- Pumps deoxygenated blood to the lungs via the pulmonary artery.
- **Valves Involved:**
  - **Tricuspid valve:** It prevents backflow into the right atrium.
  - **Pulmonary valve:** It controls flow from right ventricle to pulmonary artery.

Left Atrium

- **Location:** Upper left side of the heart
- **Function:** It receives oxygenated blood from the lungs through four pulmonary veins.
- Blood flows from the left atrium into the left ventricle through bicuspid (mitral) valve.

Aorta: It is the largest artery in human body.
Inferior Vena Cava: It is the largest vein in human body.
Coronary artery: It supplies blood to the human heart.

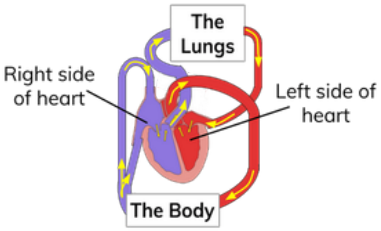
Left Ventricle

- **Location:** Lower left side of the heart.
- It is the thickest chamber of the heart.
- **Function:** It receives oxygen-rich blood from the left atrium and pumps blood into the aorta, which supplies it to the entire body.

Valves Involved:

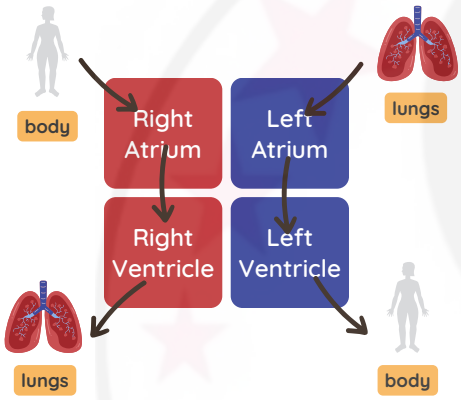
- **Bicuspid (mitral) valve:** It prevents backflow into the left atnum.
- **Aortic valve:** It prevents backflow from aorta to the left ventricle.

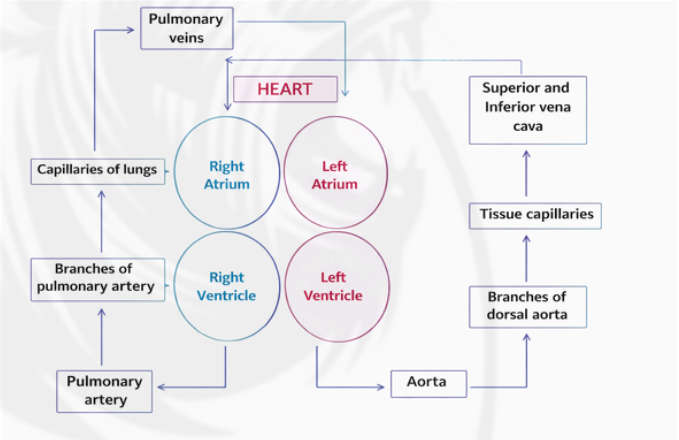
Double Circulation



- Double circulation is the type of blood circulation in humans (and all mammals) where the blood passes through the heart twice during one complete cycle around the body.
- Blood circulation was discovered by William Harvey.
- **E.g.**

1. The blood pumped by the right ventricle (deoxygenated blood) is transported through pulmonary artery to lungs where CO_2 is exchanged woith O_2 through diffusion and returns back to the heart through pulmonary vein.
2. Oxygenated blood from left ventricle is transported through aorta to different Body parts (cells and tissues) where O_2 is exchanged with CO_2 through diffusion and then returned back to the heart through vena-cava.





- **Coronary Artery:** The main blood vessel that supply oxygen rich blood to heart muscles.
- **Sinoatrial Node (Placed in right Atrium):** It act as heart's natural pacemaker, it generates electrical signals that causes heart's upper chamber to contract.

