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Biology

ENGLISH MEDIUM



**SAMPATH
LANKADHEERA**
B.Sc. (Hons), M.Sc.

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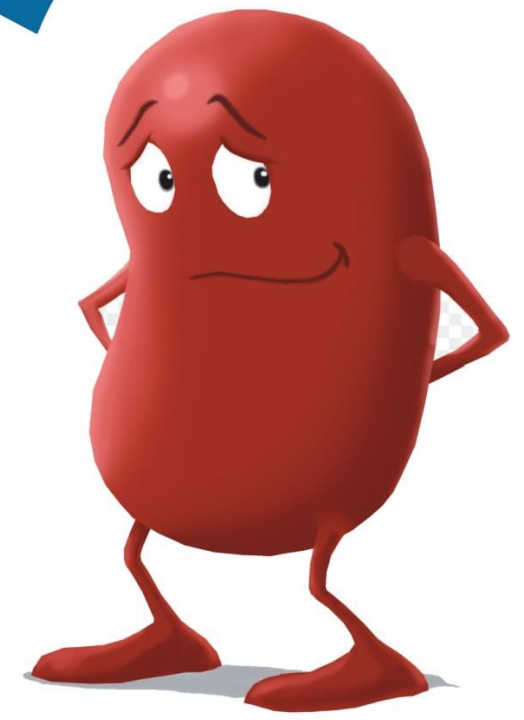
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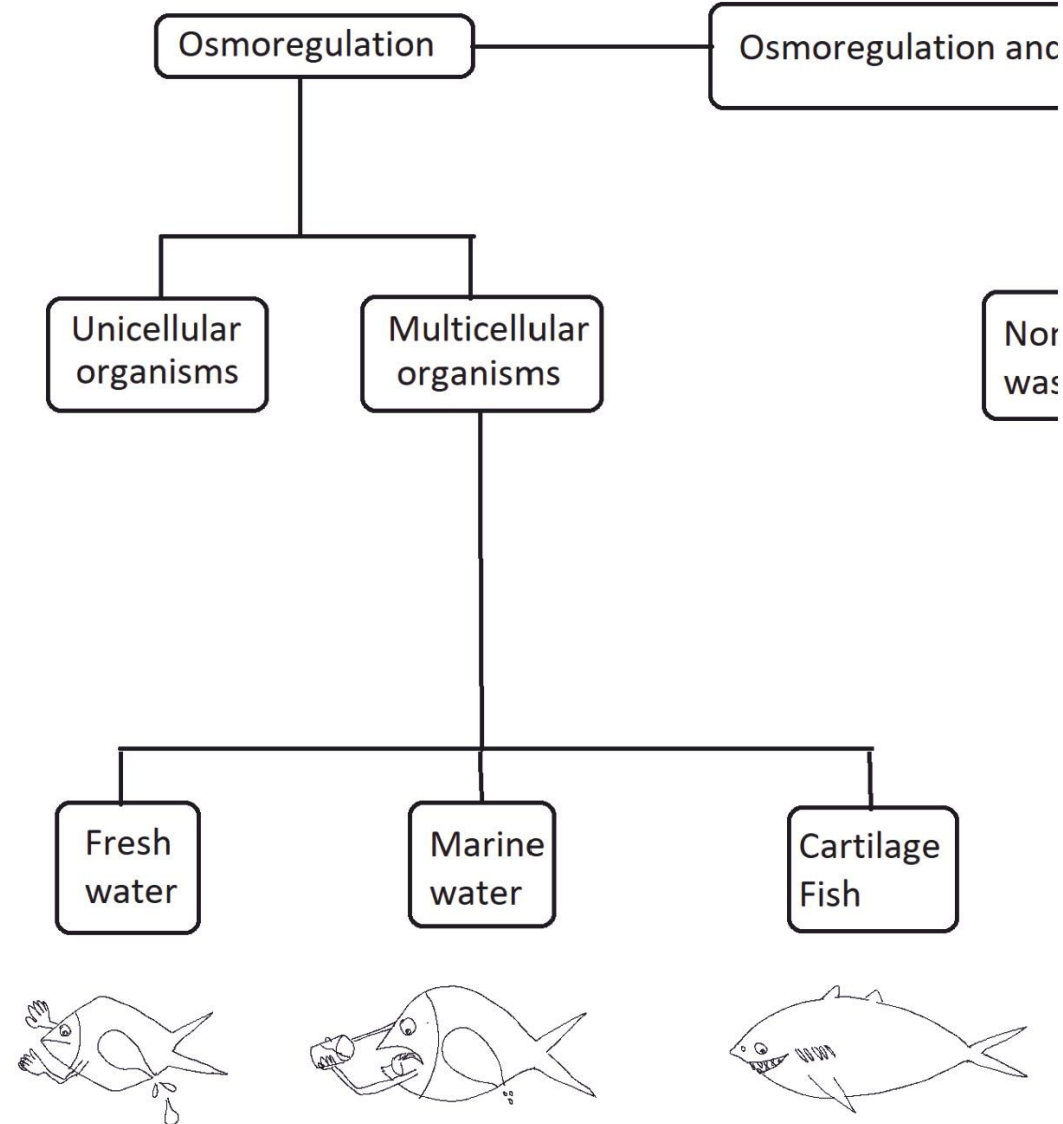
**UNIT
05**

Animal Form and Function
Excretory System



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10. Selective reabsorption (of some substances) occurs in to interstitial fluid / capillary network surrounding the tubules / blood.
11. In the proximal convoluted tubule, (Selective) reabsorption of sodium ions/ Na^+ , glucose, and amino acids (Any 2) occurs actively/by active transport (into the interstitial fluid:)
13. Reabsorption of potassium ions/ K^+ and most of the bicarbonate ions/ HCO_3^- occur passively/by passive transport (into the interstitial fluid.)
14. (As solutes move from filtrate to interstitial fluid) major portion of water is reabsorbed in the proximal convoluted tubule passively / by osmosis
15. and filtrate becomes more concentrated.
16. Secretion of hydrogen ions/ H^+ occurs actively/by active transport,"
17. ammonia/ NH_3 by passive transport / passively and
18. metabolites of drugs and toxins actively /
19. by active transport.
20. In the descending limb of loop of Henle, resorption of water occurs passively / by osmosis.
21. In the ascending limb of the loop of Henle, reabsorption of sodium ions/ Na^+ occur passively and (mainly) actively without water reabsorption and therefore,
23. the filtrate becomes diluted (as it moves towards distal convoluted tubule).
24. In the distal convoluted tubule, passive reabsorption of water (can) occurs /
25. is increased due to ADH and
26. reabsorption of sodium ions/ Na^+ and secretion of potassium ions/ K^+ occur/ is increased due the action of aldosterone.
29. (Controlled) secretion of H^+ and reabsorption of bicarbonate ions/ HCO_3^- in the distal convoluted tubule."
31. Final processing of the filtrate at the collecting duct forms urine.
32. In the collecting duct filtrate becomes/can be (more) concentrated
33. due to increased water reabsorption
34. due to the action of ADH
35. Reabsorption of sodium ions / Na^+ and secretion of potassium ions/ K^+ can be increased due the action of aldosterone in the collecting duct."

Any 34x4 = 136 Marks
Fully Labelled diagram = 14 Marks
Total 150 Marks.



B (i) Removal of nitrogenous metabolite and other metabolic waste products from the body. (ii) Nephron (iii) (a) Cortical nephrons and juxtamedullary nephrons (b) Wall of glomerular capillary wall/Inner wall of Bowman's capsule. (iv) NH_3 (v) $\text{HCO}_3^-/\text{Cl}^-/\text{K}^+$ (v) PCT

C (i) Osmoregulation is processes by which organisms control solute concentrations and water balance within the body. (ii) Maintaining constant internal environment/Preventing cell swelling/bursting from excess water/Removing toxic wastes/Regulating acid-base balance/Survival requires effective body functioning (iii) Carbohydrates $\rightarrow \text{CO}_2 + \text{water}$ in aerobic conditions, lactic acid in anaerobic/Fats $\rightarrow \text{CO}_2 + \text{water}$ /Proteins/nucleic acids $\rightarrow \text{ammonia/urea/uric acid}$ /Products vary based on chemical structure, enzymes, oxygen availability (iv) Terrestrial animals excrete urea (less toxic, moderate water needed)/Birds/reptiles excrete uric acid (least toxic, minimal water needed) (v) Ammonia: Bony fish, aquatic invertebrates, tadpoles/Urea: Mammals, adult amphibians, sharks/Uric acid: Birds, reptiles, land snails, insects

AL 2016

- (a) Describe the location of the human kidney.
(b) Briefly describe the microscopic structure of a typical human nephron.
(c) Briefly explain how human kidney regulates blood osmotic pressure.

AL 2022

- Describe the process of formation of urine in man.

Answer/AL 2016

- (a) Describe the location of the human kidney.**
 - In the abdominal cavity,
 - close to posterior wall,
 - below the diaphragm,
 - retro-peritoneal (cavity)
 - on either side of the vertebral column,
 - between thoracic and lumbar vertebrae.
 - Left kidney slightly above the right kidney.

- (b) Briefly describe the microscopic structure of a typical human nephron.**

- Tubule closed at one end and opened at other end.
- Single layered.

Consists of

- Bowman's capsule
- Proximal convoluted tubule
- Descending limb of loop of Henle
- Ascending limb of loop of Henle
- Distal convoluted tubule
- Bowman's capsule is cup shaped and
- consists of inner wall
- made up of Specialized cells/ Podocytes and
- outer wall
- made up of squamous epithelial cells and
- capsular space.
- Proximal convoluted tubule is (Irregularly) coiled;
- Made up of cuboidal epithelial cells
- with (many) microvilli/ projection/ brush boarder
- facing the lumen.
- Descending limb of loop of Henle are straight.
- Made up of squamous epithelial cells.
- Ascending limb of loop of Henle is straight;
- Made up of cuboidal epithelial cells
- Distal convoluted tubule is (Irregularly) coiled;
- Made up of cuboidal epithelial cells
- with (few) microvilli/ projection/ brush boarder
- facing the lumen.

