UNIT : 2

Life Processes : Growth, Development and Reproduction

SEED : STRUCTURE AND GERMINATION

[From Seed To Plant]

4

SYLLABUS

Germination of seeds — dicot and monocot, conditions required for germination.

* Germination of bean, pea and maize seeds — exploring conditions required for germination (using controls) (E).

Normally, plants grow by seeds, such as marigold, mango, apple, wheat, gram plants, *etc*. You eat mango and throw out its stone*. When a seed is sown, it sprouts and produces a seedling which then grows into a mature plant. This plant again produces flowers, fruits and seeds. Some plants, like wheat and marigold, produce seeds only once in a year and die out, while others continue to produce seeds for many years such as mango, apple, *etc*.

TYPES OF SEEDS

There are two types of seeds, namely, dicotyledonous and monocotyledonous.

1. Some seeds, like those of pea and bean, when opened, show two thick parts known as cotyledons. The seeds with two cotyledons are called **dicotyledonous (*di* : two)**.
2. Some seeds have only one cotyledon, as in maize. Such seeds are called **monocotyledonous (*mono* : single/ one)**.

* Seed with a hard coat is called stone and the fruits which bear such seeds are called stone fruits.

Structure of a Seed

Let us take *two* examples — bean from dicotyledonous and maize from monocotyledonous seeds.

Example : **The bean seed** (Dicot seed)

The bean seed (Fig. 4.1) is protected by a thick, greenish outermost coat called the **testa** or the **seed coat**. It protects the seed from insects and bacteria as well as from mechanical injury. Under the testa lies a very thin membrane called the **tegmen**.

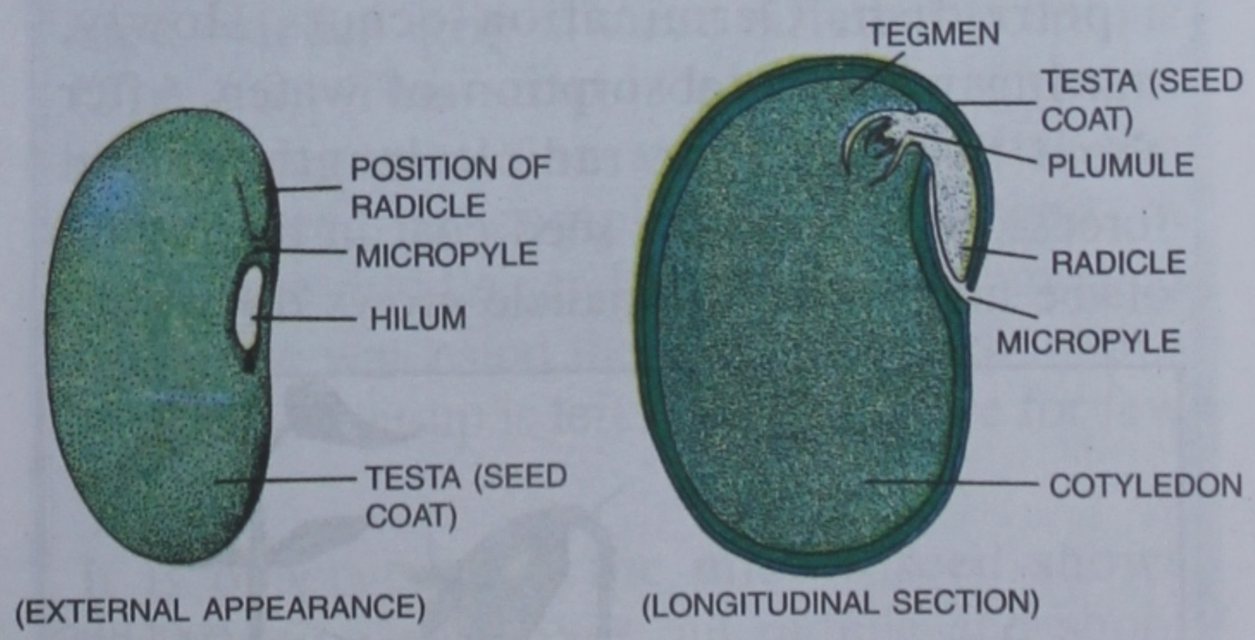


Fig. 4.1 Bean seed

On one side of the testa, there is a scar called **hilum**, which marks the place where the seed was attached to the fruit wall. Above the hilum is a small pore called **micropyle (*micro* = small, *pyle* = passage)**.

