UNIT - VII

E X C R E T I O N

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E X C R E T I O N

PART - I

Introduction :

Through the earlier Unit, namely,'Respiration and Production of energy, you have come to know what is respiration, how oxygen is utilized in the process of releasing energy from the food, the different end products produced during the process etc. Further,you have also learnt how the unutilised energy, and the end products of respiration such as carbon-di-oxide and water are thrown out by the living organisms. Think, what may happen if CO_2 and water produced during respiration are not thrown out of the body of a living organism. You knowtthat the organism will die due to accumulation of these waste products. Hence, all living organisms get rid of these waste-products in one way or the other. You should know that CO_2 and H_2O are not the only waste-products produced in the body of an organism. I am sure, you will be surprised to know that chemical reactions that go on in the body of an organism are much more than what goes on in the largest of chemical factories. During many chemical reactions, many waste products are produced. In Part - I of this Unit, you will be studying;

1. the different types of waste-products produced in the body of an organism, and
2. how they are produced.

With the background of the different types of waste-products produced in the body of an organism, in Part-II of this Unit you will come to know how living organisms get rid of these wastes. In other words, you will be studying the different organs that take part in the process of elimination of wastes in living organisms.

The learning material in both the parts are presented in different ways. At the beginning of each part, you will find instructions as to how to use the material.

P A R T - I

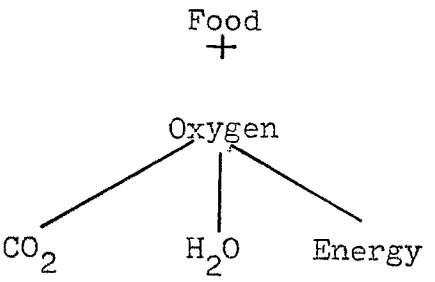
E X C R E T I O N

About the Learning Material :

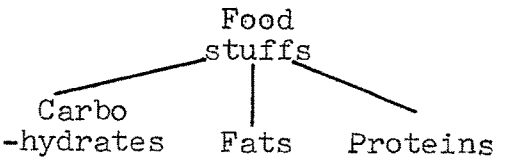
The learning material in this part is presented in the form of small paragraphs. Almost every paragraph in the material is illustrated with simple diagrams. Further, the language used in the material is simple enough for you to understand without much help from the teacher. As you read through the material, you will find a few questions to answer. By answering these questions, you will come to know how much you have learnt. However, if you get any doubt, you must feel free to discuss with your teacher.

Hope you will like this way of learning.

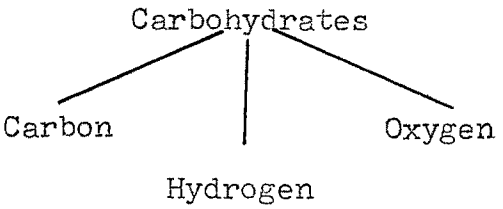
You may recall what you know about respiration. You know that respiration is a process by which food stuffs are oxidised and energy is liberated. And, during the process certain end-products are produced.

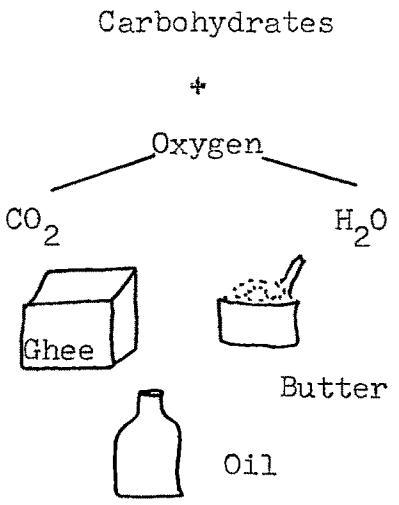


Let us consider the different types of food stuffs that are oxidised in the body of an organism and understand the end products produced.



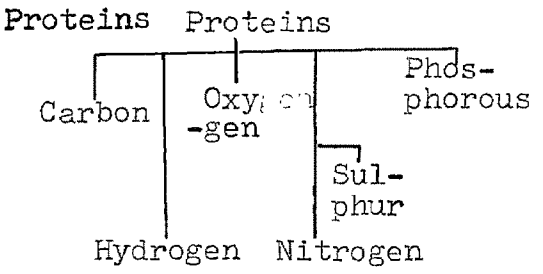
First we shall take the example of carbohydrates. Recall the composition of carbohydrates, which you have studied under protoplasm and its constituents. You have learnt that carbohydrates are organic compounds, and are composed of carbon, hydrogen and oxygen. During the oxidation of carbohydrates in the body of an organism end products such as carbon-di-oxide and water are produced.

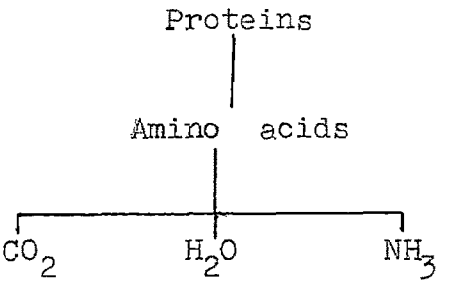




You know that like carbohydrates, fats are also organic compounds and are composed of carbon, hydrogen and oxygen. When fats are broken down in the body lot of energy is produced along with carbon-di-oxide and water.