- (c) Briefly explain how human kidney regulates blood osmotic pressure.**

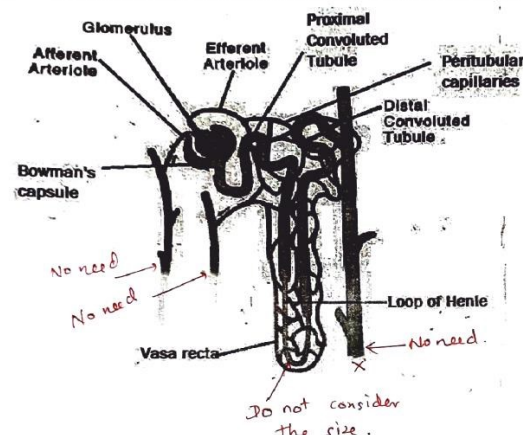
- When osmotic pressure is increased
- it is sensed by Osmoreceptors
- in the Hypothalamus
- which stimulates posterior pituitary

- to release ADH.
- ADH acts on Distal convoluted tubule and
- collecting duct
- making them permeable to water;
- Results in reabsorption of water
- producing hypertonic/concentrated urine.
- Osmotic pressure restored to normal level.
- Mechanism stops/negative feed back mechanism.
- When osmotic pressure falls
- no stimulations of osmo-receptors.
- No release/of ADH;
- No reabsorption of water in
- distal convoluted tubule and
- collecting duct;
- Produce hypotonic/ dilute urine
- Osmotic pressure restored to normal level.

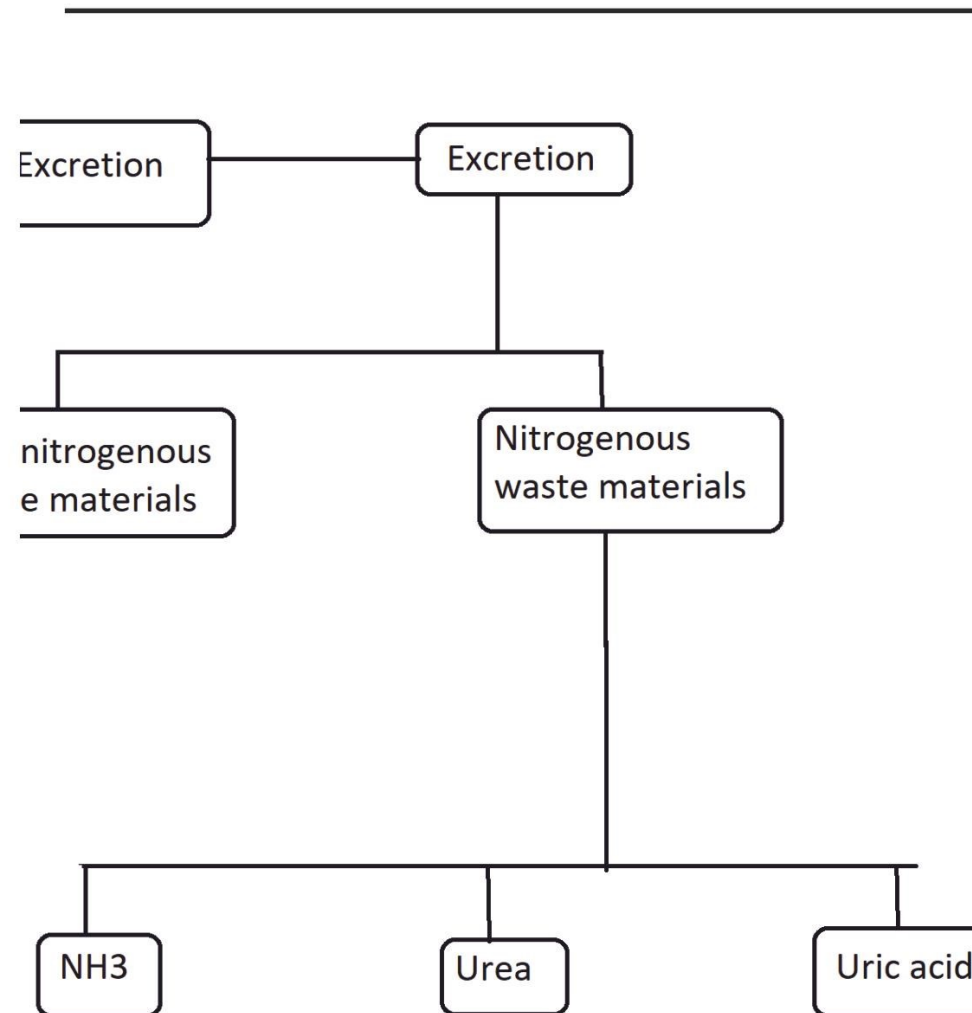
Any 50 x 03 = 150 marks

Answer/AL 2022

- Describe the process of formation of urine in man.**

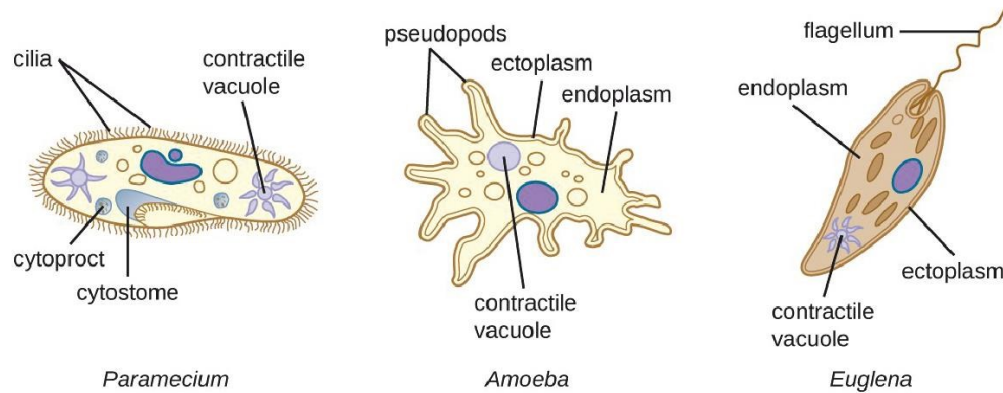


- Nephrons and associated blood vessels (in the human kidney) are involved in urine production (through three main activities namely),
- Ultrafiltration
- Selective reabsorption and
- Secretion.
- (When blood passes) through the capillary walls of glomerulus and inner wall of Bowman's capsule, blood is filtered under high pressure into the cavity of the
- Bowman's capsule retaining blood cells, platelets and large molecules/plasma proteins in the blood.
- Filtrate in the Bowman's capsule contains water, ions, amino acids, glucose, vitamins, nitrogenous waste and
- other small molecules (any three substances taken as one point)



Osmoregulation and excretion

Simple unicellular organisms such as etc. use contractile vacuoles for osmoregulation. But animals have developed different structures for osmoregulation. The chemical reactions that occur in organisms result in the formation of waste products, often toxic, which must be disposed in some way. The removal of the nitrogenous metabolite and other metabolic waste products from the body is called excretion. is not considered under as it involves the removal of from the gut. In many animals excretory and osmoregulatory systems are linked and



Importance and need of osmoregulation and excretion

For effective body functioning and survival, animals have to maintain a constant environment specially the of and within favorable limits. Therefore animals need to regulate the chemical composition of body fluids by balancing and of water and solutes. Animal cells will and if water uptake is excessive. On the other hand, animal cells will and if water loss is high. The driving force of loss of water in animals as in plants is the concentration gradient of solutes across the cell membrane. Animals have evolved different osmoregulatory strategies depending on the environment in which they live for their survival.

- (iv) (a) Name an excretory product secreted into the human nephron
- (b) Name two ions that are passively reabsorbed from the human nephron.
- (v) What is the site of obligatory reabsorption of water in the nephron?

- C. (i) What is osmoregulation?
- (ii) What is the importance of osmoregulation and excretion?
- (iii) What is the relationship between metabolic substrates and excretory products?
- (iv) What is the relationship between nitrogenous excretory products and environment?
- (v) Give examples of organisms secreting different nitrogenous wastes?

Structured Essay answers

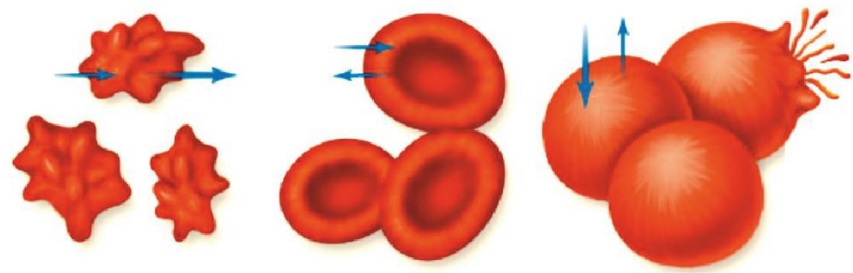
1. A (i) Removal of nitrogenous metabolite and other metabolic waste products from the body. (ii) Defecation removes undigested food from gut, while excretion removes metabolic wastes. (iii) Urine and CO₂ (iv) Birds, reptiles, land snails and insects. (v) Nephridia (vi) Living environment/Habitat, Availability of enzymes.
- B (i) Located on posterior abdominal wall, one on either side of vertebral column, behind peritoneum and below diaphragm. Right kidney is slightly lower than left. (ii) Maintaining solute concentrations and water balance/Regulating blood pH through acid-base balance/Controlling blood volume and blood pressure/Secretion of erythropoietin hormone/Production and secretion of renin (iii) High blood pressure is achieved because the efferent arteriole has a smaller diameter than the afferent arteriole, creating increased pressure in the glomerulus for ultrafiltration. (iv) ADH acts on distal convoluted tubules and collecting ducts, increasing water reabsorption. (v) ADH acts on distal convoluted tubules and collecting ducts. (v) Increased blood osmotic pressure stimulates ADH release.
- C (i) Obligatory reabsorption is the passive water reabsorption that occurs through osmosis in proximal convoluted tubules during the initial filtrate processing. (ii) Proximal convoluted tubule (iii) H⁺, K⁺, NH₄⁺ (iv) secretes renin to help regulate blood pressure and volume. (v) From the section on kidney stones, drinking plenty of water helps prevent dehydration which is listed as one of the main causes of kidney stone formation.
2. (i) Removal of nitrogenous metabolite and other metabolic waste products from the body. (ii) Annelida: Nephridia/Mammalia: Nephron (iii) Energy cost for producing ammonia is comparatively low. (iv) H⁺, K⁺ (v) PCT/DCT (vi) H⁺/K⁺ (vii) 1. Maintaining solute concentrations and water balance 2. Regulating blood pH through acid-base balance 3. Controlling blood volume and pressure 4. Secretion of erythropoietin hormone 5. Production and secretion of renin



- (iv) State one main function of the juxta-glomerular complex of the human kidney.
.....
- (v) Why is it necessary to drink water frequently to reduce the risk of developing stones in the kidney?
.....

