EXCRETION IN ANIMALS

BY ELLY KENEDDY NALITSO

0708838163- 0779031329

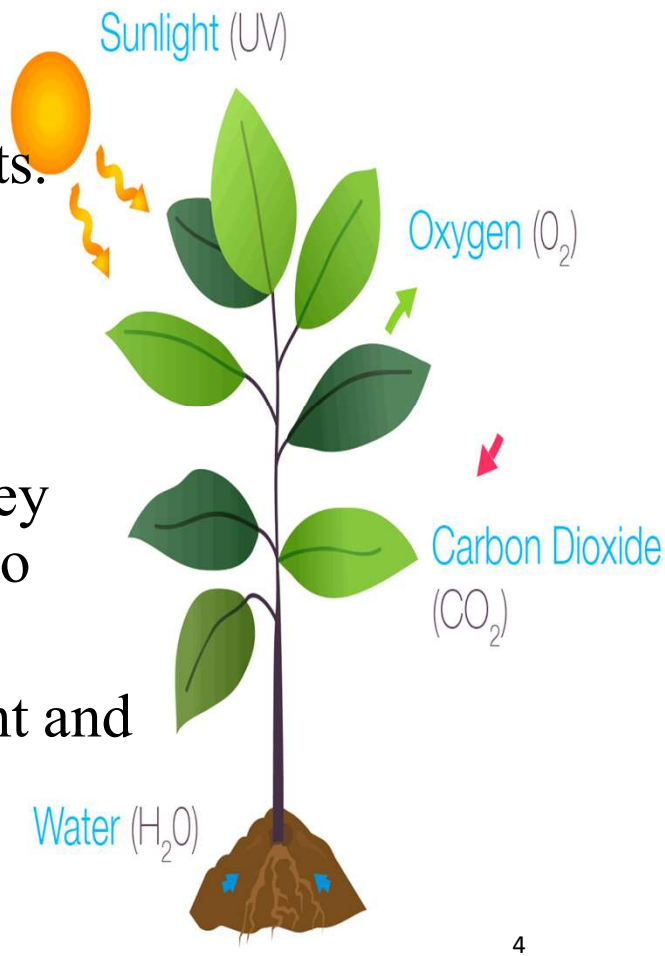
LEARNING OUTCOMES

- **The learner should be able to:**
- a) appreciate the need to remove unwanted substances from the bodies of living organisms (u)
- b) understand the process of excretion in humans, including the loss of waste products in sweat, urine and through breathing (k, u)
- c) understand and explain how and why the human body reacts to raised levels of carbon dioxide (u, s)
- d) identify the causes, symptoms and treatment of kidney failure (u)
- e) understand the need for tests to determine the presence of glucose and protein in urine, and explain the significance of the tests (u, s, v)
- f) recognise the need for proper disposal of human waste; e.g. urine (s, v)

INTRODUCTION

- **Excretion** is ***the removal of waste products of metabolism from the body***. These ***waste products are toxic*** when allowed to accumulate in the body.
- Different metabolic reactions occur to sustain life of organisms and these proceed with production of waste products.
- In animals, metabolic waste products include carbon dioxide, excess water, excess salts, bile pigments and nitrogenous compounds such as urea.
- Plants produce simple excretory by-products hence they **do not have complex excretory organs.**
- Most of their waste products can be eliminated by simple diffusion e.g carbon dioxide and oxygen.
- Plants do not locomote and they are less metabolically active than animals.

- Some waste products produced in one process are used in another process yet animals rarely reuse their waste products.
- Most of the substances broken down in plants are carbohydrates in nature which are not harmful to plants.
- Animals produce a variety of waste products in larger quantities than plants.
- Plants can store excess proteins unlike in mammals.
- Plants do not produce nitrogenous waste products. They produce non-nitrogenous wastes which are less toxic to their bodies.
- Some wastes accumulate in particular parts of the plant and they are eliminated this part of the plant falls off.



ASSIGNMENT.

- Identify any 5 metabolic reactions that take place in the body
- Identify some of the waste products produced in the reactions.
- Why should the waste products produced be removed from the body?
- Distinguish between waste products and un digested waste

NITROGENOUS EXCRETORY PRODUCTS.

These are excretory products, which contain the element nitrogen. They include ammonia, urea and uric acid.

❑**Ammonia**:

This is a **highly toxic nitrogenous waste** and **it requires a lot of water for its elimination**. It is **very soluble** in water and due to this **it requires less energy to be excreted.** Ammonia is excreted by **organisms which live in fresh water** and therefore have a lot of water in their bodies

❑**Urea**:

This is **a less toxic nitrogenous waste**. It **requires less water for its excretion**. It however requires a lot of energy for its excretion because of **its low solubility** in water compared to ammonia. Urea is excreted by **terrestrial organisms which have easy access to water and marine organisms**. Such organisms include terrestrial mammals.

❑Uric acid:

This is **less toxic than urea** and **requires no water for its elimination** from the body. It **is insoluble in water**. The disadvantage of excreting uric acid is that **it requires a lot of energy for its excretion**. Uric acid is excreted by birds, reptiles and insects and also common in desert animals.

❑Non nitrogenous excretory products.

These are excretory substances that do not contain the element nitrogen. Such products include carbon dioxide, water, excess salts and excess water.

Examples of organisms, their excretory products, their excretory organs and their habitats

Example of organism	Excretory product	Excretory organ	Habitat
Bony fish	Ammonia	Kidney	Flesh water
Cartilaginous fish	Urea	Kidney	Marine water
Reptiles	Uric acid	Kidney	Terrestrial
Birds	Uric acid	Kidney	Terrestrial
Tadpoles	Ammonia	Gills	Flesh water
Adult amphibians	Ammonia	Kidney	Flesh water
	Urea		Terrestrial
Mammals	Urea	Kidney	Terrestrial
Insects	Uric acid	Malpighian tubules	Terrestrial

TABLE SHOWING EXCRETORY ORGANS AND THEIR CORRESPONDING EXCRETORY PRODUCTS

Excretory organ	Excretory product
Lungs	Carbondioxide and water
Liver	Bile pigments
Kidney	Urea, excess salts and excess water
Malpighian tubules	Uric acid
Skin	Excess water, excess salts and some urea

IMPORTANCE OF EXCRETION

- To remove toxic waste products whose accumulation in the body poisons/harms the organisms
- To remove excess materials in the body which when left to accumulate affects the body metabolism.