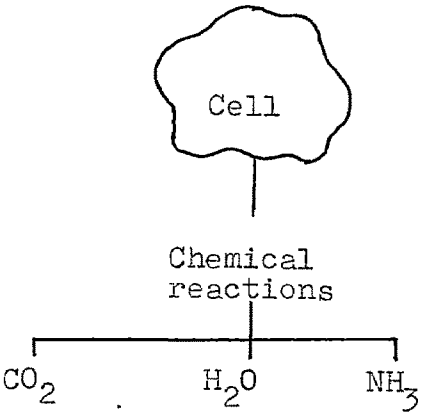
Think of the third type of food stuffs, namely, proteins. Every organism consumes proteins for its growth and development. Recall the composition of proteins. Proteins are organic compounds, and are composed of carbon, hydrogen, oxygen, nitrogen, sulphur and phosphorous. In the body of an organism, first, proteins are reduced to amino acid. When amino acids are broken down, Carbon-di-oxide, water and ammonia are produced. You know that in the body of an organism, chemical reactions like oxidation or breakdown of substances will be going on continuously along with synthesis of new substances. During these reactions, many unwanted products are produced. e.g. Carbondioxide, ammonia, water etc. You can imagine how much of unwanted materials are produced and as to what may happen if these unwanted materials are not thrown out of the body.





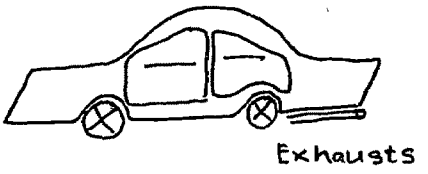
To understand this better, we shall take the same example, viz., automobiles which we had considered in the Unit Respiration.

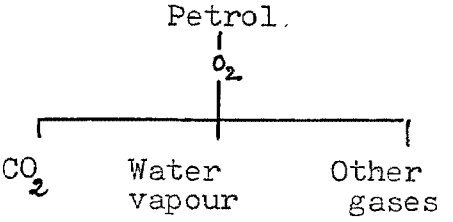
You know that all automobiles are provided with exhausts. When petrol or diesel is burnt in the carborator, carbondioxide is produced which passes out of the engine through the exhausts. Think, what will happen if these exhausts are blocked. You may say that carbondioxide produced during burning of petrol will collect in the engine and prevent further burning of petrol. This will lead to many complications in the engine.



Waste products or unwanted materials

In the same way, in living organisms also, if CO_2 produced during respiration accumulates in the body, it will lead to many disorders. This is true of the other unwanted materials like ammonia, water, etc., produced during chemical reactions in the body. Some of these unwanted materials may become toxic or poisonous if they accumulate beyond a certain concentration in the body. An important requisite for the continuation of life, therefore, is ridding the body of wastes or the unwanted materials. And the process by which living organisms get rid off these waste materials from their bodies is called as excretion.





Thrown out through exhausts

You may answer the following questions to make sure of what you have learnt so far, and can check your answers with the correct answers.

Questions:

1. What do you understand by the term excretion?
2. Why all living organisms get rid of their body wastes?

Correct Answers:

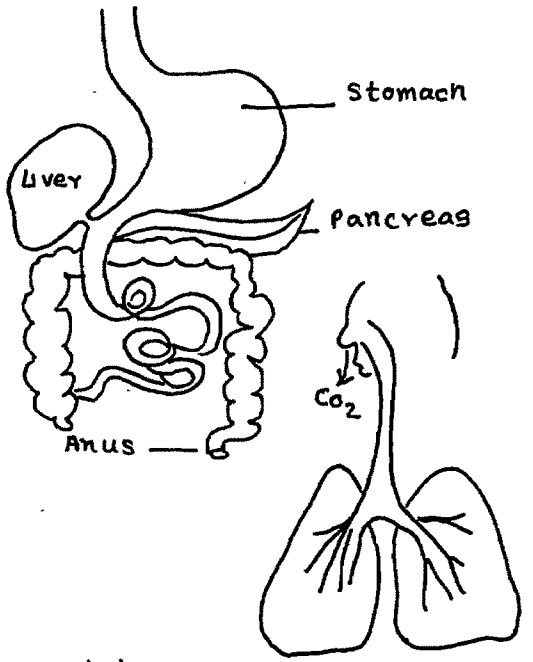
1. Excretion is the name given to the process by which living organisms get rid of their body wastes.
2. All living organisms throw away their body wastes mainly because
   a) some of them are toxic or poisonous in nature.
   b) collection of these wastes in the body will hinder the functioning of other systems in the body.

Think it over:

In what way does plants re-utilise the wastes, viz., CO_2, H_2O and NH_3 produced during oxidation of glucose in their cells.

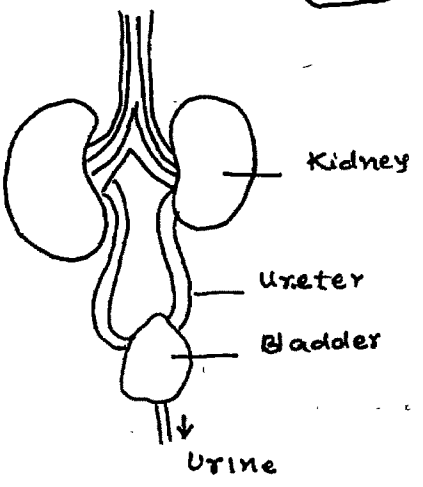
Now you know, what is excretion and why all organisms carry out this process. Now we shall try to understand in what forms are waste materials are thrown out or excreted.