2. (A) (i) What is excretion? Why is it essential for life?
.....
- (ii) Name the basic structural unit of excretion of each of the following groups.
Annelida
.....
Platyhelminthes
.....
Mammalia
.....
- (iii) State two advantage of producing ammonia as an excretory product.
.....
- (iv) State two advantages of producing urea as an excretory product.
.....
- (v) Name the parts in human nephron where bicarbonate ions are reabsorbed.
.....
- (vi) State two ions secreted by a human nephron.
.....
- (vii) State four functions of human kidney other than excretion.
.....

- B) (i) What is excretion?
.....
- (ii) Name an invertebrate excretory structure which is in close contact with blood vessels.
.....
- (iii) (a) Name the two types of human nephrons.
.....
- (b) Through what cellular layers should fluid pass from glomerulus to enter into proximal convoluted tubule of human nephron?
.....



Animals have to get rid of products produced during metabolism in order to safeguard the of their environment. Otherwise these excretory end products become toxic to the body cells. For example protein and nucleic acids are broken down within the body cells during metabolism and the amine group is converted to which is highly toxic. Ammonia also acts as a
..... Oxidation of glucose during metabolism will release which forms a weak Accumulation of such weak acids and bases will alter the acid base balance in the internal environment. Changes in acid base balance will lead to adverse effects such as of Therefore removal of excretory products from the body is essential to maintain the internal environment within favorable limits for effective body functioning and survival.

Relationship between metabolic substrates and excretory products

Metabolic substrates in the cells are,, and The excretory products of these substrates will vary depending on several factors such as the chemical structure and the composition, availability of enzymes, oxygen availability and the habitat in which they live.

If carbohydrates are metabolized within the body cells when is available final excretory end products are and If they are subjected to anaerobic respiration in general is produced.

When fats are subjected to aerobic metabolism final excretory products are CO₂ and water. Since proteins contain groups in their structure, during metabolism of excess amino acids is produced. Since nucleic acids contain nitrogenous bases ammonia is produced as an excretory product during their metabolism. Depending on the and the of ammonia will be further converted to other nitrogenous waste products such asa and uric acid.

Structured Essay

1. A. (i) What is meant by excretion?

.....
.....

(ii) How does defecation differ from excretion?

.....
.....

(iii) State the two main excretory products of man.

.....
.....

(iv) Name the main animal groups that excrete nitrogenous waste as solids.

.....
.....

(v) What are the excretory organs of a leech?

.....
.....

(vi) State two main factors which determine the nature of excretory products of an animal.

.....
.....

B. (i) State the location of the human kidneys.

.....
.....

(ii) State **three** functions of the human kidney other than urine production.

.....
.....

(iii) A high renal blood pressure is required for ultrafiltration. How is this high blood pressure brought about in the human kidney?

.....
.....

(iv) Where does ADH act on the human nephron?

.....
.....

(v) What is the stimulus for the release of ADH from the posterior pituitary?

.....
.....

C. (i) What is meant by obligatory resorption of water *in* the human nephron?

.....
.....

(ii) Where does the obligatory resorption of water take place in the human nephron?

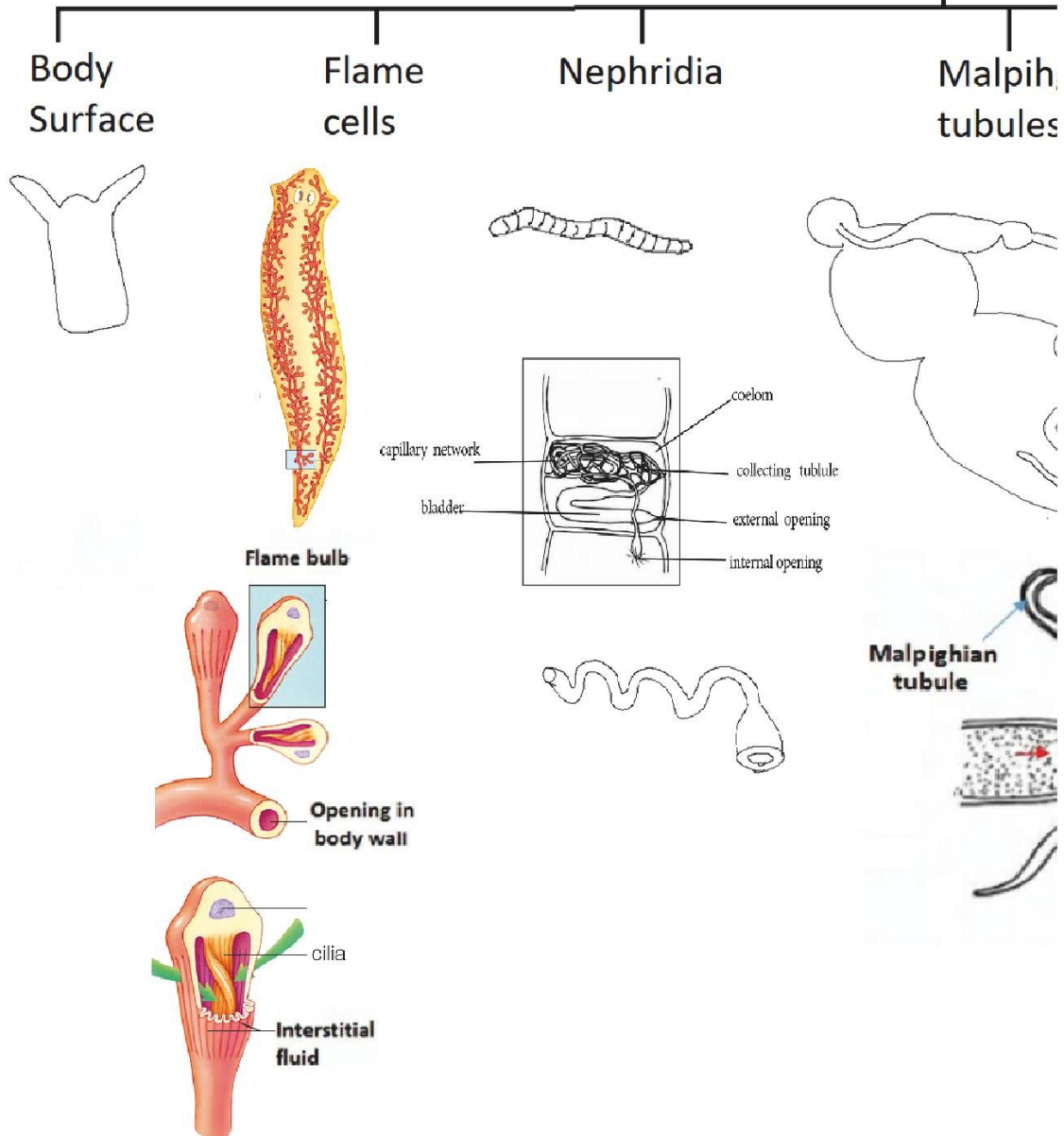
.....
.....

(iii) Name **three** ions secreted by the human nephron.

.....
.....



Different Excretory



13. Which one of the following statements regarding excretion is incorrect?
 (1) Bilirubin is considered as an excretory product.
 (2) In all animals, the first nitrogenous excretory product is ammonia.
 (3) With reference to carbon loss from the body, production of uric acid is disadvantageous.
 (4) In man, main site of urea production is the kidney.
 (5) Nephridia open both to inside and outside of the body. (AL/2014)
14. Which of the following statements regarding human nephron is/are incorrect?
 (A) Water re-absorption can occur at proximal convoluted tubule, ascending limb of loop of Henle and distal convoluted tubule.
 (B) Urea is actively reabsorbed in the proximal convoluted tubule.
 (C) Juxtamedullary nephrons have long loops of Henle. (D) Na^+ re-absorption always occurs actively.
 (E) It helps in maintaining blood volume. (AL/2014)
- Question No. 15 is based on the following ions.
 (a) Na^+ (b) Cl^- (c) HCO_3^- (d) K^+ (e) H^+
15. Which of the above ions are reabsorbed the distal convoluted tubule of the human nephron?
 (1) (a) and (c) only. (2) (a), (b) and (c) only (3) (b) and (c) only.
 (4) (c), (d) and (e) only. (5) (a), (b) and (e) only. (AL/2015)
16. Select the incorrect statement regarding excretion.
 (1) If excretion does not occur blood pH may change. (2) Defecation is a form of excretion.
 (3) Bile pigments are an excretory product in man.
 (4) Carbon loss is highest when uric acid is produced as nitrogenous excretory product.
 (5) Production of ammonia as an excretory product does not require energy. (AL 2016/20)
17. Which of the following responses correctly indicates the main nitrogenous excretory product of the given animal group?
- | Animal group | Main nitrogenous excretory product |
|--------------|------------------------------------|
| (1) Mammals | Uric acid |
| (2) Birds | Urea |
| (3) Frogs | Uric acid |
| (4) Sharks | Urea |
| (5) Insects | Ammonia |
- (AL 2019/23)
18. Select the correct combination regarding excretory structures in animals.
 (1) Nephridia — Platyhelminthes (2) Malpighian tubules — Annelids (3) Green glands — Crustaceans
 (4) Sweat glands — Reptiles (5) Salt glands — Insects (AL 2020/Old/20)
19. Which of the following excretory structures of animals opens into digestive tract?
 (1) Green glands (2) Salt glands (3) Flame cells (4) Malpighian tubules (5) Nephridia (AL 2020/24)
20. Excretory structures of crustaceans, annelids and flat worms are respectively
 (1) green glands, body surface and flame cells. (2) salt glands, body surface and nephridia.
 (3) green glands, nephridia and body surface. (4) salt glands, flame cells and nephridia.
 (5) green glands, nephridia and flame cells. (AL 2021/23)
20. Select the correct statement/statements regarding nitrogenous excretory products of animals
 (A) Secretion of ammonia occurs in production human nephrons.
 (B) Energy cost for urea production is less than that of ammonia
 (C) Uric acid is the main nitrogenous excretory product of land snails.
 (D) Sharks excrete urea as the main nitrogenous excretory, product.
 (E) Urea is less toxic than uric acid. (AL 2023/45)
21. The process of osmoregulation is essential for organisms because:
 (1) It prevents cell death through water imbalance (2) It maintains internal solute concentrations
 (3) It controls water balance in body fluids (4) It ensures survival in different environments
 (5) All of the above
22. Which statement about excretion is incorrect?
 (1) It involves removal of metabolic wastes (2) It includes removal of undigested food
 (3) It removes toxic products from metabolism (4) It helps maintain homeostasis
 (5) It involves specialized organs