Sphygmomanometer

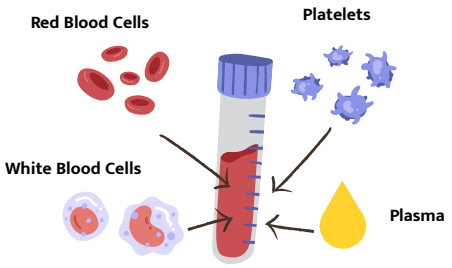
- A sphygmomanometer is a medical instrument used to measure blood pressure.
- **It Measures**:
  - **Systolic Pressure**: The heart contracts and pumps blood out of the body (normal-120 mm of Hg).
  - **Diastolic Pressure**: The heart relaxes and fills with blood to prepare for the next beat (normal: -80 mm of Hg).

Pulse rate

- The number of times your heart beats per minute.
- **Normal range**: 60-100 beats per minute.

Blood

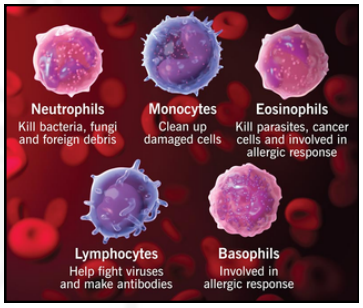
- Blood is a special connective tissue consists of fluid matrix (plasma), and solid components (blood cells).



Red Blood Cells

- **Structure:** Red in colour, circular and biconcave in shape, denucleated, elastic, lack of cell organelles like ER, ribosomes, mitochondria etc.
- Normal range of RBC count in human blood: 4.5 to 5.5 million per cubic millimetre.
- **Formed in:** Bone marrow (from birth) having a lifespan of about 120 days.
- **Function:** Transport of oxygen and some amount of CO_2.
- **Graveyard of RBC:** Spleen (a large bean-shape lymphoid organ).
- Low blood count causes Anemia.

WBC (White Blood Cells)/Leukocytes



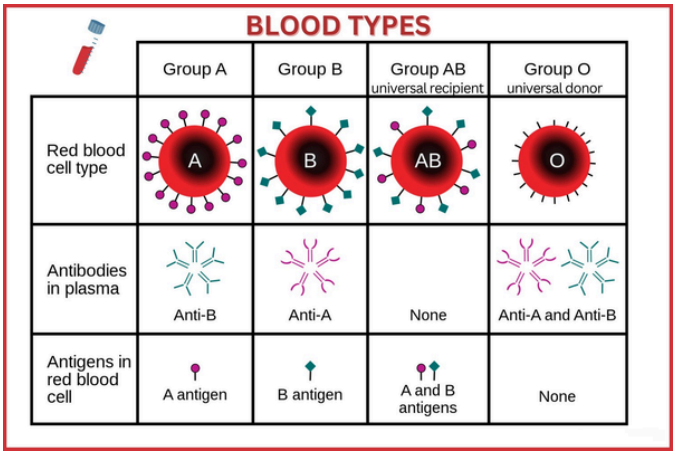
- **Normal range of WBC count in human blood**: 5000–8000 per cubic millimetre.
- Leukemia is a type of blood cancer that affects blood cells in bone marrow usually WBCs.

Plasma

- The liquid part of blood or lymph which is yellow coloured, viscous fluid and contains about 90–92% water and 6–8% proteins.

Blood Group

- The four main blood groups (A, B, AB, and O) were discovered by **Austrian scientist Karl Landsteiner in 1900**. He identified the O, A, and B blood types, which led to the understanding of the ABO blood group system.
- Bombay Blood Group was discovered by **Y. M. Bhende in 1952**.



