

# **URINE FORMATION PART 1**

**E-MODULE**

**BY**

**DR. SEEMA MARWAHA**

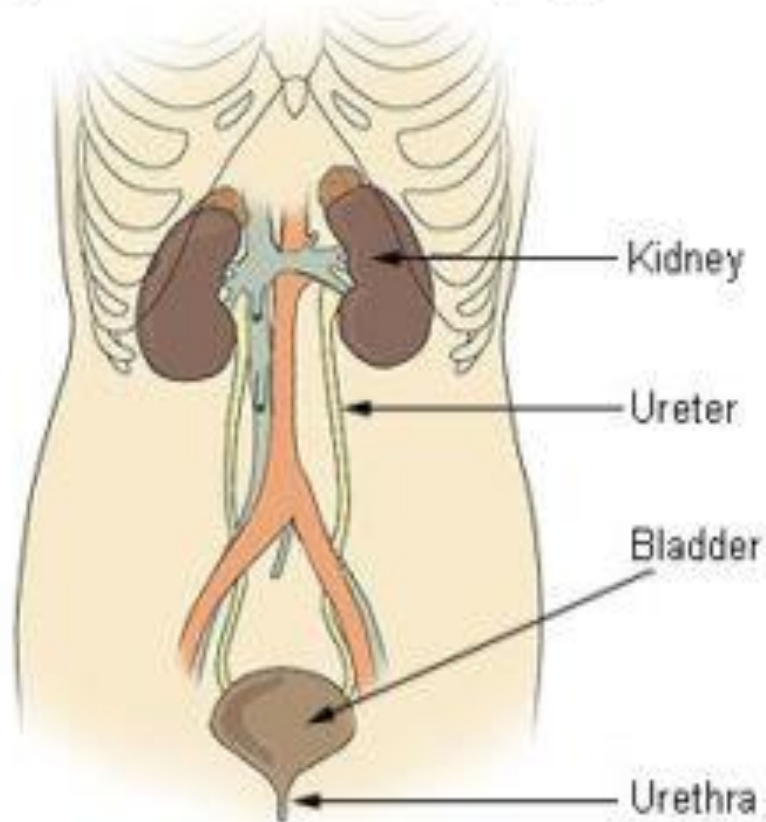
**ZOOLOGY DEPTT.**

# EXCRETORY SYSTEM

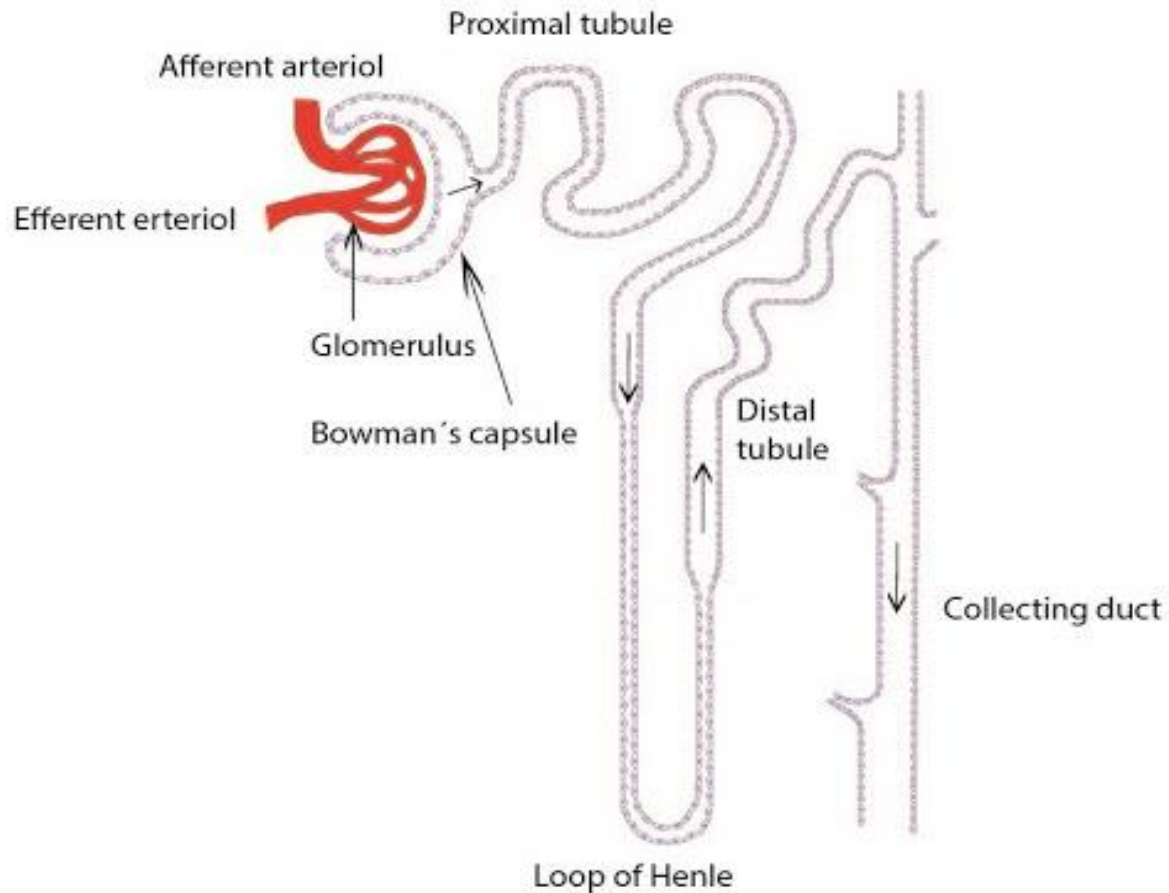
- Every living organism generates waste in its body and has a mechanism to expel it. In humans, waste generation and disposal are taken care of by the human excretory system. The human excretory system comprises of the following structures:
  - 2 Kidneys
  - 2 Ureters
  - 1 Urinary bladder
  - 1 Urethra