Recall what you have studied about digestion in animals. You know that all the food that is taken through the mouth is not absorbed by the cells. The indigested food is thrown out as faeces through the anus, usually in solid or semi solid form.



Living organisms expel out CO_2 and water vapour in gaseous form. You know already CO_2 is exhaled through the respiratory organs. This is the second form in which waste materials are removed to outside.

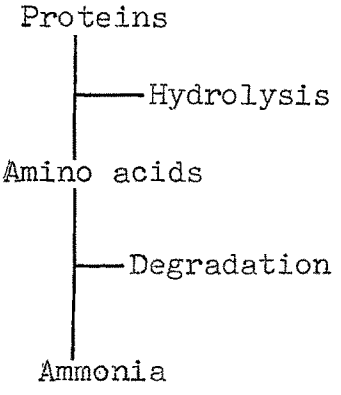
The third form in which waste products are removed is in liquid form, that is, through urine. Many of the waste products such as urea, uric acid etc., are washed out through urine.



It is clear to you that living organisms get rid of the wastes in the form of solid, liquid and gases. We shall try to understand in detail, the nature of these waste products that are eliminated to outside. The most important waste products produced during chemical reactions in the cells are carbondioxide and ammonia. You know already how carbondioxide is produced and eliminated. Let us concern ourselves with the origin and disposal of ammonia.

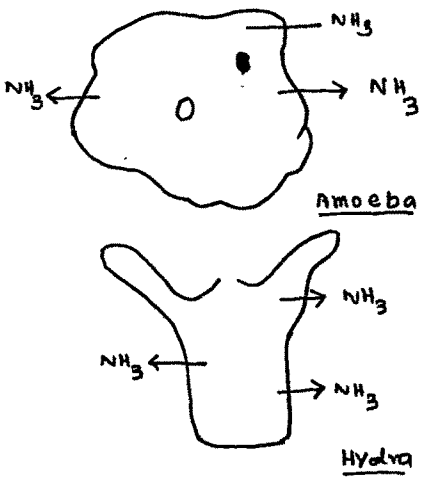
Ammonia:

Recall what you have studied about proteins under protoplasm and its constituents. As you know, it is made up of amino acids. It is because of this reason amino acids are called as the 'Building blocks' of Proteins. When proteins are broken down in the cells, amino acids are formed. (You will study the breakdown of amino acids in your higher classes) These amino acids, when further broken or degraded, forms ammonia. In plants, ammonia thus produced is reused for the synthesis of new products. Hence, in plants there will be hardly any ammonia left unused. But in the animals major part of ammonia produced during breakdown of amino acids is not



When proteins are degraded in the body, amino acids are produced. These amino acids, after further degradation, yield Ammonia.

reused. If this unused ammonia is not thrown out, it becomes toxic to the organism.



In lower animal NH_3 is thrown out directly through the process of diffusion.

You may recall how lower organisms like amoeba, Paramaecium etc., get rid of ammonia so produced. Lower organisms get rid of ammonia through the process of diffusion. During diffusion, molecules of ammonia move from the region of higher concentration viz., body of the organism to the region of lower concentration, that is, surrounding pond water.

In higher animals, this direct diffusion of ammonia to outside environment will be slow and hence, it will be converted into urea, uric acid etc., and then thrown out. We shall now take up urea and understand how it is formed and expelled.

In higher animals NH_3 produced during degradation of amino acids.

Urea — Uric acid

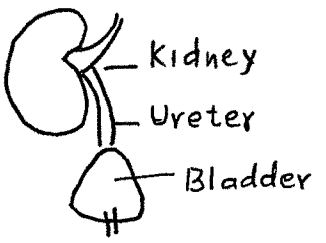
Urea:

Urea is formed by the combination of ammonia with carbondioxide. It is less poisonous than ammonia and is soluble in water. Most higher animals dispose of

ammonia in this form, e.g., Fish Frogs, mammals, earthworms etc. It is first formed in the liver, from where it is carried to the kidneys by the blood and thrown out in the form of urine. If the concentration of urea raises in the blood, it becomes toxic or poisonous. Lot of water will be required to wash out this urea. You know we drink lot of water in a day. This washes away urea through urine. It is estimated that human body requires one litre of water a day, to wash out urea. But think of animals which live in places where there is no abundant water,e.g., birds, insects etc. These animals dispose of ammonia in the form of uric acid. We shall understand it further.

$NH_3 + CO_2$ --- Urea

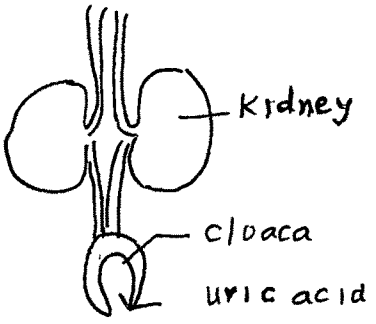
Urea Liver



Urea is passed out through urine.