MCQs

- In a nephron of a normal healthy person,
 - Ultra filtration taken place in the proximal convoluted tubule
 - Sodium ions are completely reabsorbed before the filtrate reaches the distal convoluted tubule
 - All glucose in the filtrate is reabsorbed from proximal convoluted tubule.
 - Permeability of water at descending limb of the Henle loop is increased due to ADH
 - Re-absorption of sodium salts in the filtrate is completed in the ascending limb of the Henle loop

(AL 2000)
- Which of the following statements is/are correct regarding human nephron?
 - It is involved in the regulation of blood glucose level.
 - Obligatory resorption of water occurs in the proximal convoluted tubule.
 - Active resorption of Na^+ occurs in the descending limb of loop of Henle.
 - Resorption of Cl^- occurs in the proximal convoluted tubule
 - ADH acts on the ascending limb of loop of Henle.

(AL/2003)
- Which of the following statement/statements is/are true regarding human kidney?
 - It is involved in the production of red blood cells.
 - It regulates the pH of blood.
 - Its tubules secrete glucose.
 - It is the major osmoregulatory organ of tile body.
 - It synthesizes urea.

(AL/2005)
- Which of the following statements is/are correct regarding human nephron?
 - Several nephrons open into a single collecting duct.
 - ADH acts on the distal convoluted tubule.
 - Obligatory resorption of water occurs at proximal and distal convoluted tubules.
 - Na^+ is actively resorbed from all main parts of the nephron.
 - Ultrafiltration occurs in the Bowman's capsule.

(AL/2007)
- A damage to which part of the human nephron given below is most likely to produce glucose positive urine?
 - Proximal convoluted tubule
 - Descending limb of loop of Henle.
 - Loop of Henle
 - Ascending limb of loop Henle
 - Distal convoluted tubule.

(AL/2008)
- Select the incorrect statement regarding the proximal convoluted tubule of human nephron.
 - It is connected to the Bowman's capsule.
 - Its lumen is lined with cuboidal epithelium.
 - It is the site of obligatory re-absorption of water.
 - It actively reabsorbs Na^+
 - It secretes K^+ .

(AL/2009)
- Which of the following cannot be present in the glomerular filtrate of a normal healthy adult person?
 - Albumin
 - Platelets
 - glucose
 - Amino acids
 - Vitamins

(AL/2010)
- What is the main function of the Loop of Henle in the human nephron's descending and ascending limbs?
 - Both limbs actively transport sodium ions
 - Both limbs are impermeable to water movement
 - Descending limb allows water reabsorption while ascending limb is impermeable to water
 - Ascending limb allows water reabsorption while descending limb is impermeable to water
 - Both limbs allow free water movement
- Which of the following statements regarding excretion is incorrect?
 - It is an essential process for life.
 - Production of ammonia as an excretory product does not require energy,
 - Carbon loss is high when uric acid is produced as an excretory product.
 - First product of nitrogenous excretion in mammal is urea.
 - water conservation is highest when uric acid is produced as an excretory product.

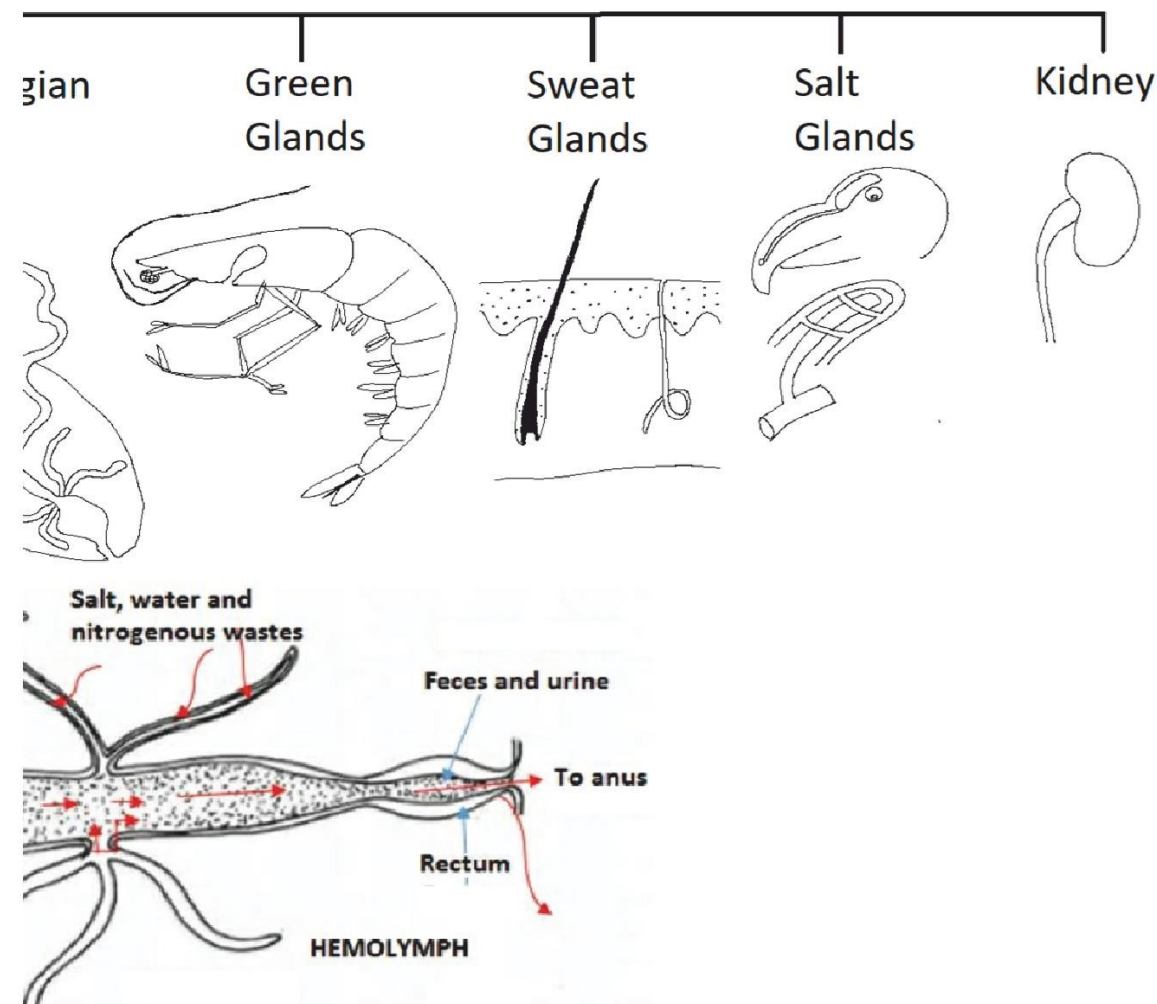
(AL/2012)
- Which one of the following is not an end- produce of nitrogenous excretion?
 - Ammonia
 - Urea
 - Creatinine
 - Uric acid
 - Bile pigments

(AL/2012)
- Which one of the following statements regarding the end products of nitrogenous excretion is correct?
 - Urea is the least toxic nitrogenous waste product in vertebrates.
 - Excretion of urea requires a large amount of water due to its high solubility.
 - Due to excretion of urea, loss of carbon from body is high.
 - Main nitrogenous excretory product of aquatic birds is uric acid.
 - Creatine is a nitrogenous excretory product of mammals.

(AL/2013)
- If proteins are present in the urine of a person, which of the following structures could have been damaged?
 - Bowman's capsule
 - Proximal convoluted tubule
 - Descending limb of loop of Henle
 - Ascending limb of loop of Henle
 - Glomerulus

(AL/2013)

Structures



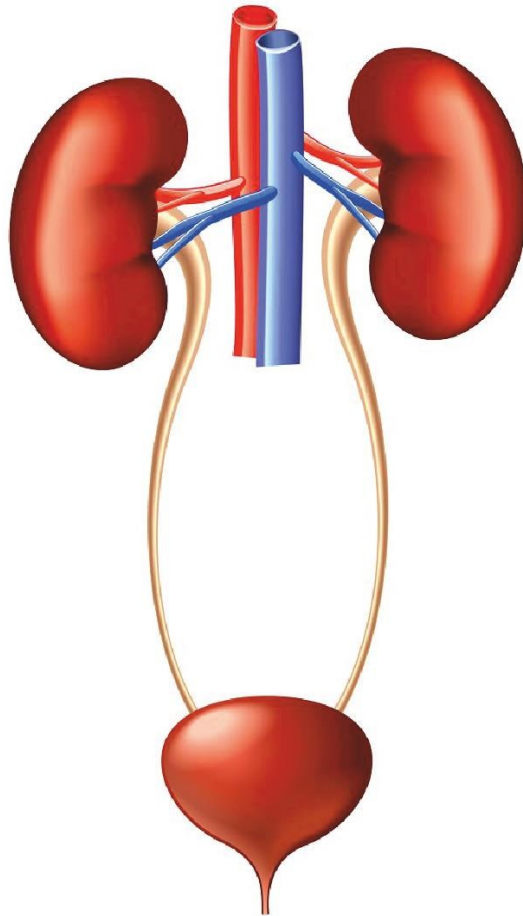
Some terrestrial animals such as, many, and excrete uric acid as the main excretory product. Uric acid is relatively non-toxic and generally insoluble in water. Therefore it is excreted as a with trace amount of water. However uric acid production from ammonia requires more energy than urea production

Kidney

- These are the major excretory and osmoregulatory organs of all vertebrates.