The micropyle absorbs as much water as is required for germination.

On removing the testa and the tegmen, you will find that the seed is made up of two fleshy seed leaves called the **cotyledons**. They contain stored food material which is used by the seedling during germination. What we eat as washed pulses, like the pea or gram, are actually the cotyledons of their seeds.

In between the two cotyledons is located, the delicate embryo which consists of a **radicle** and a **plumule**. On getting the right environment, the radicle develops into a root, while the plumule develops into a shoot.

The process by which an embryo within the seed becomes active and grows into a young plant is called **germination**.

Activity 1

Germination of bean seed

Put some bean seeds in moist cotton placed in a petri dish. Germination occurs slowly, starting with the absorption of water. After about two days, the radicle lengthens and forces out through the seed coat in the region of the micropyle. The radicle grows downward and develop the roots, while the plumule grows upward and develops the shoot.

This type of germination is called **epigeal** germination. In this type of germination, the cotyledons are pushed above the soil to form cotyledon leaves. The leaves start preparing food for the growing plant.

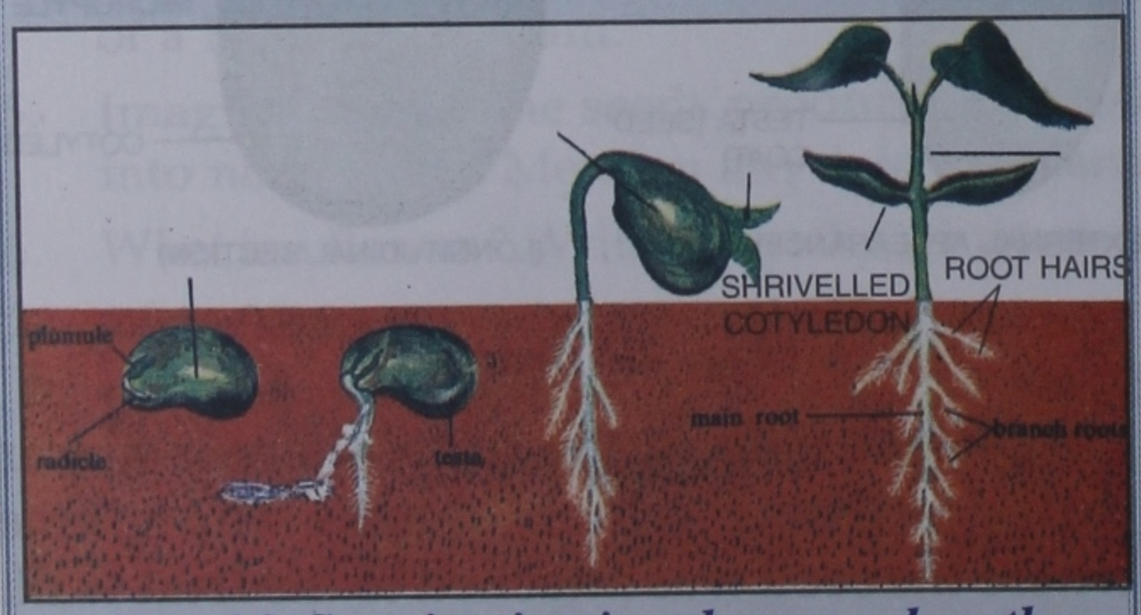
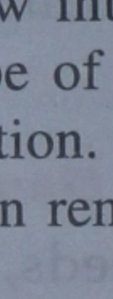
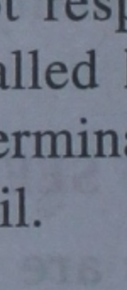


Fig. 4.2 Germination in a bean seed — the epigeal germination



Activity 2



Germination of pea seed

Soak some pea seeds, wrap them in moist cotton and keep them overnight. Next morning, try to remove the seed coat from one seed. You will observe that there are two cotyledons inside the pea seed.

