Ratna Sagar

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Education, Our Mission

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Rama Sagar
Education, Our Mission!

Revised and Updated

LIVING SCIENCE BIOLOGY

D K Rao • J J Kaur

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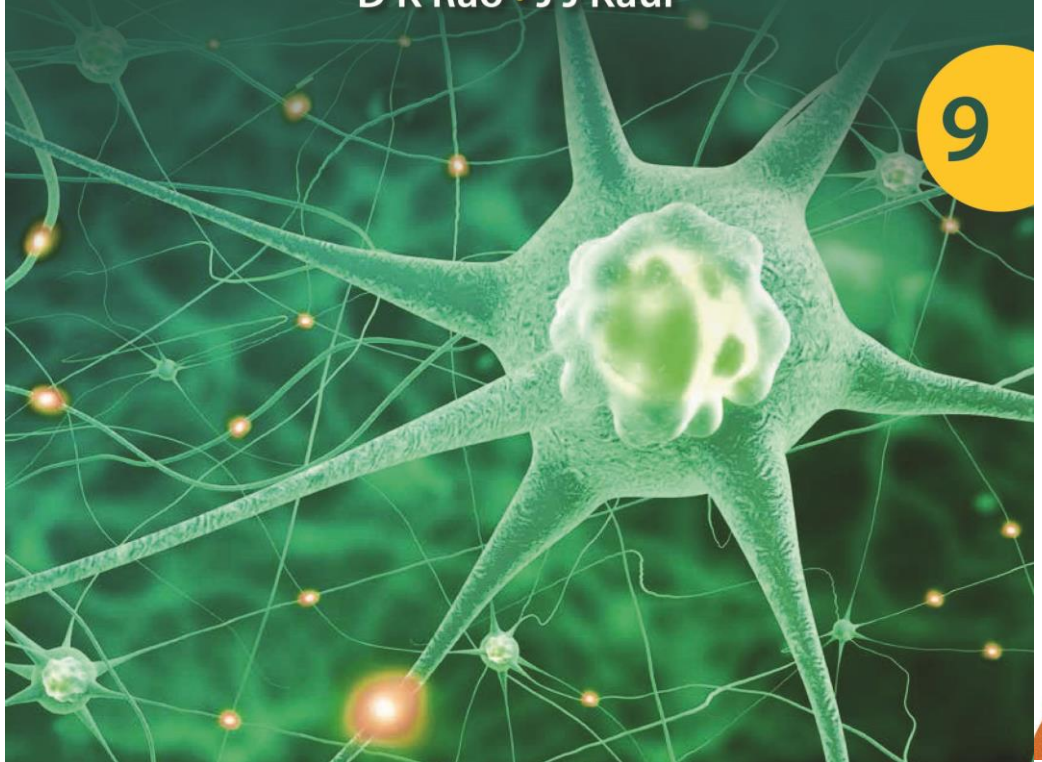


ICSE
Living Science
Biology

Class 9

Chapter 5 Germination of Seeds

LEARNING OBJECTIVES

Types of Seeds

- Monocotyledonous and dicotyledonous seeds
- Albuminous and exalbuminous seeds

Structure of Seed

- Structure of a monocot seed
- Structure of a dicot seed

Seed Germination

- Conditions necessary for seed germination
- Types of seed germination
- Epigeal germination
- Hipogeal germination

What is a seed?

A seed is the first stage in the life cycle of a plant. **A seed is the mature ovule after fertilization** which contains an embryonic plant, stored food material for nourishment and a protective seed coat.

Types of Seeds

Depending upon the number of cotyledons, there are two kinds of seeds – monocotyledonous and dicotyledonous.

Monocotyledonous seeds contain one cotyledon or embryonic leaf. These seeds do not separate into two halves. Examples: Maize, rice, wheat, coconut and grasses.

Dicotyledonous seeds contain two cotyledons.

These seeds absorb and store the nutrients from the endosperm before the seed germinates. The cotyledons are usually thick with stored nutrients. Examples: Pea, gram, bean, peanut and apple.

Albuminous and exalbuminous seeds

On the basis of presence or absence of special food-storing tissue called **endosperm**, seeds are also classified as albuminous and exalbuminous.

❖ In **albuminous** or **endospermic seeds**, endosperm is present and the **cotyledons are thin and membranous**. For example, custard apple and poppy seeds are albuminous dicot seeds while cereals, millets and palm seeds are albuminous monocot seeds.

