UNIT - VIII

W A T E R E C O N O M Y

UNIT - VIII

WATER ECONOMY

Introduction:

Friends, through the Unit Excretion you have come to know how the waste products are removed to outside in plants and animals. You also got an idea about the different forms through which they are removed, and the different organs that take part in the mechanism. You know that excess water is thrown out as waste by all living organisms, in different forms. If you consider animals, water is removed through sweat, as water vapour through lungs, etc. Plants throw away water as waste from the aerial parts such as leaves and stem, for example, the process of Guttation, which you have studied. For a moment think as to what may happen to living organisms if they loose all the water they take. Definitely you would say that the organism will perish due to lack of water. Same way, it would be equally harmful to an organism if all the water taken is retained in the body itself. Hence, all living organisms regulate the inflow and outflow of water in their body. In simpler terms, they always maintain a water balance.

In this Unit, you would be studying something about the different mechanisms through which they maintain the water balance. This you would be studying in the form of small paragraphs with intermittent Questions, so that you can make

sure as to whether you have understood the idea at every step.

Hope you would enjoy in going through this Unit.

Recall what you have studied about the importance of water to all living organisms. You know that it is an essential compound, without which life cannot simply exist on the world. Protoplasm, which is the physical basis of life is composed of nearly 60-90% of water.

Protoplasm contains nearly 60-90% of water.

Water is a must for all organisms to carry on their life functions, because i)Chemical reactions can take place in a cell only in the presence of water; ii) as a universal solvent, it is helpful in dissolving many of the nutrients and lastly, without water free-flow of substances into and out of the cell cannot take place. Such being the case, you can imagine the fate of an organism if it loses all the water. Hence, in all living organisms a balance is maintained between the water thrown out and water taken in. But the Question is, How?

Water is needed by all living organisms because:

1. It enables the chemical reactions to take place in the cell.
2. It is helpful in dissolving many of the substances
3. It is needed for the free flow of substances into and out of the cell.

Before we proceed in finding out an answer to the above question, you may answer the following question.

Question:

Why is water needed by all living organisms?

Answer:

All organisms require water because it is mainly responsible for the chemical reactions to take place in the cell; it is needed for dissolving many of the food substances; and it is needed for the free flow of substances into and out of the cell.

Activity to perform:

(1) Collect leaves of plants growing in wet areas, dry areas, and water plants, and write a brief note about the place from where you picked the leaves, the thickness and smoothness, the size of the leaves etc. If you find any difference, try to think of the reasons as to why this difference exists.

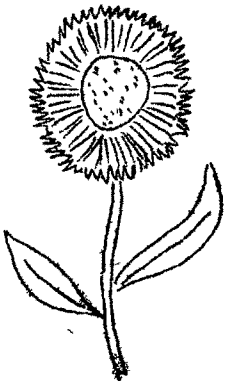
(2) Take a potted plant and keep it in hot sun without watering. Observe the changes that take place in leaves and stem. Note down your observations in a separate sheet and proceed further.

Let us study, how plants and animals maintain water balance in their bodies. First, we shall consider the case in plants.

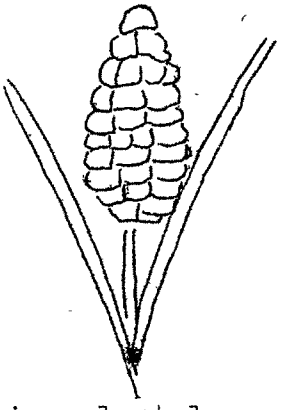
Water balance in Plants:

Some times, the amount of water that a plant lo ses is greater than its own weight, especially on a dry sunny day. The total quantity of water that evaporates from a single plant is considerable. It is estimated that the loss of water from a single sunflower plant during a period of 144 days is 27,000 cc, which means there is a daily average loss of 187.5 cc. In a maize plant, it is estimated that it loses about 231 litres of water during its period of growth. These examples give you an idea as to how much of water is lost through transpiration (You have already studied that the process of transpiration. However, for your convenience, the exact meaning is given under the glossary). Imagine what may happen to plants if the roots do not absorb sufficient quantity of water in order to make up this loss.

In such cases the shoot and leaves of the plant will droop. On other words, plants start wi ting (wi ting means, the shoot and leaves of the plant



Sunflower plant lo ses approximately 187.5 cc. of water daily through transpiration.



Maize plant lo ses 231 litres of water during its period of growth.

