



### 3.1 INSTRUCTIONAL OBJECTIVES

1. Given the figure of a plant, the pupil will be able to name and recognise the two main parts of a plant. (U)
2. The pupil will be able to recall that the root is in the soil, while the shoot is above the soil. (K)
3. The pupil will be able to identify that the colour of the root is not green. (U)
4. Given a root system, the pupil will be able to recognise the (a) Primary root and (b) Secondary roots. (U)
5. The pupil will be able to recall that the secondary roots are also fixed in the soil along with the primary root. (K)
6. a. The pupil will be able to recall what a root cap is (K)  
b. The pupil will be able to identify the root cap. (U)
7. The pupil will be able to recall the function of the root cap. (K)
8. The pupil will be able to discriminate between germinated seeds and ungerminated seeds. (U)
9. The pupil will be able to recall what is germination. (K)
10. The pupil will be able to recall what is seedling. (K)
11. Given a root, the pupil will be able to recognise root hairs. (U)
12. The pupil will be able to recall what are root hairs. (K)

13. The pupil will be able to recall the function of the root hairs. (K)
14. Given a situation, the pupil will be able to reason out that the water present in the leaves comes from soil through root hairs. (A)
15. The pupil will be able to recall that when the root grows, new root hairs develop near the root tips and old root hairs die off. (K)
16. The pupil will be able to recall the two types of roots and describe each of them. (K)
17. Given normal and adventitious roots, the pupil will be able to discriminate between adventitious roots and normal roots. (U)
18. The pupil will be able to recall what is a root system. (K)
19. The pupil will be able to recall the two types of root systems and describe each of them. (K)
20. Given root systems, the pupil will be able to discriminate between the tap root system and the fibrous root system. (U)
21. Shown the taproot system, the pupil will be able to recognise the tap root. (U)
22. The pupil will be able to state why it is difficult in pulling a plant from the soil. (U)
23. The pupil will be able to see the relationship between the length of root and firmness with which it is fixed to the soil. (U)
24. The pupil will be able to see the relationship between the branching of the root and firmness with which it is fixed to the soil.

25. The pupil will be able to reason out that the number of branches on the root and the length of roots are two factors which determine the firmness by which the plant is fixed to the soil. (A)
26. The pupil will be able to recall the two main functions of the roots as taught in the class. (K)
27. Given roots, the pupil will be able to recall the special function of it - storage of food and support. (U)
28. The pupil will be able to recognise and describe what are proroots and mention their special function. (U)
29. The pupil will be able to recognise and describe what are stilt roots and mention their special function. (U)

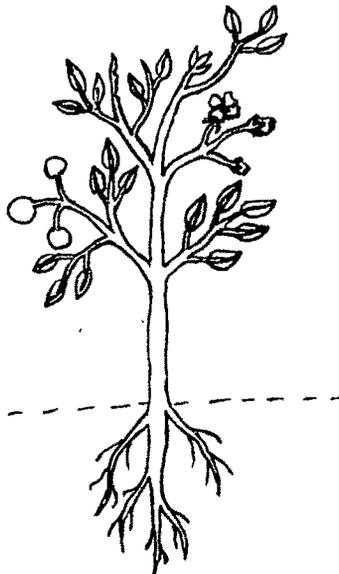
### 3.2 INITIAL INSTRUCTION

§§ 1. Name some of the parts of a plant.

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Leaf, stem, fruit, flowers and root are some of the parts of a plant. Look at this picture of the plant.



You will observe that leaf, fruit, stem and flowers are growing in the upward direction above the soil and the root is growing in the downward direction, into the soil. Leaf, fruit, stem and flowers together form the shoot system and the root and its parts form the root system. Therefore, the two main parts of the plant are the root and the shoot. Today you are going to learn about the root and its parts.

You must have seen plants which are huge such as tamarind and plants which are small such as balsam. These plants remain erect even when there is a strong wind. How is it that they remain erect?

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You must have seen huge buildings. They also remain erect during rains or cyclone. How is it that they can remain erect?

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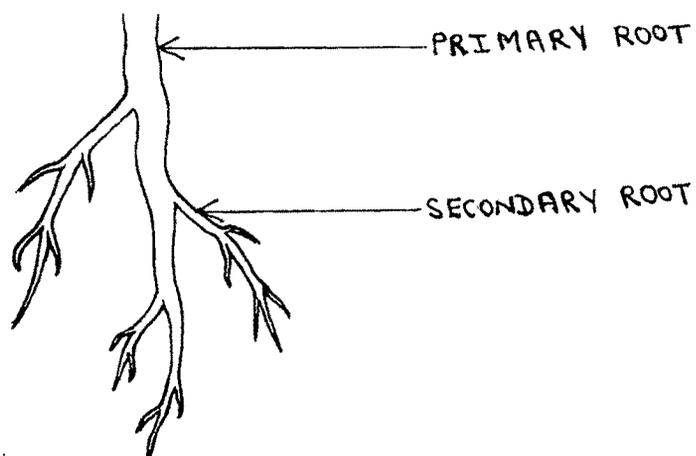
They are built in such a way that they have deep foundation. A pole remains erect because its lower part is buried deep in the ground. The plant too remains erect because the lower part of the plant grows deep in the soil. What is the name of this part?

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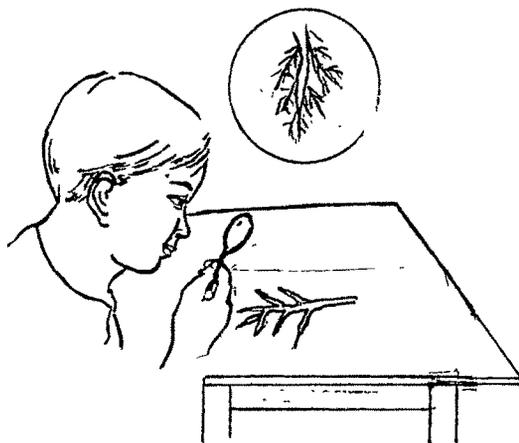
This part of the plant is called the root. The root grows deep in the soil and it fixes itself in the soil so as to hold the upper part of the plant firmly above the soil. This is one of the main functions of the root.

Have you seen the root? When you dig out a plant carefully, you will find the root. Look at this figure of the root.



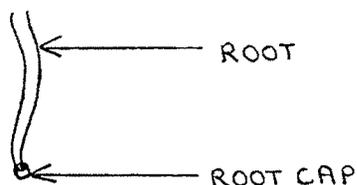
The root has a long and thick structure which has small branches on it. The long and thick structure is called the primary root and the branches are called the secondary roots. Both the primary root and the secondary roots are fixed in the soil.

If you look at the surface of the root with the lens, you will find very small hairs. They cannot be seen easily with the eye. We can see them with the lens because lens makes small things look big.



On the surface of the root, you will observe hairs. They are called root hairs.

The tips of the root are covered by small caps. These caps cannot be seen so easily in most of the plants. However, at the tip of some of the roots of banyan tree, we can see the root cap. Look at the figure of the tip of the root. You will find the root cap on the tip of the root.



The tip of the root is tender. The root cap protects the tip of the root.

SS 2. Why do you water the plants?

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The plant needs water to prepare its food.

But how does water enter the different parts of the plant?

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The root of the plant absorbs water from soil and transports it to the other parts of the plant. The root hairs which are present on the surface of the root, absorb water and salts dissolved in it and transport

them to the roots. From the roots, it is transported to the stem, leaves etc. Absorption takes place slowly in plants. You dip a tip of the strip of blotting paper in a solution. You will see how the solution is absorbed by the strip of paper. In the same way, the root absorbs water and sends it slowly to the other parts of the plant. This is another main function of the root.

Thus the two main functions of the root are:

1. To help the plant be firmly fixed in the soil.
2. To absorb water and salt dissolved in it and to transport them to the other parts of the plant.

You must have noticed your mother soaking moong (dal) in water and then tying it into a wet cloth. Let us do the same thing and notice what happens after a day.

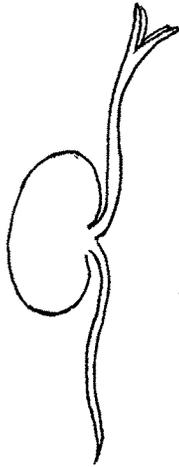
What do you observe?



The seed no longer looks the same. It has some thread like structures coming down. These structures are the roots. These seeds have sprouted now and are called the germinated seeds. This process is known as germination. A germinated seed is called a seedling and the process of development of a seedling is called seed germination.

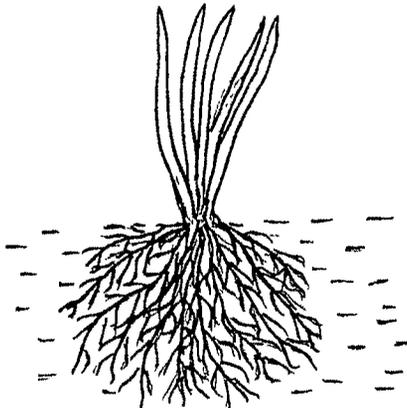
3. Look at the figure of the root drawn below.

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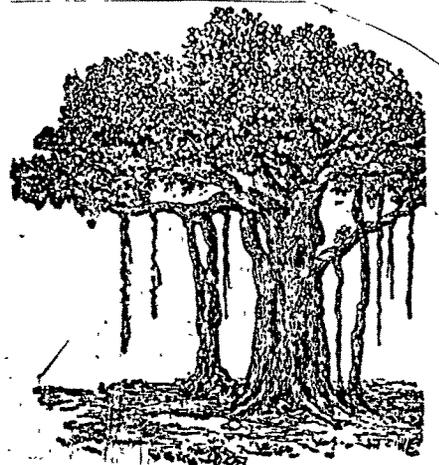


This root arises from the part of the seed called the radicle. Such a type of root is called a normal root. Examples of plants with such type of roots are Mango and Tamarind.

Look at these roots.

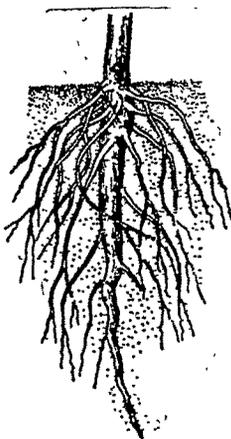


These roots arise from any other part of the plant except the seed. They are called as Adventitious roots. Examples of such type of roots are roots arising from the stem of onion and banyan.





The roots with its branches forms the root system. Look at these two types of root systems.



What difference do you find between these two root systems?

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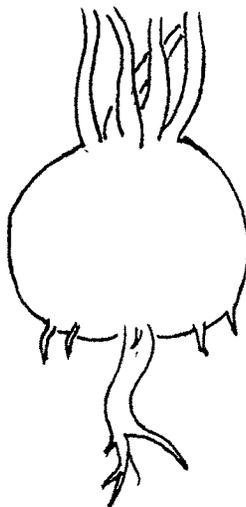
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The root system of tamarind has a root called the tap root. Since it tapers it is called the tap root. It is long and strong. Small branches grow out of it. They are called the secondary roots. This type of root system is called the tap root system.