Uric Acid:

Uric acid is a complex nitrogenous compound and is almost insoluble in water. Further, it is least poisonous in nature. It is mainly formed in liver and to some extent in kidneys, and is thrown out in solid form along with



Uric acid is passed out along with faeces. And it is produced only in birds and insects.

faeces through Cloaea in birds and insects. Thus, ammonia is removed to outside.

Now you know how living organisms get rid of their body wastes. Let us summarise what all we have studied so far in this part.

S u m m a r y:

1. Many waste products are produced during chemical reactions that go on in a cell.
2. All organisms throw away these wastes in one form or the other.
3. The process by which body wastes are thrown out is called as Excretion.
4. Body wastes are thrown out in three forms, viz., solid, liquid and gaseous.
5. Ammonia and other nitrogenous wastes produced during degradation of amino acids are thrown out mainly in two forms.
   a) as Urea - seen in animals like fish, frogs, mammals, earthworms etc.
   b) as Uric acid - seen in animals like birds and insects.

You may answer the following questions to make sure of what you have learnt so far.

Questions:

1. What are the three different forms in which waste-products are removed to outside?
2. Name the important nitrogenous waste products produced in living organisms.
3. How is urea produced in human beings, and how it is thrown out?
4. What is the composition of urine?
5. In what forms are nitrogenous substances thrown out in birds and insects?

Check your Answers:

1. The three different forms in which waste products are removed to outside are; 1. Solid form, 2. liquid form and 3. gaseous form.

2. The important nitrogenous waste products produced in living organisms are: 1. Urea and 2. Uric acid, 3. Ammonia.

3. When proteins are hydrolysed, Amino acids are produced. When these amino acids are degraded, Ammonia is formed. Ammonia combines with CO_2 produced during burning of food to form urea and uric acid. Urea thus produced is filtered from the blood and passed to ureters, from where it

reaches the bladder. Ultimately, it is passed out of the body through urine.

4. Urine of a healthy person is composed of 95% of water, 2.5% of urea and 2.5% of other nitrogenous products such as ammonia.

5. In birds and insects, nitrogenous wastes are thrown out in the form of uric acid.

P A R T - II

EXCRETION

Dear Pupil,

Through Part-I of the Unit (Excretion), you have come to know what is excretion, in what forms are excretory Products removed from the body of an organism, and the nature of these waste products. In this part, you will be studying the different kinds of excretory organs seen among animals.

This you would be learning through projections and teacher's explanation. This is not a strange method of learning to you. You have learnt topics such as "Digestion in Animals, Transportation in Plants and Animals," this way. You may remember that after a few projections, you were asked to answer a few questions in the work-booklet. In the same way, here also you are to answer a few questions after some projections are over. After answering, you can discuss your doubts if any, with your teacher.

Hope you will find this as interesting as other topics presented this way.

1. Let us start our study of different types of excretory organs by considering lower organisms first.

> In the case of lower organisms such as amoeba, paramaecium, Chlamydomonas etc., there are no specialised organs for removing the body wastes. The waste products such as ammonia and Carbon-di-oxide produced in the body diffuses into the surrounding pond water.

2. The multicellular and highly developed organisms e.g., earthworms, cockroaches, frogs, man, etc., there are specialised organs which take part in the process of excretion. The organs which are associated with the process of excretion are called as excretory organs and the system is called as excretory system.

3. First we shall consider the case of earthworms. In earthworms, excretion of nitrogenous wastes take place with the help of specialised organs known as nephridia. The Nephridia are segmentally arranged, coiled and twisted tubules, and opens to the exterior on the surface of the body of the earthworm.

4. If a single Nephridium is observed under microscope, it will appear as a long coiled tube. One end of the tube is like a funnel and is situated in the body. The other end of the tube opens to the exterior on the surface. The funnel shaped structure collects nitrogenous wastes from the body cavity and throws out through the opening on the surface.

5. The other animals which are having this type of excretory organs are leeches, fresh water mussels, etc.

These organisms also throw out the liquid nitrogenous as earthworms do.

6. Let us see the case of Cockroaches, with which you are all familiar.

The excretory system of cockroach consists of organs known as malpigian tubules. These tubules are slender tubes attached to the anterior end of the hindgut. They lie in the body cavity floating in the body fluid.

7. The liquid nitrogeneous wastes, viz., uric acid is collected by these tubules from the body fluid and is poured into the hind gut. From the hind gut, it passes out through the faecal matter.

8. The other insects which are having this type of excretory system are grasshopper, honeybees, prawns, stick insects, etc.

9. So far as we have seen, two types of excretory systems, viz., Nephridial system and Malpighian system. Let us summarise what we have studied about them.

1. Nephridial system:- It is a system which consists of organs such as Nephridia. It is usually seen in segmented animals, e.g. earthworms.

2. Malphigian System:- It is a system which consists of thin finger like tubules known as Malphigian tubules. It is commonly seen in insects.

10. Now let us try to understand the process of excretion in vertebrates. We shall consider human beings as the example, since they are the highly evolved organisms among vertebrates.

Recall what you have studied about extretory system in human beings, in your 7th standard. You have studied that excretory system in human beings consists of a pair of kidneys, ureters, bladder and urethra.