Normal and Healthy plant.

will droop due to excess of water loss). You might have noticed wi ting of leaves in the plant which you had kept in the sun without watering it. In the diagrams are shown a healthy and normal plant, and a wi ted plant.

Wilted plant

You might have noticed wi ting of leaves during hot day times. You can guess the reason. This is because, the evaporation of water from the leaves and shoots is more but the absorption of water from the the root is very less. During evening hours, when the surrounding atmosphere becomes cool, transpiration is very less and hence the stem and leaves come back to their original position. Think, what may happen if there is no sufficient water in the soil for the roots to absorb. No doubt, plants will wilt permanently. Hence, plants absorb great amount of water from the soil to compensate the water loss by transpiration and thus maintaining water balance.

Transpiration

How do plants get sufficient water to compensate the loss during transpiration.

But the question is, will all plants get sufficient water to compensate this water loss?

Before you proceed further, answer the following questions and perform the activity given under.

Question:

1. What do you understand by the term wilting?
2. Why do plant wilt during hot summer days?

Answer :

1. Wilting is a process during which the leaves and shoots droop due to excessive loss of water from the aerial parts.
2. During hot summer days, the evaporation of water from the shoots and leaves will be greater than the absorption of water from the soil. Hence, due to lack of water, the shoots and leaves droop.

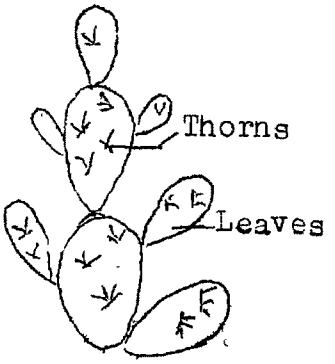
Activity to perform:

1. Observe the leaves and shoots of a plant carefully during morning and evening hours of a hot summer day, and note down your observation. Think of the reasons for any change in the plant.
2. Recall the different types of plants which you saw in your trip to Ajwa. Read the observations which you noted down about these plants.

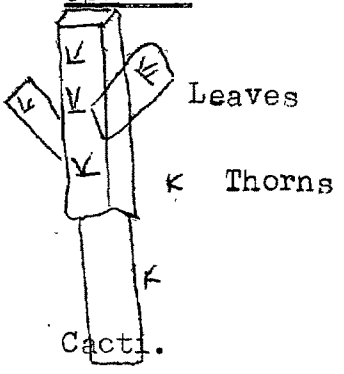
I am sure, your answer to the question, ... Will all plants get sufficient water to compensate the heavy loss of water from their aerial parts? will be 'no'.

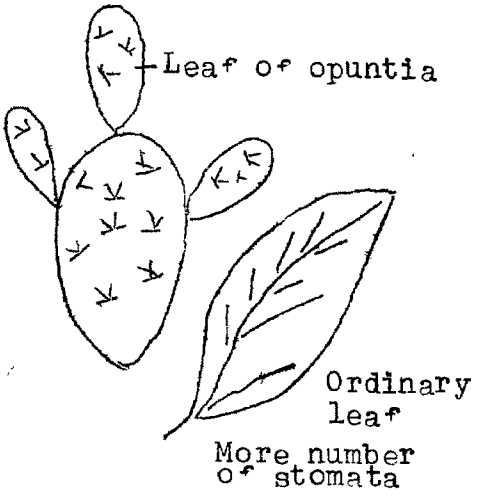
Will all plant get sufficient water to compensate the water loss through transpiration?

You know the different places in which plants grow, in other words, tha different habitats of plants. Some plants grow in desert area, where there will be very little water. In your surroundings itself you might have seen plants growing in places where there is very little supply of water, e.g., Cacti and Opuntia plants. Let us recall what we studied about these plants in our field trip. You observed that these plants were growing in regions where there was very little water; the soil was almost dry. In these plants, since there is scarcity for water in the regions where they grow, absorption of water by the roots from the soil will be less. But still, these plants were living, how? Recall what you observed with regard to the leaves and stems in these plants. You observed that the stems and leaves were very thick (You can make use of the bottle specimens of Cacti and opuntia kept in biology laboratory for further observation). You may remember your teacher explaining that the number of stomata in these plants will be very less. Owing to these reasons, water loss from the aerial parts, in other words, transpiration will



