

## Excretion

Excretion is the process by which the byproducts of metabolism are removed from the body. In vertebrates the kidney is the most important and specialized excretory organ.

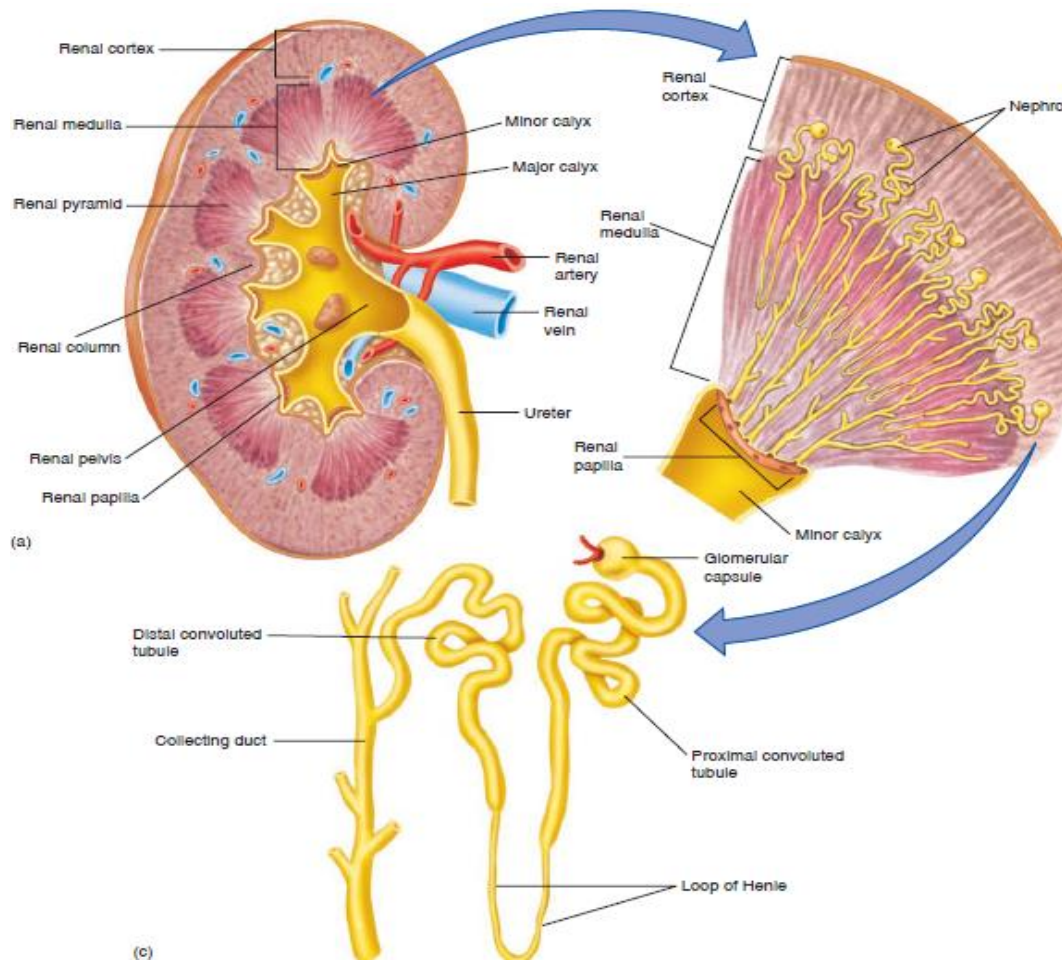
## Urinary System

The urinary system consists of two kidneys, two ureters, urinary bladder, urethra, and excretory opening.

The paired **kidneys** lie on either side of the vertebral column below the diaphragm and liver. Each adult kidney weighs about 160 g. Urine produced in the kidneys is drained into a cavity known as the renal pelvis and then is channeled from each kidney via long ducts called the **ureters** to the **urinary bladder**. The urinary bladder is a storage sac for urine, and its shape is determined by the amount of urine it contains. An empty urinary bladder is a pyramidal; as it fills, it becomes ovoid. The urinary bladder is drained inferiorly by the tubular **urethra**.