NEED FOR EXCRETION

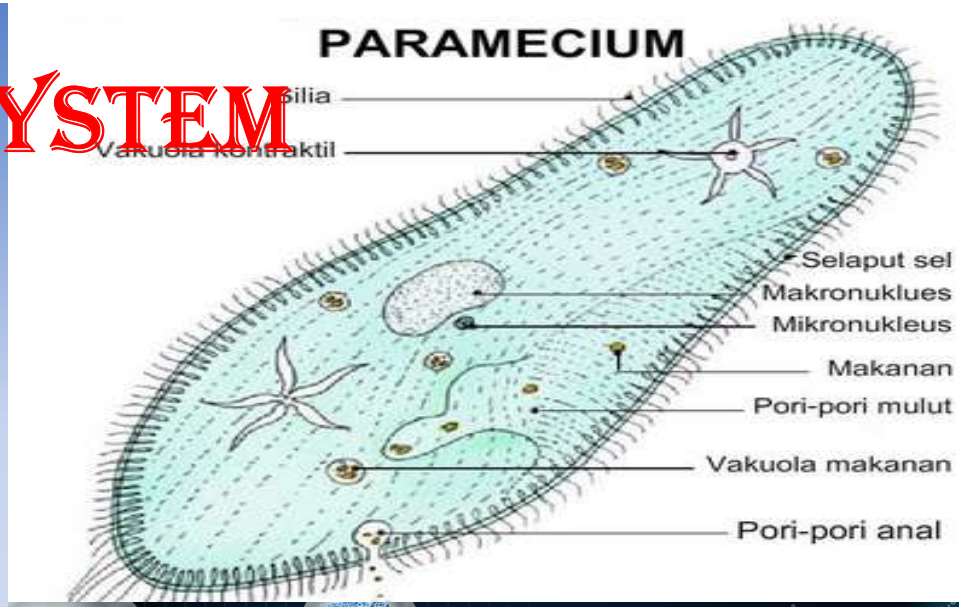
- Metabolic waste products are toxic. If allowed to accumulate in the cells or tissues to toxic levels(high concentrations), they would toxify the cells leading to illness and eventually death of the organism.
- This is because they affect the metabolic reactions and normal functioning of the body therefore must be eliminated from the body

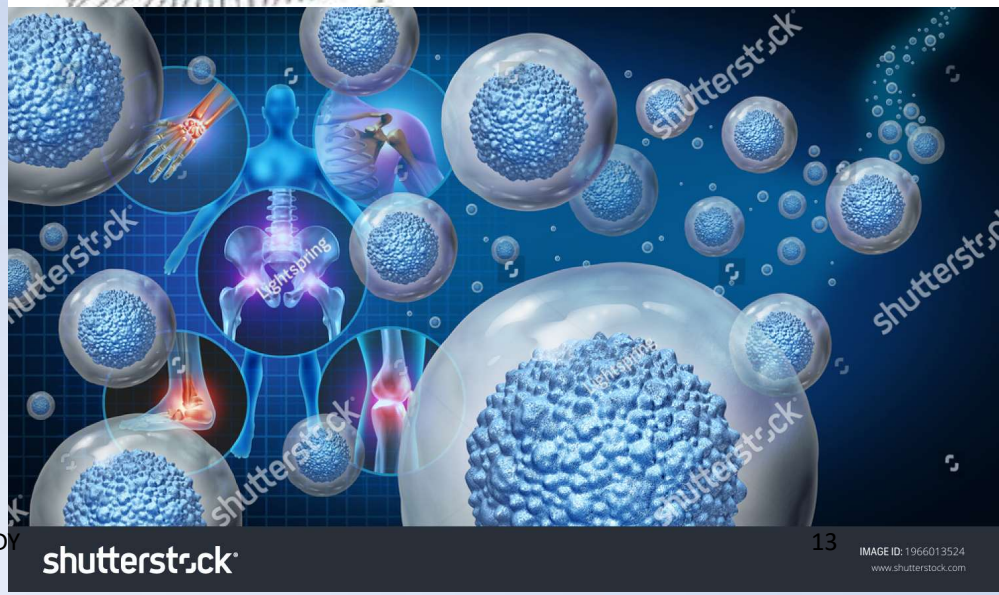
PRECAUTION.

- How does the body respond to prolonged blocking of carbon dioxide exhalation?
- How does the observed response benefit the body?
- How do carbon dioxide levels affect the breathing rate. Consider the breathing rate during exercise and during rest?

NEED FOR EXCRETORY SYSTEM

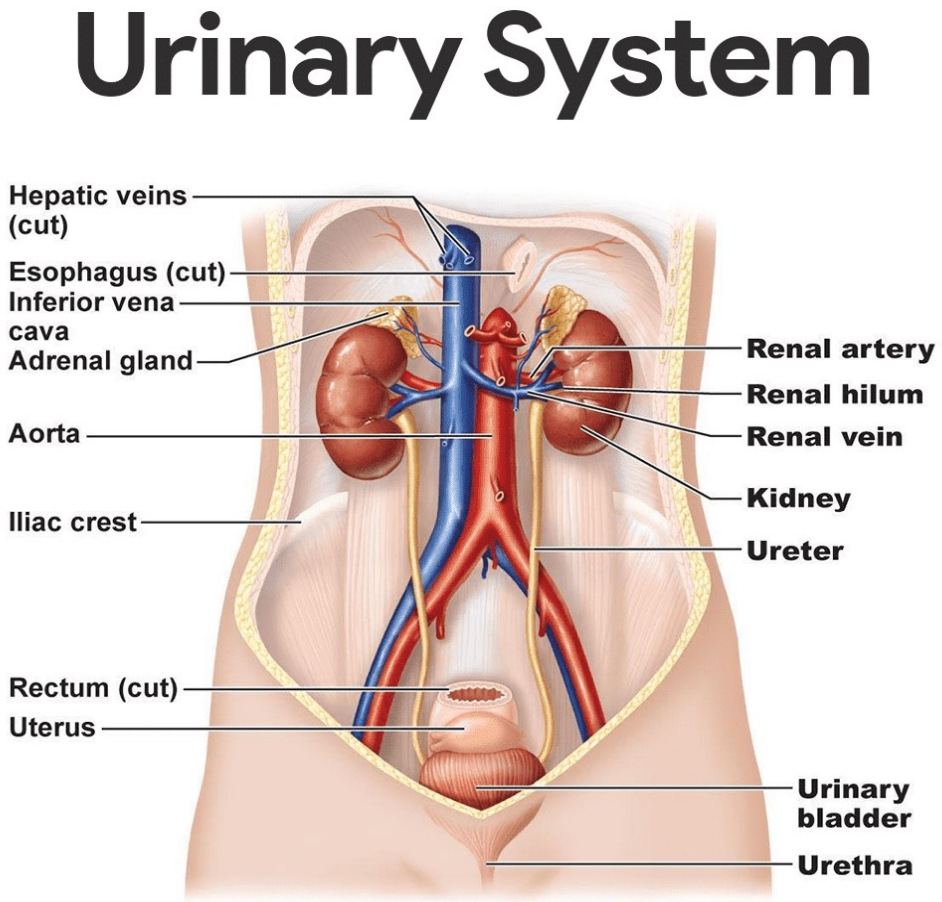
- Single celled organisms like amoeba lack excretory systems however, large multicellular organisms like humans need specialized excretory system. Explain why?
- **Relate to**: metabolic rate, nature of skin, and distance moved by materials.





EXCRETORY ORGANS.