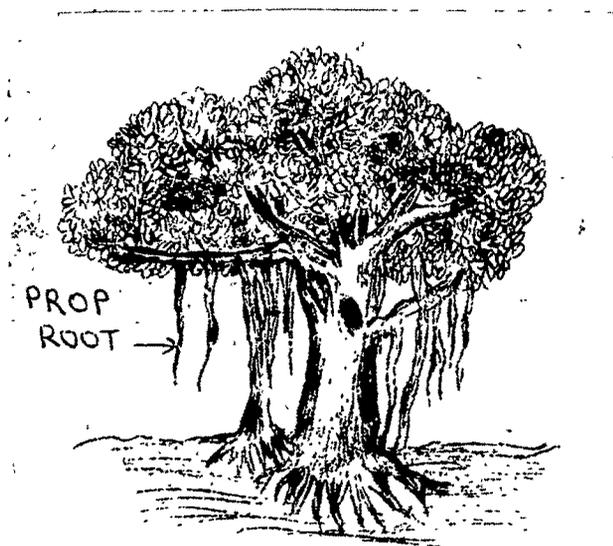
The root system of grass does not have a primary root. Fibre like roots are seen on the lower end of the shoot. These roots do not go deep in the soil but they spread in the upper layers in a cluster. These roots are called the secondary roots. Since these roots together give a fibre like appearance, the root system is called as Fibrous root system. In some plants, the primary root is present in the fibrous root system, but it is very much shortened.

Some roots perform special functions besides their normal functions and hence they undergo a modification in their structure. The beet root stores food and hence it is large. The sweet potato is also an enlarged root because it stores food.

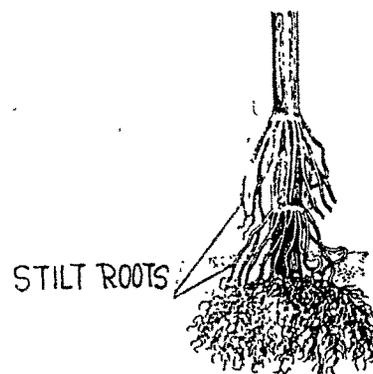


Some plants need extra support for their branches.

Example: The banyan tree has large branches which need support. Hence roots grow from the stem downwards and enter the soil and fix themselves firmly in the soil. These roots are called prop roots.



Some plants need extra support for their stem. Example: Maize plant. From the stem of maize, arise roots which grow downwards, enter the soil and fix themselves firmly there. Thus, the stem is given additional support. These roots are called stilt roots.



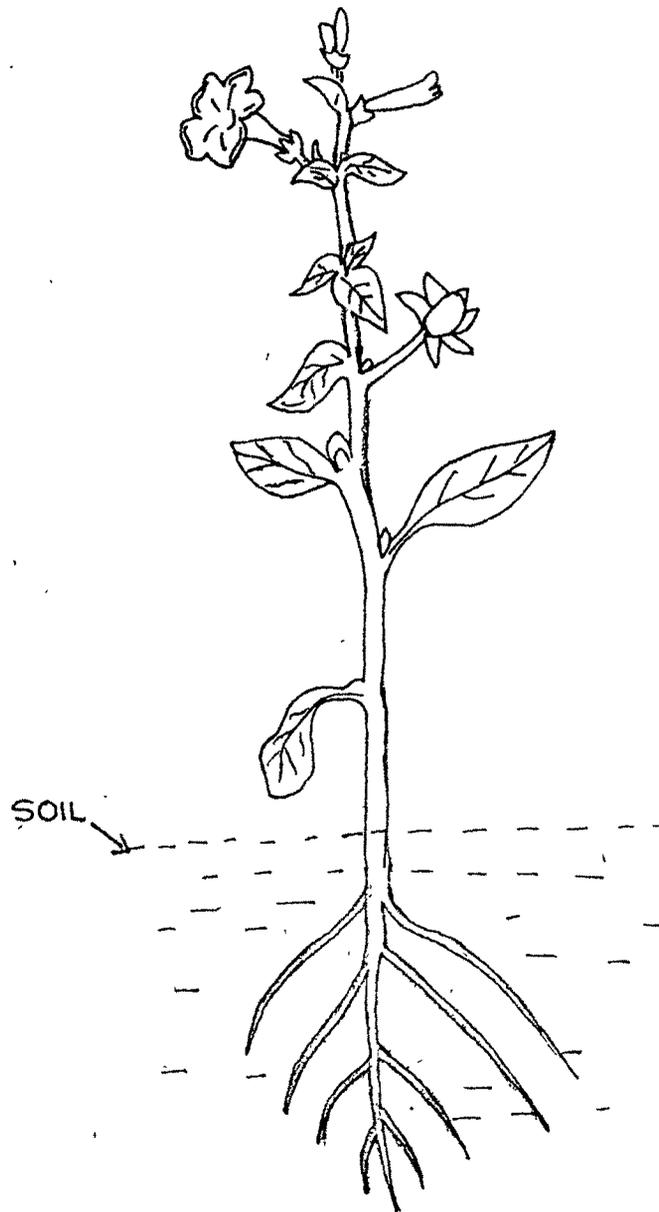
Summary

The two main parts of the plant are the root and the shoot. The root grows downwards into the soil and the shoot grows upwards above the soil. The root has a long and thick structure called primary root. From the primary root arise branches called the secondary roots. The secondary root gives out more branches. All these roots together form the root system. There are two types of root systems: Tap root system and Fibrous root system. In the tap root system, the primary root grows deep in the soil and then gives rise to secondary roots and other roots. The primary root tapers and hence it is called the tap root. In the fibrous root system, the primary root diminishes and secondary roots grow in its place. These roots give a fibre like appearance. At the tip of each root, there is a cap like structure called the root cap. It protects the tender tip of the root. Tiny hairs are present on the surface of the root. They are called the root hairs. The root hairs absorb water and salts dissolved in it and transport them to the stem and leaves. The root performs the function of fixing the plant firmly in the soil and absorption of water and <sup>salts</sup> dissolved in it and transports them to the stem.

Some of the roots perform some special functions besides the normal functions. Some roots store food. For performing this function, they undergo modification in the structure. E.g. - Carrot. Some roots grow from the branches of plants towards the ground and enter into the soil and fix themselves firmly to it so as to give support to these branches. Some roots grow from the stem towards the ground and enter into the soil and fix themselves firmly to it so as to give support to the stem.

### 3.3 FORMATIVE TEST

1. In the figure given below, point out the two main parts of the plants and give their names.



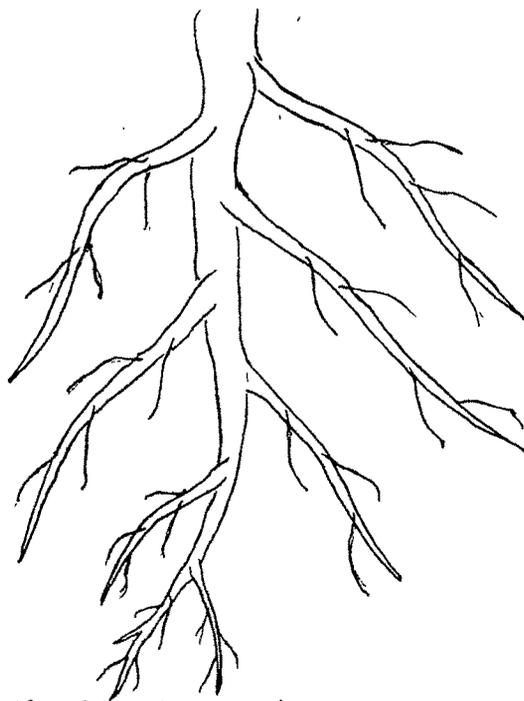
2. Fill in the blanks :

- a. The part of the plant which is generally in the soil is called the \_\_\_\_\_
- b. The part of the plant which is generally above the soil is called the \_\_\_\_\_

3. State whether true or false :

The colour of the root is green (            )

4. Point out the primary root and the secondary roots in this figure of the root system.

5. Fill in the blanks :

\_\_\_\_\_ of the plant are also fixed in the soil along with the main root.

6. a. What is a root cap?

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b. Point out the root cap in the root labelled 'A'.

7. What is the function of the root cap?

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8. Given seeds in packet A. Put the germinated seeds in packet B and the ungerminated seeds in packet C.

9. What is Germination?

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10. What is seedling?

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11. Point out the root hairs on the root labelled 'B'.

12. Fill in the blank :

The cotton fibre like hairy structures seen on the surface of the root are called \_\_\_\_\_.

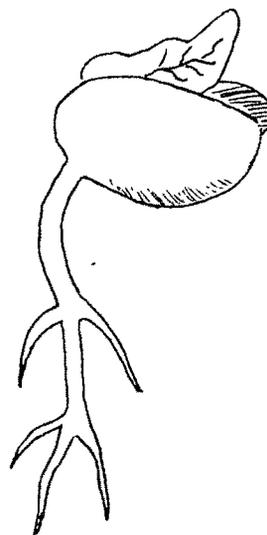
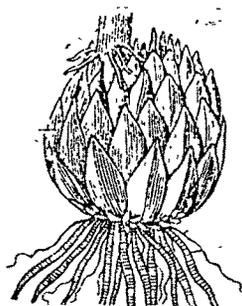
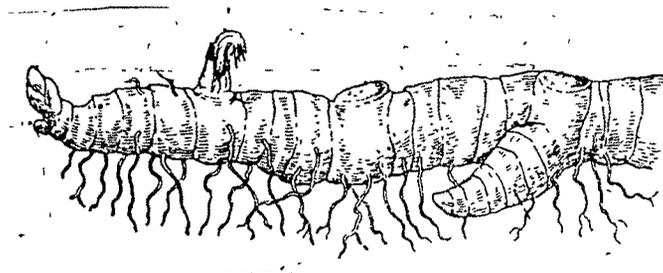
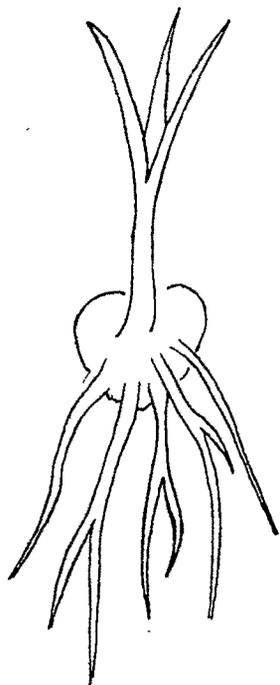
13. What is the function of the root hair?

