10

"In all things of nature there is something of the marvelous." – Aristotle

Living Creatures Exploring Their Characteristics

The Big Question

Look around! From ants to trees to your own heart – what makes something alive? How is a playful puppy different from a stone, or a seed from a pebble? This chapter explores the amazing traits of living things, their life cycles, and the mystery of how life begins from a tiny seed.

Meet EeeBee.AI

Hello, curious life explorers! I'm EeeBee, your AI buddy. Let's distinguish living from non-living, trace life cycles, and uncover germination's secrets!

Still curious? Talk to me by scanning the QR code.

Learning Outcomes

By the end of this chapter, students will be able to:

- Identify and describe the main characteristics that distinguish living organisms from non-living objects.
- Understand the requirements for seed germination.
- Learn about the life stages of plants and animals, and grasp the significance of each stage in ensuring species survival and continuity.

From Last Year's Notebook

- What Are Living and Non-living Things?
- Characteristics of Living and Non-Living Things

Science Around you

Understanding living creatures is fundamental to biology and our existence. From diagnosing diseases and developing new medicines, to growing food, conserving biodiversity, and even space exploration, the principles of life are at the core. Grasping these concepts helps us appreciate the intricate world around us and our place within it.

NCF Curricular Goals and Competencies

CG-6 (C 6.1 and 6.2): Investigates the nature and processes of science, emphasizing scientific knowledge development and inquiry-based learning.

Mind Map

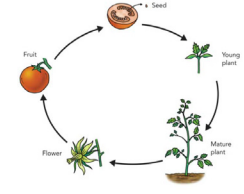
Living Creatures – Exploring Their Characteristics

Distinguishing Living from Non-living

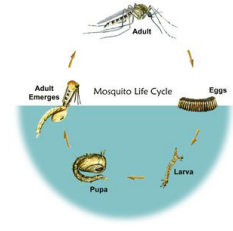
Key Characteristics	Living	Non-living
Movement	Movement in response to stimuli	Does not move on its own
Growth	Growth, increase in size, and complexity	Does not grow, only changes form
Nutrition	Consumes or produces food for energy (autotrophs & heterotrophs)	Does not consume or produce food
Respiration	Cellular respiration to produce energy	No respiration
Excretion	Removes waste from the body	Does not excrete waste
Response to Stimuli	Reacts to environmental stimuli (light, temperature, etc.)	No response to external stimuli
Reproduction	Capable of producing offspring (sexual/asexual)	Cannot reproduce

Life Cycle

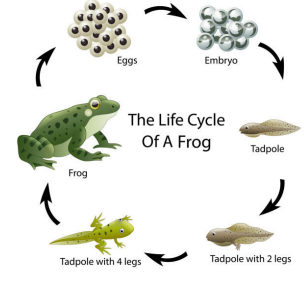
❖ **Life Cycle of a Plant**



❖ **Life Cycle of a Mosquito**



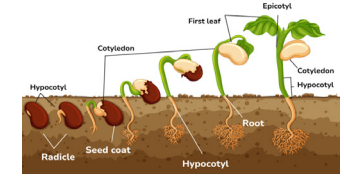
❖ **Life Cycle of a Frog**



Factors Influencing Seed Germination

❖ **Seed Germination**

✓ Process of a seed sprouting into a new plant



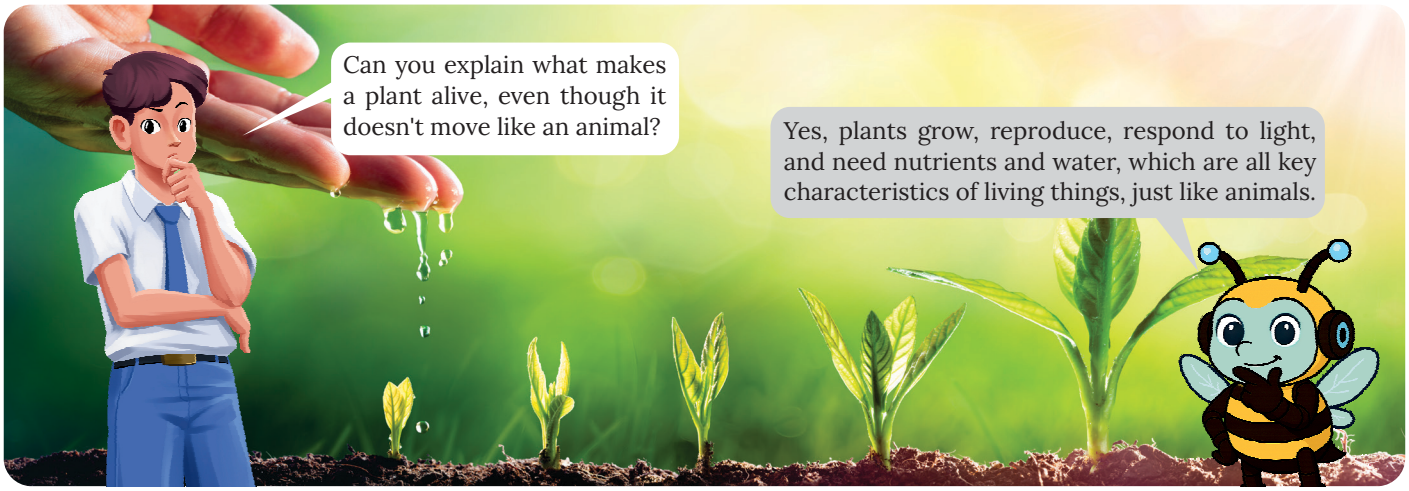
❖ **Essential Conditions for Seed Germination**