Sow the remaining seeds in a pot of moist soil and wait for 2-3 days so as to allow the pea seeds to germinate. After the seeds have germinated, the radicle and plumule come out and grow into roots and shoot respectively. This type of germination is called **hypogeal** germination. In this type of germination, the cotyledon remain within the soil.

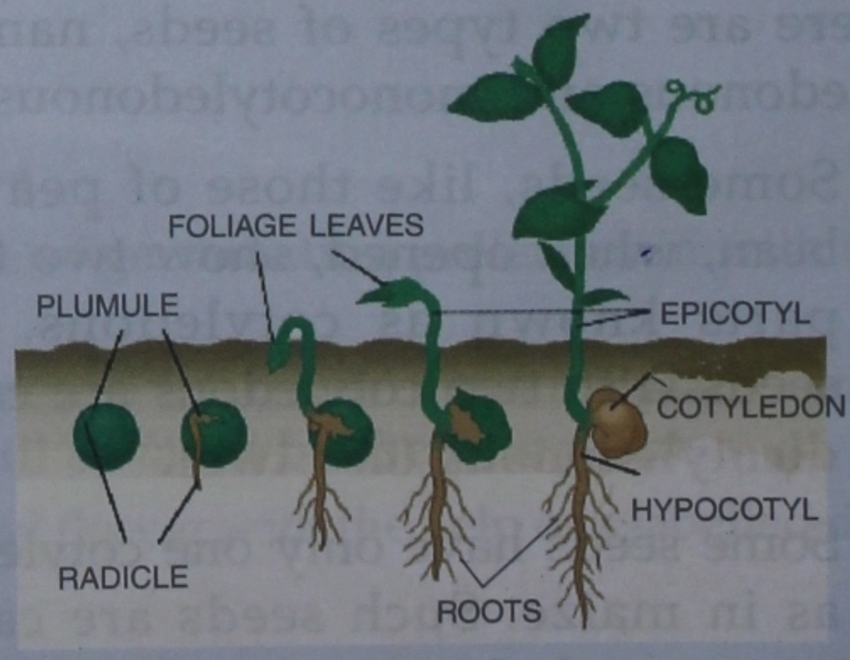


Fig. 4.3 The pea seeds remain in the soil — the hypogeal germination

Example : **The maize grain** (monocot seed).

The maize grain has only one cotyledon, hence it is said to be monocotyledonous.

Cut open a soaked maize grain through the middle and study its one half as shown in Fig. 4.4. The upper part which stores the food, mainly in the form of starch, is called the **endosperm,** and the lower part gives rise to plumule and radicle.

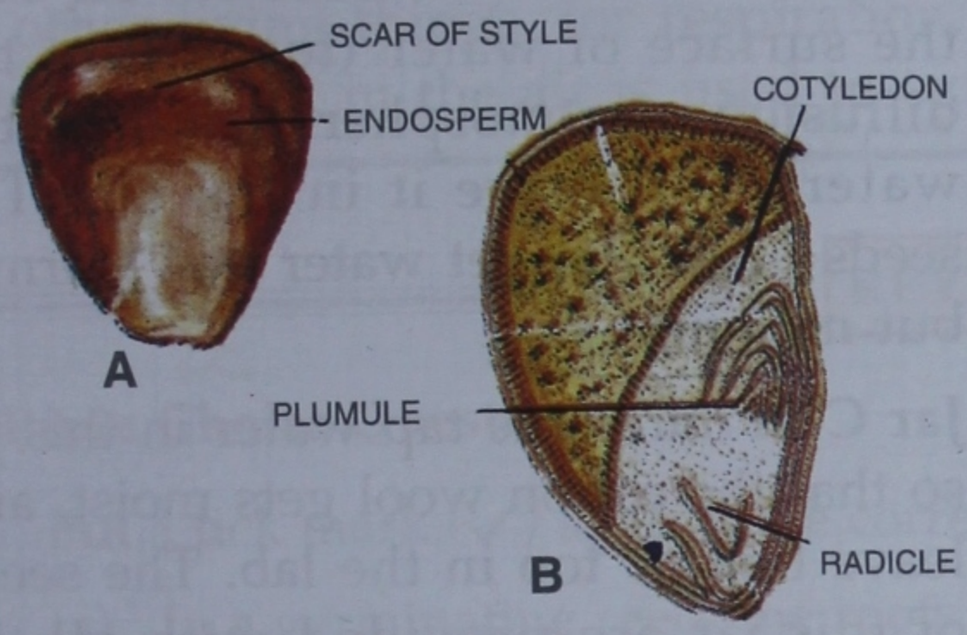
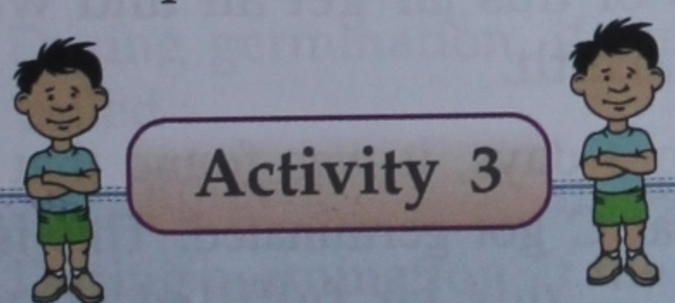