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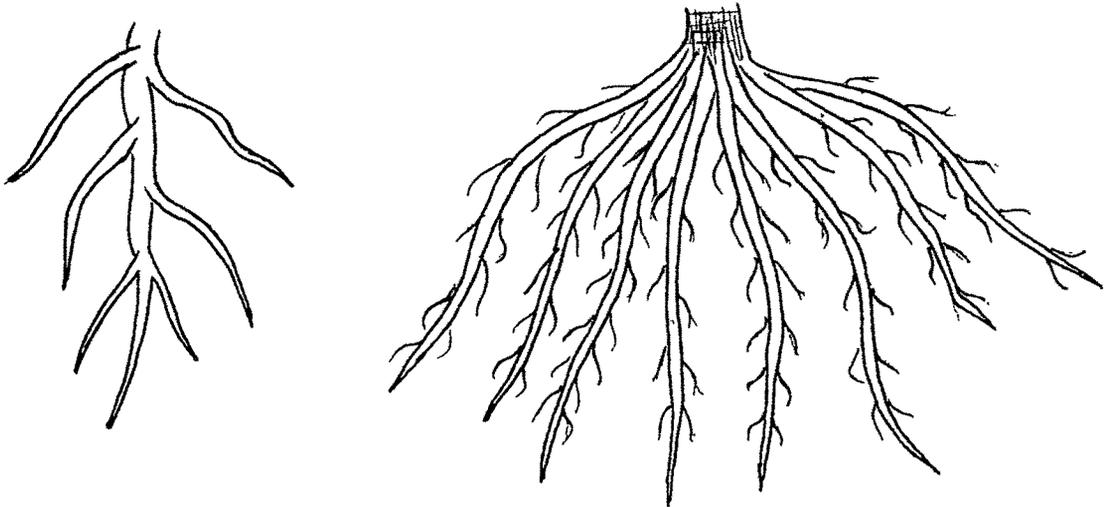


17. Name the type of roots, each of them belongs to.





20. Name the type of root system each of them belongs to.



21. Point out the ~~tap~~ root in the root system labelled 'C'.

22. Give reason why it is difficult to pull a plant from the soil.

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23. There are two plants A and B, one has short root, one has long root. If you try to pull these plants along with the roots from the soil, which will be easier for you to pull out and why?

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24. There are two plants, A and B, one has many branches on its root, and the other has lesser number of branches on its root. If you try to pull these roots, which will be easier for you to pull and why?

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25. There are 4 plants A, B, C, D. Plants A and C have long roots, B and D have short roots, A and B have many branches on their roots and C and D have less branches on their roots.

- a. Of A and C which is easier to pull out. Give one reason for your answer.

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- b. Of A and B which is easier to pull out. Give two reasons for your answer.

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26. State the two functions of the root.

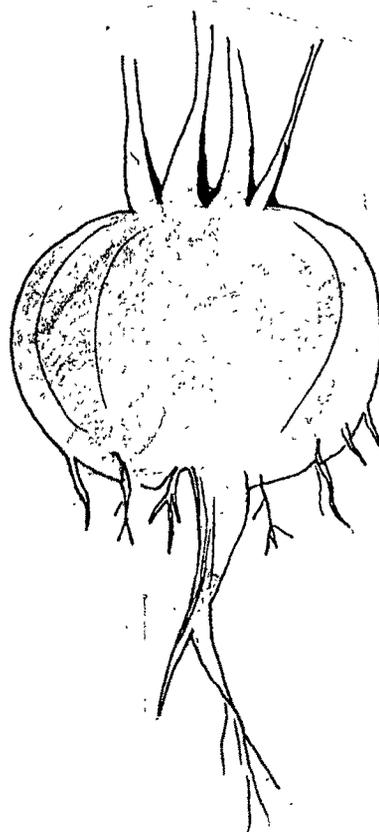
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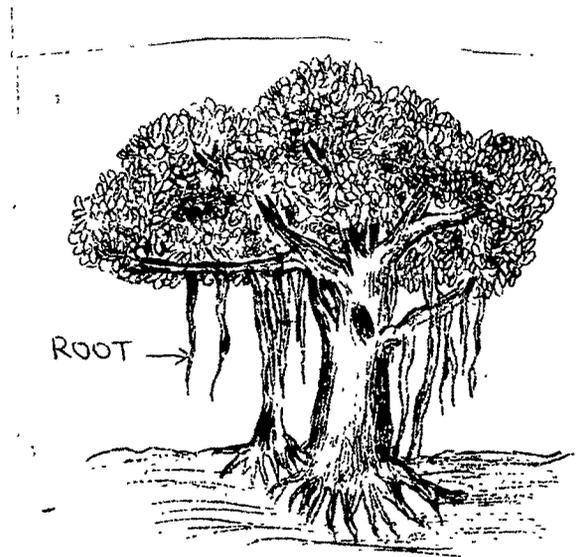
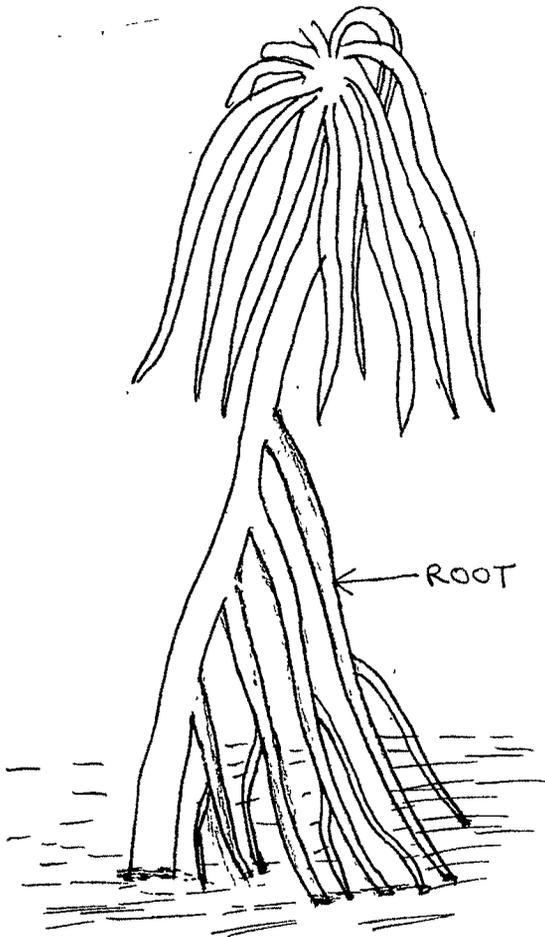
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27. Write down the function of each of the figures of the root shown below.



28. Name what type of roots each of these are. Describe each of them and mention the special function they carry out.



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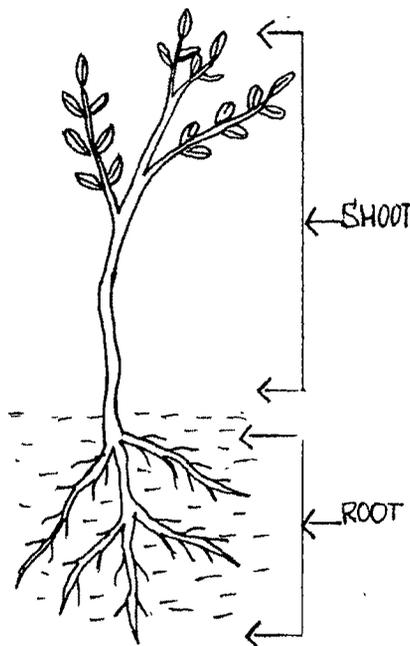
3.4.1 Instructional Objective.1

Main parts of the plant

(i) P.L.M. (Deviated form)

Section A

The plant is divided into two main parts. They are the root and the shoot.



Fill in the blanks :

- The plant is divided into \_\_\_\_\_ main parts.
- The plant is divided into two main parts. They are the \_\_\_\_\_ and the root.
- The plant is divided into two main parts. They are the shoot and the \_\_\_\_\_.
- The plant is divided into two main parts. They are the \_\_\_\_\_ and the \_\_\_\_\_.
- The \_\_\_\_\_ parts of the plant are the root and the shoot.

Turn to Section BSection B

Among the following parts of the plant, tick mark (  ) the two main parts of the plant.

- a. Flower (     )
- b. Leaf (     )
- c. Root (     )
- d. Fruit (     )
- e. Shoot (     )
- f. Stem (     )

(ii) Oral Verbal Elaboration

Teacher (investigator) states "The plant is divided into two main parts. They are the root and the shoot."  
Teacher takes a plant and then points out these parts.

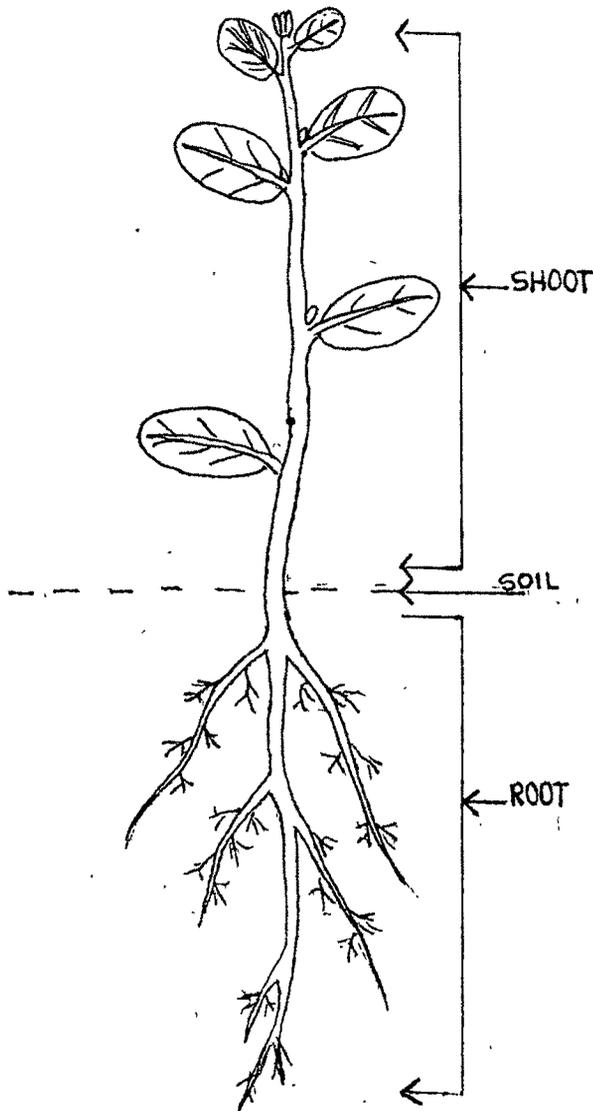
3.4.2 Instructional Objective.2

Direction of the growth of the shoot and root.

(i) P.L.M. (Deviated form)

Section A

Look at the picture of the plant. You will observe that the shoot grows in the upward direction above the soil and the root grows in the downward direction into the soil.



Fill in the blanks :

- a. In the plant the \_\_\_\_\_ grows in the upward direction and the root grows in the downward direction.
- b. In the plant, the shoot grows in the upward direction and the \_\_\_\_\_ grows in the downward direction.
- c. In the plant, the shoot grows in the \_\_\_\_\_ direction and the root grows in the downward direction.
- d. In the plant, the shoot grows in the upward direction and the root grows in the \_\_\_\_\_ direction.

Tick mark ( / ) the correct statement.