✓ **Water –** Necessary for the seed to swell and break open

✓ **Oxygen –** For cellular respiration during growth

✓ **Temperature –** Optimal temperature for metabolic activities

✓ **Light –** Some seeds require light to germinate (e.g., small seeds)



In Focus

- Distinguishing Living from Non-living
- Life Cycle
- Factors Influencing Seed Germination

Introduction

Living creatures are all around us, from the plants in our gardens to the animals we see daily. These organisms share certain unique traits that distinguish them from non-living things, such as the ability to grow, respond to their environment, and reproduce. Living beings rely on energy to carry out various life processes, whether through sunlight, food, or other means. This chapter dives into the fascinating characteristics that define life, helping us understand what makes something truly "**alive**" and how different forms of life sustain themselves and interact with their surroundings.

From History's Pages

Aristotle, in the 4th century BCE, was among the first to classify living organisms based on their observable traits, laying the foundation for biology. During the 17th century, Antonie van Leeuwenhoek's invention of the microscope led to the discovery of microorganisms, greatly expanding the understanding of what constitutes a living organism. In the 19th century, Charles Darwin's theory of evolution by natural selection further advanced the study of living beings by emphasizing adaptation and diversity. The 20th century saw major advancements, including the discovery of DNA, which helped explain the hereditary nature of all living creatures.

Distinguishing Living from Non-living

The world around us is filled with both living and non-living entities, each playing a crucial role in shaping the environment. Distinguishing living things from non-living ones is fundamental to understanding the complexity of life and nature. Living organisms, such as animals, plants, and microorganisms, possess unique characteristics like growth, reproduction, and the ability to respond to stimuli. In contrast, non-living things, like rocks, water, and air, do not exhibit these life processes. This distinction not only helps us classify and appreciate the diversity of nature but also aids in understanding the intricate balance that sustains life on Earth.

Living things are characterized by a set of key traits that distinguish them from non-living things. These traits include movement, growth, nutrition, respiration, excretion, response to stimuli, and reproduction. In the absence of these characteristics, a thing is classified as non-living. Let us explore these characteristics in greater detail.

Movement

Movement is one of the defining characteristics that separate living beings from non-living objects.

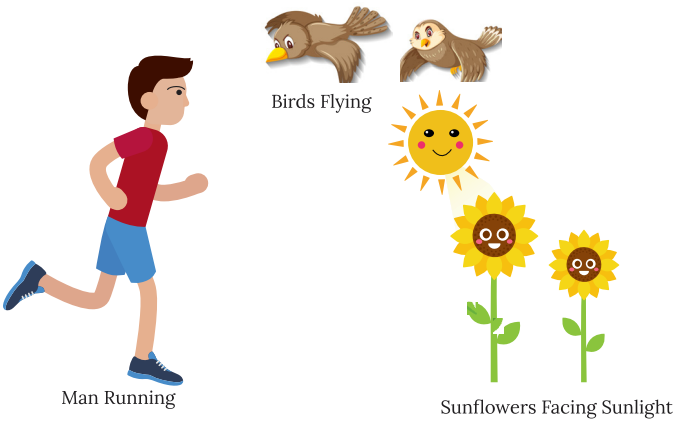


Fig. 10.1 Movement

- **Animals:** Most animals actively move in search of food, mates, or shelter. Animals are capable of exhibiting different types of bodily movements, such as running, flying, swimming, or crawling.
- **Plants:** Unlike animals, plants do not move from one location to another as they are fixed to the ground. However, plants exhibit movement in some specific areas. Roots grow downward into the soil, while stems grow upward towards sunlight. Additionally, some plants exhibit specific types of movement despite being stationary:
- **Insectivorous Plants:** Insectivorous plants such as Drosera exhibit movement to capture insects. Drosera is recognized by its saucer-shaped leaves with hair-like projections. These projections move inward and trap insects using their sticky ends.
- **Climbers:** Climbers like cucumber and grapes display movement by coiling themselves around nearby objects for support.