Opuntia

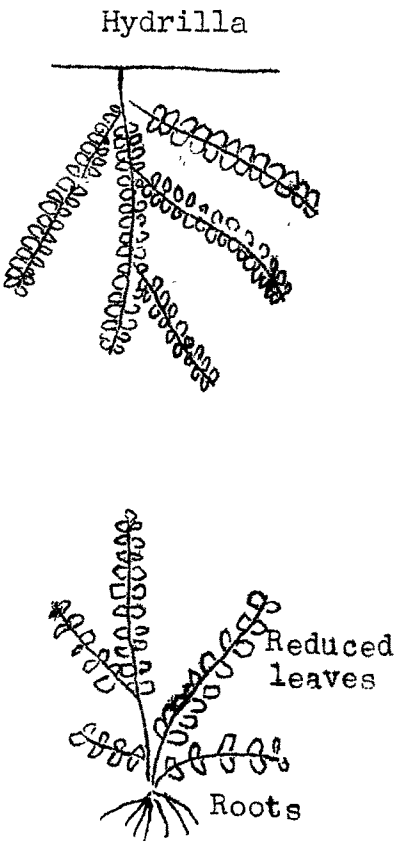




Opuntia and Cacti plants are called Xerophytes

be very less. This is one way of regulating the water loss. These types of plants are called as Xerophytes and the habitat is called as Xeric habitat.

Let us proceed further in our study of the habitats of plants. You may remember that in the field you observed some plants which were growing only in water, that too many of them submerged under water, e.g., the plants seen in the water tanks of Ajwa water purification plant. You know that these are the water plants. Recall what you observed in these plants. You observed that stem was spongy, and the roots were not well developed. Further, you also noticed that the leaves which were completely submerged in water were very small when compared to the ones which were exposed. You may think as to why these plants had such modifications. It is mainly to reduce the intake of water. Since these plants live only in water, they are called as water plants or Hydrophytes.



Hydrilla, Vallisnaria are Hydrophytes

Well, so far you have studied about two types of plants, viz., Xerophytes and Hydrophytes. You may answer the following questions to make sure of what you have studied so far.

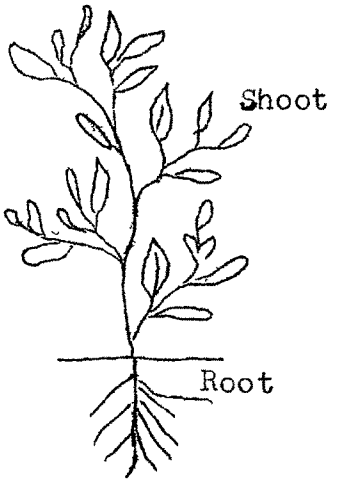
Questions:

1. In Xeris habitat, there will be _____ percentage of water in the soil (More/Less)
2. In hydrophyte plants, the leaves which are completely submerged under water will be of _____size. (small/big/moderate)
3. What are Xerophytes?
4. What are the major differences between xerophytic and hydrophytic plants?

Answers:

1. less ; 2. small
3. Xerophytes are the plants which grow in places where there is less percentage of water in the soil.
4. The major difference between Xerophytes and hydrophytes are:
   (i) Xerophytes grow in dry areas, and have thick and fleshy leaves. Number of stomata on the leaves are completely reduced, whereas (ii) hydrophytes grow in water, often submerged. They have small leaves, spongy leaves and stems.

Well, you know about two types of habitats, viz., Xerophytic and hydrophytic. Think of the common plants which grow in open fields, in your garden, etc. In these cases there is moderate supply of water. They are intermediate between Xeric and aquatic habitats. Such a type of habitat is called as mosie habitat, and the plants are called mesophytes. These plants .....



In Mesophytes both shoot and root systems are well developed

have root and shoot system well developed. Roots get sufficient quantity of water, so that they can compensate the water loss through transpiration. Throns, spines are absent in these plants.

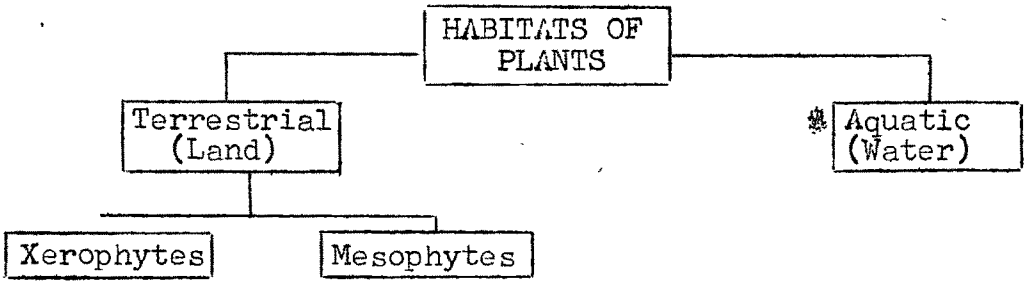
Think of how you can classify the plants according to the place where they live. Write your answer in a separate sheet, and check your answer with the correct answer given.