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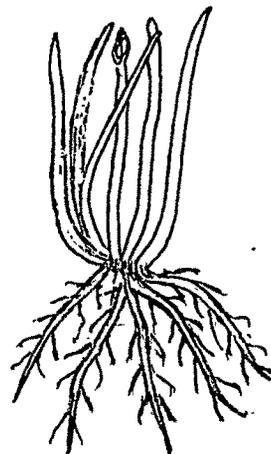
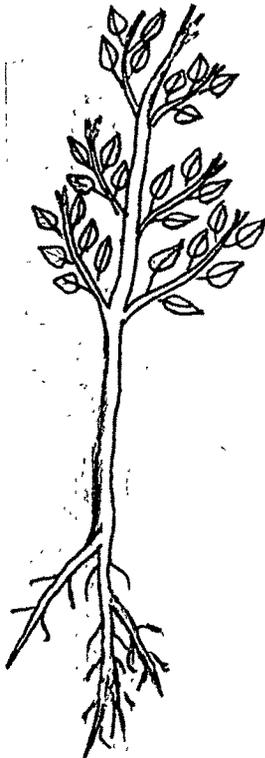
- a. In the plant, the shoot grows in the upward direction and the root grows in the same direction. ( )
- b. In the plant, the shoot **grows** in the upward direction and the root grows in the downward direction. ( )
- c. In the plant, the shoot grows in the downward direction and the root grows in the upward direction. ( )

Turn to Section B

Section B

Fill in the blanks :

- a. In the plant, the shoot grows in the \_\_\_\_\_ direction and the root grows in the \_\_\_\_\_ direction.
- b. Pictures of plants have been given below. Label the shoot and the root in each of them.



(ii) Oral Verbal Elaboration

Teacher (investigator) states "The root grows in the downward direction into the soil. The shoot grows in the upward direction above the soil." Teacher shows some plants and points out the direction of growth in the root and shoot.

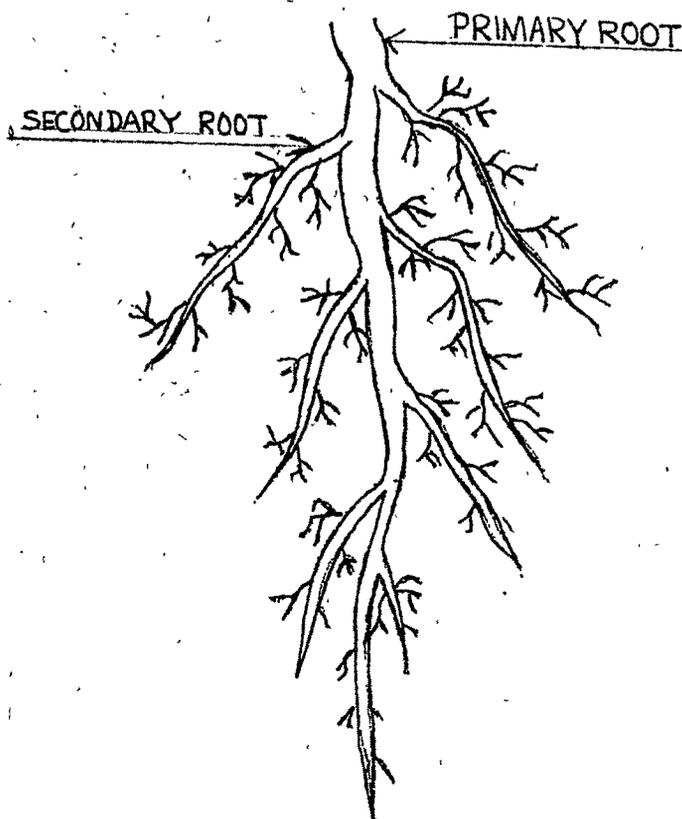
3.4.4 Instructional Objective.4

Description of the primary root and the secondary root.

(i) P.L.M. (Deviated form)

Section A

Look at the picture of the root. You will see a long and thick structure. It is called the primary root. The primary root has branches on it. These branches are called secondary roots.



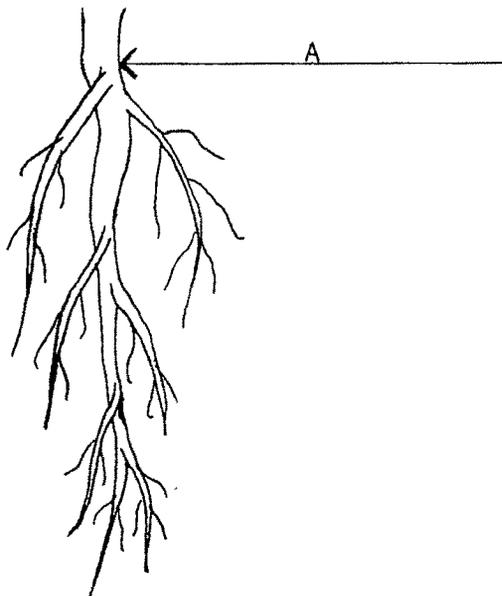
1. Fill in the blanks :

- a. In the root system, the \_\_\_\_\_ root is long and thick compared to the other roots.
- b. In the root system, the primary root is \_\_\_\_\_ and \_\_\_\_\_ compared to the other roots.
- c. The primary root has branches on it. These branches are called \_\_\_\_\_ roots.

2. State whether True or False.

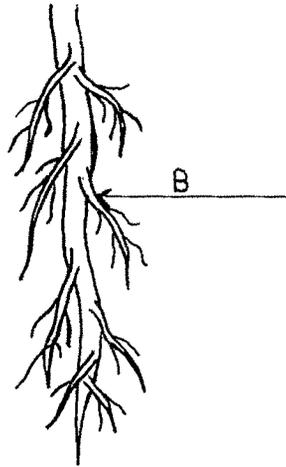
- a. The secondary root is the largest root in the root system. (      )
- b. The branches present on the primary root are called secondary roots. (      )
- c. The primary root is the longest and thickest root in the root system. (      )

Name the part pointed A.



Name the part pointed B

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Turn to Section B

Section B

In the figure of the root given below, point out the primary and secondary roots.



(ii) Oral Verbal Elaboration

The teacher (investigator) takes a root system and points out to the primary root and states, "Look at this part of the root system, it is long and thick compared to the other parts of the root system. It is called the primary root." The teacher then points to the secondary roots and states "Look at the branches arising from the primary root. They are called the secondary roots."

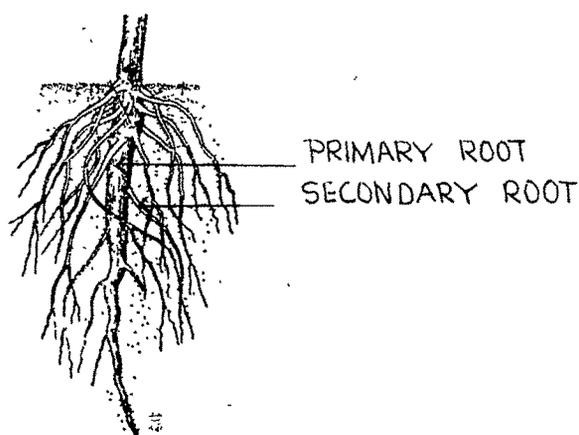
3.4.5 Instructional Objective.5

Fixation of the root to the soil

(i) P.L.M. (Deviated form)

Section A

Look at the picture of the root. You will observe that the primary root is fixed in the soil. Furthermore the secondary roots which are present on the primary root are also fixed in the soil.



Fill in the blanks :

- a. Both the primary root and the \_\_\_\_\_ roots are fixed in the soil.
- b. Both the \_\_\_\_\_ root and the secondary roots are fixed in the soil.
- c. Both the \_\_\_\_\_ root and the \_\_\_\_\_ roots are fixed in the soil.

State whether True or False

- a. Only the primary root is fixed in the soil. (     )
- b. Both the primary root and the secondary roots are fixed in the soil. (     )

Turn to Section BSection BFill in the blanks :

The \_\_\_\_\_ root along with the \_\_\_\_\_ roots is fixed in the soil.

(ii) Oral Verbal Elaboration

The teacher (investigator) digs out a plant from the soil and simultaneously points out the primary root and states "Look at the primary root, it is fixed in the soil." The teacher then points the secondary root and states "Look at the secondary root, it is also fixed in the soil."

3.4.6/7 Instructional Objective. 6 & 7Root cap(i) P.L.M. (Deviated form)Section A

The tip of the root is very tender. Hence, there is a cap present on it. This cap is called the root cap. It protects the tip of the root.

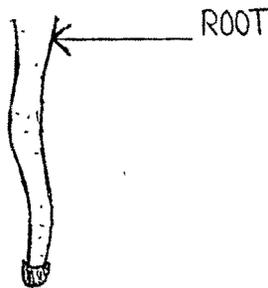


Fill in the blanks :

- a. The tip of the root is very \_\_\_\_\_.
- b. To protect the tender tip of the root, a \_\_\_\_\_  
\_\_\_\_\_ is present on it.
- c. The root cap \_\_\_\_\_ the tender tip of the root.
- d. The \_\_\_\_\_ is present on the tender tip of the root.
- e. The function of the root cap is to \_\_\_\_\_ the tender tip of the root.

Turn to Section B

- a. Name the part of the root pointed out in the picture.



- b. Where is it present?

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- c. What is the function of it?

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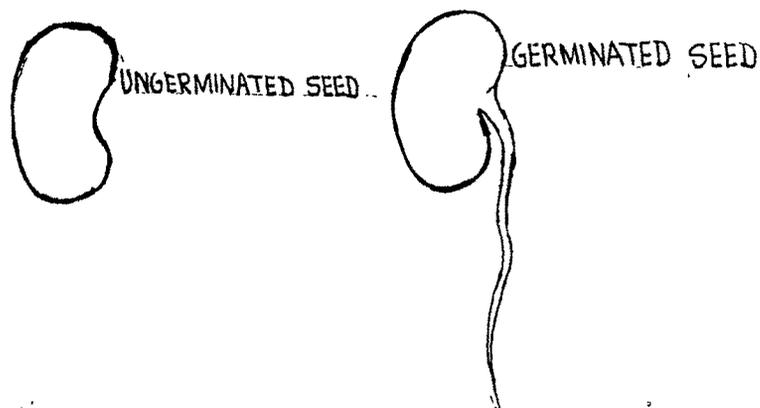
(ii) Oral Verbal Elaboration

Teacher (investigator) takes the tip of the aerial root of banyan tree and points the tip and states "Look at the tip of this root. It is tender. Hence it is protected by a cap called the root cap". Teacher points to the root cap and states "Look at this root cap over the tip of this root. In all plants, the root cap is present at the tip of the roots. The root cap is generally very small and cannot be seen so easily with the naked eye."

3.4.8 Instructional Objective.8Germinated seeds and ungerminated seeds(i) P.L.M. (Deviated form)Section A

If the seeds are soaked overnight, thread like structures will be seen growing from them the next day. These structures are the roots. The seeds are now said to be germinated.

Look at the ungerminated and germinated seeds in the figures given below.



Tick mark (  ) the correct statement

- a. The germinated seed can be identified from the ungerminated seed by the presence of a thread like structure i.e. the root. (    )
- b. Both the germinated and the ungerminated seeds have roots arising from them. (    )

Turn to Section B

## Section B

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Packet 8 has been given to you in which are placed germinated and ungerminated seeds. Place the germinated seeds in packet 8, a., and the ungerminated seeds in packet 8.b.

### (ii) Oral Verbal Elaboration

Teacher (investigator) states and demonstrates: "Let us soak the mustard seeds overnight. Dip the mustard seeds in water. Then place them in a wet cloth. Keep it for a day and occasionally wet the cloth to keep it damp."

The next day.

Teacher shows the seeds in the damp cloth and states "These seeds no longer look the same. Thread like structures are seen growing from them. They are the roots. These seeds are said to be germinated seeds whereas the seeds before developing their roots are called ungerminated seeds."