Growth

All living things exhibit growth, which is defined as an increase in size or mass over time.

- **Living Organisms:** Growth in living organisms is a permanent, internal, and irreversible process. **For example**, a human baby grows into an adult, and a seed grows into a mature plant.

Fig. 10.2 Grawth

- **Non-living Objects:** Non-living objects do not grow on their own. If they show any apparent growth, it is usually due to the addition of external materials. For instance, a small snowball can grow in size if more snow is added. This type of growth is reversible and external.

Nutrition

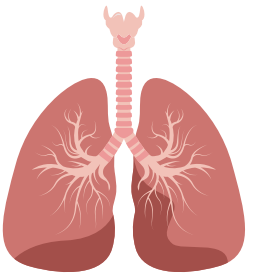
Nutrition is essential for the growth, development, and sustenance of all living beings. Food provides the energy required for various life processes.

- **Plants:** Plants are autotrophic and prepare their own food through the process of photosynthesis.
- **Animals and Humans:** Animals and humans are heterotrophic and depend on plants or other organisms for food.

Fig. 10.3 Nutrition

Respiration

Respiration is the process through which living organisms release energy from food, usually in the presence of oxygen.



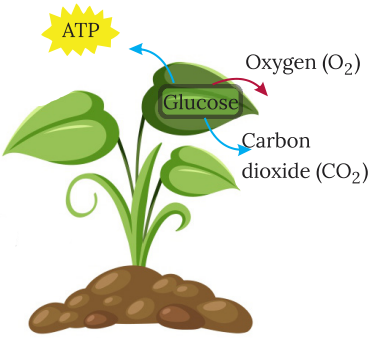


Fig. 10.4 Respiration

- **Breathing vs. Respiration:** Breathing is the physical process of inhaling oxygen and exhaling carbon dioxide. Respiration, on the other hand, involves the release of energy from food and is a broader process.
- **Respiration in Animals:** Different animals have different mechanisms for respiration. Most animals, including humans, breathe in oxygen through lungs. Fish, however, use gills to extract oxygen from water, while earthworms breathe through their moist skin.
- **Respiration in Plants:** Plants take in oxygen and release carbon dioxide through tiny pores on their leaves called stomata.

Excretion

Excretion is the process of removing waste materials produced by the body as a result of digestion and respiration. These wastes are toxic and must be eliminated to maintain healthy functioning.

Fig. 10.5 Excretion

- **Animals:** Animals excrete waste products such as carbon dioxide, urine, feces, and sweat to maintain homeostasis.
- **Plants:** Plants excrete waste through different mechanisms. Water vapor and oxygen are expelled through the stomata on leaves. Some plants also produce sticky excretory products such as latex.

Response to Stimuli

Living organisms can respond to changes in their environment, a characteristic known as responsiveness. A stimulus is any external change that triggers a reaction, while a response is the action taken by the organism as a result.

Fig. 10.6 Response to Stimuli

- **Plants:** Plants respond to stimuli by moving specific parts. For example, the stem of a plant tilts towards sunlight. Flowers like sunflowers face the sun throughout the day. Mimosa pudica (touch-me-not) closes its leaves when touched, showing its response to stimuli.
- **Animals and Humans:** Animals, including humans, have the ability to quickly respond to external stimuli. For example, humans **reflexively** withdraw their hands if they touch a hot object.

Reproduction

Reproduction is the biological process through which living organisms produce new individuals of their own kind, ensuring the survival and continuation of their species.

Fig. 10.7 Reproduction

- **Animals:** Animals reproduce in various ways. Birds lay eggs, while mammals, including humans, give birth to live young.

Keywords

Reflexively: It means doing something automatically without thinking, like a quick reaction. For example, blinking your eyes when something comes close is a reflexive action.

- **Plants:** Plants reproduce through different methods. Some plants, such as mango, gram, and pea, use seeds for reproduction. Others, like roses and henna, use vegetative propagation through stem cuttings. In Bryophyllum, reproduction occurs via the leaves, and in potatoes, it occurs through stems.