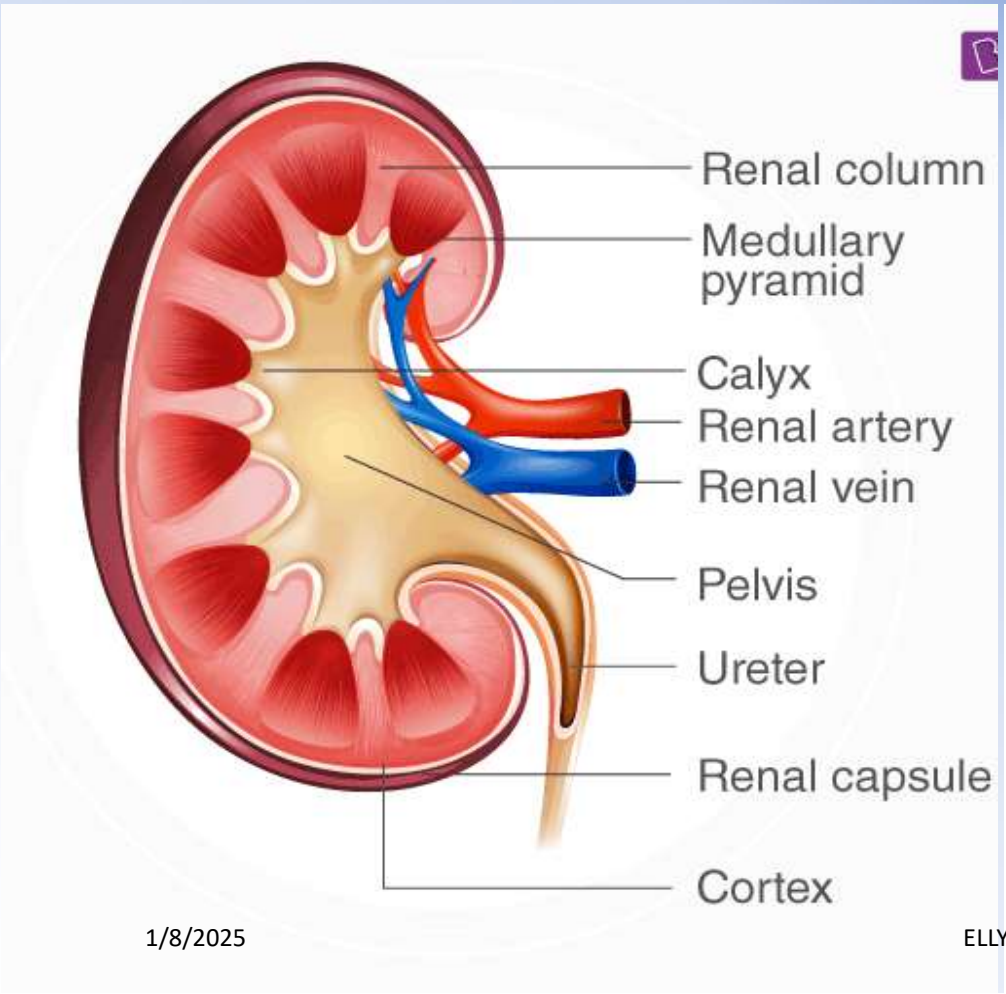
- The major mammalian excretory organs are the kidney and lungs.
- Observe and describe the structure of urinary system.
- Identify organs associated with the urinary system
- Identify the functions of each part.

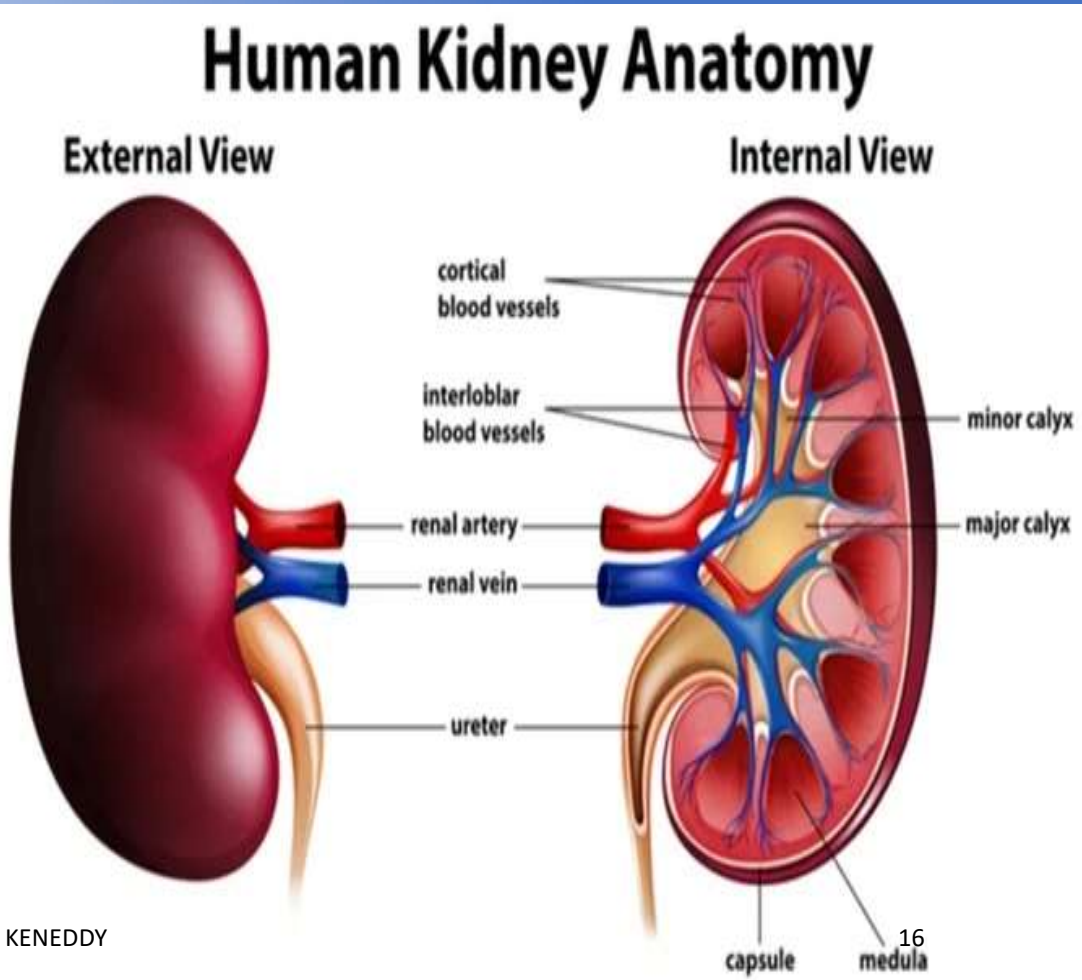


RESPONSES

- ✓**Aorta** It carries oxygenated blood with all food nutrients to the kidney.
- ✓**Renal artery:** This arises from dorsal aorta. It brings blood containing excretory products to the kidney.
- ✓**Renal vein:** It carries filtered blood from the kidney to the posterior vena cava.
- ✓**Ureter:** These are two narrow tubes arising from hilum of each kidney. They connect the kidneys to the urinary bladder. They transport urine to the urinary bladder.
- ✓**Urinary bladder:** It is a thick walled elastic sac-like structure which stores urine.
- ✓**Sphincter muscle:** These muscles are elastic thus can contract and relax to control urine flow.
- ✓**Urethra:** It is a passage for urine to the outside of the body.