How can you classify plants according to their habitats?

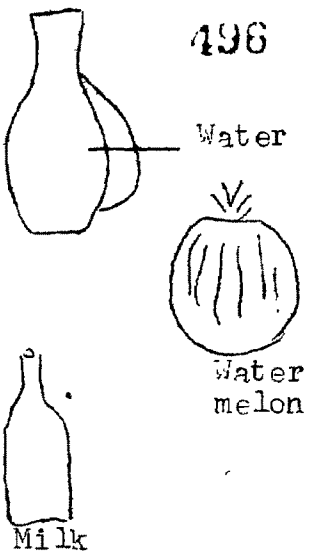
Answer:

Broadly the habitats of plants can be classified into two viz., 1) Terrestrial plants growing on land, 2) Aquatic-plants growing in water.

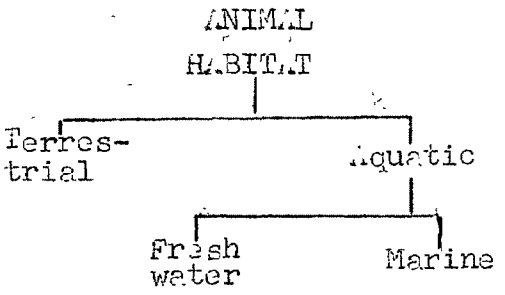
The terrestrial habitat can again be classified into two categories, viz., Xerophytic-plants growing in places where there is little water supply; and 2) Mesophytic -plants growing in places where there is moderate supply of water



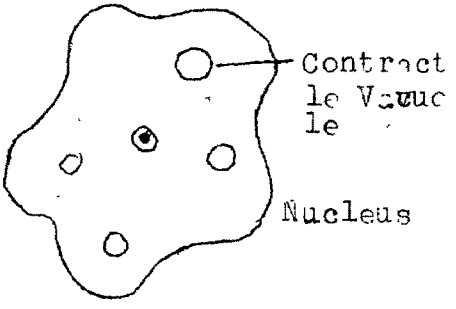
Heitherto, we tried to concentrate on plants alone. Now we shall try to understand the mechanism of water balance in animals.



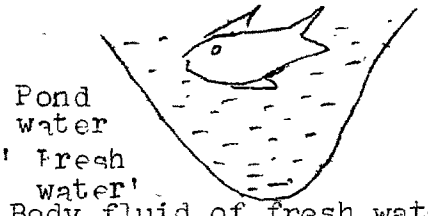
You already know the different forms in which water is lost from the body of animals. Animals drink lot of water to compensate this water loss, e.g., we drink lot of water, take milk, eat juicy fruits etc. If this water loss is not compensated, then there will be dehydration and will cause death to the organism.



As in plants, the habitat of animals can also be classified into three, viz., i) Terrestrial, -land animals, ii) fresh water-animals living in fresh water e.g., animals in ponds, pools, etc. iii) Marine-animals living in sea water.

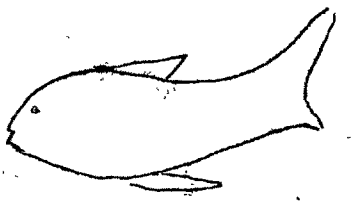


In small micororganisms such as amoeba, paramaecium, etc., water balance is maintained through special structures known as contractile vacuole. These vacuoles contract and expand, and as a result excess water is thrown out.



Body fluid of fresh water fishes contain less of Sal

In fresh water animals, the concentration of their body fluid is less when compared to the concentration of the surrounding water. Hence, water will be diffusing continuously into the body of the organism. If the animals do not get rid of this excess water that enters the body, their body may burst. Hence these animals continuously throw out large volumes of water through urine, and thus water balance is maintained.



Body fluids of marine animals have greater contration than fresh water animals.