11. Each kidney is a bean shaped structure and is situated in the abdomen on either side of the vertebral column. The urine that is filtered in the kidneys is passed on to the bladder where it is stored. When the bladder is full, urine is passed out through the uretra to the exterior.

12. What you see in the diagram is a median section of the kidney. You can see in the digram an outer portion labelled as Cortex and a inner portion Medulla. In the outer portion are situated millions of tiny tubules known as nephrons.

The medulla consists of the collecting tubules. The nephrons extract uria and other nitrogenous waste products from the blood and

passed it on to the collecting tubules. From the collecting tubules, it is thrown out through Ureter, bladder and urethra.

13. In the diagram is shown an enlarged view of a single Nephron. Each Nephron consists of two parts, viz., Renal capsule and Renal tubules. Renal capsule is made up of a cup shaped structure known as Bowman's capsule. Inside this Bowman's capsule, there is a lump of arterioles known as glomerulus. Body wastes such as urea, [illegible], water etc., from the blood are filtered in the Bowman's capsule, and the filtrate is thrown out as uring.

14. Let us understand the details as to how urine is formed.

The first step in urine formation is filtration. Waste products are brought to the glomerulus by arteries. The blood corpuscles and proteins are left in the capillaries and the clear plasma flows out. This filtered blood in the tubules contain essential substances like glucose, salts, amino acids and waste products such as urea, water,etc.

15. The cells lining ~~in~~ the Bowman's capsule reabsorb the essential substances such as glucose, amino acids, etc. The non-essential substances like urea, water, uric acid are collected by the collecting tubules of the medulla and are poured into the ureter. From the Ureter, it passes on to the bladder, and from there it is thrown outside through the urethra. The mechanism by which the essential substances are re-absorbed is not yet known to scientists.

16. In frogs, the ureters or the kidney ducts open into the digestive tract near the hind gut. Thus, urine is thrown out through the cloaca.

17. If a sample of urine is collected and analysed in the laboratory, one will find that it consists of about 95% of water, about 2.5% of urea and the rest, of other waste products. It is, in reality, blood from which the essential components have been filtered. In normal persons, urine does not contain sugar, or blood. In patients suffering from diabatis, urine will contain lot of sugar. Any damage to the kidney will cause the presence of blood in the urine. Doctors analyse urine and diagnose many diseases.

18. Besides kidney ~~in men~~, skin also functions as an excretory organ. Through skin, waste products such as water with salts, traces of carbon-di-oxide, nitrogenous wastes are removed to the exterior.

19. This is the diagramatic view of the human skin. Skin possess numerous sweat glands. Each sweat gland is made up of a coiled tube, which opens to the outside on the surface of the skin through a pore. The coiled tube is surrounded by numerous capillaries. When blood flows in the capillaries, water, salts and urea are absorbed by the cells of the tubules from the blood. When the tube gets filled, the contents are thrown out through the opening on the surface. This process of elimination of waste products is called as <u>Perspiration</u>. However, the main function of of skin is temperature regulation,and perspiration is only a minor function.

20. Now let us summarise what we have studied about excretory system in human beings.

1. Excretory system of human beings consists of organs such as kidneys, ureter, bladder, and urethra.
2. Urine is filtered in the Bowman's capsule and is thrown out through collecting tubules, ureter, bladder and urethra.
3. Urine in normal individuals, i.e., healthy individuals contains 95% of water, 2.5% of urea and 2.5% of other nitrogenous wastes.
4. Urine shows the presence of sugar in diabetic patients, and blood stains in the persons whose kidneys are damaged.

21. Well so far, we have concerned ourselves with excretion in animals. Now let us try to understand how waste products are removed in plants.

In plants waste products such as CO_2 and NH_3 produced during respiration and other chemical reactions are reutilised by themselves, e.g., CO_2 produced during respiration is utilised by plants for the manufacture of food. In the same way, ammonia produced during degradation of proteins are reutilised for the production of amino acids. It is because of this ability of plants to reutilise waste products, plants do not have specialised excretory organs as seen in animals.

22. However, in some plants, certain waste products are excreted out, e.g., in trapoleaum leaves, water droplets can be seen at the tip of the leaves during early morning. This process is called exhudation. Sometimes you might have seen thin white layer of lime on the leaflets of fern. These are the waste products that are disposed by the plants.

23. Some of the waste products of plants are very useful to man. They are of economic importance, e.g., rubber, gum, sandalwood oil, eucalyptus oil, etc.

These are the liquid waste products of plants, which fetch money.

24. Some plants produce waste products in the form of solids, e.g., patravali, suran, etc., which you use in your home contain calcium oxalate. Many a time, you might have experienced the itching sensation after eating patravali. This is due to the presence of the crystals of calcium oxalate in the leaves. Usually, these stored solid wastes are discarded by these plants by shedding the leaves in winter season.

25. Let us summarise what we have studied about excretion in plants. Plants do not have specialised excretory organs for throwing away the waste products produced during metabolic activities. Secondly, the waste products such as CO_2, water, NH_3 produced during metabolic activities and re-utilized by plants themselves.

26. Summarising the Part-II of the Unit VII,

1. Excretion in lower organisms takes place through the process of diffusion.

2. Excretion in higher organisms is done through specialised organs known as excretory organs.

3. Kidneys form the main excretory organs in human beings. Much of the nitrogenous wastes such as urea, water are thrown out in the form of urine.