Fig. 4.4 A. Maize grain, B. Its Longitudinal section

The plumule which gives rise to the shoot lies upward near the cotyledon. The radicle which gives rise to the root lies downward near the lower pointed end of the grain.



Activity 3

Germination of maize grain

Soak some maize grains in water for about 24 hours. The grains start swelling up with the absorption of water and germination starts slowly. The stored food in the endosperm is used by the plumule and the radicle.

The radicle lengthens and bursts out. The plumule too emerges out from the grain and forms the first leaf. The radicle grows downward while the plumule grows upward.

This type of germination is called **hypogeal** germination ('hypo' means below and 'geal' means earth). In such a type of germination, the cotyledons remain under the soil. The plumule comes out of the soil to form leaves (Fig. 4.5).

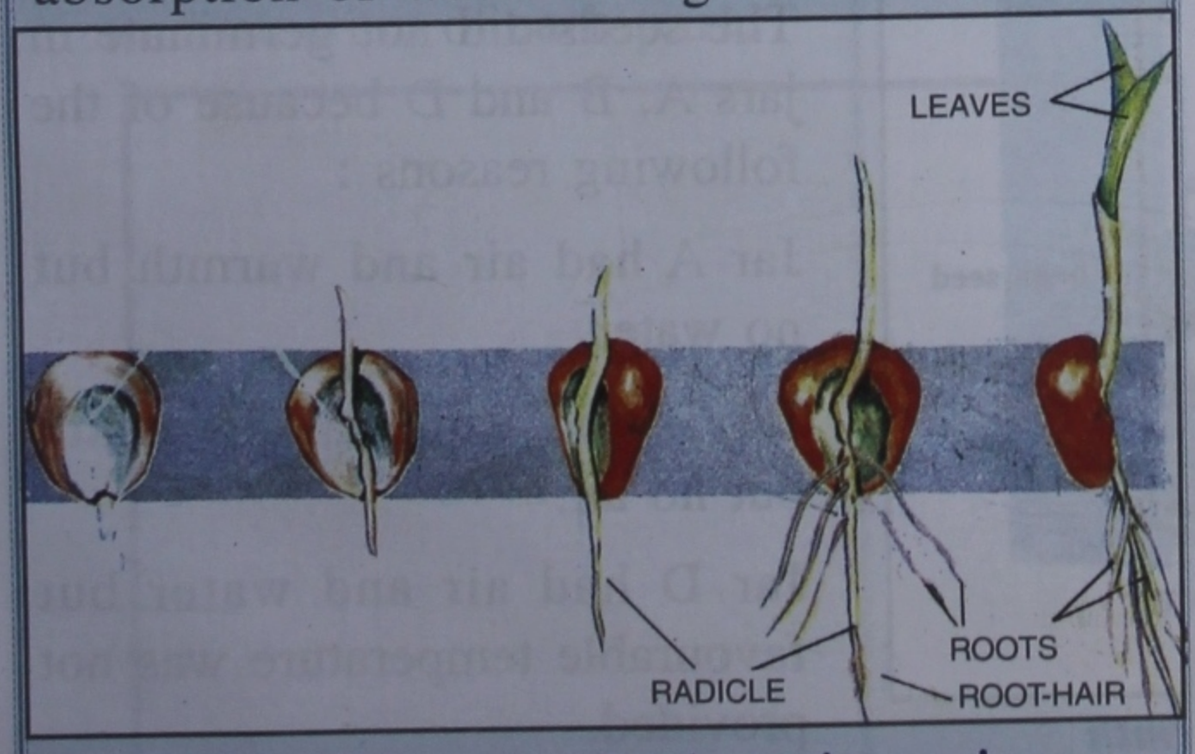
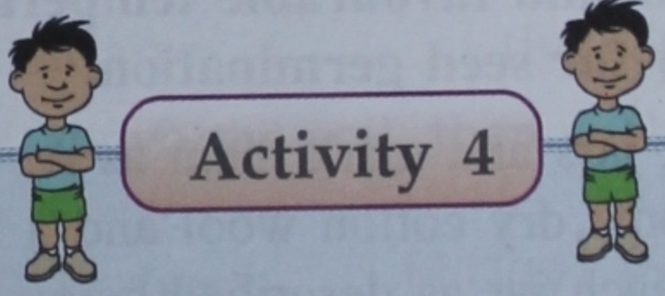


