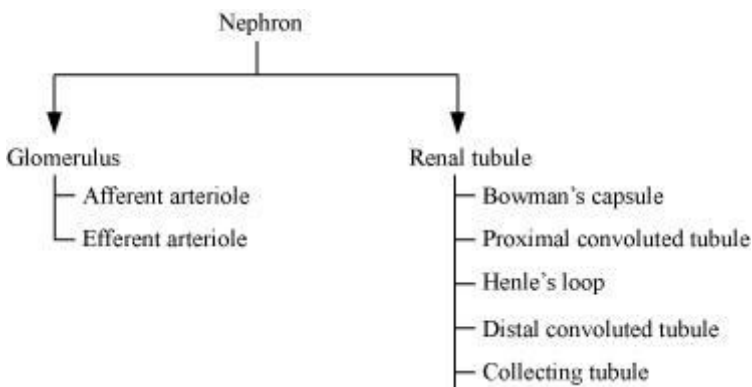


## 16. Excretion and Osmoregulation

**Excretory system-** The organ system that performs the function of excretion is known as the excretory system

- **Excretion** – It is the process of removing harmful waste products produced in the cells of living organisms.
- The excretory system in humans includes – a pair of kidneys, a pair of ureters, a urinary bladder and a urethra.
- **Kidney**- It is the main excretory organ of the human body. It plays an important role in the formation of urine. Human kidney produces about 1 – 1.8L of urine in a day. The urine consists of 95% water, 2.5% urea and 2.5% other waste products.
- It is divided into two layers - outer cortex and inner medulla.
- Nephrons are the basic filtering units of the kidneys.
- The main components of a nephron are the **glomerulus**, **Bowman's capsule**, and a long **renal tube**.
- **Ureter** carries urine to the bladder.
- **Urinary bladder** collects and stores urine.
- **Urethra** carries urine out of the body.
- **Dialysis**- The process of removing wastes using an artificial kidney is called dialysis.
- **Kidney** is divided into outer cortex and inner medullary region.
- The cortical portion that projects between the medullary pyramids are known as **columns of Bertini**.
- **Nephrons** are basic functional units of kidney.

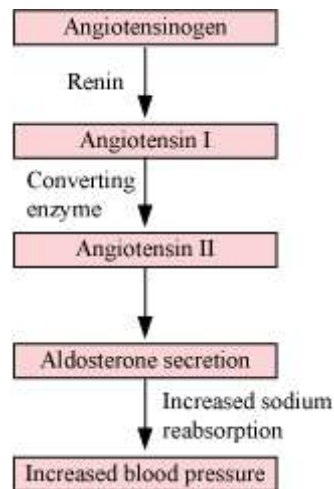


- **Malpighian body or renal corpuscle** comprises of Bowman's capsule and glomerulus.

- **Malpighian body, Proximal Convoluted Tubule (PCT), and Distal Convoluted Tubule (DCT)** are located in the **cortical region** of kidney.
  - **Loop of Henle's** is found in the medullary region of kidney.
  - **Vasa recta** – It is a loop of capillaries that runs parallel to Henle's loop.
  - **Afferent arteriole:** The arterioles that breaks into numerous capillaries to form glomerulus present inside the Bowman's capsule.
  - **Efferent arteriole:** Emerging from the Bowman's capsule these capillaries combines together and travels a short distance and break up into the secondary capillary network.
- 
- **Urine formation**
  - **It involves three process:**
    - **(i) Glomerular filtration** - Filtration of water and dissolved substances out of the blood in the glomeruli and into Bowman's capsule
    - **(ii) Reabsorption** - Reabsorption of water and dissolved substances out of the kidney tubules back into the blood. This process prevents substances required by the body from being lost in the urine.
    - **(iii) Secretion** - Secretion of hydrogen ions ( $H^+$ ), potassium ions ( $K^+$ ), ammonia ( $NH_3$ ), and certain drugs out of the blood and into the kidney tubules, where they are eventually eliminated in the urine
  - **Glomerular filtration rate:** It is the amount of glomerular filtrate formed in all nephrons of both kidneys per minute.
  - It is about 125 mL/ minute in a healthy individual.
  - Regulation of glomerular filtration rate is auto regulative. It is carried out by **juxtaglomerular apparatus**.
  - About 99% of filtrate is reabsorbed by renal tubule.
  - Glucose, amino acids, and sodium are actively absorbed.
  - Nitrogenous wastes and water are reabsorbed passively from filtrate.
  - **Descending limb of Henle's loop** is permeable to water and impermeable to electrolytes.
  - **Ascending limb of Henle's loop** is impermeable to water.
  - **Distal convoluted tubule** involves reabsorption of sodium ions.
  - **Counter current mechanism**
    - It is an adaptation for conservation of water.
    - Two current mechanisms operating in kidney are – Henle's loop and vasa rectae. They both help in maintaining a concentration gradient in the medullary interstitium.

## Regulation of Kidney

- Juxtaglomerular apparatus contains juxtaglomerular cells that release renin.
- **Renin – Angiotensin mechanism**



- **Anti-diuretic hormone (Vasopressin)** secreted by neurohypophysis facilitates water reabsorption from distal convoluted tubule and collecting duct. Hence, it is quite important for the process of osmoregulation.
  - **Atrial natriuretic factor (ANF)** keeps a check on renin-angiotensin mechanism.
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- **Uremia** – Accumulation of urea in blood. It can be cured by performing haemodialysis.
  - **Renal failure** – It is the condition when the kidney loses the ability to form urine and concentrate it. It can be corrected by kidney transplantation method.
  - **Renal calculi** – Accumulation of insoluble crystallised salts within the kidney
  - **Glomerulonephritis** – Inflammation of glomeruli
  - **Glycosuria** – Presence of glucose in urine
  - **Ketonuria** – Presence of ketone bodies in urine

## Excretory organ in various animals

- **Protonephridia (flame cells):** Examples, platyhelminthes, rotifers and some annelids  
Amphioxus is a chordate that has flame cells.
- **Nephridia:** Example, earthworm
- **Malpighian tubules:** Examples, insects such as cockroach
- **Antennal glands (green gland):** Examples, crustacean such as prawns