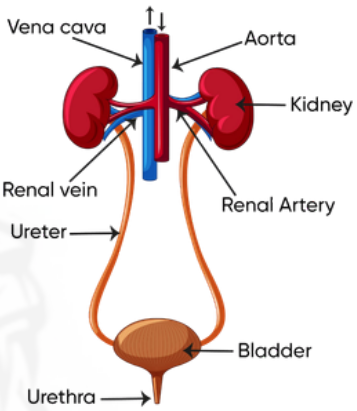
Blood Type	Gives	Receives
A+	A+, AB+	A+, A-, O+, O-
O+	O+, A+, B+, AB+	O+, O-
B+	B+, AB+	B+, B-, O+, O-
AB+	AB+	Everyone
A-	A+, A-, AB+, AB-	A-, O-
O-	Everyone	O-
B-	B+, B-, AB+, AB-	B-, O-
AB-	AB+, AB-	AB-, A-, B-, O-

Rh Factor

- The Rh factor (Rhesus factor) is an inherited protein found on the surface of red blood cells.
- A person has the Rh protein, they are said to be Rh-positive (Rh+).
- If they lack the Rh protein, they are Rh-negative (Rh-)

Excretory System

- The excretory system is responsible for removing waste products from the body to maintain internal chemical balance (homeostasis).
- The main waste product removed is urea, along with excess water and salts.
- **The main organs of the human excretory system:** Kidneys (2), Ureters (2), Urinary Bladder and Urethra.



Kidney

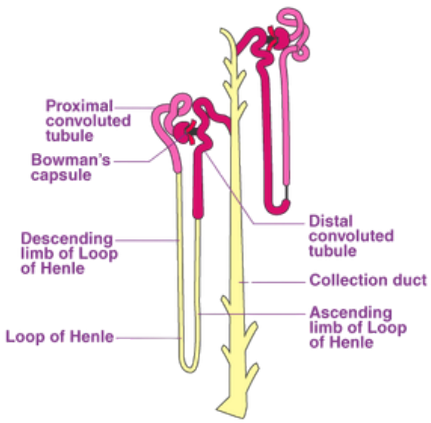
- **Size and structure:** 10-12 cm in length, 5-7 cm in width, 2-3 cm thick, and average weight is about 120-170 g.
- It is a bean-shaped organs located on either side of the backbone, just below the ribcage.
- Right kidney is positioned slightly lower in comparison to left kidney (located on dorsal side).
- **Main function:** Filter blood to remove urea, excess salts, and water, forming urine.
- Each kidney contains about 1 million nephrons (basic functional units).
- **Outer layer of kidney:** Renal cortex and Renal capsule

Nephron

- It is a basic unit of Kidney.
- Nephrons remove waste material from blood, through ultrafiltration.