Characteristic	Description	Examples
Movement	Ability to change location or show movement of parts.	Animals move in search of food and shelter. Plants exhibit movements like growth of roots, opening of insectivorous plants, and response to sunlight.
Growth	Increase in size or mass over time. In living organisms, growth is internal and irreversible.	A baby grows into an adult, a seed grows into a tree. Growth in non-living things, such as a snowball, occurs by adding external material.
Nutrition	Need for food to provide energy and support life processes.	Plants make their own food through photosynthesis. Animals and humans rely on other organisms for nourishment.
Respiration	Release of energy from food, often involving oxygen.	Humans use lungs for respiration, fish use gills, and plants use stomata for gas exchange.
Excretion	Elimination of waste products produced during metabolic processes.	Animals excrete urine, sweat, carbon dioxide, and feces. Plants release water vapor and oxygen through stomata or may produce sticky substances like latex.
Response to Stimuli	Ability to react to changes in the environment.	Plants like Mimosa pudica close their leaves when touched. Animals react to heat by quickly withdrawing from the source.
Reproduction	Biological process of producing new individuals to ensure species survival.	Animals may lay eggs or give birth to young. Plants reproduce via seeds, stem cuttings, or leaves.

Fact Flash

Did you know that some non-living things, like crystals, can "grow" by adding more molecules to their structure, but this is different from the complex, internal growth of living organisms? Living growth involves increasing cellular mass!

Common Misconceptions

× **Misconception:** Anything that moves is living.

✓ **Correction:** Non-living things like cars, clouds, or even a ball rolling down a hill can move, but they don't possess other characteristics of life like growth, reproduction, or metabolism.

× **Misconception:** Plants are not living because they don't move.

✓ **Correction:** While plants don't move from place to place, they exhibit growth, reproduction (e.g., flowers, seeds), response to stimuli (e.g., growing towards light), and metabolism (photosynthesis).

Science Around You

The world around us is filled with an incredible diversity of objects, some alive and some not. How do we tell the difference? Living organisms, from the smallest bacteria to the largest whales, share a set of fundamental characteristics that distinguish them from non-living things. These characteristics include: cellular organization (being made of one or more cells), metabolism (obtaining and using energy for life processes), growth and development (increasing in size and complexity), reproduction (producing offspring), response to stimuli (reacting to changes in their environment), and adaptation (evolving over generations to suit their environment).

Activity

Living or Non-living Scavenger Hunt

- **Objective:** To apply the characteristics of living things to classify objects in the environment.
- **Materials Required:**
  - Notebook or worksheet with two columns: "Living" and "Non-living"
  - Pen or pencil
  - (Optional) Magnifying glass for close observation

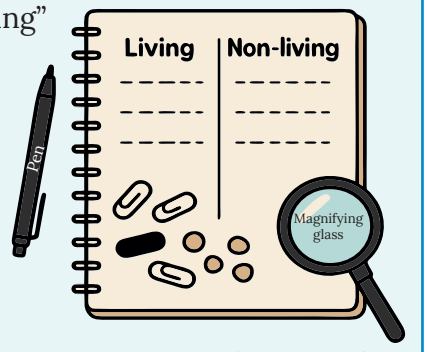


Fig. 10.8 Materials Required

- **Procedure:**
  1. **Understand Characteristics:** Review the characteristics that define living organisms (growth, reproduction, metabolism, response, cellular organization, adaptation).
  2. **Scavenger Hunt:** Go outside (e.g., garden, park, schoolyard) or look around your classroom/home.
  3. **Identify and Classify:** Find at least five items that you think are living and five that are non-living. For each item, write it in the correct column.
  4. **Justify:** For each item, briefly write down why you classified it as living or non-living, referring to the characteristics. For example, "Tree - Living: It grows, reproduces, makes its own food (metabolism)." "Rock - Non-living: It doesn't grow, reproduce, or respond."
- **Observation:** Observe how the specific characteristics of life help in clearly distinguishing between living and non-living objects in the real world.

Knowledge Checkpoint

Gap Analyzer™ Homework | Watch Remedial

Remembering

Multiple Choice Questions:

1. Which of the following is a characteristic of all living organisms?
   a) Ability to fly ☐ b) Needs sunlight directly ☐
   c) Reproduces ☐ d) Has bones ☐
2. A robot moving and making sounds is generally considered non-living because it does not:
   a) Consume energy ☐ b) Have a fixed shape ☐
   c) Grow by increasing cells ☐ d) Move from one place to another. ☐

Understanding

3. If an object is able to respond to changes in its environment, it shows which characteristic of life?

a) Reproduction ☐ b) Metabolism ☐

c) Response to stimuli ☐ d) Growth ☐

Short Answer Question:

Applying

4. List three key characteristics and explain how they can be used to identify a living organism.
5. Explain with reasons why a fire is treated as non-living, even though it consumes fuel and gives heat.