### 3.4.9 Instructional Objective.9

#### Germination

#### (i) P.L.M. (Deviated form)

##### Section A

If the seeds are soaked overnight, the next day thread like structures will be seen growing from them. These are the roots. Such a seed is called a germinated seed, and the process of development of a seed into a germinated seed is called Germination.

Fill in the blanks

- a. The process by which a seed develops into a germinated seed is called \_\_\_\_\_.
- b. The process by which a \_\_\_\_\_ develops into a germinated seed is called germination.
- c. The process by which a seed develops into a \_\_\_\_\_ is called germination.

Turn to Section BSection B

What is Germination ?

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(ii) Oral Verbal Elaboration

Teacher (investigator) states "The process by which the seeds develop into germinated seeds is called Germination. Thus germination involves the development of roots by the seeds."

3.4.10 Instructional Objective.10Seedling(i) P.L.M.(Deviated form)Section A

The germinated seed is called a seedling.

Fill in the blanks :

- a. The \_\_\_\_\_ seed is called a seedling.
- b. The germinated seed is called a \_\_\_\_\_.

Turn to Section B

Section B

What is a seedling?

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(ii) Oral Verbal Elaboration

Teacher (investigator) states "When the seed is soaked overnight or kept wet, it develops roots. These seeds are said to be germinated seeds. They are also called seedlings."

3.4.11/12 Instructional Objective.11 & 12Root Hair(i) P.L.M. (Deviated form)Section A

Look at the surface of the root by using a lens. Tiny hairs can be seen. These are called the root hairs.

Fill in the blanks

- a. Tiny hairs seen on the surface of the root are called \_\_\_\_\_ hairs.
- b. Tiny hairs seen on the surface of the root are called root \_\_\_\_\_.
- c. Tiny hairs seen on the \_\_\_\_\_ of the root are called root hairs.
- d. Tiny hairs seen on the surface of the root are called \_\_\_\_\_.

Turn to Section B

Section BFill in the blanks

- i. Tiny hairs seen on the surface of the root are called \_\_\_\_\_.
- ii. Look at this root. Point out the root hairs.

(ii) Oral Verbal Elaboration

Teacher (investigator) takes a root and using a lens, points out the root hairs on the surface of the root and states "Look at the surface of the root. Hairs are seen on it. These are called the root hairs."

3.4.13 Instructional Objective.13Function of the Root Hair.(1) P.L.M. (Deviated form)Section A

The function of the root hair is to absorb water from the soil.

Fill in the blank :

- a. The root hair \_\_\_\_\_ the water from the soil.
- b. The \_\_\_\_\_ absorbs the water from the soil.
- c. The function of the root hair is to absorb the \_\_\_\_\_ from the soil.
- d. The function of the root hair is to absorb the water from the \_\_\_\_\_.

Turn to Section B

Section B

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Tick mark ( / ) the correct answer

Among the following parts of the root, which part of the root absorbs water from the soil.

- a. Primary root ( )
- b. Root hair ( )
- c. Root cap ( )
- d. Secondary root ( )

Turn to Section C

Section C

What is the function of the root hair?

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(ii) Oral Verbal Elaboration

Teacher (investigator) states "The root hair carries out a function for the plant. It absorbs water from the soil and transports it to the root."

3.4.15 Instructional Objective.15

Development of Root hairs

(i) P.L.M. (Deviated form)

Section A

When the root grows, old root hairs die off and new root hairs develop at the tips of the root.

Fill in the blanks :

- a. When the root grows, \_\_\_\_\_ die off and new root hairs develop at the tip of the root.
- b. When the root grows, old root hairs die off and new root hairs \_\_\_\_\_ at the tip of the root.
- c. When the root grows, old root hairs \_\_\_\_\_ and new root hairs develop at the tip of the root.
- d. When the root grows, old root hairs die off and \_\_\_\_\_ develop at the tip of the root.

Turn to Section BSection B

- a. What happens to the old root hairs when the root grows?

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- b. Where do the new root hairs develop?

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- c. When do the new root hairs develop?

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(ii) Oral Verbal Elaboration

Teacher (investigator) states "When the root grows, the old root hairs that are on the tip of the root die off. They are then replaced by the new root hairs."

3.4.16 Instructional Objective.16Types of roots(i) P.L.M. (Deviated form)Section A

There are two types of roots a) Normal roots  
b) Adventitious roots. The root that arises from the radicle of the seed is called Normal root. The root that arises from any other part of the plant except the radicle is called Adventitious root.

Fill in the blanks :

- a. There are \_\_\_\_\_ types of roots.
- b. The two types of roots are \_\_\_\_\_ roots and Adventitious roots.
- c. The two types of roots are Normal roots and \_\_\_\_\_ roots.
- d. The root that arises from the \_\_\_\_\_ of the seed is called Normal root.
- e. The root that arises from the radicle of the seed is called \_\_\_\_\_.
- f. The root that arises from any other part of the plant except the radicle is called the \_\_\_\_\_ root.
- g. The root that arises from \_\_\_\_\_ of the plant except the \_\_\_\_\_ is called the Adventitious root.

Turn to Section B

Section B

Name the two types of roots.

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Describe each of them.

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(ii) Oral Verbal Elaboration

Teacher (investigator) shows the root 'A' and explains "Look at this root 'A'. You can see that it is growing from the radicle of the seed. Such type of roots that grow from the radicle of the seed are called normal roots."

Teacher shows the root 'B' and explains "Look at this root 'B'. You can see that it is growing from the stem of the plant and not from the radicle of the seed. Such type of roots which grow from any other parts of the plant except the radicle of the seed are called adventitious roots. Adventitious roots are also seen growing from the leaf and branches of the stem."

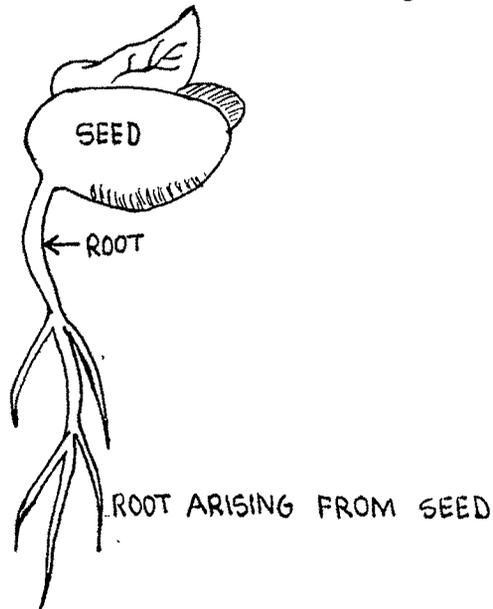
Teacher states "There are two types of roots and they are the normal root and the adventitious root."

Difference between Normal and Adventitious roots

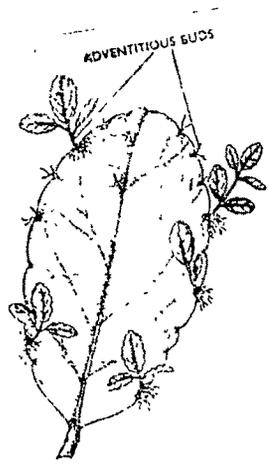
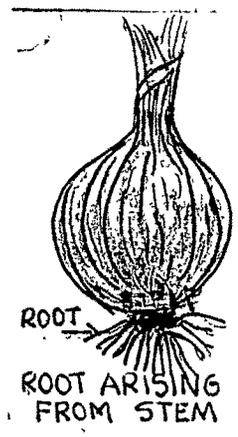
(i) P.L.M. (Deviated form)

Section A

The roots that arise from the radicle of the seed are called normal roots. Examples of the plants having such type of roots are tamarind, mango and bean.



The roots that arise from any other parts of the plant except the radicle are called adventitious roots. Examples of such type of roots are roots arising from the stem of grass, onion and from the leaves of bryophyllum. (Pan Futi)



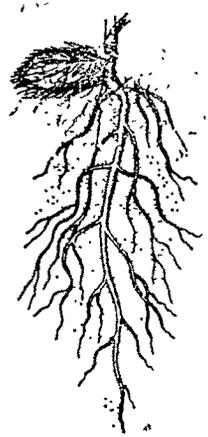
Fill in the blanks :

- a. The roots arising from the bean seed are \_\_\_\_\_ roots.
- b. The roots arising from the bryophyllum leaves are \_\_\_\_\_ roots.

Turn to Section B

Section B

Figures of roots are given below.  
Name what type of root it belongs to.



(ii) Oral Verbal Elaboration

Teacher (investigator) shows some normal roots and some adventitious roots and explains "Look at these roots labelled 'A'. They are called normal roots. Look at these roots labelled 'B'. They are called adventitious roots. If you observe the normal roots, you ~~will see that they differ from the~~ <sup>adventitious</sup> roots. All the normal roots grow from the radicle of the seed. While none of the adventitious roots grow from the radicle. This is the main difference between normal and adventitious roots. Adventitious roots are seen growing from the stems, branches and leaves of plants.

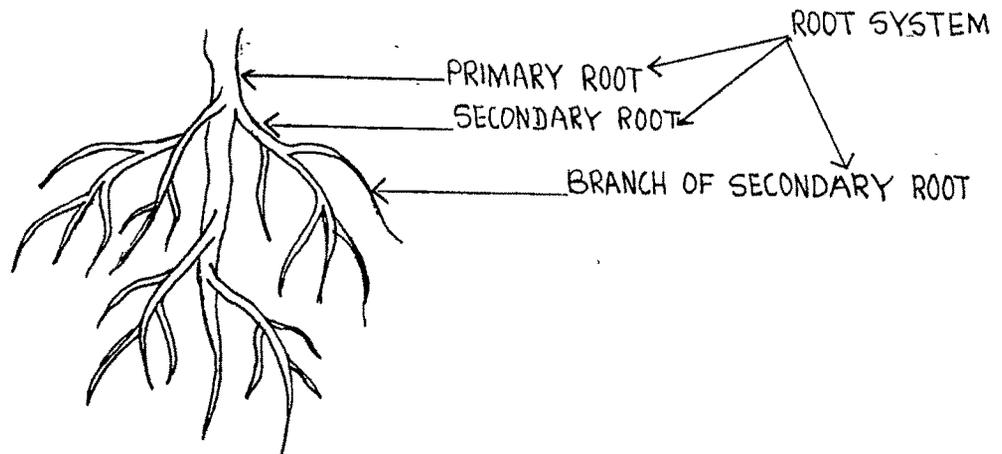
3.4.18 Instructional Objective.18

Root system

(i) P.L.M. (Deviated form)

Section A

The main root with its branches forms the root system. Thus the root system comprises the main root called primary root, the secondary roots and its branches. Look at the picture of the entire root system.



Fill in the blanks :

- a. The root system consists of \_\_\_\_\_ root, secondary root and its branches.
- b. The root system consists of primary root, \_\_\_\_\_ and its branches.
- c. The primary root, the secondary roots and its branches together form the entire \_\_\_\_\_

Turn to Section B

Section B

What does the root system comprise of ?