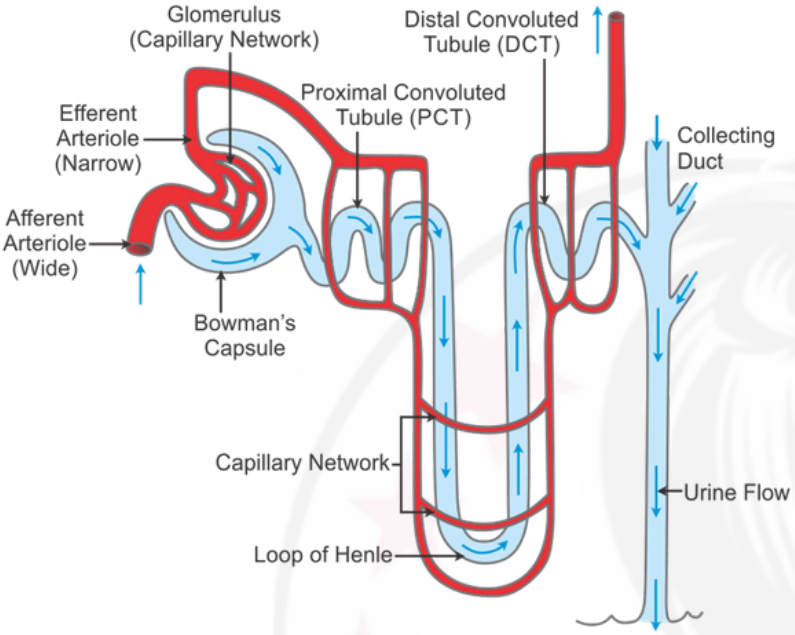
Structure of Nephron

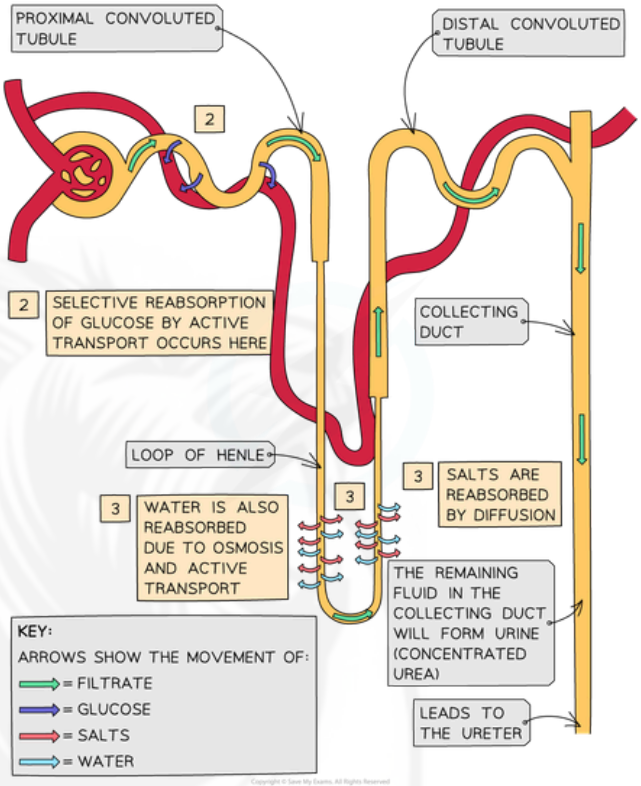
- **Bowman's Capsule:** Cup-shaped structure that encloses the glomerulus.
- **Glomerulus:** A bunch of capillaries where blood is filtered. The filtration of blood in glomerulus, about 1100-1200 ml of blood is filtered by the kidney per minute.
- **PCT (Proximal convoluted tubule):** Reabsorbs useful substances like glucose, water, and salts.
- **Collecting Duct:** Collects urine and passes it to the renal pelvis.
- **JGA (Juxtaglomerular Apparatus):** Responsible for regulating blood pressure and glomerular filtration rate (GFR).



Processes in the Nephron

- **Ultrafiltration**: Blood pressure forces water and solutes into the Bowman's capsule.
- **Reabsorption**: Useful substances (like glucose and some water) are reabsorbed in the tubule.
- **Secretion**: Some extra wastes are actively secreted into the tubule.
- **Excretion**: Final urine is sent to the collecting duct.



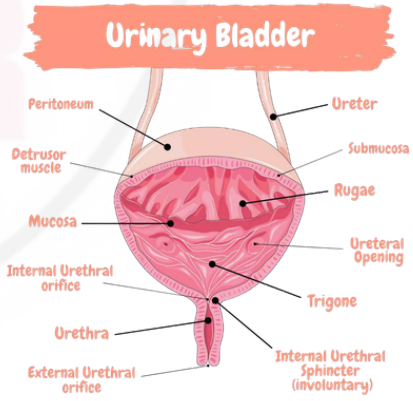


Ureters

- Two narrow tubes that carry urine from the kidneys to the urinary bladder.

Urinary Bladder

- It is a muscular sac that stores urine temporarily that can expand and contract.
- When urinary bladder is full, it sends signals to the brain to initiate urination.



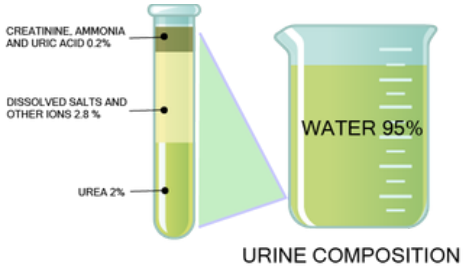
Urethra

- It is a tube through which urine is excreted out of the body.
- It is controlled by a sphincter muscle that opens during urination.