INTERNAL STRUCTURE OF KIDNEY





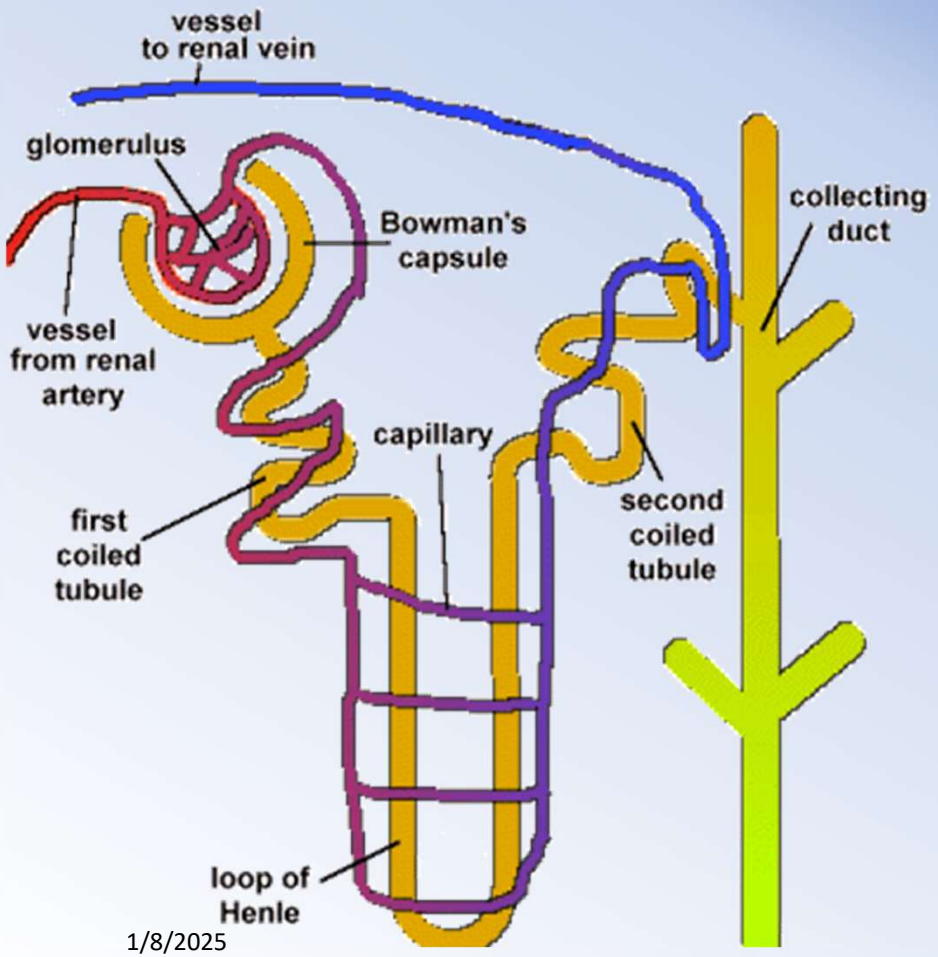
CONT.....

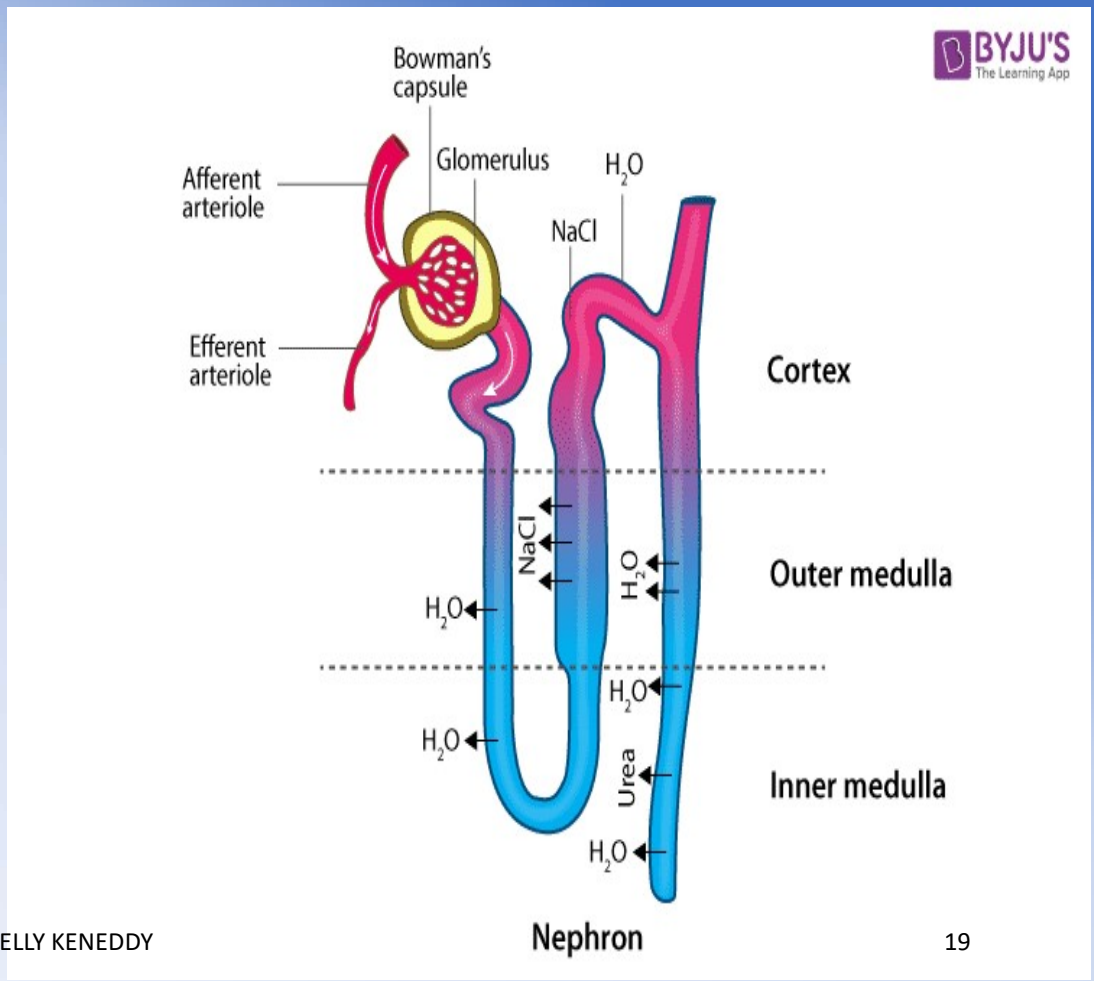
- The **cortex** which is a dark outer part. It consists of the **Bowman's capsule which is responsible for ultra-filtration** of blood passing across it.
- The **medulla**, which is a lighter inner, part. It is made up of many cone shaped portions called pyramids. It consists of the loop of **Henle and collecting ducts where water re-absorption** takes place.
- The **pelvis** is the area where the ureter leaves the kidney.

FUNCTIONS OF THE KIDNEYS

- It contains endocrine glands, which secrete hormones.
- Excretion of metabolic waste products such as urea, excess water, uric acid, ammonia, etc.
- Regulation of water and solute content of blood (osmoregulation)
- Maintenance of PH of body fluids at 7.4.
- Regulation of blood levels of ions such as Na, K, Cl, Ca
- Retention of important nutrients such as glucose and amino acids through reabsorption from glomerular filtrate into blood.

