

Excretion

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- There are various metabolic activities which take place inside the living organisms, as a result waste products are formed.
- The process of removal or elimination of metabolic wastes from the body is called as excretion. Waste materials are ammonia, urea, uric acid etc.

(a) Excretion in plants:

- Plants do not have special organs for excretion.
- Carbon-dioxide water and oxygen are eliminated through stomata or lenticels by diffusion.
- Some waste products are collected in lenticels and barks of the tree.
- Some excretory materials are transformed into harmless products and stored inside the plant body. E.g., rubber.
- Some plants secrete a number of useful products like tannin, resin, gum, mucilage, sandalwood oil, eucalyptus oil, etc.

(b) Organs of Excretion:

- Lungs: Carbon dioxide produced by the oxidation of glucose or other food substances in the tissues is removed by the blood.
- The carbon dioxide is carried to the lungs through the blood where it diffuses into the alveoli and out through the respiratory tract.
- Water vapour in small amount is also exhaled during expiration from the lungs.
- (ii) Skin: Substances like soluble food matter, oxygen, water, dissolved mineral salts, traces of urea and uric acid diffuse from the thin walls or capillaries into the walls of the sweat glands.
- Metabolic wastes are excreted out of the body through the sweat duct which opens on the surface of the skin. However, in aquatic animals, skin is the major excretory organ. They excrete ammonia through their skin by diffusion.

- (i) Kidney: Humans have two kidneys, which help in removal of urea in the form of urine.

(c) Excretory products of Humans:

As a result of various metabolic processes going on in our body a number of waste products are formed. These have to be eliminated as they are toxic to the body.

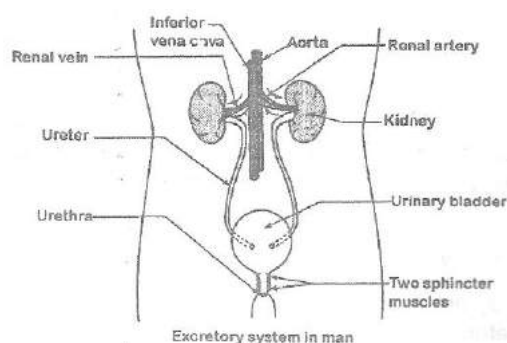
- The waste products include:

- (i) Carbon dioxide which is liberated during respiration and is eliminated by the lungs.
- (ii) Nitrogenous metabolic wastes, such as urea and uric acid produced in the liver from excessive proteins.
- (iii) Bile pigments: Bile pigments (e.g., bilirubin & biliverdin) derived by the breaking down of haemoglobin of the erythrocytes.
- (iv) Excess salts, water & vitamins: Concentration of these substances above the required level, is harmful to the body. Elimination of all metabolic nitrogenous wastes from the body is called as excretion.

• Excretory products:

S.No.	Animal group	Main nitrogenous waste	Excretory organs
1.	Platyhelminthes (Planarians, flukes & tape worms).	Ammonia.	Protonephridia or flame cells.
2.	Annelids (Earthworm, Nereis & Leeches)	Ammonia or urea.	Nephridia.
3.	Arthropods (i) King crabs (ii) Scorpion & spiders. (iii) Insects (e.g. cockroach)	Ammonia. Guanine and uric acid.	Coxal glands & Malpighian tubules.
4.	Vertebrates (Fishes, Amphibians, Reptiles, Birds & Mammals)	Ammonia, urea & uric acids.	One pair of kidneys.

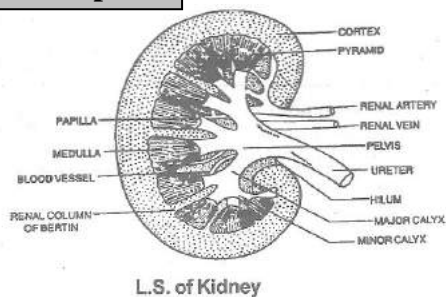
Human Excretory system



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

- **Kidney:** The kidneys are reddish-brown bean shaped structures present in the abdominal cavity, on either side of the vertebral column.
- Each kidney is made up of large number of coiled tubes called nephrons. These filter the nitrogenous waste materials and excess of water from the blood and form the urine.
- Ureters are tubular structure through which urine passes to the urinary bladder, are called ureters.
- The urinary bladder stores the urine. When the muscles around the urinary bladder contract, the urine is excreted out through a small opening called the urethra.

Structure of Nephron



- Bowman's capsule:** It is a single-cell thick, double-walled cup-shaped structure present in the cortex region of the kidney. The cup-shaped capsule contains a network of capillaries called Glomerulus. Glomerulus and Bowman's capsule are together called as Renal corpuscle.
- Proximal convoluted tubule (PCT):** It starts after the Bowman's capsule and is greatly twisted. The whole PCT lies in the cortex region.
- Henle's loop:** Henle's loop is a U-shaped tubule located in the medulla region. It consists of
 - A thin-walled descending limb in the medulla
 - A thick-walled ascending limb in the cortex.
 Henle's loop is long in those animals which pass hypertonic urine.
- Distal convoluted tubule:** The ascending limb continues into the distal convoluted tubule which forms several coils in the cortex.
- Collecting duct:** Collecting tubule receives distal tubules of several uriniferous tubules. Several

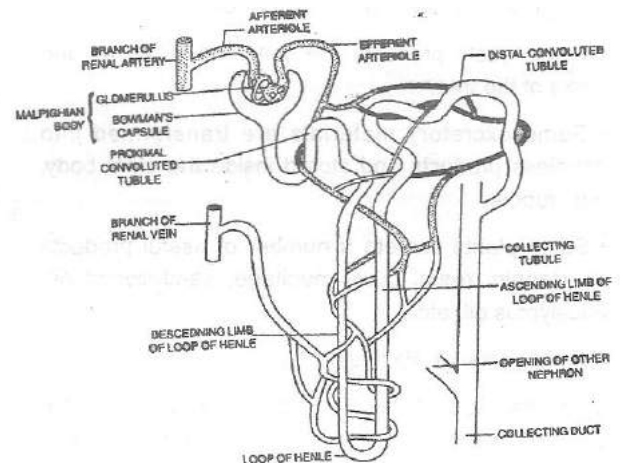
such tubules unite to form a large collection duct.