Urine

- **Urine components:** Water (95%) and Urea (2%).
- **pH:** 4.5-5.5.
- **Waste Product:** Ammonia.
- **The colour of urine is yellow** → This colour comes from urochrome/urobilin, a waste product that comes from breakdown of haemoglobin.

The yellowish colour of feces is due to stercobilin, which is formed from bilirubin.



URINE COMPOSITION

Dialysis

- The procedure involves filtering of waste and excess fluid from the blood, when the kidneys are no longer functioning properly, the machine removes blood from body filters it through a dialyzer and returns the clean blood to the body.

Kidney Stone

- Kidney stones (made of Calcium Oxalate) are hard deposit of minerals and acid salts that stick together in concentrated urine.
- **Main causes of kidney stones:** Drinking less than 2L of water, obesity, eating food with too much salt and sugar.
- **Bilirubin**: An orange-yellow pigment formed in the liver by breakdown of haemoglobin and excreted in bile.
- The colour of solid waste from anus is yellow due to bilirubin.

Role of Other Organs in Excretion

- **Lungs:** It removes CO_2 (18L/day) and water.
- **Liver**: It secretes bile pigments like **bilirubin** and **biliverdin**, which are by products of the breakdown of hemoglobin. These substances, along with cholesterol, certain drugs, and degraded steroids hormones are eliminated from the blood via bile.

Sweat and Sebaceous glands

- The sweat glands of the skin help eliminate a small amount of urea, sodium chloride (NaCl), lactic acid through sweat.
- The sebaceous gland secrete sebum, an oily substance that helps eliminate certain lipid-based waste products, such as steroids, hydrocarbons, and waxes.

Saliva

- It can help to eliminate small amount of nitrogenous waste.

Excretion in animals

Ammonotelism

- The animals which excrete ammonia are called ammonotelic and excretion of ammonia is known as ammonotelism.
- **E.g.** Amoeba, sycon, hydra, liver fluke, tapeworm, Leech, Prawn, bony fishes, etc.

Ureotelism

- Excretion of urea is known as ureotelism and the animals which excrete urea are ureotelic animals.
- **E.g.** Mammals, many terrestrial amphibians and marine fishes and sting rays, etc.

Uricotelism

- Excretion of uric-acid is known as uricotelism and the animals which excrete uric-acids are called uricotelic.
- **E.g.** Most insects, land snails, lizards, etc.



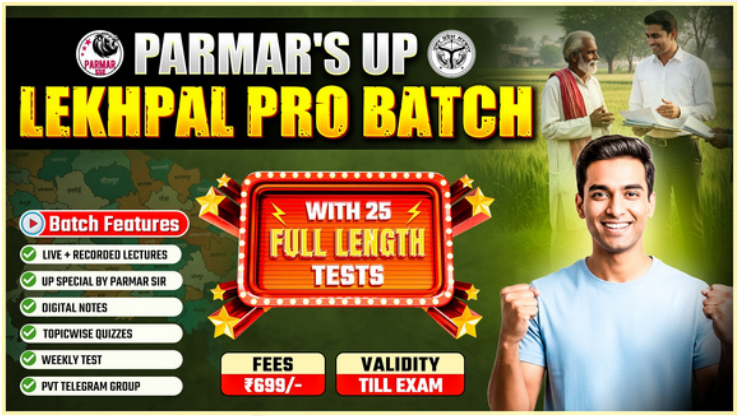


Join Now – Start Your Smart Preparation Today!

CLICK HERE

Join Now – Start Your Smart Preparation Today!

CLICK HERE





Join Now – Start Your Smart Preparation Today!

CLICK HERE

Join Now – Start Your Smart Preparation Today!

CLICK HERE





Join Now – Start Your Smart Preparation Today!

CLICK HERE