Human Urinary System

- Human urinary system consists of two kidneys, two ureters, urinary bladder and urethra. Their main functions are given in the following table;



2. Usage of low quality utensils for preparation of foods.
3. High Flouride (F) levels in water.
4. Exposure to pesticides.
5. Genetic factors.
6. Malnutrition and dehydration.

PRACTICAL NO. 27

- Explaining the major types of excretory structures in animals using diagrams and charts

Objectives

- Students should be able to
- describe the structure and location of a body surface, contractile vacuoles, flame cells, nephridium, malphigian tubules, green glands, sweat glands and salt glands,
- explain the structure of human kidney, ureters, bladder, urethra and their locations,
- explain the gross internal structure of human kidney,
- draw and label diagrams of observed structures.

Materials and equipment

- Diagrams/charts/ slides of body surface as excretory surface, contractile vacuoles, flame cells, nephridium, malphigian tubules, green glands, sweat glands and salt glands
- Charts/models of human excretory system and slides of L.S of mammalian kidney to study the gross internal structure, diagram of nephron
- Light microscopes

Instructions

- Allow students to examine body surface as excretory surface, contractile vacuoles, flame cells, nephridium, malphigian tubules, green glands, sweat glands and salt glands using diagrams/charts.
- Instruct students to observe the kidney, ureters, urinary bladder and urethra of man using diagrams/models/ specimens/ slides.
- Make them to observe L.S of kidney under a light microscope and recognize cortex, medulla, distribution of nephrons and parts of a nephron
- Instruct them to draw and label line diagrams of observed structures.



- High blood pressure
- Having family history
- Getting older

Chronic kidney disease (CKD)

- It is a condition of gradual loss of kidney function over time. There are many reasons for Kidney failure:

Prevent CKD

- Follow a low salt, low fat diet
- Doing proper exercise
- Having regular check ups
- Prevent smoking

Dialysis

- Dialysis is done for the patients with kidney failure. It is a process of removing excretory products, excess solutes and toxins from the blood by an artificial method.

Chronic kidney disease of unknown/uncertain etiology (CKDu) in Sri Lanka

- It is a condition of gradual loss of kidney function over time. The root cause of CKDu has not been definitively established yet—hence it is referred to as ‘Chronic kidney disease of unknown/uncertain etiology’. However it is a different form of chronic kidney disease (CKD), which is associated with conventional risk factors such as diabetes and high blood pressure, genetic disorders and urinary tract problems
- The onset of the disease appears to be asymptomatic, and by the time the patient seeks treatment the kidneys have reached a stage of irreversible damage -end stage renal disease (ESRD).
- In Sri Lanka, initially CKDu was prevalent among rural communities in North Central province (Medawachchiya, Kabithigollawa, Padaviya, Medirigiriya), Uva (Girandurukotte), Eastern Provinces (Dehiattakandiya). CKDu is also reported in North Western, Southern and Central provinces, and parts of the Northern Province of the island.

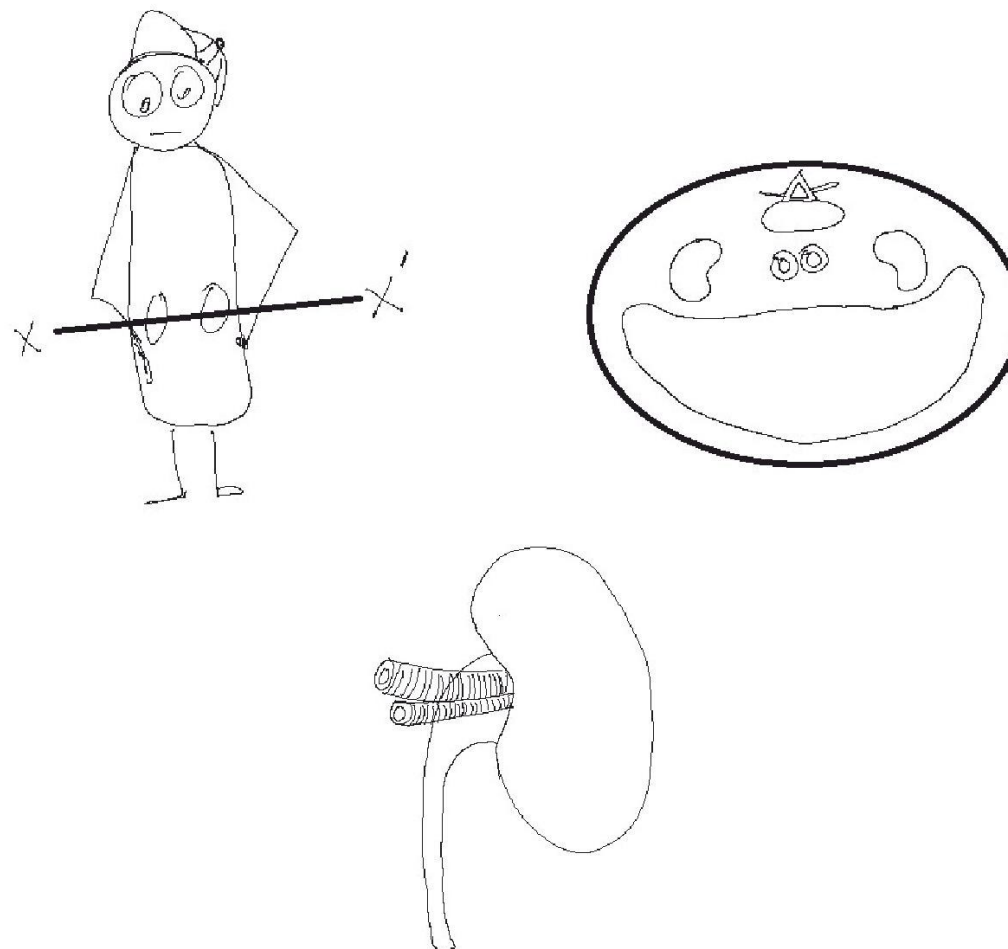
Hypothesized reasons for CKDu

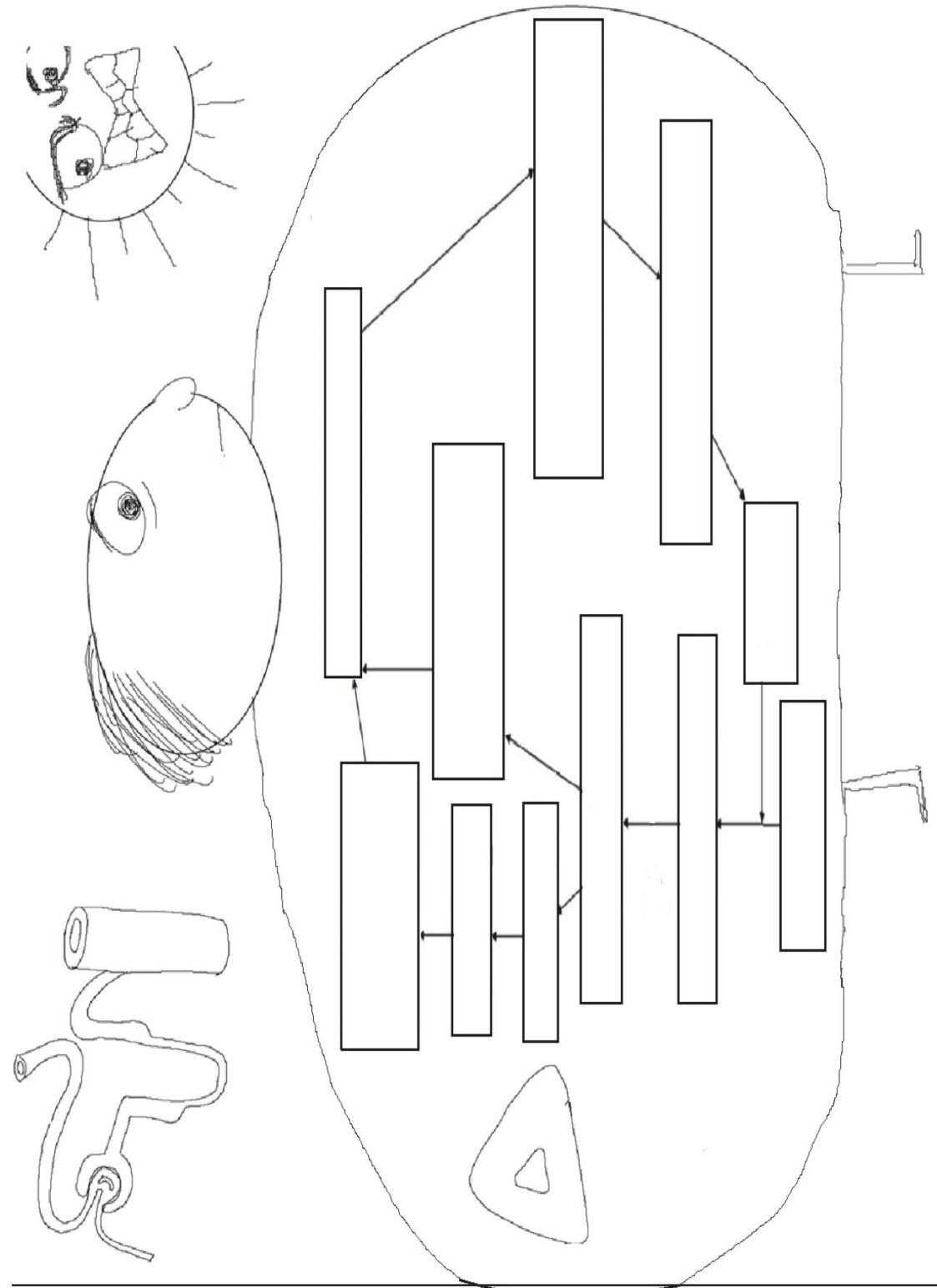
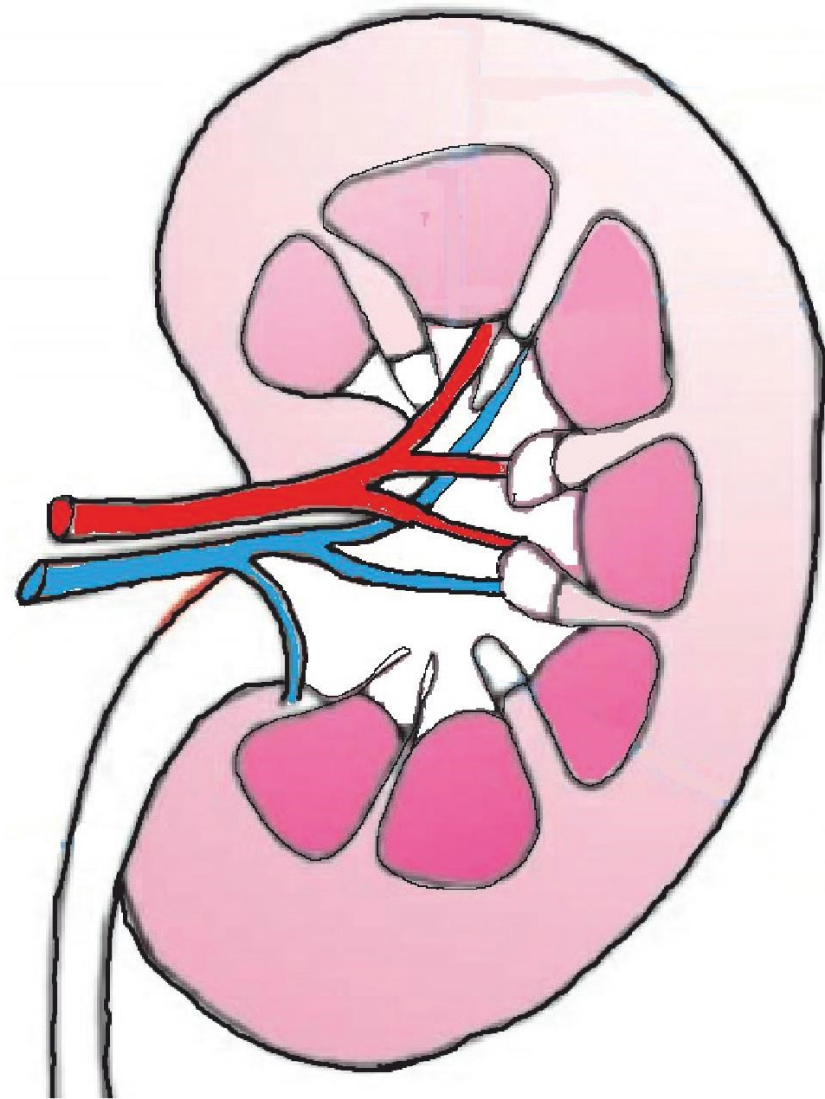
- Cause of CKDu seems to be multifactorial.
1. Exposure to Heavy metal/ metalloid such as Arsenic (As) and Cadmium (Cd) through food and water.