# URINARY SYSTEM

## Components of the Urinary System



# URINE FORMATION AND OSMOREGULATION



# NEPHRON

- The basic functional unit for the urine formation is called **nephron**. Very important is the arrangement of nephron: it begins with **renal corpuscle** that consists of a **glomerulus**(which is supplied by **afferent glomerular arteriole** and drained by **efferent glomerular arteriole**) and **Bowman's capsule**.
- **Renal tubules** have three segments. The **proximal tubule**, **loop of Henle** ( **descending limb** and **ascending limb**) and **distal convoluted tubule** that subsequently joins the **collecting ducts**.

# URINE FORMATION STEPS

- **Three stages of urine formation are**
- **Filtration** – Removing maximum waste from blood into nephron and creating a filtrate.
- **Reabsorption** – Bringing useful molecules back into the blood
- **Tubular Secretion** – Bringing as much harmful molecules from the blood as possible

# GLOMERULAR FILTRATION

- At the glomerulus there is very high pressure, thus this type of filtration is called pressure filtration.
- The substances removed create a plasma-like filtrate in the Bowman's capsule
- **Things that are filtered into the Bowman's capsule from the blood:**
  - Water
  - NaCl
  - Glucose
  - H<sup>+</sup>
  - Urea/Uric acid

## GLOMERULAR FILTRATION

1) Fluid is not exchanged between the capillary and the interstitium, but between the capillary and the fluid of Bowman's capsule

2) Hydrostatic pressure in the capillaries is different, the movement is thus only one-sided (in the direction of filtration)

3) Filtration barrier (see above) has a unique structure and properties which do not allow passage of proteins into the filtrate (primary urine)

GFR is therefore dependent on the **renal blood flow**, the **filtration pressure**, the **plasma oncotic pressure**, and the **size of the filtration area**.



# TUBULAR REABSORPTION

- Occurs at the **proximal convoluted tubule** and the **Loop of Henle**.
- **In the proximal convoluted tubule:**
- **Selective reabsorption:** Nephron **actively transports** glucose, amino acids, and  $\text{Na}^+$  ions back into the blood (useful molecules – takes ATP).
- Negative ions (i.e.  $\text{Cl}^-$ ) follow the positive ion ( $\text{Na}^+$ ) **passively**
- More ions/molecules moving back into the blood **concentrates** the blood making an **osmotic gradient** (Difference in concentration between two solutions )
- This causes water to reenter the blood vis **osmosis**.
- This causes the **filtrate** to become concentrated as it moves through the **proximal convoluted tubule**.