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(ii) Oral Verbal Elaboration

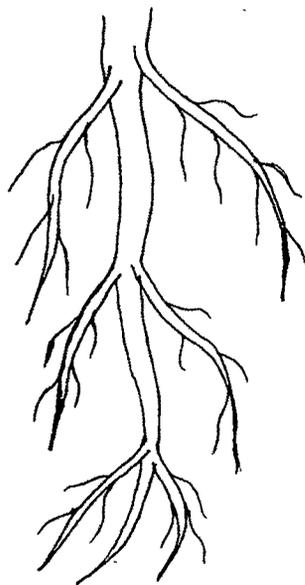
Teacher (investigator) shows a root system and pointing to each part explains as follows "Look at this root system. It consists of this root which is called the main root. The main root is also called the primary root. The primary root gives out these branches. They are called the secondary roots. The secondary roots further give out branches. Thus, all these roots i.e. primary roots, secondary roots and the branches together form the root system."

Types of root systems

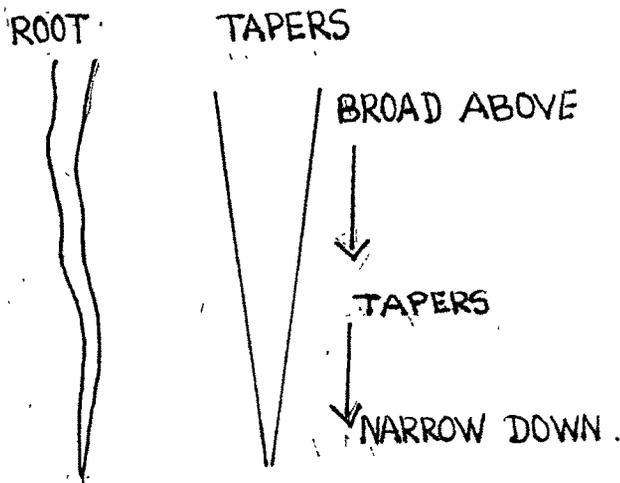
- (i) P.L.M. (Deviated form)

Section A

There are two types of root systems. The tap root system and the fibrous root system.



Look at the figure shown above. The primary (main) root is long. Since the primary root tapers, it is called



the taproot. The taproot has small branches called secondary roots which further have smaller branches. The tap root grows deep in the soil. In this root system, the tap root is larger compared to the other roots.

Fill in the blanks

- a. In the tap root system, the \_\_\_\_\_ root tapers and hence is called the tap root.
- b. In the tap root system, the primary root tapers and hence is called the \_\_\_\_\_.
- c. In the \_\_\_\_\_, the primary root tapers and hence is called the tap root.
- d. The tap root has small branches called \_\_\_\_\_ roots.
- e. The \_\_\_\_\_ root grows deep in the soil.
- f. The tap root grows \_\_\_\_\_ in the soil.
- g. In the tap root system, the \_\_\_\_\_ root is larger compared to the other roots.
- h. In the tap root system, the taproot is \_\_\_\_\_ compared to the other roots.
- i. In the \_\_\_\_\_ system, the tap root is larger compared to the other roots.

Turn to Section B

Section B

- a. In the tap root system, what is the primary root also called as ? Give reason why it is called so.

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b. Fill in the blanks

The tap root system has small branches called as \_\_\_\_\_ .

c. Tick mark (✓) the most appropriate answer

i) The tap root grows

1. in the upper layers of the soil. ( )
2. deep in the soil. ( )
3. above the soil. ( )

ii) In the tap root system

1. The secondary roots are as large as the tap root. ( )
2. The tap root and the secondary roots are of equal size. ( )
3. The tap root is larger than the secondary roots. ( )

Section A

In the fibrous root system, the primary root is shortened or in some plants it has diminished. There are secondary roots which grow in the upper layer of the soil and are fixed there. These roots together give a fibre-like appearance. Hence the root system is called Fibrous root system.



FIBRE LIKE



Fill in the blanks

- a. In the \_\_\_\_\_ root system, the primary root is shortened or in some plants it has diminished.
- b. In the fibrous root system, the \_\_\_\_\_ root is shortened or in some plants it has diminished.
- c. In the fibrous root system, the \_\_\_\_\_ roots grow in the upper layers of the soil.
- d. In the fibrous root system, the \_\_\_\_\_ roots together give a fibre-like appearance.
- e. In the \_\_\_\_\_ root system, the secondary roots together give a fibre-like appearance.
- f. In the fibrous root system since the roots together give a \_\_\_\_\_ appearance, it is called the fibrous root system.

Turn to Section B

Section B

- a. State whether True or False :

In the fibrous root system, the primary root is always present. ( )

- b. Tick mark (✓) the most appropriate answer

In the fibrous root system, the secondary roots grow

- i) In the upper layers of the soil. ( )
- ii) Deep in the soil. ( )
- iii) Above the soil. ( )

- c. Why is it called a fibrous root system.

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(ii) Oral Verbal Elaboration

Teacher (investigator) states "There are two types of root systems. The tap root system and the fibrous root system."

Teacher then shows the tap root systems and explains "Look at these root systems. They have some similarity to each other. The main root is long and thick. Since the root tapers, it is called the tap root. Look at the tap root, it has branches. These are called secondary roots. Look at the secondary roots. These roots have further small branches. The tap root grows deep in the soil. In this type of root system, the tap root is bigger than the secondary roots or other branches (roots). This root system is called the tap root system."

Teacher then shows the fibrous root systems and explains "Look at these root systems. They have some similarity to each other. Of these, look at these root systems, the primary root is shortened. Now, look at these root systems, the primary root has diminished. So, in these type of root systems the primary root is shortened or diminished."

The teacher points to the secondary roots and explains "Look at these roots. They are called the secondary roots. They grow in the upper layer of the soil and are fixed there. The secondary roots with their branches together give a fibre-like appearance and hence the root system is called fibrous root system."

3.4.22 Instructional Objective.22Fixation of the root system to the soil(i) P.L.M. (Deviated form)Section A

The root system fixes the plant firmly to the soil.

In the tap root system, the primary root, the secondary roots and their branches form the root system. Thus, all these roots are fixed firmly in the soil. Hence, it is difficult to pull a plant with the taproot system from the soil.

In the fibrous root system, the secondary roots and their branches form the root system. Thus all these roots are fixed firmly in the soil. Hence, it is difficult to pull a plant with the fibrous root system from the soil.

Fill in the blanks :

- a. The \_\_\_\_\_ system fixes the plant firmly in the soil.
- b. The root system \_\_\_\_\_ the plant \_\_\_\_\_ in the soil.

State whether True or False :

- a. It is difficult to pull a plant from the soil as the stem is thick and long. ( )
- b. It is difficult to pull a plant from the soil as the root system fixes it firmly in the soil. ( )

Turn to Section B



3.4.23/24/25 Instructional Objective.23, 24 & 25Fixation of the root system to the soil(i) P.L.M. (Deviated form)Section A

The root system fixes the plant firmly in the soil.

In the tap root system, the primary root and the secondary roots and their branches form the root system. Thus, all these roots are fixed firmly in the soil.

A pole which is buried deep in the soil is difficult to pull out. In the same way, if the root grows deep in the soil, it is difficult to pull it out. Thus deeper the root, the more difficult it becomes to pull it out. Further, if the root has many branches, it becomes difficult pulling the root, as, besides the main root, all the other roots are also fixed in the soil.

In the fibrous root system, the secondary roots and their branches form the root system. Thus, all these roots are fixed firmly in the soil.

If the number of secondary roots and their branches are more then it becomes more difficult pulling the root system out.

Thus if the number of roots are more and the root system is deep, both these factors contribute to the greater/stronger fixation of the root system to the soil and hence it becomes difficult pulling the plant from the soil.

Fill in the blanks

- a. The \_\_\_\_\_ the root system, the more difficult it gets to pull it out.
- b. The deeper the root system, the \_\_\_\_\_ it gets to pull it out.
- c. The deeper the \_\_\_\_\_, the more difficult it gets to pull it out.
- d. The more number of branches in the root system, the \_\_\_\_\_ it gets to pull it out.
- e. The \_\_\_\_\_ number of branches in the root system, the more difficult it gets to pull it out.
- f. The more number of branches in the \_\_\_\_\_, the more difficult it gets to pull it out.

State whether True or False

The deeper the root system and the more the number of branches in it, the more difficult it is to pull it out. ( )

Turn to Section BSection B

Among the plants A, B, C, D

- a. Which is the easiest to pull out?

Plant A has long root and many branches on it.

Plant B has short root and many branches on it.

Plant C has long root and less branches on it.

Plant D has short root and less branches on it.

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- b. Sequence the plants A, B, C, D from one to four according to their increasing difficulty in pulling each out.

Write the sequential number in the brackets given against each of these plants.

Plant A	(	)
Plant B	(	)
Plant C	(	)
Plant D	(	)

(ii) Oral Verbal Elaboration

The teacher (investigator) points out to two potted plants and asks a pupil to pull out the two roots. After the pupil pulls out the roots, the teacher asks "Which root was easier to pull?" After the pupil replies. The teacher states "Root B was easier to pull because its root was not as deep in the soil as the root A. It can be seen also that Root A is longer than Root B." Teacher points out to two other potted plants and asks another pupil to pull out the two roots. After the pupil pulls out the roots, the teacher asks "Which root was easier to pull?" After having the response of the pupil, the teacher explains "Root C was easier to pull because its root had less branches compared to Root D. Thus, if the root system is deep and the branches are many, then it is difficult pulling the root. The deeper the root system and more the number of branches, the more difficult it gets to pull it out."

Functions of the root

- (i) P.L.M. (Deviated form)

Section A

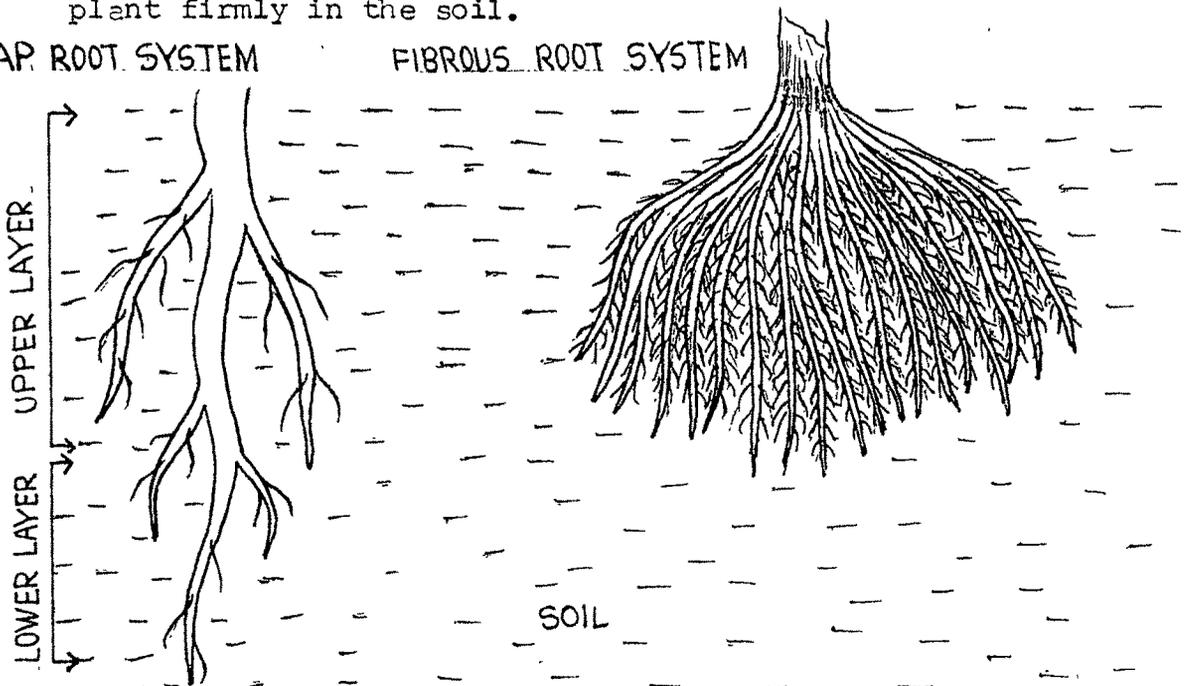
(1) Look at the tap root system, the main root grows deep into the soil. It has secondary branches on it. The main root and the secondary branches are fixed in the soil.