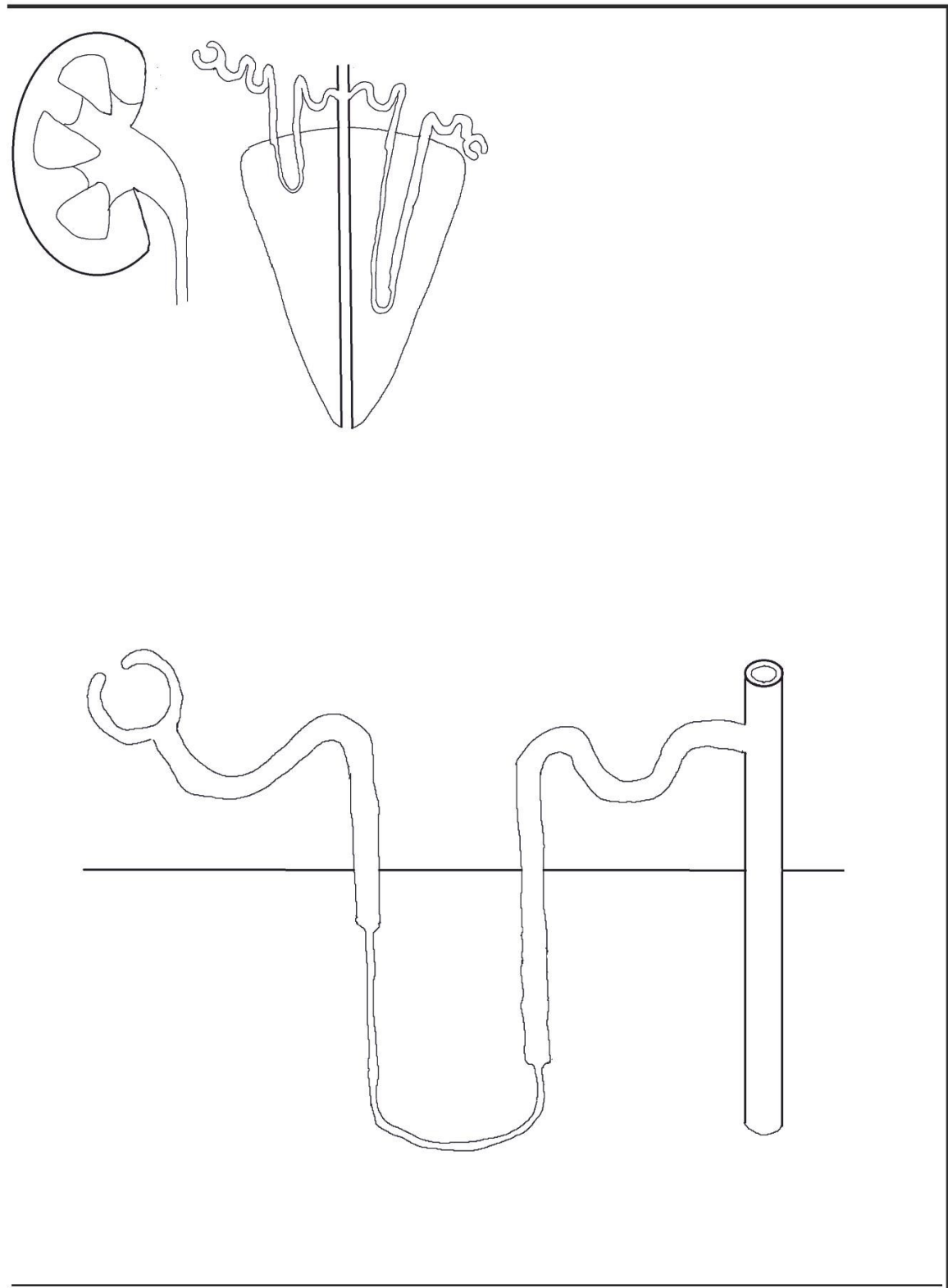
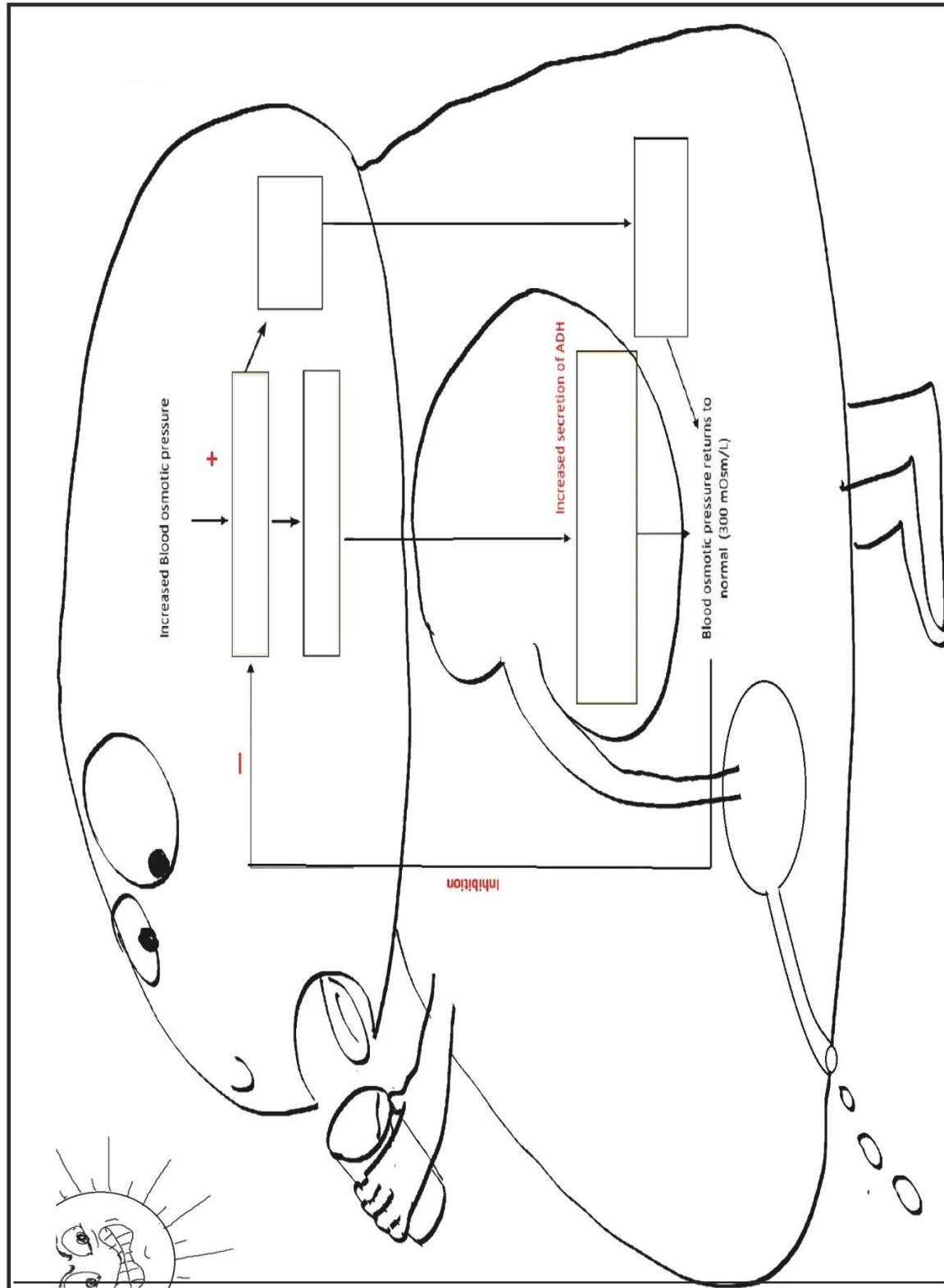
Part	Main Function
Kidney	Produce urine to excrete waste products while maintaining osmotic balance and acid base balance.
Ureter	Receives urine from kidney and send it to bladder
Urinary bladder	Temporary storage of the urine
Urethra	Provide the passage through which urine stored in bladder leaves the body