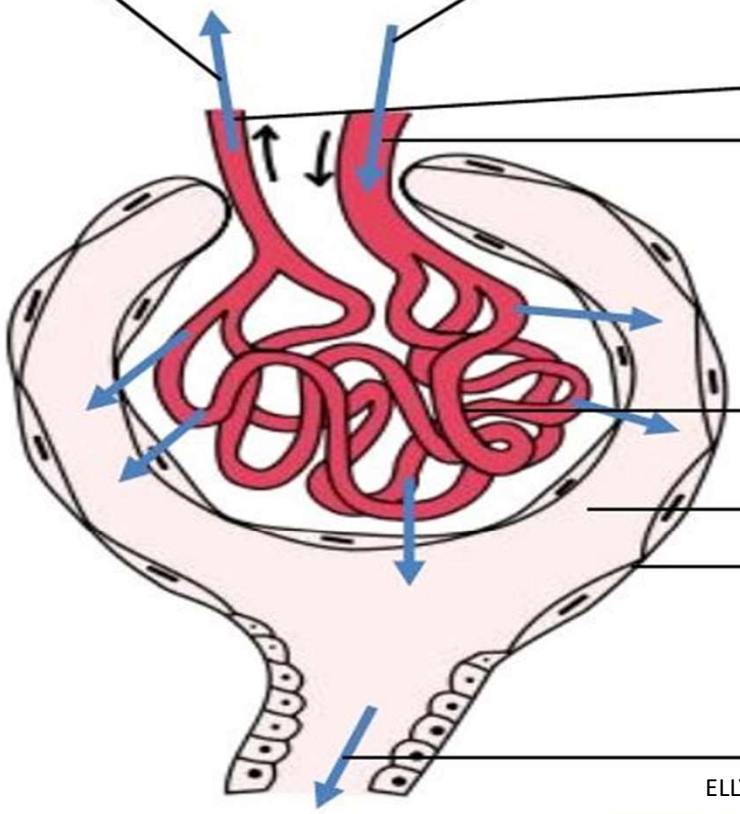
STRUCTURE OF KIDNEY NEPHRONS





Blood leaving the glomerulus contains proteins and blood cells because they have bigger molecules, which cannot pass through the walls of the glomerulus.

Blood entering through the afferent vessel contains proteins, red blood cells, white blood cells, urea, water, salts, amino acids and vitamins.



Efferent arteriole

Afferent arteriole

Glomerulus

Capsular space

Bowman's capsule

Glomerular filtrate flowing to proximal convoluted tubule

URINE FORMATION

- The process of urine formation takes place in the nephron. It occurs in two phases i.e. **Ultra-filtration** and **Selective re-absorption**.
- Much blood comes from the **afferent vessel** into the glomerulus than that which leaves through **efferent.**
- This generates pressure in the capillaries of the glomerulus forcing small molecules to filter out to form the glomerular filtrate.
- Small molecules filter out by ***ultra filtration*** to form the glomerular filtrate.
- This contains **glucose, urea, water, salts and vitamins**.
- ***Proteins and blood cells*** *do not filter out* because they cannot pass through the tiny pores of the glomerulus.

SELECTIVE RE-ABSORPTION

- The glomerular filtrate flows into proximal convoluted tubule where useful substances are selectively reabsorbed back into the blood capillaries.
- ***Proximal convoluted tubule :*** food materials are re absorbed into the blood capillaries by active transport e.g. **all the glucose**, **amino acids vitamins**, **sodium chloride** is re absorbed by **diffusion** and enters into blood capillaries.
- ***The loop of Henle:*** The loop of Henle is U-shaped with a **descending** and **ascending** limb
- As the filtrate flows down the **descending limb**, **water is re absorbed back into the capillaries *by osmosis*** (increasing concentration of the filtrate)
- As the filtrate ascends, the thick **ascending limb** of loop of Henle, **salts like Na and K are reabsorbed** *by* ***active transport***. (decreasing concentration of the glomerular filtrate)

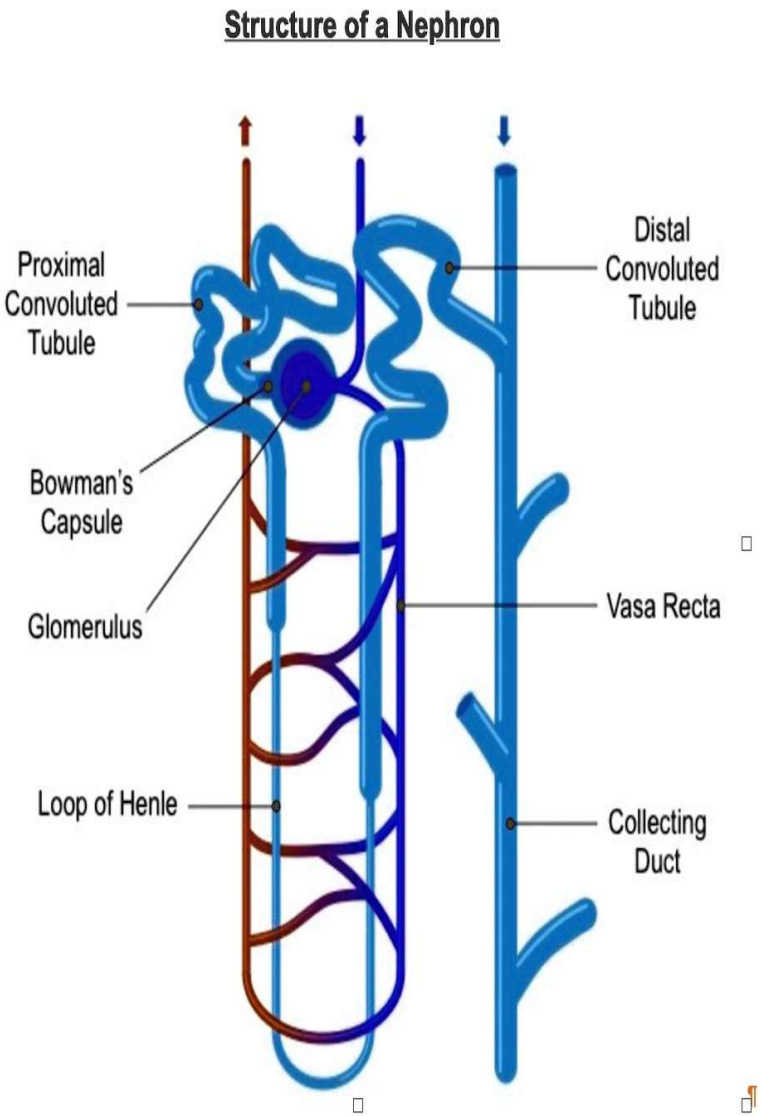
The glomerular filtrate flows to the distal convoluted tubule.

- ***In the distal convoluted tubule*:** Selective re absorption of salts by diffusion occurs. Also water is reabsorbed depending on the permeability of the tubules which is affected by hormones.

The glomerular filtrate flows to the collecting ducts.

- ***In the collecting duct*:** Water is lost to the highly concentrated medulla tissues by osmosis.