- The collecting ducts are held together and converge to form a pyramid.
- The pyramid opens into the pelvis which leads into the ureter.

Blood supply to nephrons

Inside the kidney, the renal artery branches into a number of renal arterioles.

- A branch from a renal arteriole enters each Bowman's capsule, and is called the afferent arteriole. It breaks up into a network of capillaries which reunite to form an efferent arteriole.
- Glomerulus is a mass of network of capillaries in the Bowman's capsule.
- The efferent arteriole after emerging from the Bowman's capsule runs a short distance and breaks up into a capillary network which surrounds the renal tubule and rejoins to form a vein. By reuniting again and again with other veins of the kidney it forms the renal vein which drains into the posterior vena cava.



Functional unit of kidney-nephron

(a) Working of Nephron:

Main function of nephron is to form urine. There are three main processes involved in the urine formation:

- Glomerular ultrafiltration:** It is the filtration of body fluids and solutes from the blood, out of the glomerular capillaries into the Bowman's capsule due to the pressure in the glomerulus.
- This fluid in the glomerular capsule is called as glomerular filtrate.

- It consists of water, urea, salts, glucose and other plasma solutes.
- (ii) Tubular reabsorption: Glomerular filtrate contains a lot of useful materials like glucose, Salts such as that of sodium and water.
- These substances are reabsorbed from the renal tubule at various levels and in varied proportions.
- (iii) Tubular secretion: This occurs mainly in the distal convoluted tubule and the collecting duct duct of the nephron.
- In this process substances like water, urea, uric acid, etc. are secreted.

Chemical composition of urine

Normal human urine consists of about 95% water and 5% of solid wastes such as organic compounds: Urea -2%; Uric acid-Ammonia – Inorganic Compounds are NaCl, KCl

Artificial Kidney

- In case of or damage of one kidney, the other kidney performs the function of both the kidneys and the person can lead a normal life. But the failure of both the kidney leads to death. Artificial kidney is a dialysis machine which cleans blood of waste products, thus acting like a kidney.
- The patient's blood is led out from the radial artery of the arm through the machine where urea and other salts are removed and pure blood is returned to vein in the same arm.
- Diseased kidney may be replaced with healthy one by kidney transplantation. To lead a normal life, one healthy kidney is more than enough. Therefore, a healthy person can donate his one kidney to a patient who has both kidneys impaired.

EXERCISE

1. Blood vessels leading into Bowman's capsule are called-
 - (a) Renal vein
 - (b) Renal artery
 - (c) Efferent arteriole
 - (d) Afferent arteriole
2. Protozoa and earthworm are respectively –
 - (a) Ammonotelic and ureotelic
 - (b) Aminotelic and ureotelic
 - (c) Aminotelic and uricotelic
 - (d) Ureotelic and uricotelic
3. There is no water loss through-
 - (a) Skin
 - (b) kidney
 - (c) Lung
 - (d) liver
4. Uricotelism is found in
 - (a) Mammals & birds
 - (b) Fishes and fresh water protozoans
 - (c) Birds, reptiles and insects
 - (d) Frogs and toads
5. Urea formation occurs by
 - (a) Arginine cycle
 - (b) Krebs cycle
 - (c) Ornithine cycle
 - (d) citrulline cycle
6. Filtration of blood occurs in
 - (a) Bowman's capsule
 - (b) Loop of henle
 - (c) Neck of nephrons
 - (d) Renal papillae
7. The basic functional unit of human kidney is:
 - (a) Nephron
 - (b) Nephridia
 - (c) Glomerulus
 - (d) Bowman's capsule
8. In Amoeba, ammonia is excreted by:
 - (a) Food vacuole
 - (b) Plasma membrane
 - (c) Nucleus
 - (d) All of these
9. Flame cells (protonephridia) are excretory structures of:
 - (a) Planarians
 - (b) Flukes
 - (c) tapeworms
 - (d) All of these
10. Water reabsorption mainly occurs through:
 - (a) Bowman's Capsule
 - (b) PCT
 - (c) Glomerulus
 - (d) Loop of Henle & DCT
11. Tubes extending between the kidneys and urinary bladder are:
 - (a) Ureters
 - (b) Vasa deferentia
 - (c) Urethra
 - (d) Oesophagus
12. In case of renal failure and uraemia, one of the following is employed:
 - (a) Kidney replacement
 - (b) Lithotrophy
 - (c) Haemodialysis
 - (d) Kidney removal

13. Excretion is

- (a) The passing out of faeces from the anus
- (b) The passing out of urine from the urinary bladder
- (c) The removal of nitrogenous waste products of metabolism from the body.
- (d) The removal of waste products of digestion from the body

14. Hormone which controls amount of urine is-

- (a) TSH
- (b) ADH
- (c) Adrenalin
- (d) Thyroxin

15. Which of the following has least urea

- (a) Renal artery
- (b) Renal vein
- (c) Efferent arteriole
- (d) None of the above

ANSWER – KEY

EXCRETION

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A.	D	A	D	C	C	A	A	B	D	D	A	A	C	B	B