Look at the fibrous root system. The main root may be absent or small, the secondary roots spread out from the tip of the stem (touching the ground). These roots grow in the upper layers of the soil and are fixed there.

Thus the root carries out the function of fixing the plant firmly in the soil.

TAP ROOT SYSTEM

FIBROUS ROOT SYSTEM

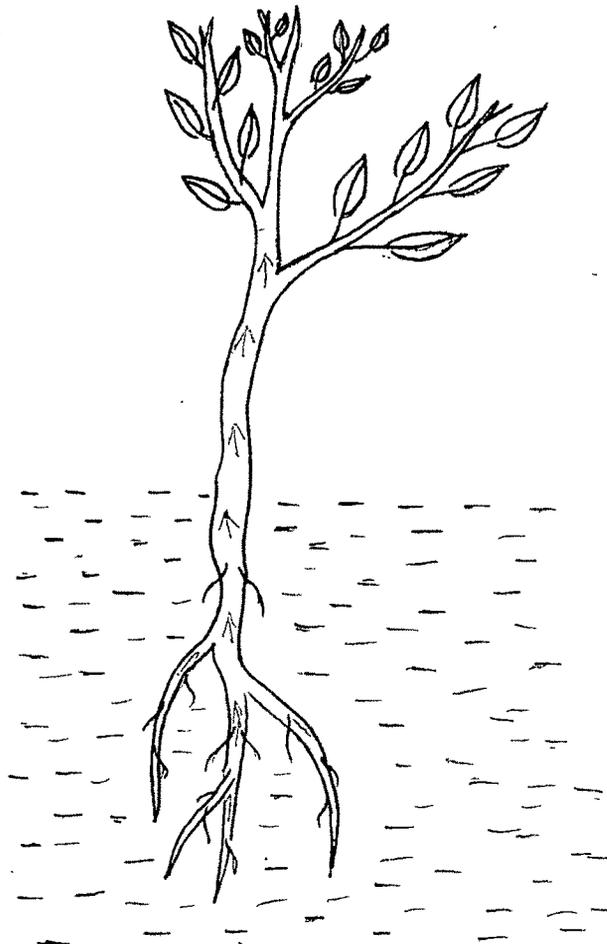


Fill in the blanks :

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- a. The root carries out the function of \_\_\_\_\_ the plant firmly in the soil.
- b. The \_\_\_\_\_ carries out the function of fixing the plant firmly in the soil.
- c. The root carries out the \_\_\_\_\_ of fixing the plant firmly in the soil.
- d. The root carries out the function of fixing the \_\_\_\_\_ firmly in the soil.
- e. The root carries out the function of fixing the plant \_\_\_\_\_ in the \_\_\_\_\_.

(2) The root hair absorbs the water and salts dissolved in it from the soil and transports them to the other parts of the plant. This is another function of the root.



- WATER

Fill in the blanks

- a. The root \_\_\_\_\_ absorbs the water and salts dissolved in it from the soil and transports them to the other parts of the plant.
- b. The root hair \_\_\_\_\_ the water and salts dissolved in it from the soil and transports them to the \_\_\_\_\_ of the plant.
- c. The root hair absorbs the \_\_\_\_\_ and \_\_\_\_\_ dissolved in it from the soil and transports them to the parts of the plant.
- d. The root hair absorbs the water and salt dissolved in it from the soil and \_\_\_\_\_ them to the other parts of the plant.
- e. The root hair absorbs the water and salt dissolved in it from the \_\_\_\_\_ and transports them to the other parts of the plant.

(3) Thus the two main functions of the root are:

- a. Fixation of the plant firmly to the soil.
- b. Absorption of water and salt dissolved in it and transportation of them to the other parts of the plant.

Turn to Section B

Section B

State the two main functions of the root.

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(ii) Oral Verbal Elaboration

The teacher (investigator) states "In the tap root system and the fibrous root system, all the roots get fixed to the soil so as to fix their plants firmly in the soil. This is one of the functions of the root. The root hairs present on the surface of the root absorbs water and salts dissolved in it from the soil and transport them to the other parts of the plant. This is another function of the root. Both these functions are the two main functions of the root."

3.4.27 Instructional Objective.27

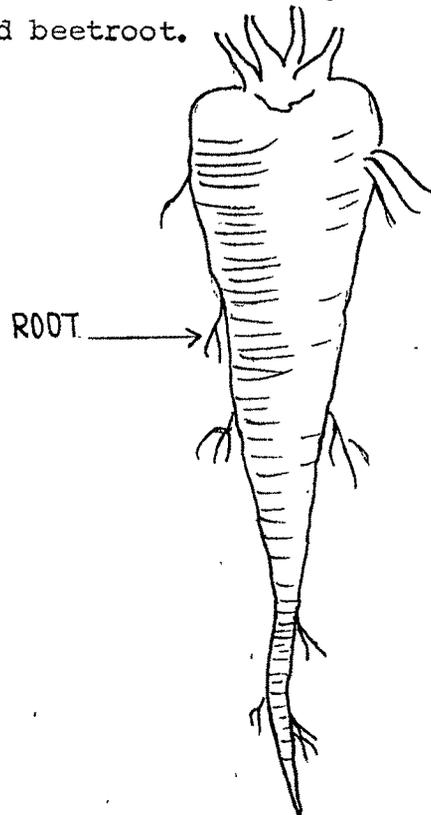
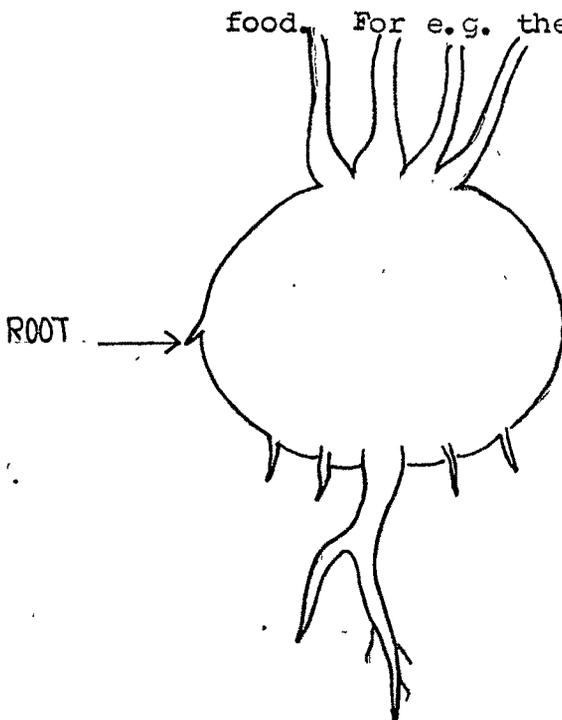
Special function of the root

(i) P.L.M. (Deviated form)

Section A

Some of the roots take up some functions besides their normal functions. These are called special functions.

Some roots undergo a modification in their appearance as they have to carry out the function of storage of food. For e.g. the carrot and beetroot.



It can be seen that the root namely carrot and beetroot 189  
have swollen to store up the food.

Fill in the blanks :

- a. Some roots are \_\_\_\_\_ to store the food.
- b. Besides the normal function, some roots carry out some \_\_\_\_\_ functions.
- c. Carrot performs the function of \_\_\_\_\_.
- d. The beet root has undergone modification in its \_\_\_\_\_ to carry out the special function of storing food.

Turn to Section B

Section B

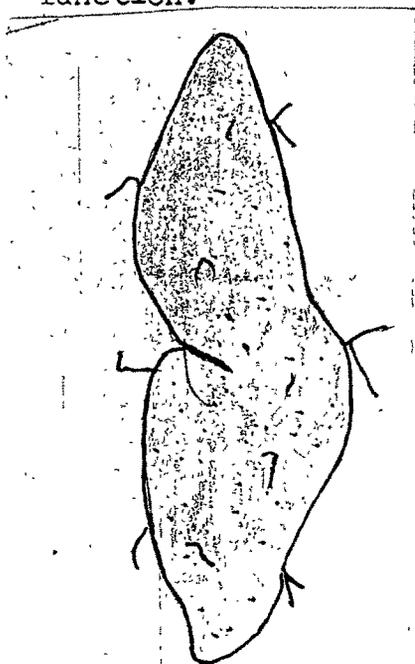
Look at the picture of root given below. What function does it carry out?

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What modification has it undergone to carry out this function?



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(ii) Oral Verbal Elaboration

Teacher (investigator) explains "Some roots take up some other functions besides their normal functions. These functions are called special functions.

Some of the roots e.g. Carrot, Sweet potato undergo modification in their structure in order to carry out the special function of storage of food."

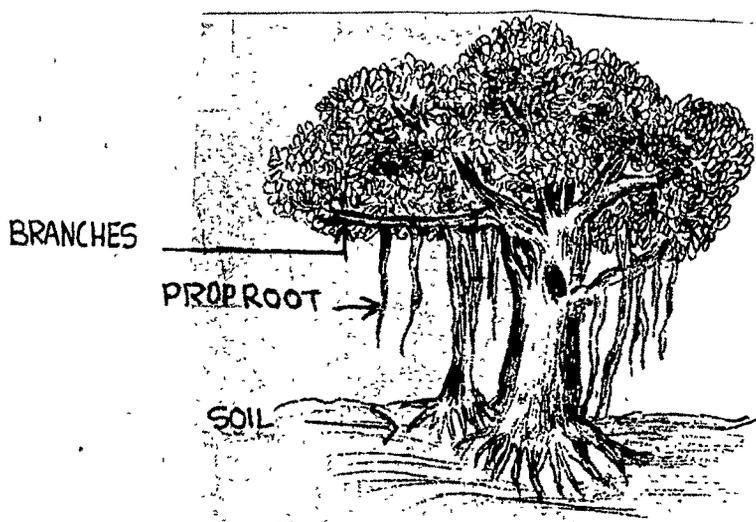
3.4.28 Instructional Objective.28

Special function of the root

(i) P.L.M. (Deviated form)

Section A

Some plants need support for their branches. e.g. Banyan tree. Hence the root grows from the branches downwards and enters into the soil, thus giving support to the huge branches of the plant. These roots are called prop roots.