The urine drains into the pelvis. It then flows to the urinary bladder through the ureter.



NOTE

- ✓There are proteins in blood and there is none in urine because proteins are not filtered out of the blood vessels into the glomerulus due to the large size of their molecules.
- ✓ Urea is more in urine than in blood because it is filtered out of blood and it is not reabsorbed back in the blood.
- ✓Water is more in urine than in blood because it is used to dissolve urea.
- ✓There is glucose in blood and no glucose in urine because all glucose is reabsorbed from the glomerular filtrate back into the blood.
- ✓Salts like chlorides and sodium ions are more in urine than in blood. This is because they are in excess and they are not reabsorbed back into the blood. Because of this they tend to concentrate in urine.

URINALYSIS

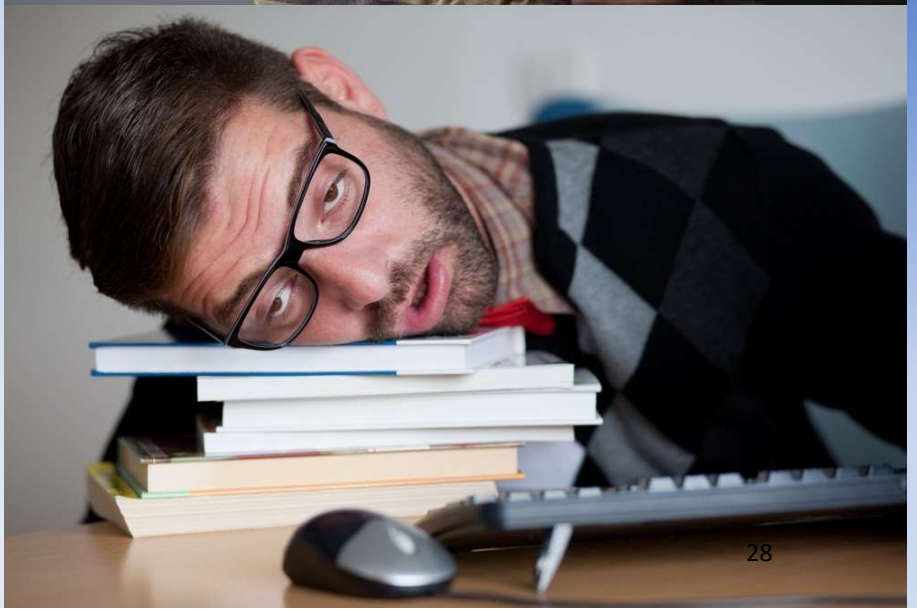
- It's a test that analyses composition of urine. This is used to check for signs of diseases and abnormalities.
- It mainly focuses on colour, appearance, glucose, protein, PH and blood cells in urine
- Attempt activity 3.4, page 50 in St BERNARD book 3

KIDNEY FALIURE

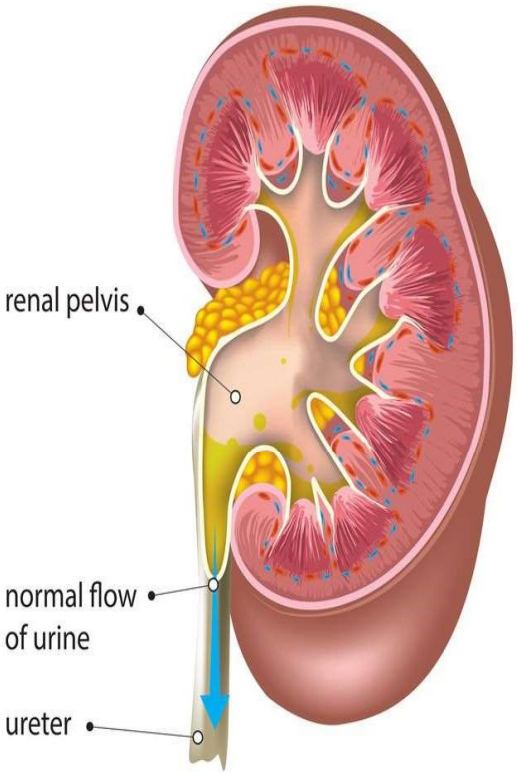
- This refers to the situation when one or both kidneys can no longer function well on their own. It arises due to different reasons E.g
- Severe dehydration
- Very high blood pressure
- Urinary tract obstruction
- Uncontrolled systematic diseases e.g heart diseases
- Unsafe medications like aspirin
- Auto immune kidney diseases
- Taking a lot of salt in food.

SYMPTOMS OF KIDNEY FAILURE

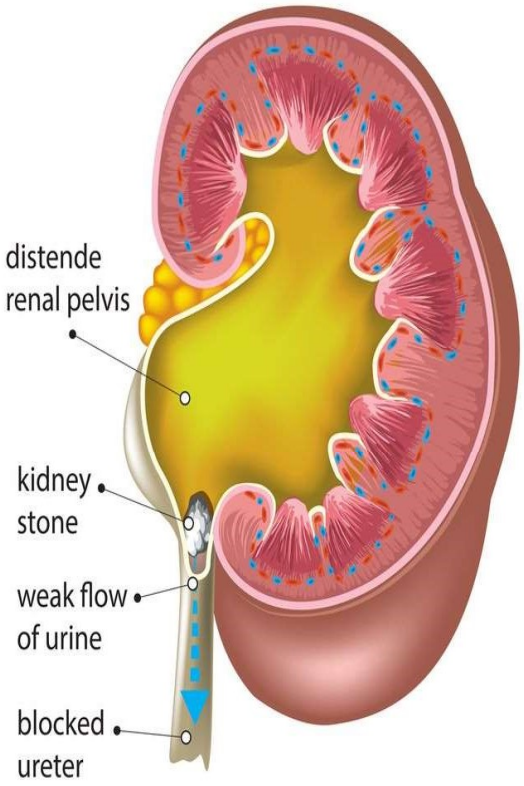
- ✓Fatigue
- ✓Upset stomach and vomiting
- ✓Trouble in concentrating
- ✓Swelling especially around hands and ankles
- ✓Frequent bathroom trips
- ✓Dry or itchy skin
- ✓Poor appetite
- ✓Decreased urine output
- ✓Internal bleeding
- ✓Comma