4. Urine of human beings contains about 95% of water, 2.5% of urea and 2.5% of other waste substances.

5. In plants, much of the waste products are re-utilized by themselves, hence there are no specialised excretory organs.

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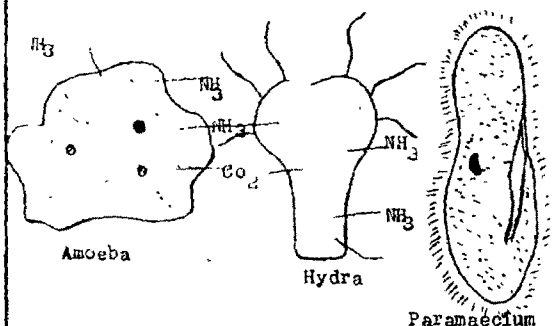

In lower organisms, waste products such as Co_2, NH_3 Are produced during metabolic processes are thrown out through the proces of Diffusion

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The organs which are associated with the process of removal of body wastes are known as Excretory organs. And, the system is calledas Excretory organs

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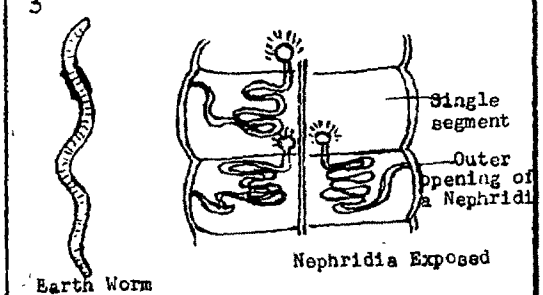

Excreation of nitrogenous wastes in earthwor takes place with the help of excretory orga such as Nephridia

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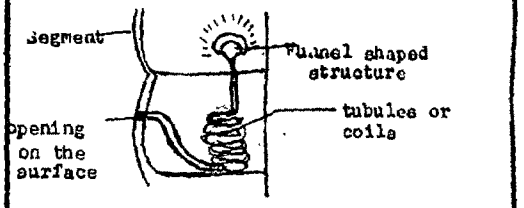

Each nephridium consists of a funnel shaped structure and a long coil or tubule which ppens on the surface of the body to the

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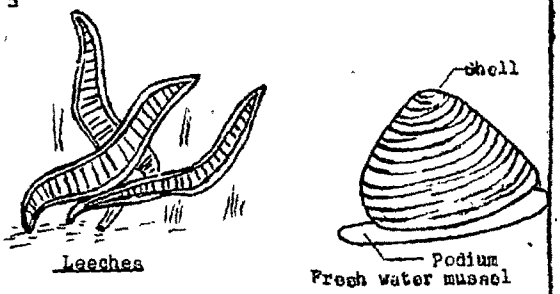

The other animals which throw away their nitrogenous wastes through Nephridia are Leeches and fresh water mussel

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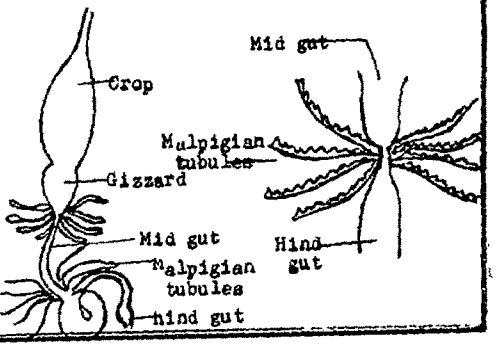

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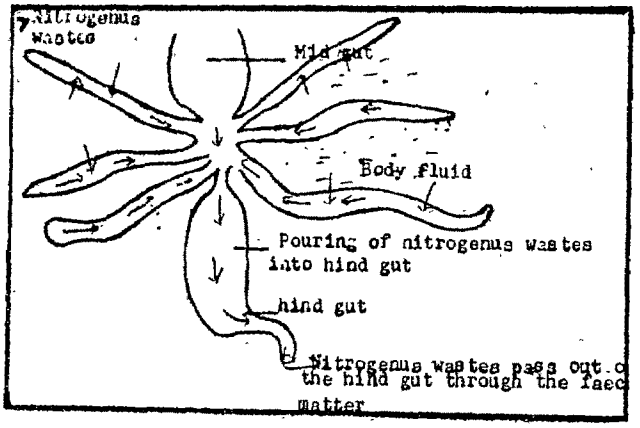

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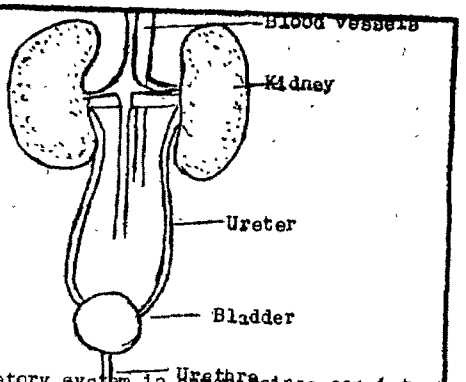

Excretory system in human beings consists of organs such as Kidneys, ureter, bladder