Fig 4.5 Germination in maize grain

Conditions Necessary For Germination

Water, air, and favourable temperature are the three necessary conditions for germination of a seed.

We can demonstrate the necessity of these conditions by the following two simple experiments :



Activity 4

Three mature dried bean seeds are taken and tied on a wooden strip at three different positions (Fig 4.6). This strip is placed in a beaker containing water in such a way that the lower seed is completely submerged in water, the middle seed is partially submerged inside the water and the top seed is kept above water. This set-up is left in a warm place for few days.

It is observed that the middle seed shows germination and gives out radicle and shoot leaves. The top seed shows no growth and the bottom one shows negligible growth.

The middle seed gets fully germinated due to the fact that this seed has all the favourable conditions required for germination, *i.e.*, air (oxygen), moisture and warmth (favourable

temperature), which are necessary for germination.

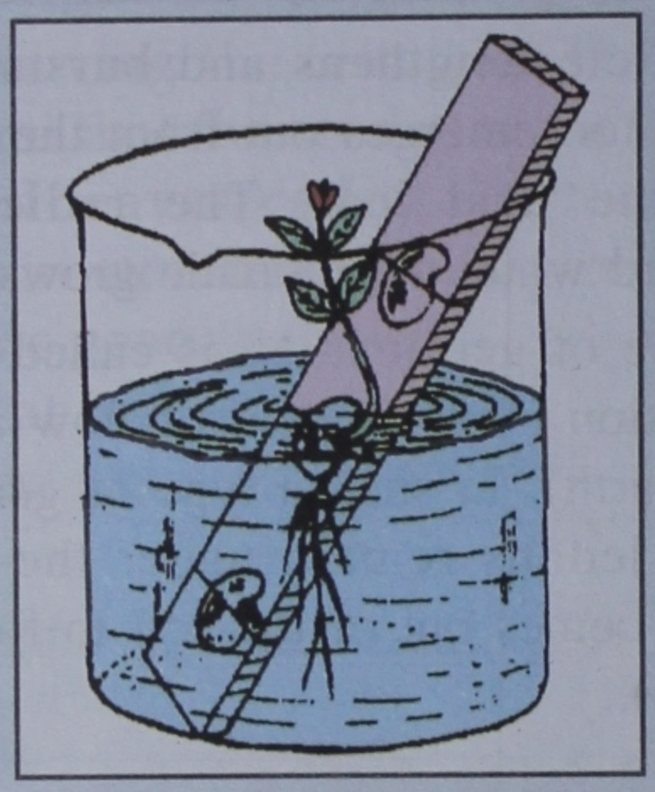
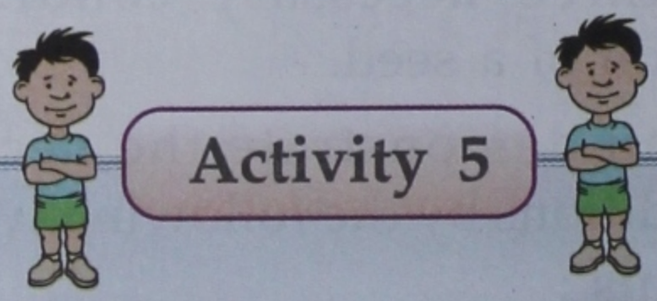