KIDNEY OBSTRUCTION AND SWELLING OF ANKLES



NORMAL KIDNEY



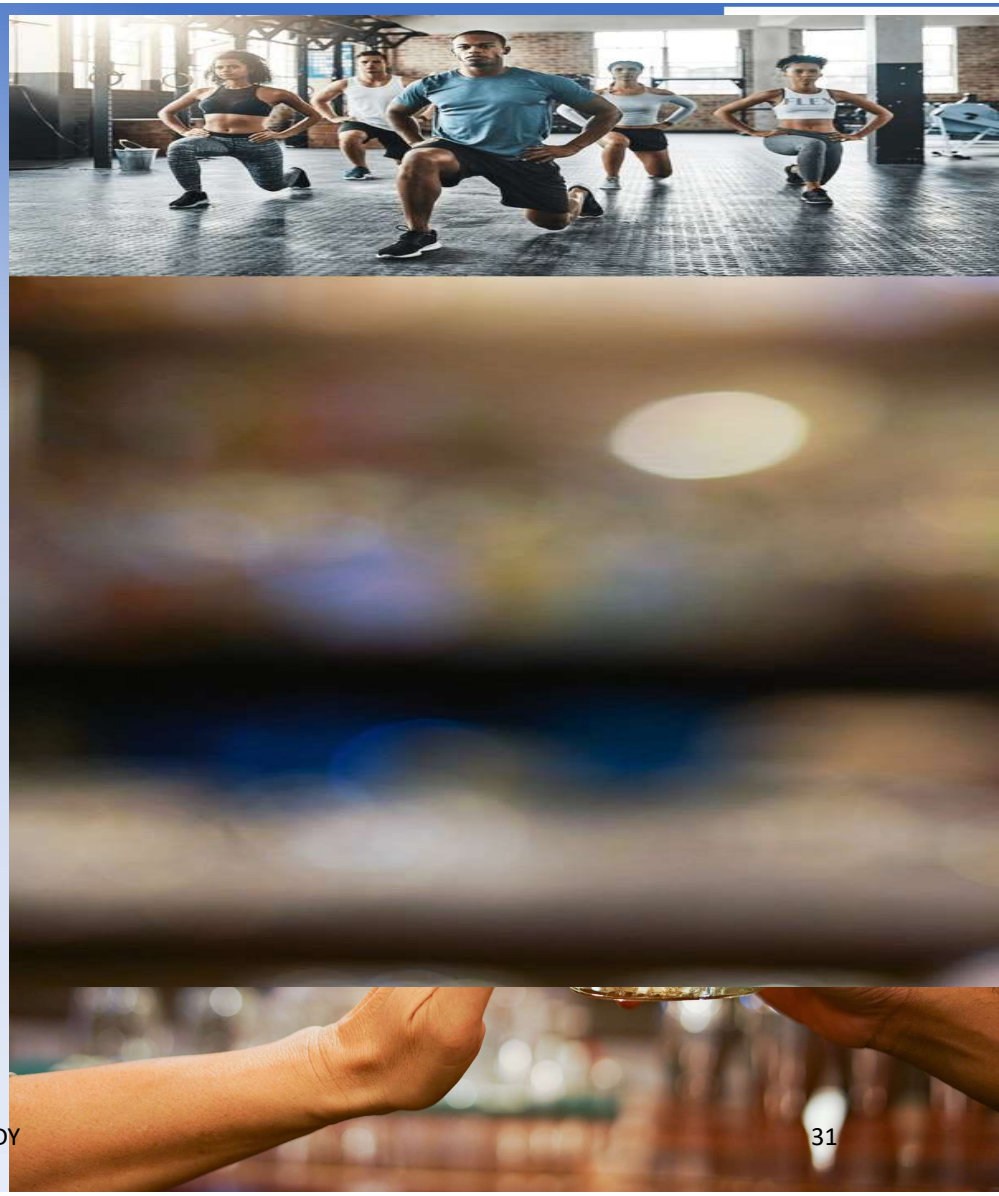
HYDRONEPHROSIS

ASSIGNMENT.

- Basing on the causes, how can we maintain and ensure that our kidneys are healthy (8 marks)

TREATMENT AND CARE

- Restricted salt intake
- Performing exercise
- Managing blood pressure
- Drinking enough water
- Avoid smoking
- Avoid alcohol
- Don't resist the urge to urinate.
- Chronic kidney failure maybe resolved treated through using dialysis or kidney transplant



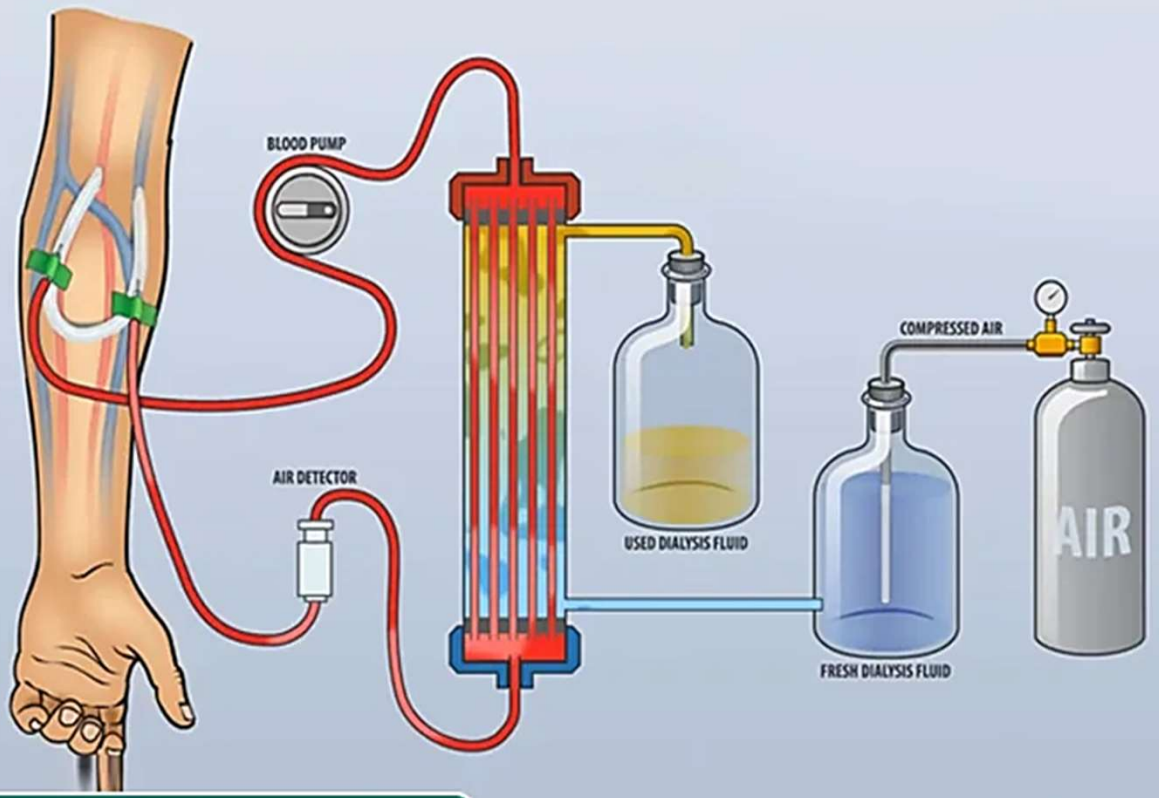
- ❑Avoid self medication
- ❑Eat a balanced diet

❖DIALYSIS.