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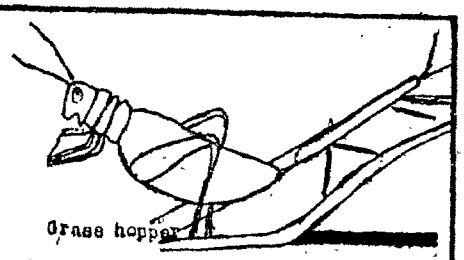

Insects such as grass hopper, stick insects bees eTc., pass out their nitrogenus wastes as uric acid through the system of Malpigian Tubules

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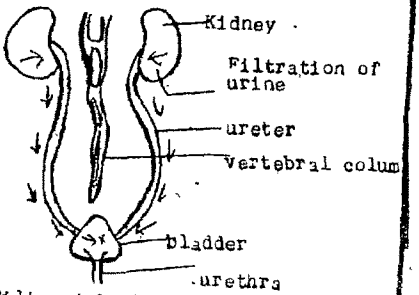


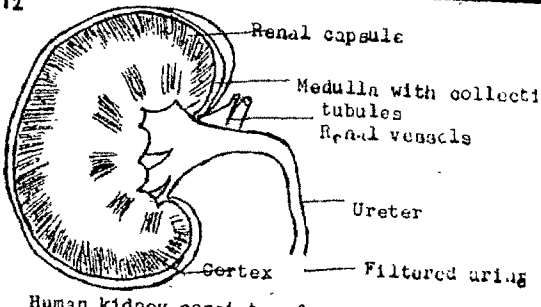
Thee urine filtered in the kidneys comes to bladder through ureters; it passes through urethra.

9

Nephridial System: Consists of organs such as Nephridia. They are usually seen among segmented animals

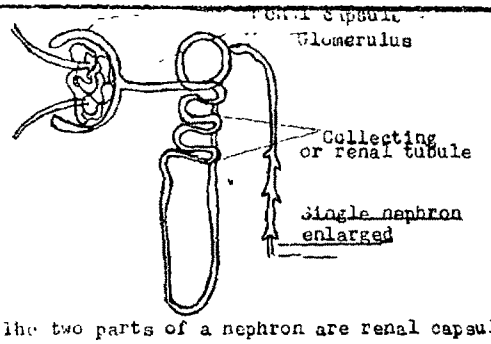
Malpigian system: Consists of organs such as Malpigian tubules. This type of excretory system is commanly seenin Insects.

12



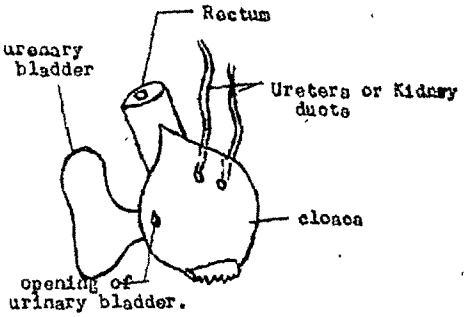
Human kidney consists of an outer cortex & inner medulla. Cortex consists of Nephrons & medulla consists of tubules.

13



The two parts of a nephron are renal capsule and renal tubules or collecting tubules. Inside the renal capsule, is present the glomerulus.

16



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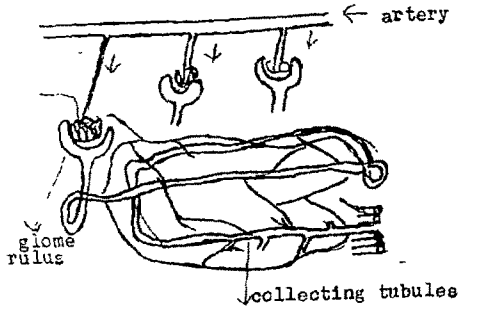
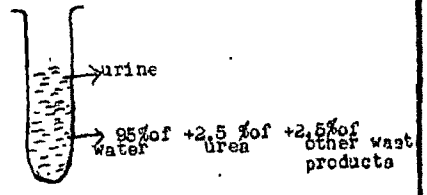


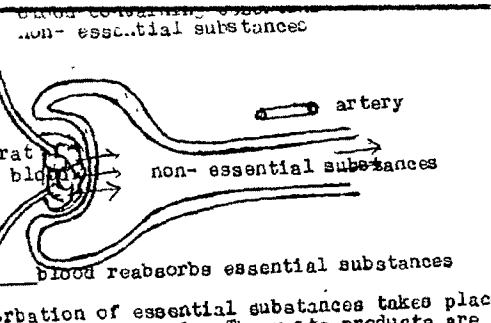
Blood containing waste products are filtered in the Bowman capsule. Thefiltered blood contains essential substances like glucose, salts, amino acids etc.

17



There will be no traces of sugar(glucose) or blood in the urine of normal (healthy) indivisuals. In diabetic patients, urine will show the presence of sugar. When kidneys are damaged, blood will be seen in urine.