❖ **Exalbuminous** or **non-endospermic seeds** lack endosperm and the **cotyledons are thick and fleshy as they store food**.

For example, gram, pea, mango and mustard seeds are exalbuminous dicot seeds, while orchids, *Amorphophallus* and *Vallisneria* seeds are exalbuminous monocot seeds.

Structure of Seed

The basic structure of a seed consists of:

- **Cotyledons:** Food storage organs that function as first seed leaves.
- **Epicotyl:** The part of the embryo above the cotyledons is called epicotyl. The epicotyl becomes the stem and leaves of the plant.
- **Plumule:** The epicotyl along with embryonic leaves is called plumule.
- **Radicle:** The stem tip of the plant embryo developing into a root is called radicle.
- **Hypocotyl:** The area of the plant embryo between the cotyledons and the radicle.
- **Hilum:** Along the concave edge of the seed is the hilum, which is a scar that marks where the seed was attached to the ovary wall.
- **Micropyle:** It is a small opening on the concave side of seed responsible for absorption of water as well as exchange of gases that take place during germination. It is present adjacent to the hilum.

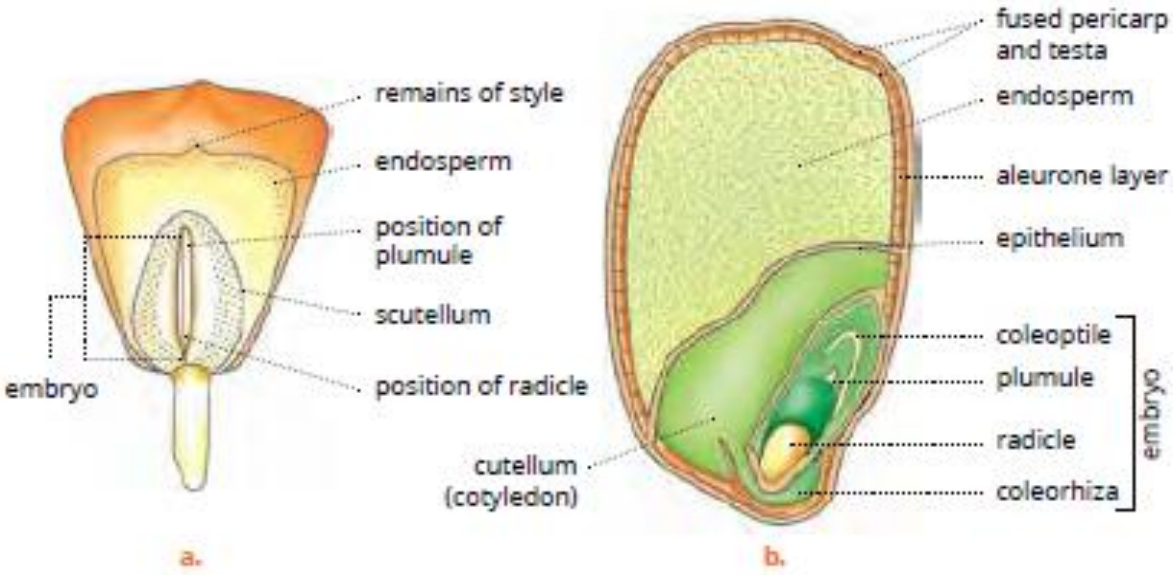
❖ **Seed coat:** It is a covering around the seed that protects the embryo and its food supply, i.e. endosperm.

❖ **Coleoptile:** In the seeds of monocots, it is the sheath that protects the plumule as it grows out of the soil.

❖ **Endosperm:** It is a special food-storing tissue.

Structure of a monocot seed (Maize grain)

Maize grain is actually a fruit in which the seed coat and pericarp of the fruit wall are fused together forming a protective layer. That is why it is called as grain.