Now think about animals that live in sea water. In these, the concentration of their body fluid is more than the surrounding water. Hence, water diffuses out from the body of the organism to the surrounding water. In order to compensate this water loss, these animals drink lot of water. But you know that sea water is rich in some salts. It will be fatal to the organism if it takes in all the salt present in water. This is prevented in these animals by special structures present in the intestinal walls which absorb only water and not salts. Thus a balance of water is maintained.

Now we shall see in the case of animals which live in deserts, e.g., Camels. Camels can live for long periods without water. Since water is not available in deserts, it tries to check the water loss by excreting very thick urine. In addition to this, some of the organs are capable of functioning normally, even after losing nearly 30% of water from their body. (But in our case, our body cells can lo se water upto 15%, but beyond this it will be fatal). Besides these two advantages, some water is stored in the skin folds also. These Camels are better adopted to desert life.

Lastly, we shall try to understand the maintenance of water balance in human beings, who are the highly developed animals. You know how water is lost from out body and also how this water loss is compensated. The amount of water lost during summer and winter through urine and faeces is same. But, during summer when the outside or surrounding temperature is high, we perspire more and hence more water is lost. In order to compensate this water loss, we drink lot of water. However, we should not think that sweating is mainly to lo se water, but it is to regulate the temperature of the body. During summer when our body temperature raises, sweat glands

become more active. Due to this, more water is lost or thrown out in the form of sweat. This cools down the body to original temperature. Since much water is lost through sweat, amount of urine passed out will be less. During winter, quite the reverse takes place. The sweat glands will not be active and hence sweating is reduced. The heat produced during the metabolic activities is retained and we feel warm. Since water is not thrown out through sweating, the amount of urine passed out will be more when compared to during summer.

Well, so far we have tried to understand the maintenance of water balance in plants and animals, Why this balance of water is maintained, etc. You may answer the following Questions to make yourself sure, of what you have learnt.

Questions:

1. What are the different habitats of animals?
2. What difference you notice between a marine fish and a fresh water fish with regard to intake of water and salts?
3. Classify the following animals according to their habitat.

   a) Birds, b) Crocodiles, c) Fish, d) Monkeys

   e) Frogs, f) Cats, g) Seal, h) Whale, i) Hawks.

UNIT TEST VIII

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Name : _____

I. Tick (_/) the most appropriate answer:

(1) Water is essential for all living organisms because: K

(a) it dissolves many types of food and body wastes.

(b) it is needed for the free flow of substances into and out of the cell.

(c) most of the chemical reactions can take place only in the presence of water.

(d) of all the above reactions.

(2) Human beings lose water from their body: K

(a) in the form of sweat.
(b) in the form of urine
(c) in the form of water vapour
(d) in all the above forms.

(3) The process of evaporation of water from the aerial parts of a plant is called as: K

(a) translocation (c) exudation
(b) transpiration (d) evaporation

(4) Wilting in plants takes place due to: K

(a) less evaporation of water and more absorption of water.

(b) more evaporation of water and more absorption of water.

(c) more evaporation of water and less absorption of water.

(d) lack of water.

29 (5) Sweating is mainly to: C

(a) throw away the excess of water.

(b) throw away the toxic substances produced in the body.

(c) regulate the body temperature.

II. (1) Below is given the description of the nature of a plant. Tick (_/) the habitat to which it belongs.

Description of the plant: Plant having spongy stem, leaves being reduced to small size, root system is not developed properly, and the stomata are more on the upper surface of the leaf. It means it belongs to: C

(a) Mesophytic habitat. (b) Xerophytic habitat.
(c) Hydrophytic habitat.

(2) Write 'H' it it belongs to Hydrophytes, 'X' if it belongs to Xerophytes and 'M' if it belongs to Mesophytes, against the following statements: C

(a) Plants growing in fields ( )
(b) Plants growing in ponds ( )
(c) Plants growing in deserts ( )
(d) Plants which have thick, fleshy stems and leaves ( )
(e) Plants having normal leaves and stems, with both shoot and root system well developed ( )
(f) Plants having small leaves, spongy stem with stomatal openings on the upper surface of the leaves. ( )

III. Write 'T' if it is true and 'F' if it is false against the statement given below: A

Evaporation of water from the serial parts of a plant will be more during:

30 (a) hot summer days

(b) rainy days

(c) winter days

(d) windy days

(e) day time

(f) afternoon hours

(g) night times.

(2) In some animals which live in water, the concentration of the body fluid will be less than the concentration of the surrounding water. That means, these animals are _____ _____. C

(marine animals / fresh water animals).