15

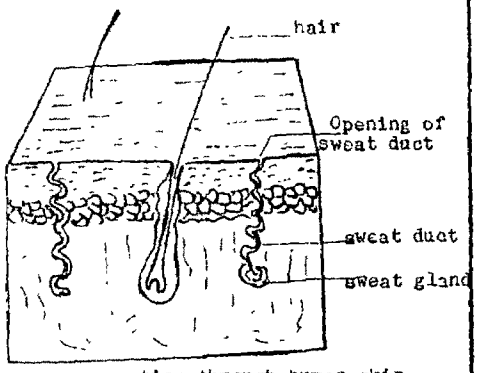


Reabsorbation of essential substances takes place in the Bowmans capsule. The waste products are passed over to the collecting tubules, from wher it is thrown out.

18

Skin in Human beings function as an excretory organ. Through skin, many waste products are thrown out.

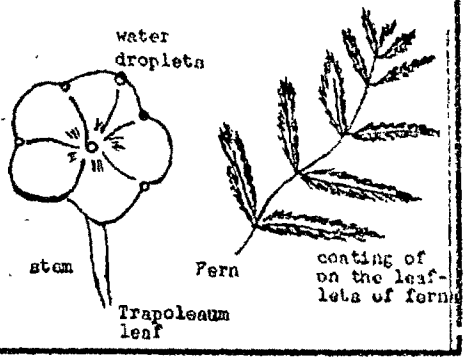
19



Section through human skin

Prespiration is a process by which waste products are thrown out of the body through skin. However, the main function of skin is regulation of body temperature.

22

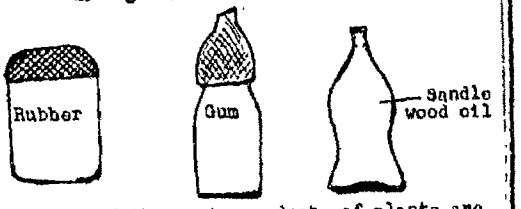


20

1. Excretory system of human beings consists of organs such as kidneys ureter, bladder and urethra.
2. Urine is filtered in thee Bowmans capsule & is thrown out through collecting tubules, ureter, bladder & urethra.
3. Urine in normal (healthy) individuals contains 95% of water 2.5 %of urea, and 2.5%of other nitrogenus wastes.

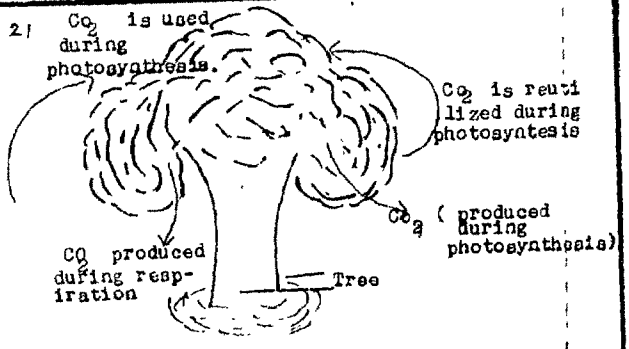
23

The process by which water is thrown out through the leaves is called exhudation



Many of the waste products of plants are useful to man. To name a few- rubber, gum, sandlewood oil, etc.

21



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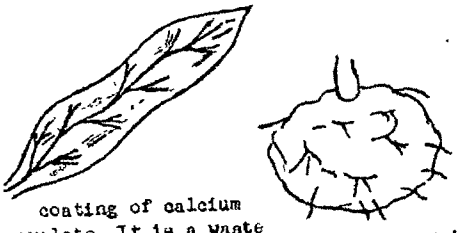

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UNIT TEST VII

NameL _____

I. Fill in the Blanks:

(1) (a) When proteins are oxidised, waste products such as _____, _____, &_____, are formed.

(b) When sugars and fats are oxidised, _____, _____, are the waste products produced. K

(H_2O, CO_2, ammonia, urea, uric acid).

(2) In human beings, waste products are removed in the form of solids through _____, in the form of gases through _____, and in the form of liquid through _____.

(Nephridia, anus, gills, lungs, kidneys). C

(3) The major function performed by kidneys in human beings is removal of _____ through urine. K

(Uric acid, urea, CO_2)

(4) The process by which the organism gets rid of its waste products is called as _____. K

(a) respiration (c) Photosynthesis

(b) digestion (d) excretion

II. Put a tick (✓) against the most appropriate Answer:

1. In amoeba and hydra, ammonia is thrown out through: K
(a) Nephridia (c) Diffusion
(b) Malphigian tubules (d) Skin.

2. In human beings skin functions in:
(a) removing wastes in the form of sweat. C

26 (b) maintaining body temperature constant.

(c) protecting the body.

(d) all the above ways.

(3) Put 'X' mark against the waste products which are nitrogenous in nature: K

(a) water (c) uric acid

(b) urea (c) creatin

III. (1. Name atleast three waste products produced in animals. C

2. Write the different steps involved in the process of urine formation in human beings, and its removal. C

3. Write in a few sentences as to how plants differ from animals with regard to elimination of CO_2. C

IV. Give your Reasons:

1. Reason out as to what may happen to the person, if his kidneys get damaged. A

2. Reason out as to why plants do not have any specialised excretory organs as animals have. C

3. Reason out the importance of drinking lot of water during summer.

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4. Write in 3 to 4 sentences as to why a person passes comparatively less amount of urine during summer than in winter. A

5. Reason out as to why a person feels cool under a working electric fan. A

V. Name three waste products of plants which are helpful to man.

VI. Draw a neat sketch of the cross section of human kidney and label its parts.