- This is a medical procedure in which the patients blood is filtered through a a machine that pumps out wastes and return blood back to the body. There are 2 types of dialysis ie

HAEMODIALYSIS

- This is done through a tube (catheter) stuck into ones veins in the patients neck.
- This is done atleast thrice for 3 to 4 hours



NEET SS- MEDICINE
Nephrology

HAEMODIALYSIS APPARATUS
Dialysis System, Dialysis Machine

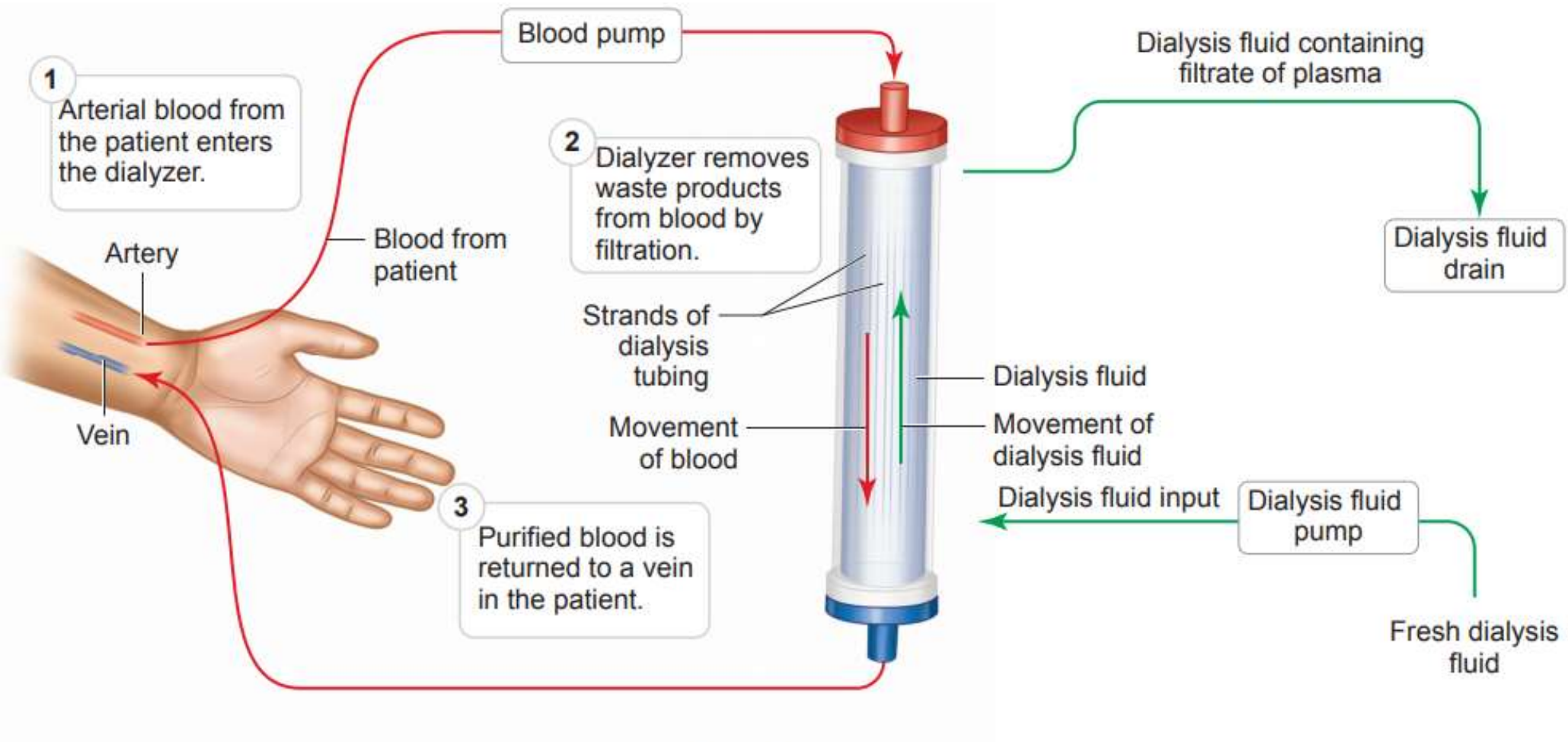


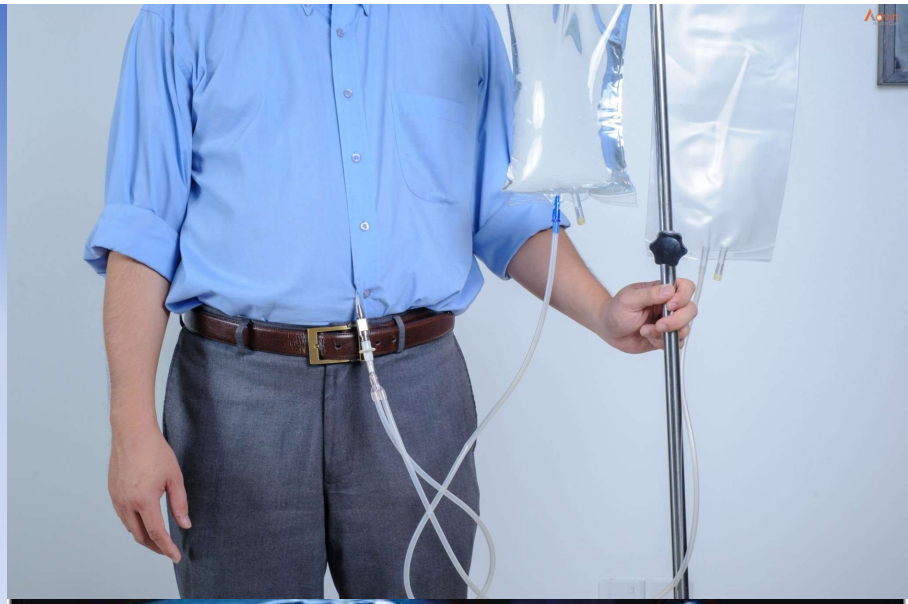
Figure 8.12 Simplified diagram of hemodialysis

❑Peritoneteal dialysis

- This type of dialysis is done through a tube permanently set in the patients belly as shown.
- This is done about 3 to 5 times a day. It is mostly done in children at home.

❑Kidney transplant.

- Since dialysis is not permanent solution and chronic kidney failure rarely heal itself, the solution is kidney transplant.
- Kidney transplant is a surgical process where a surgeon puts a healthier kidney from another person



HUMAN WASTE RECYCLING

QUESTIONS.

- How is urine disposed in your school?
- How can urine be disposed properly?
- What are the possible hazards of poor urine disposal?
- How best can urine be put to good use?

INTRODUCTION.

- Human wastes are by-products of respiration that become toxic to tissues if left to accumulate.
- These are excreted from the body however; they need to be disposed off properly.
- Why doesn't carbon dioxide require means of disposal?
- **Carbon dioxide diffuses freely into the atmosphere once exhaled**
- Other wastes require to be disposed off properly once excreted from the body
- Proper human waste disposal can be achieved through the following ways.

WAYS OF PROPER URINE DISPOSAL.

- **Recycling urine to get safe water** for domestic use and agricultural purposes
- **Using it as a fertilizer** in agriculture to improve soil productivity since they are rich in nitrogen e.g. urea and ammonia
- **Production of bio gas** which serves as a cheap alternative source of fuel and in homes for cooking, lighting ,etc.
- **Land fills**
- **Production of hydrogen fuel**. This is obtained by passing current through human urine to produce methane and CO2 which pass through a tri-generation process to produce hydrogen.
- **Source of medicine**(research)

POSSIBLE HAZARDS WHICH MAY ARISE DUE TO POOR DISPOSAL.

- Diseases transmission
- Air pollution
- Distraction of vegetation
- Water pollution.

Research for more hazards


ALWAYS AIM FOR EXCELLENCE
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