Fill in the blanks :

- a. The \_\_\_\_\_ roots give support to the huge branches of the banyan tree.
- b. The prop roots give \_\_\_\_\_ to the huge branches of the banyan tree.

Describe how the branches of the banyan tree get support.

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Turn to Section B

Section B

Look at the picture given. Label the part pointed out.



What is its function?

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(ii) Oral Verbal Elaboration

Teacher (investigator) explains "Some roots take up some other functions besides their normal functions. These functions are called special functions.

Some of the plants need support for their branches. e.g. Banyan tree. From the branches of these plants, roots grow downwards, enter into the soil and give support to these branches. These roots are called prop roots and serve a special function of supporting the branches."

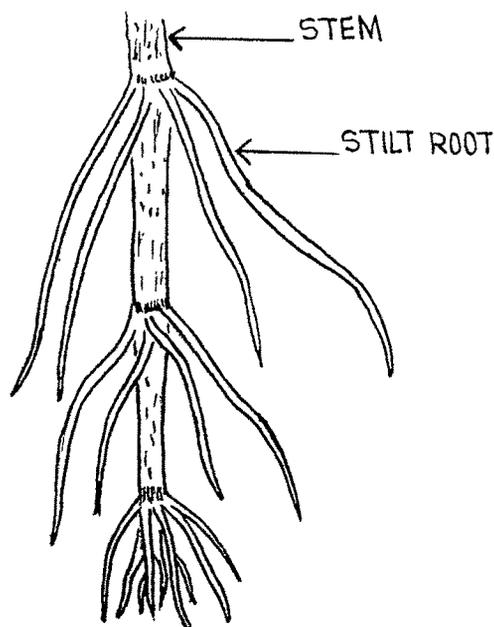
3.4.29 Instructional Objective.29

Special function of the root

(i) P.L.M. (Deviated form)

Section A

In case of maize plant, the roots also arise from the lower part of the stem and enter into the soil to give the stem support. They are called stilt roots.



Fill in the blanks :

- a. The roots that arise from the lower part of the stem and enter into the soil to give the stem support are called \_\_\_\_\_ .
- b. The stilt roots carry out the function of \_\_\_\_\_ the stem.

Turn to Section B

Section B

Name the part pointed out in the picture given below.



What is its function ?

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(ii) Oral Verbal Elaboration

Teacher (investigator) explains "Some roots take up some other functions besides their normal functions. These functions are called special functions."

Some of the plants need support for their stem. E.g. Maize. From the stem of these plants, roots grow downwards, enter into the soil and give support to the stem. These roots are called stilt roots and serve a special function of supporting the stem."

3.5 ENRICHMENT ACTIVITIES

1. Prepare an album of pressed specimens of
  - a) Root system showing primary root, secondary root and its branches.
  - b) Tap root system.
  - c) Fibrous root system.
  - d) Root tip with root cap.
2. Stick picture in the same album of :
  - a) Plant showing its main parts.
  - b) Normal roots.
  - c) Adventitious roots.
  - d) Seedling.
  - e) Roots performing special function of storage of food.
  - f) Roots performing special function of supporting the stem.
  - g) Roots performing special function of supporting the branches.

3. Carry out the following activities at home:
- a) Soak some seeds overnight. Place a piece of dark coloured cloth on the bottom of a large shallow saucer. Wet the cloth thoroughly with water, but do not have excess water on it. Scatter the seeds on the wet cloth and cover the saucer with a glass sheet. Place the saucer in a darkened part of the room. The seeds will germinate in 2 or 3 days. Keep the cloth moist constantly. Examine the seeds each day. Note that the primary root grows directly from the seed, and the secondary roots branch out from the primary root.
  - b) Observe root hairs: Use a magnifying glass to examine the roots grown in the activity. Look closely at the fuzzy outgrowths at the tips of the primary and secondary roots. These are the root hairs which absorb water and dissolved minerals from the soil.
  - c) Carefully dig up a small tamarind plant trying to get the complete root. Also, dig up a small clump of grass. Place both the tamarind plant and grass together. Note the long taproot of the tamarind and the many shorter fibrous roots of the clump of grass.
  - d) Dig up a complete balsam plant, removing the roots carefully, and gently wash the soil from its roots. If balsam are unavailable, use plants grown from bean, radish or tomato seeds instead. Place the roots in a glass jar containing water that has been coloured very deep red. In a few hours or by the next day, the veins of the balsam

leaves and stem will be coloured red because the water and the dissolved food colour have been absorbed by the roots and then have been transported to the stem and leaves.

### Reading Material

#### I. Definition and Kinds of Roots

- A. The roots are the part of the plant that grow downwards into the ground.
1. When a seed first begins to grow, a root grows rapidly and pushes its way into the soil.
  2. This root is called the primary root.
  3. After a while, secondary roots branch out from the primary root, first near the top of the primary root, and then farther down.
  4. The roots keep branching and rebranching until a complete root system is formed.
- B. There are two main kinds of root systems: the taproot system and the fibrous root system.
- C. In the taproot system, the primary root grows until it is the largest root in the root system.
1. This large root is called the taproot.
  2. Much smaller secondary roots grow from this large taproot.
  3. Tamarind and Carrot have taproots.
- D. In the fibrous root system, the primary root lives only for a short time.
1. The secondary roots then continue to grow as a cluster at the base of the stem.
  2. These secondary roots are all thin, have the same size, and are called fibrous roots.

3. Beans, Corns and grasses have fibrous roots.
- E. Some taproots and fibrous roots store food for the plant and become large.
1. These large roots are called fleshy roots.
  2. Beets, carrots, and radishes are examples of fleshy taproots.
  3. Sweet potato is an example of fleshy fibrous roots.
- F. In some plants, roots grow from the stem or leaves of the plant.
1. These kinds of roots are called adventitious roots.
  2. The tomato and Cucumber plants form adventitious roots when their stems touch the ground.
  3. The leaves of the bryophyllum, (Pan Futi) form adventitious roots when placed in the soil.
- G. Some plants send out roots from their stems just above the ground.
1. These roots are a special kind of adventitious root, called prop roots or brace roots.
  2. They grow into the ground and help hold the plant upright.
  3. The corn plant is an example of a plant with prop root or brace roots.
- H. Climbing plants, such as English ivy, poison ivy, and tropical orchids send out roots from their stems.
1. These roots are also a special kind of adventitious roots, called aerial roots.
  2. The aerial roots grow in the air, clinging to a wall or tree and holding the stem firmly in place.

## II. The Structure of the Root

- A. A short distance behind the tip of each root are many tiny, fuzzy root hairs.
  - 1. These root hairs take in, or absorb, water and dissolved minerals from the soil.
  - 2. As the root moves downward into the soil, new root hairs grow from near the tip, and the older root hairs wither and die.
- B. At the tip of the root is the root cap, which protects the delicate end of the root.
- C. The length of the root varies according to the needs of the plant and conditions of the environment.
  - 1. The taproot of the mesquite plant has been known to grow 40 feet down into the desert to reach a water supply.
  - 2. The fibrous roots of a cactus plant cover large areas just below the surface of the ground to absorb quickly the water from infrequent rains.
  - 3. The bringal <sup>plant</sup> grows downward about 7 feet and spreads sideways from 2 to 20 feet.

## III. The Functions of Roots

- A. The roots absorb, or take in, water and dissolved minerals from the soil, and send them to the stem and up into the leaves of the plant.
  - 1. Water and dissolved minerals are absorbed by the root hairs.
  - 2. The root hairs give off an acid that helps dissolve the minerals in the soil.

- B. The roots also help hold the plant firmly in place.
- C. Some roots, such as the beet, carrot, sweet potato, and dahlia, help store food for the plant.
- D. Some roots such as the sweet potato and dahlia, can produce new plants.
- E. Roots adapt to the needs of the plant and conditions of the environment.

### 3.6 FINAL TEST

- 1.
  - a. In packet 1.a., you are supplied with a plant and a piece of adhesive tape. Observe the plant carefully and stick the tape around the root. Place this plant in the same packet.
  - b. In packet 1.b., you are supplied with a plant and a piece of adhesive tape. Observe the plant carefully and stick the tape around the shoot. Place this plant in the same packet.
- 2.
  - a. Name the part of the plant which generally grows in the soil.

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- b. Name the part of the plant which generally grows above the soil.

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3. Tick mark ( ✓ / ) the correct answer
- a. Generally the root is green in colour. (      )
- b. The root is generally not green in colour. (      )
4. a. In packet 4a, you are supplied with a root system and a piece of adhesive tape. Observe the root system carefully and then stick the tape around the primary root. Place this root system in the same packet.
- b. In packet 4b, you are supplied with a root system and a piece of adhesive tape. Observe the root system carefully and then stick the tape around secondary root. Place this root system in the same packet.
5. Fill in the Blanks :
- \_\_\_\_\_ of the plant are also fixed in the soil along with the main root.
6. a. Tick mark ( ✓ / ) the correct answer :
- The root cap is
- i) cap like part on the tip of the stem. (      )
- ii) cap like part over the tip of the root. (      )
- b. In packet 6.b., you are supplied with a root and a piece of adhesive tape. Observe the root carefully and then stick the tape around the root cap. Place the root in the same packet.
7. What is the function of the root cap ?

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8. Some seeds are placed in packet 8. Place the germinated 201 seeds in packet 8a. and the ungerminated seeds in packet 8b.

9. What is Germination ?

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10. What is seedling?

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11. Point out the root hair on the root 'A'.

12. Fill in the blanks :

The cotton fibre-like hairy structures seen on the surface of the root are called \_\_\_\_\_ .

13. Fill in the blank choosing the most appropriate answer:

\_\_\_\_\_ of the root absorbs water from the soil.

- (a) Root cap            (b) Secondary root  
(c) Root hair           (d) Root tip.

14. Sometimes the plant gives out water in the atmosphere in the form of watervapour through its leaves. From where does the plant get this water and how does it reach the leaves ?

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15. Fill in the blanks :

When the root grows, \_\_\_\_\_  
\_\_\_\_\_ develop near the root tips and old root  
hairs die off.

16. a. Fill in the blanks :

The two types of roots are \_\_\_\_\_ and \_\_\_\_\_

b. Describe each of these two types of roots

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17. In packet 17, you are supplied with normal roots and adventitious roots. Observe the roots carefully. Place the normal roots in packet 17.a., and the adventitious roots in packet 17.b.



21. In packet 21, you are supplied with the tap root system and a piece of adhesive tape. Observe the root system carefully and stick the tape on the tap root. Place this root in the same packet.
22. Give reason why it is difficult to pull a plant from the soil.
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23. Look at the plants P and D. If both these plants were in the soil, which of them would <sup>be</sup> easier to pull out from the soil and why?
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24. Look at the plants R and Q. If both these plants were in the soil, which of them would be easier to pull out from the soil and why?
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25. Look at these four plants A, B, C and D. If all these plants were in the soil.

a. Of A and C which would be easier to pull out? Give one reason for your answer.

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b. Of C and D which would be easier to pull out? Give two reasons for your answer.

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26. State the two functions of the root.

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27. State the function of the <sup>roots</sup> 'b' & 'c' placed on the table.

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28. Look at the figures of the roots. Mention the types of roots each of them belongs to and the special function each of them carries out.