A coronal section of the kidney shows two distinct regions. The outer **cortex** is reddish brown and granular in appearance because of its many capillaries. The deeper region, or **medulla**, is striped in appearance due to the presence of microscopic tubules

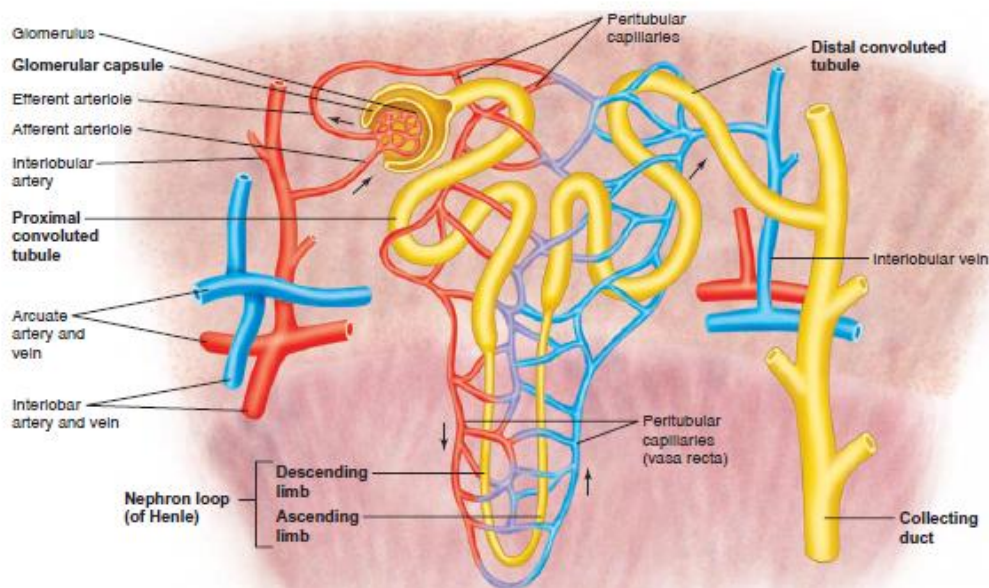
and blood vessels. The medulla is composed of 8 to 15 conical renal pyramids separated by renal columns.



**Figure 9: Kidney structure**

Each kidney in the human contains about 1 million **nephrons**, each capable of forming urine. The kidney cannot regenerate new nephrons. Therefore, with renal injury, disease, or

normal aging, there is a gradual decrease in nephron number. Each nephron contains (1) **Malpighian body**, which is made up of a glomerulus and a Bowman's capsule. The glomerulus is a mass of convoluted blood capillaries supplied by a wide afferent arteriole and drained by a narrow efferent arteriole. (2) **The uriniferous tubule**, which is divided into three parts; a proximal convoluted tubule, Henel's loop, and a distal convoluted tubule which opens into a collecting tubule. The collecting tubules of all excretory units are joined together forming a duct of Bellini, which runs up to the pelvis.



**Figure 10:** Nephron structure

## Physiology of excretion

### 1- Glomerular filtration:

The efferent arterioles are narrower than the afferent arterioles, hence blood enters into the glomerulus under higher pressure. Blood is filtered through the Bowmans capsule. The membrane of the glomerulus is impermeable to plasma proteins having high molecular weight. The filtrate is known as the primary urine and it contains glucose, urea amino acids, sodium salts, potassium salts and a large quantity of water.

### 2- Selective reabsorption:

Useful substances are reabsorbed selectively along the tubules of the nephrons. The reabsorbed substances are glucose, water, mineral salts, amino acids and urea. Glucose is reabsorbed in the proximal convoluted tubule by active transport. Water is reabsorbed along the whole tubules, so the urine becomes more concentrated.

### 3- Tubular secretion:

Tubules can collect specific waste materials from blood (e.g. creatinine and drugs) and secrete them in the lumen to be added to the filtrate.