Location of kidneys

- Two kidneys are located on the abdominal wall one on either side of the column, behind the and below the
Right kidney is slightly than the





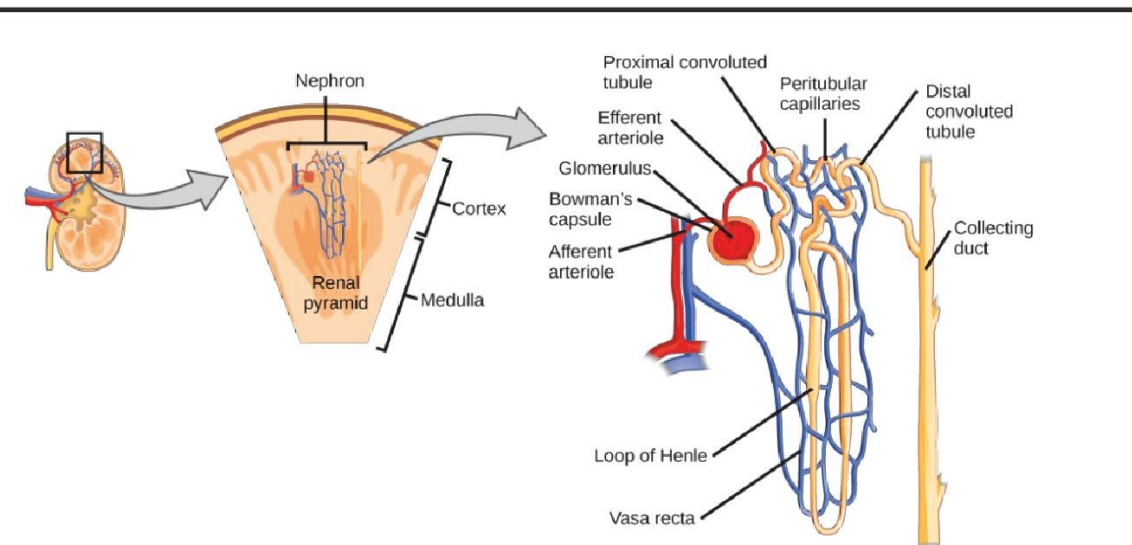


amino acids are transported to the fluid. Cells lining the actively transport Na^+ into the fluid and this transfer a charge out of the tubule drives the passive transport of Cl^- . Proximal tubule also reabsorbs and most of the; by passive transport. Reabsorption of HCO_3^- in the filtrate contributes to the pH balance in body fluids. As solutes move from the filtrate to interstitial fluid is by A major portion of water reabsorption from the filtrate occurs at this site. As the filtrate pass through the convoluted tubule, secretion of specific substances into the filtrate takes place. Cells lining the tubule secrete (by active transport) and (by passive transport) into the lumen of the tubule. Secreted ammonia act as a to trap H^+ forming NH_3 . In addition some materials such as and that have been metabolized in the liver are actively secreted into the lumen of the proximal convoluted tubule. As a result of water reabsorption and secretion of different substances, the filtrate becomes more concentrated as it passes through the convoluted tubule.

As the filtrate moves into the descending limb of loop of Henle passive reabsorption of water through osmosis continues and filtrate becomes more concentrated. The filtrate reaches the ascending limb of the loop of Henle via the tip of the loop. Ascending limb is impermeable to water so that no water reabsorption takes place but a considerable amount of NaCl reabsorption occurs at this site actively as well as passively. Most of the Na^+ is reabsorbed into the interstitial fluid by active transport. As a result of losing NaCl but not water the filtrate become more diluted as it moves towards the distal convoluted tubule.

The distal convoluted tubule plays an important role in regulating K^+ and Na^+ concentration of body fluids. The amount of Cl^- secreted (by active transport) into the filtrate and the amount of Na^+ (by active transport) reabsorbed from the filtrate can be varied at this site according to the needs of the body. Distal tubule also contributes to pH regulation by controlled secretion of H^+ and reabsorption of HCO_3^- . At the distal convoluted tubule passive water reabsorption can be increased under the influence of Antidiuretic hormone (ADH) to form concentrated urine. Aldosterone secreted by the adrenal gland stimulates increase reabsorption of Na^+ and water and excretion of K^+ . This filtrate of the distal convoluted tubule finally leads to the collecting duct.

As the filtrate pass along the collecting duct filtrate become concentrated and urine is formed.

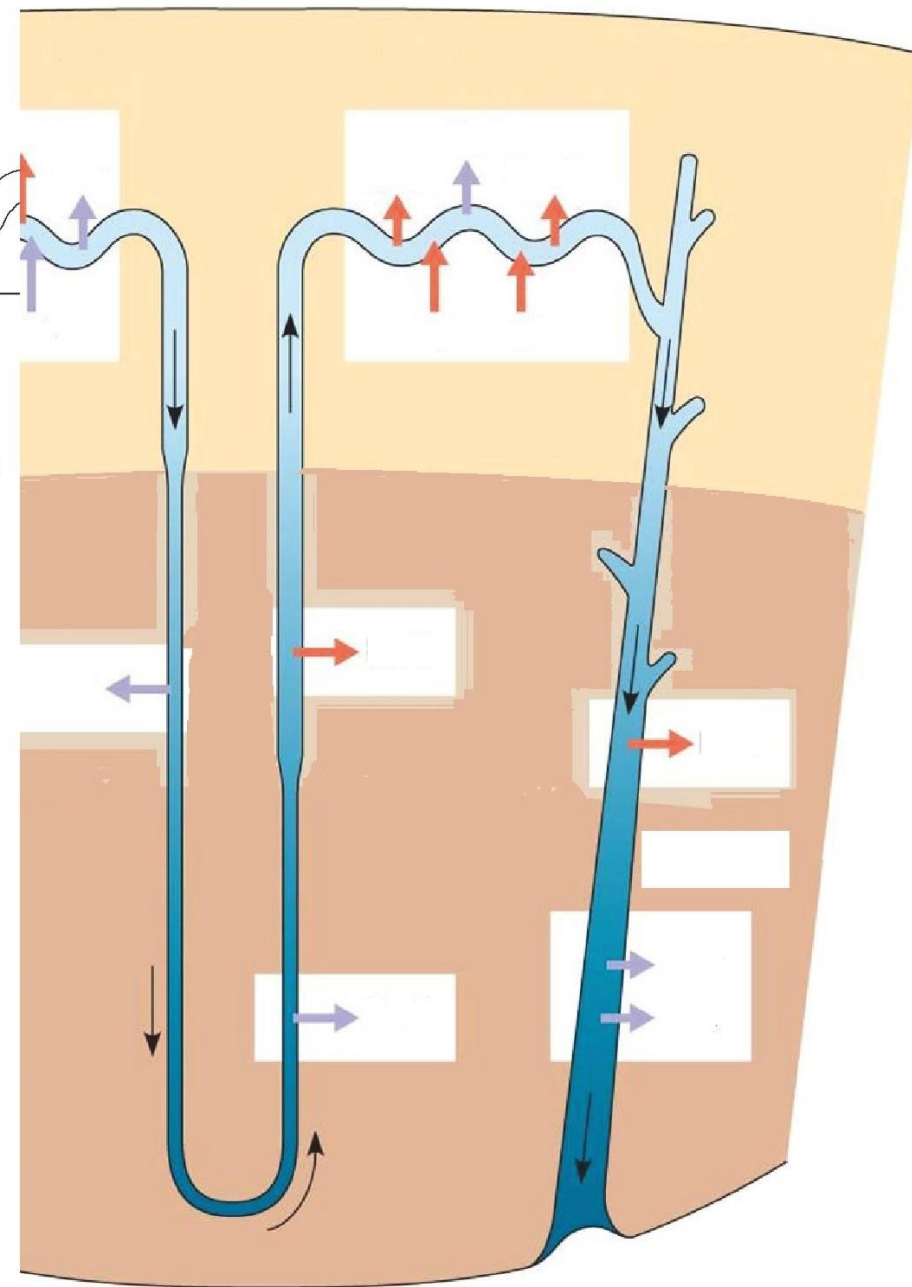
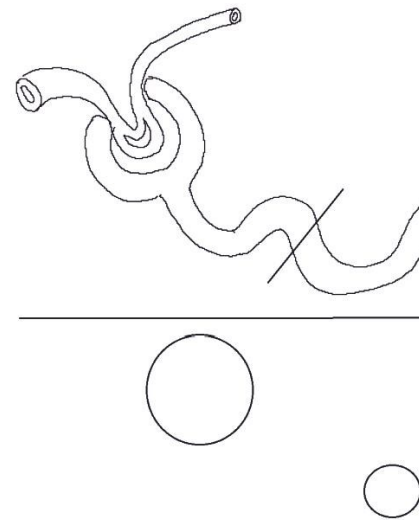
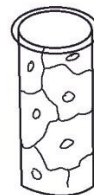
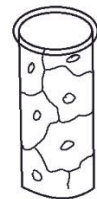
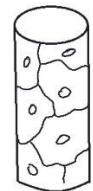
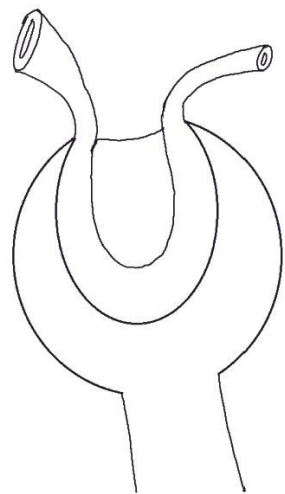
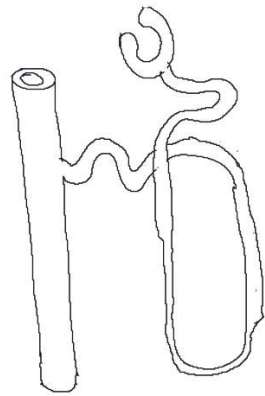
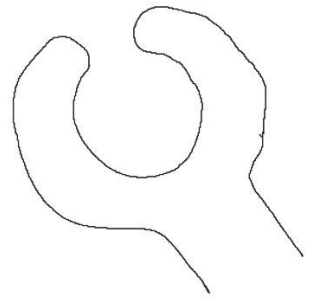