Fig. 4.6 The three-bean experiment to demonstrate germination



Activity 5

Water, air and favourable temperature are necessary for seed germination.

Take four jars and mark them as A, B, C and D. Put some dry cotton wool and a few bean seeds in each jar as described below :

1. **Jar A :** It is kept inside the laboratory. It gets air and normal warmth, but no water.
2. **Jar B :** Add water to jar B, which has been boiled and cooled (boiling of water dissolves all the air in it), so as to submerge the seeds. Put a few drops of mustard or coconut oil over the surface of water (to prevent the diffusion of atmospheric air into the water), and leave it in the lab. The seeds of this jar get water and warmth but no air.
3. **Jar C :** Pour some tap water in this jar so that the cotton wool gets moist, and leave this jar too in the lab. The seeds of this jar are provided with all the three conditions for germination — air, water and warmth.
4. **Jar D :** Pour some tap water in this jar too, so that the cotton wool gets moist. Put this jar inside a refrigerator. The seeds of this jar get air and water, but no warmth.

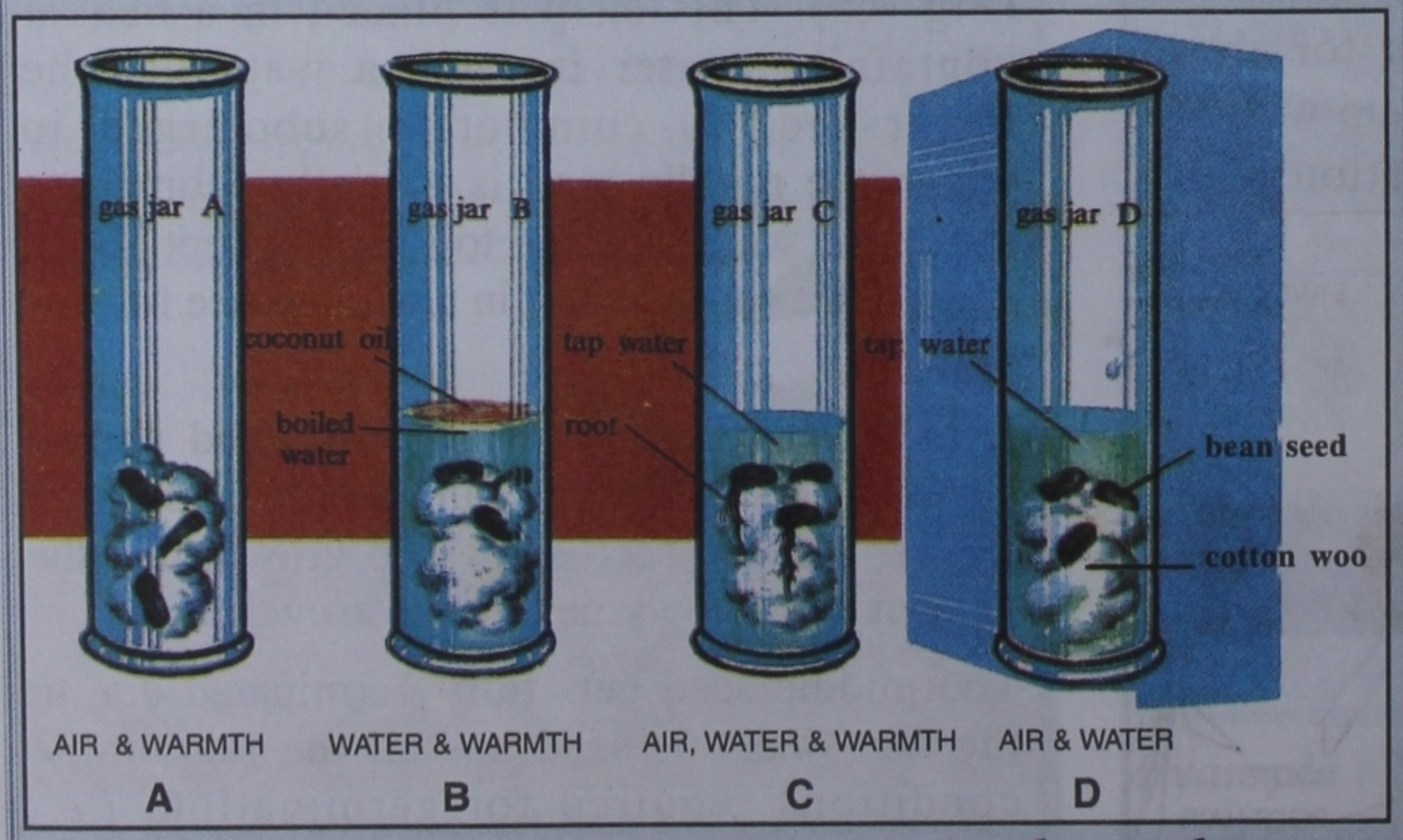


Fig. 4.7 Germination requires air, water and warmth

After 2 to 3 days, it was found that only the seeds in jar C got germinated. This is because this jar fulfilled all the three conditions necessary for germination, namely, air, water and suitable warmth.

The seeds did not germinate in jars A, B and D because of the following reasons :

Jar A had air and warmth but no water.

Jar B had water and warmth but no air.

Jar D had air and water but favourable temperature was not provided.

We observed from the above activities that all living things require **water** to carry out their life processes. Most chemical reactions occur in water. Seeds, like any other living thing, also need water during germination.

Seeds also need air, similar to most of the other living things, for respiration. The oxygen present in the air is used to oxidise the stored food and thus release energy. This energy is required for growth.

A suitable temperature (warmth) is necessary for all chemical activities assisted by enzymes. The enzymes are inactive at low temperatures and gets destroyed at higher temperatures. The enzymes act best at a temperature between 35° and 40°C.

REVIEW QUESTIONS

Multiple Choice Questions :

1. Put a tick mark (✓) against the correct alternative in the following statements :

(a) In a germinating seed, the roots develop from :
(i) Radicle (ii) Plumule (iii) Tegmen (iv) Hilum

(b) In a germinating seed, the shoot develops from :
(i) Radicle (ii) Plumule (iii) Tegmen (iv) Hilum