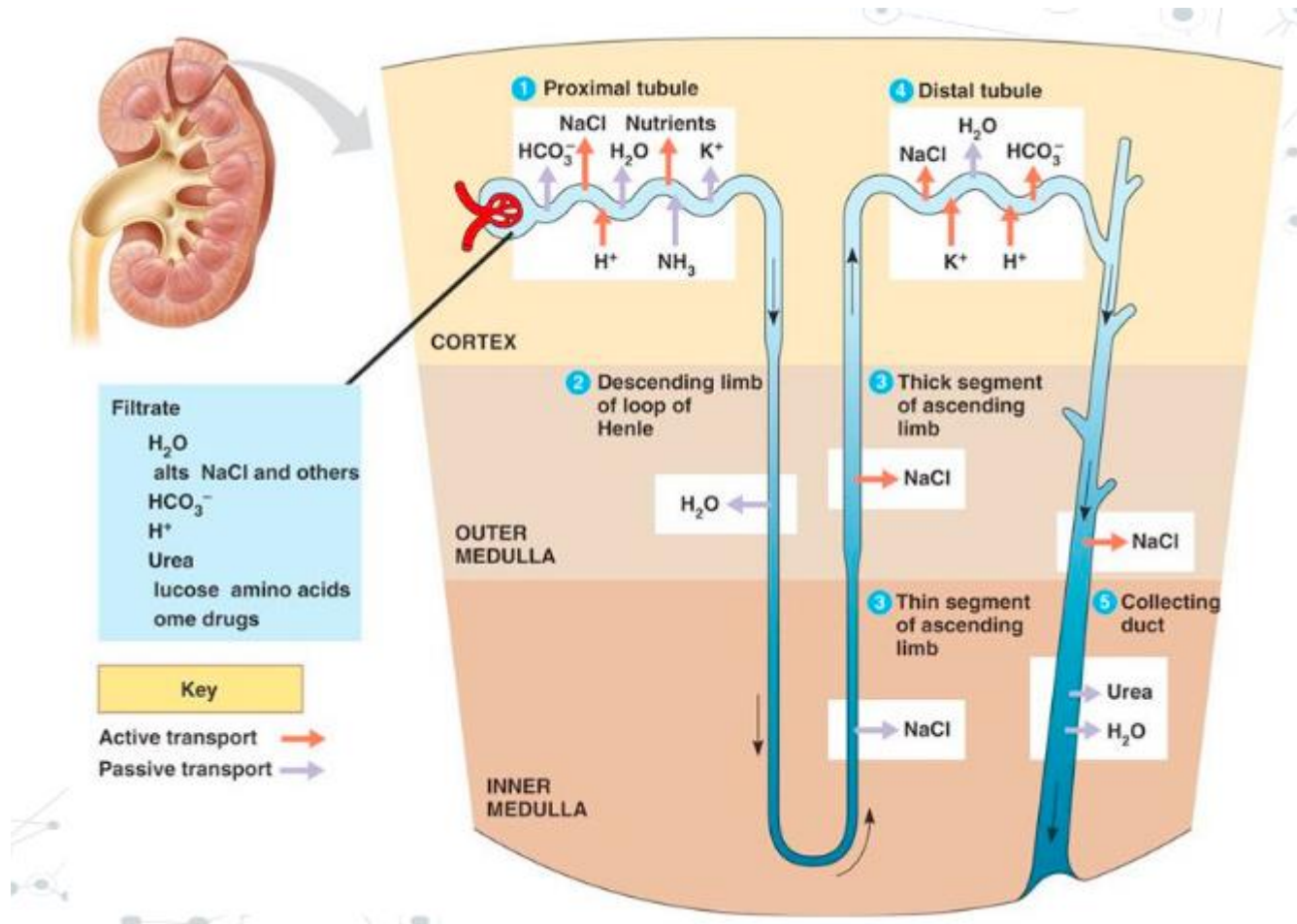
# TUBULAR REABSORPTION

- **In the Loop of Henle:**
- In the descending loop: not permeable to ions, permeable to water.
- Water leaves nephron, urine becomes more concentrated
- In the ascending loop: permeable to ions, not permeable to water.
- Na<sup>+</sup> leaves the nephron, fluid around **descending loop** becomes concentrated
- This allows for **more water reabsorption** (back into the blood) anytime the nephron passes back into that region (even the collecting duct!)

# TUBULAR SECRETION

- Occurs in the **distal convoluted tubule** (+ little in collecting duct).
- Movement of waste still in blood into nephron
- **Active Transport: Urea, Uric acid, excess K+, vitamin C, drugs, H+.**
- Some water enters the urine again
- The urine is now collected in the collecting ducts and carried to the bladder through the ureter for excretion.

# URINE FORMATION



# COMPOSITION OF URINE

- **Physical characteristics:** Urine is the waste product that is eliminated by the kidneys. Urine contains waste products like urea, salts, excess ions, water, and metabolized products of drugs.
- Urine is often light or pale yellow in colour and fresh urine has a slight ammoniacal smell. It is often clear in turbidity with a [pH](#) of around 4-8. These characteristics vary depending upon the nature of the disease in the body. Often a urine sample analysis helps to detect diseases like diabetes, kidney failures etc.
- **Chemical composition:** Chemically, urine is composed mainly of urea, sodium chloride, potassium ions, creatinine, ammonia products, and some amount of protein, and other metabolites.

# MICTURITION

- **Micturition or urination** is the process of expelling urine from the bladder. This act is also known as voiding of the bladder.
- The kidneys filter the urine and it is transported to the urinary bladder via the ureters where it is stored till its expulsion.
- The process of micturition is regulated by the nervous system and the muscles of the bladder and urethra.
- The urinary bladder can store around 350-400ml of urine before it expels it out.