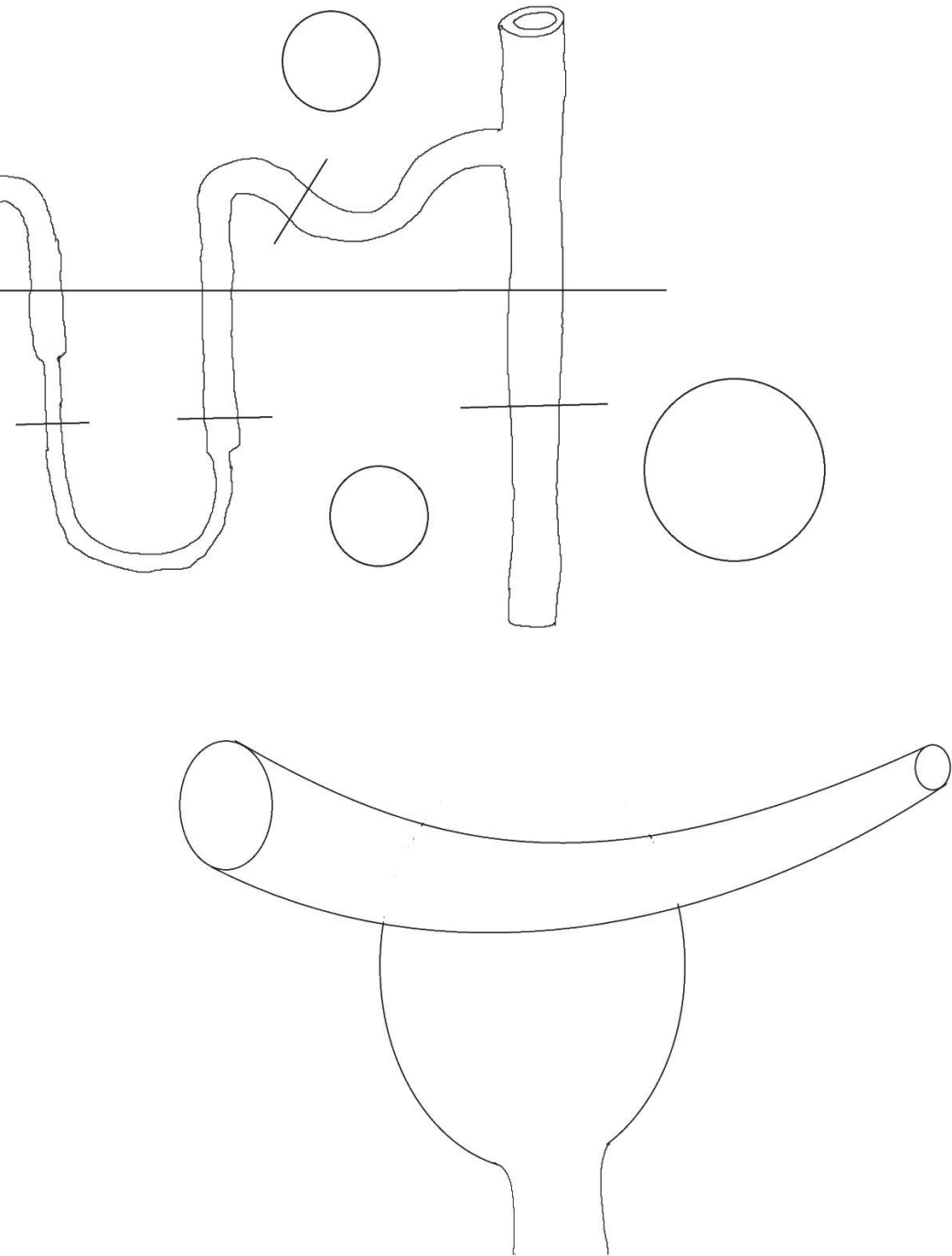
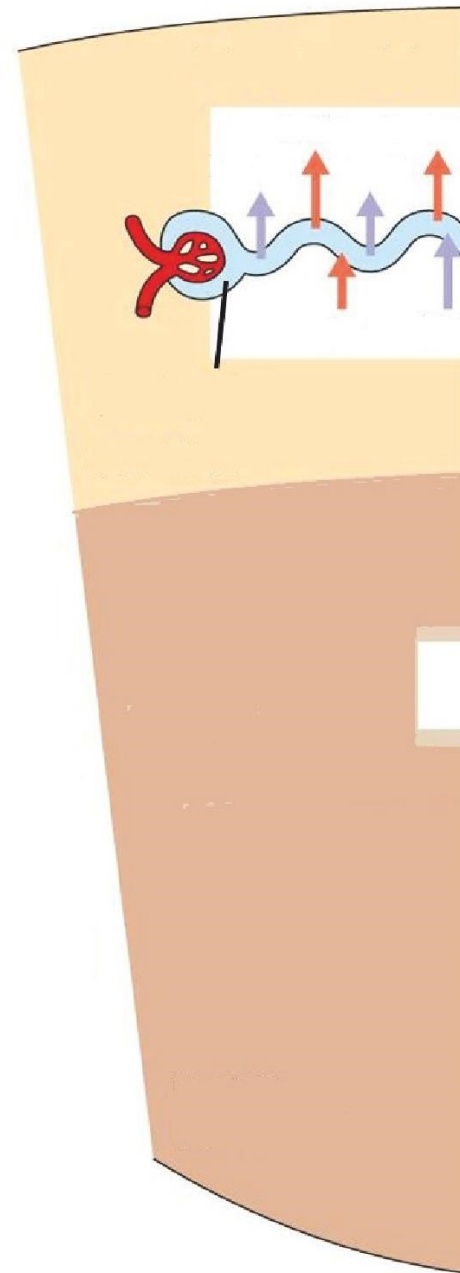
Bowman's capsule (Glomerular capsule)

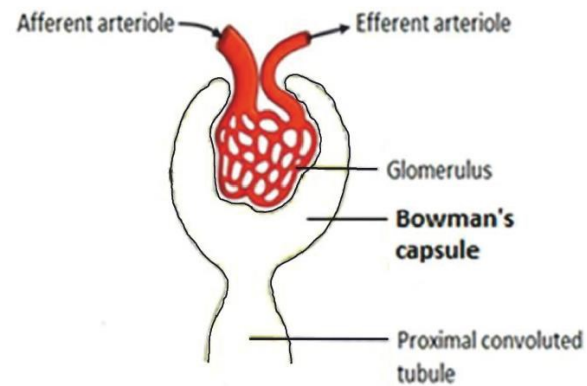
This is and end of the structure of the It is a cup shaped and structure. Inner layer of Bowman's capsule consists of a single layer of epithelial cells specialized for Outer layer of the Bowman's capsule composed of simple epithelium. Space between the inner and outer layers is known as which is responsible for receiving of glomerular filtrate. The glomerular filtrate pass through three major tubular regions of the nephron: proximal convoluted tubule, loop of Henle and distal convoluted tubule.

Glomerulus

The glomerulus is a of which is surrounded by Bowman's capsule. The nephron is supplied with blood from the afferent arteriole. The blood vessel leaving away from the glomerulus is the arteriole. The efferent arteriole has a smaller diameter than the arteriole. This modification is important for increasing blood in the glomerulus for The efferent arteriole form two capillary networks, one form the capillaries which surrounds the and convoluted tubules and the other network form the which extend towards the medulla the of







Proximal convoluted tubule

It is comparatively and than the convoluted tubule. This is lined by simple which has been for selective reabsorption of substances (nutrients, ions and water) from the glomerular filtrate.

Loop of Henle

It is a 'U' shaped part of the nephron with limb and limb which are lined by simple epithelium. Lining of the descending limb of loop of Henle is specialized for water as it allows movement of water. But lining of the ascending limb of loop of Henle is impermeable to water

Distal convoluted tubule

It is lined by simple epithelium which has been for of specific and It leads into collecting duct.

Process of Urine formation

Main steps in urine formation

There are 3 processes involved in urine formation. They are;

1.
2.
3.

Ultra filtration

- Filtration of the blood under high pressure into the cavity of the Bowmans' capsule is called ultrafiltration.
- Filtration occurs through the capillary walls of glomerulus and inner wall of Bowman's capsule.

- Blood capillaries of glomerulus are porous and cells lining the Bowmans' capsule are specialized for filtration of small size molecules and ions. These specializations allow passage of water and small solutes through the blood capillary walls into the Bowman's capsule. But due to their large size, blood cells, platelets and large molecules such as plasma proteins do not pass into the Bowmans' capsule.
- The filtrate in the Bowmans' capsule contains , water, ions, amino acids, glucose. vitamins, nitrogenous wastes and other small molecules. The composition of the glomerular filtrate is similar in composition to plasma with exceptions of blood cells, platelets and plasma proteins.

Selective reabsorption

- The process through which useful molecules, ions and water from the glomerular filtrate are recovered and returned to the interstitial fluid and then into capillary network of the tubules is called selective reabsorption.
- Most of the reabsorption from the glomerular filtrate back into the blood takes place in the convoluted tubule. Ions (Eg: Na⁺), water and valuable nutrients (eg: glucose, amino acids) are reabsorbed either active or passive transport from initial filtrate.

Secretion

- The process by which foreign materials and substances not required to the body including Waste are cleared from the peritubular capillaries and interstitial fluid into the filtrate is called secretion.
- Secretion is required because such substances may not be entirely filtered due to the short time they remain in the glomerulus.
- Substances that are secreted in to the filtrate include H⁺, NH₃, creatinine, drugs (e.g. penicillin, aspirin) and excess K⁺. Tubular secretion of H⁺ and NH₃ are important to maintain the normal pH in the blood by formation of NH₄⁺ in the urine. NH₃ can combine with H⁺ to form NH₄⁺
- Secretion occurs in the proximal and distal convoluted tubules. Secretion may be either active or passive depending on the location and / or the substance.

Glomerular filtrate in the Bowmans' capsule which contains all the substances in the blood except and pass to the convoluted tubule. At this region reabsorption of (eg. Na⁺), and (eg. glucose and amino acids) from the filtrate occurs. Nutrients especially glucose and