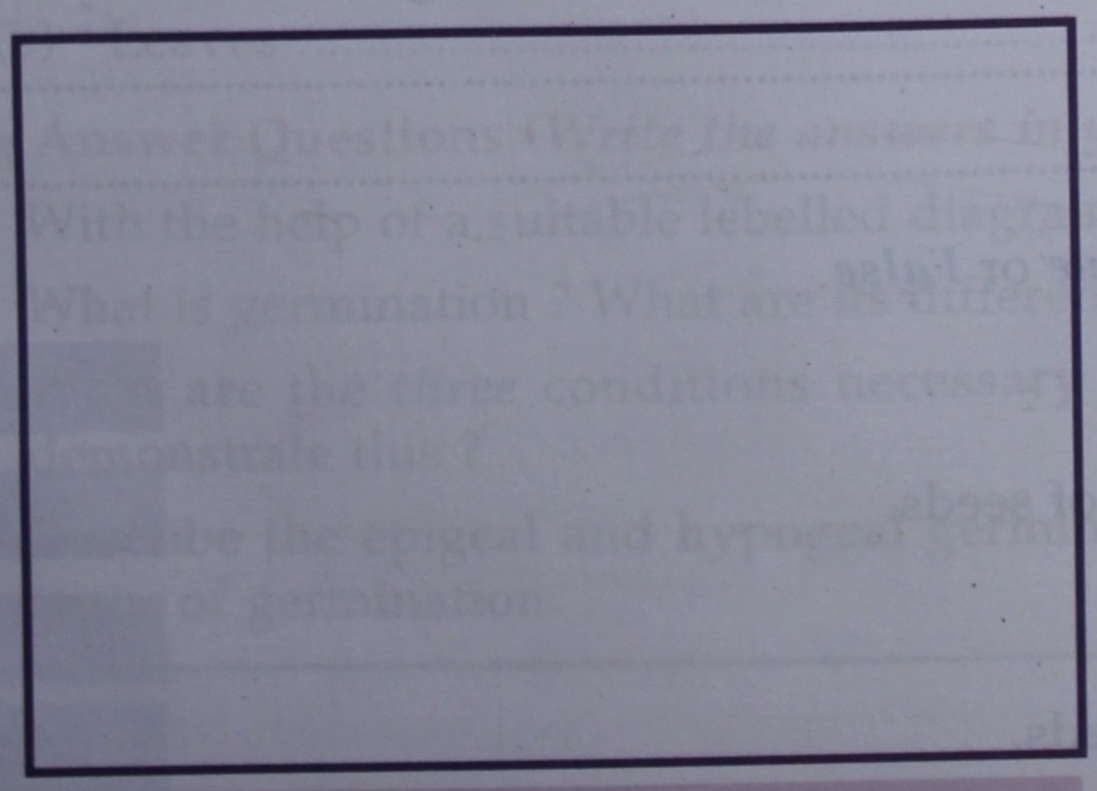
(c) Which one of the following is a monocotyledonous seed ?
(i) Bean (ii) Pea (iii) Maize (iv) Gram

(d) During germination, if the cotyledons are pushed above the soil, then such seeds are called :
(i) Epigeal (ii) Hypogeal (iii) Perigeal (iv) Progeal

(e) During germination, if the cotyledons remain under the soil, then such seeds are called :
(i) Epigeal (ii) Hypogeal (iii) Perigeal (iv) Progeal

Short Answer Questions :

1. Draw a labelled diagram of the longitudinal section of a bean seed. Write down the structure and function of each part.



.....
.....
.....
.....
.....
.....
.....
.....

2. Write down the various stages in the germination of a monocot seed.

.....

.....

3. Name the following :

(a) A seed which shows hypogeal germination.

.....

(b) A monocot seed.

.....

(c) A dicot seed.

.....

(d) A seed which shows epigeal germination.

.....

4. Differentiate between the following pairs :

(a) Radicle and plumule.

.....

(b) Hilum and micropyle.

.....

(c) Testa and tegmen.

.....

5. What are the functions of the following ?

(a) Radicle .....

(b) Plumule .....

(c) Cotyledons .....

6. Radicle emerges out of the seed earlier than plumule. What one advantage is served by this ?

.....

.....

7. State whether the following statements are *True* or *False*.

(a) Some seeds have no cotyledons.

(b) Warmth is necessary for the germination of seeds.

(c) All seeds have two cotyledons.

(d) Air is necessary for the germination of seeds.

8. In a seed, food is generally stored in :

   (a) radicle .....

   (b) cotyledons or endosperm .....

   (c) fruit .....

   (d) micropyle and testa .....

9. The ***three*** conditions necessary for germination of seeds are (tick the correct answer) :

   (a) Oxygen, suitable temperature and water.

   (b) Good soil, water and air.

   (c) Good soil, suitable temperature and light.

   (d) Light, oxygen, and temperature.

   (e) Oxygen, carbon dioxide, and light.

10. In the spaces provided below, draw labelled diagrams to show the three stages in the germination of any seed you have observed.

Complete seed	Radicle emerged	Plumule emerged

11. Name the part of the seeds from which the following are given out :

   (a) Roots : .....

   (b) Leaves : .....

Long Answer Questions (*Write the answers in your note-book*) :

1. With the help of a suitable lebelled diagram, describe the structure of a dicot seed.
2. What is germination ? What are its different types. Explain with examples.
3. What are the ***three*** conditions necessary for the germination of seeds. How would you demonstrate this ?
4. Describe the epigeal and hypogeal germination. Give the main difference between the *two* types of germination.