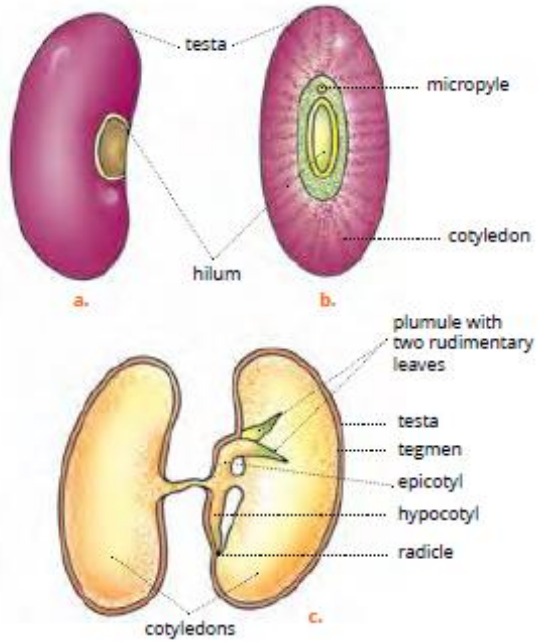


The **embryo** in maize grain consists of a single cotyledon called **scutellum**, a **radicle** and a **plumule**.

The radicle lies towards the pointed side of the embryonic region of the seed. It is covered by a protective sheath called **coleorhiza**.
The **plumule** is located towards the upper side of the embryonic region opposite to radicle. It is also enclosed in a protective sheath known as **coleoptile**. Angiosperms, also known as flowering plants, are plants

Structure of a dicot seed (Bean seed)

A bean seed is covered by a **testa** or **seed coat** usually brown in colour. The outer seed coat protects the embryo from mechanical damage and helps to prevent it from drying out. Each seed has a unique **seed coat** which gives seeds their distinctive appearances.
Lying next to testa is **tegmen**. It is a thin layer that also protects the inner parts of the seed. Hilum marks the area where the seed was attached to the wall of ovary.



A tiny **micropyle** is also situated near the hilum. **Micropyle is the pore through which pollen tube enters the ovule during fertilization.** Seeds absorb water through this micropyle. It also allows diffusion of respiratory gases during seed germination.Bean seed contains **two cotyledons**.

They absorb and store the nutrients from the endosperm before the seed germinates. The cotyledons, thick with stored nutrients, emerge above ground during germination, and then transport the stored nutrients to the developing seedling.

The embryo in bean seed contains two parts – a radicle and a plumule. The radicle forms the roots while plumule forms the stem and leaves of the developing plant.

Seed Germination

When this seed is placed in proper conditions necessary for seed germination, it becomes active and seedling is developed from the embryo. This is called **seed germination**. **Thus, formation of seedling from embryo is called germination.**

Conditions necessary for seed germination

A seed will not germinate until it is exposed to certain suitable environmental conditions. It must pass through a period of dormancy during which it undergoes physiological maturation. Environmental factors such as water, air and temperature help a seed in its germination.

Water: Water softens the seed coat and activates the enzyme that converts starch in the cotyledons or endosperm into simple sugars.

These sugars provide energy for the embryo to grow. The seed swells, ruptures the seed coat and radicle elongates, comes out and forms root system.

Air containing oxygen: Rapid cell division and growth must occur for seed germination for which energy is required. This energy is provided by oxidation of food through respiration. If the oxygen supply is not proper, the seeds will not germinate. This is why seeds grown very deep in the soil do not germinate.

Temperature: Seeds will grow only if the temperature is suitable (i.e. within a certain range). A very low temperature inhibits the growth of the embryo and a very high temperature destroys its delicate tissues. Generally, optimum germination occurred at temperatures ranging between 25 ° C to 35 ° C in most of the seeds.

Types of seed germination

There are two types of seed germination – epigeal and hypogeal.

Epigeal germination

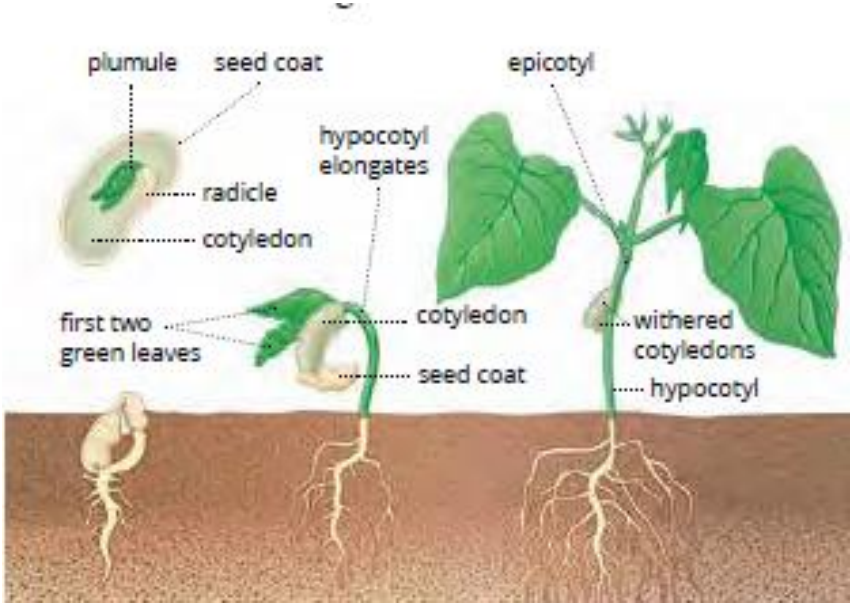
If the hypocotyl elongates rapidly, **comes above the soil and cotyledons are pushed above the soil, it is called epigeal germination**. In this, the cotyledons become green and form the first leaves. Examples: Castor, bean and cotton.

Germination in bean seed – epigeal germination

❖ Under favourable conditions, the seed absorbs water and swells up.

❖ The seed coat ruptures and the radicle grows downwards to form the root system and grows further there.

❖ The radicle forms the primary root from which lateral roots emerge.



❖ The hypocotyl elongates, becomes straight and pushes the cotyledons into the air above the soil.

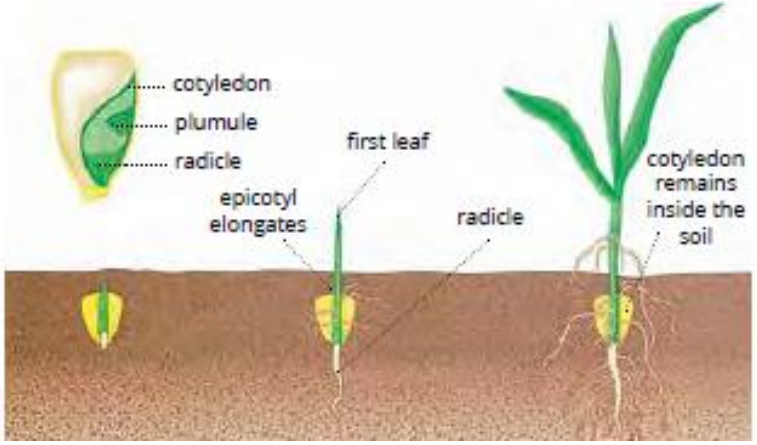
❖ The two cotyledons form the first green leaves.

❖The young leaves unfold at the tip of epicotyl and start preparing food for the plant through photosynthesis. In this germination, the hypocotyl elongates and the germination is epigeal.

Hypogeal germination

The epicotyl elongates, the cotyledons remain below the soil and the plumule is carried as the tip of the elongated epicotyl. This is called hypogeal germination. Examples: Pea, gram, maize, rice and mango.

Germination in maize grain – hypogeal germination



❖ The seed absorbs water and swells. The radicle begins to emerge by penetrating the coleorhiza (protective root sheath) and the fruit wall. It grows downward to form the root system but soon dies.

❖ The epicotyl elongates and pierces out of the grain in opposite direction to coleorhiza and cotyledons remain underground.

❖ The plumule pierces out of the coleoptile and grows straight upwards.

❖ The cotyledon absorbs food from endosperm till it is exhausted. Soon more leaves appear in succession which start synthesizing food for the plant.

In this germination, the epicotyl elongates but the hypocotyl does not elongate and the germination is hypogeal.

Note: Refer to P 59-60 for Experiments on seed germination

SUMMARY...

❖ A seed is the mature ovule after fertilization which contains an embryo, stored food material and a protective seed coat.

❖ There are two kinds of seeds – monocotyledonous and dicotyledonous.

❖ Dicotyledonous seeds, such as gram and pea, contain two cotyledons enclosed in a seed coat with large plumule. The cotyledons contain food for the embryo.

❖ A monocotyledonous seed, such as maize, contains one cotyledon, a large endosperm, a small embryo which contains small plumule.

❖ The three conditions necessary for seed germination are water, adequate temperature and oxygen.

❖The germination of seeds may be hypogeal or epigeal.

❖ In epigeal germination, cotyledons are pushed above the ground and hypocotyl elongates.

❖ In hypogeal germination, cotyledons remain underground and the epicotyl elongates.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