Long Answer Question:

Analyzing

6. Imagine you discover a new object. Describe how you would investigate if it is a living organism or a non-living thing, by systematically checking for at least three different characteristics of life.

Life Cycle

All living organisms, whether plants or animals, go through a series of events from birth to death. A life cycle represents the sequence of biological changes that occur as an organism grows and matures. It begins at the earliest stage, such as an egg or seed, and progresses through various stages of development until the organism becomes an adult. Eventually, the cycle concludes with the end of its life. Each stage of the life cycle is crucial for the growth, reproduction, and continuation of the species. Understanding these stages helps illustrate the complete journey of an organism from its origin to maturity and beyond.

Life Cycle of a Plant

Introduction to the Life Cycle:

The life cycle of a plant refers to the entire process of growth and reproduction, starting from a seed and continuing until the plant produces the next generation of seeds.

Stages of the Plant Life Cycle

- **Seed to Young Plant:** The life cycle begins when a seed germinates and grows into a young plant or seedling.
- **Mature Plant:** As the plant grows, it matures and produces flowers and fruit.
- **Reproduction:** The fruit contains seeds, which eventually lead to the development of new plants, continuing the cycle.

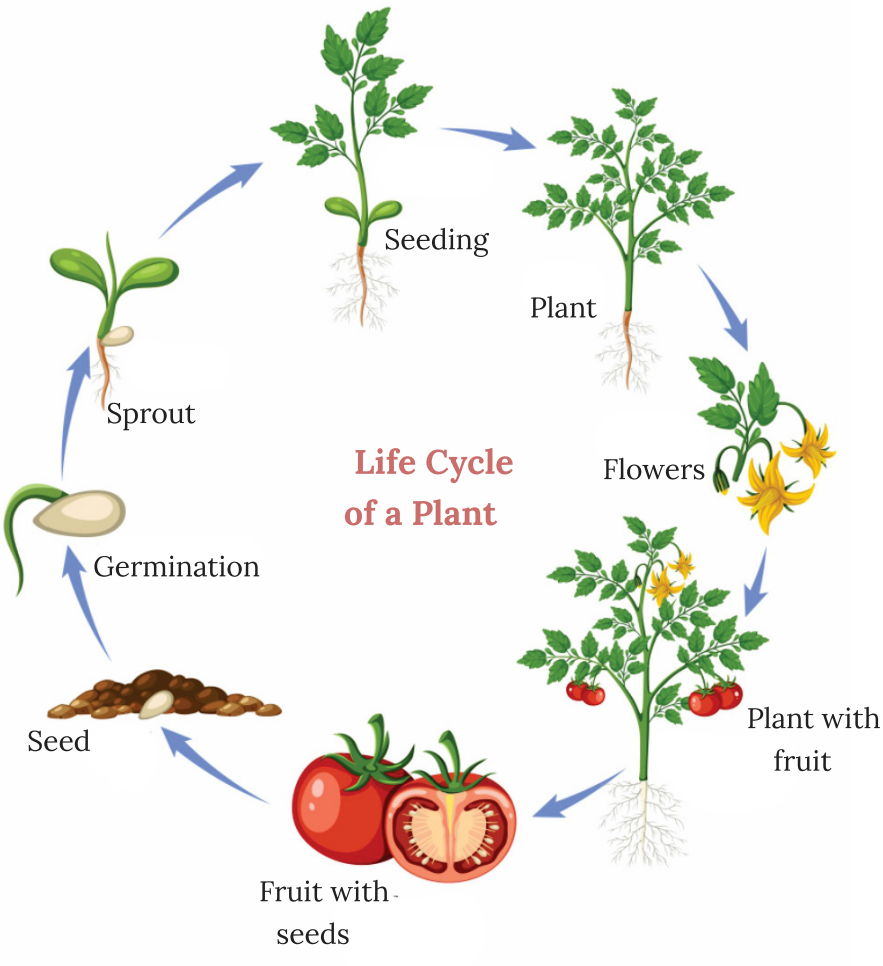


Fig. 10.9 Life Cycle of a Plant

Life Cycle of a Mosquito

Mosquitoes are common insects found in many surroundings, often breeding in areas with standing water.

Stages of the Mosquito Life Cycle

Egg Stage:

- Female mosquitoes lay eggs on stagnant water, commonly found in open containers, plant pots, and coolers.
- Eggs hatch into larvae when conditions are favorable.

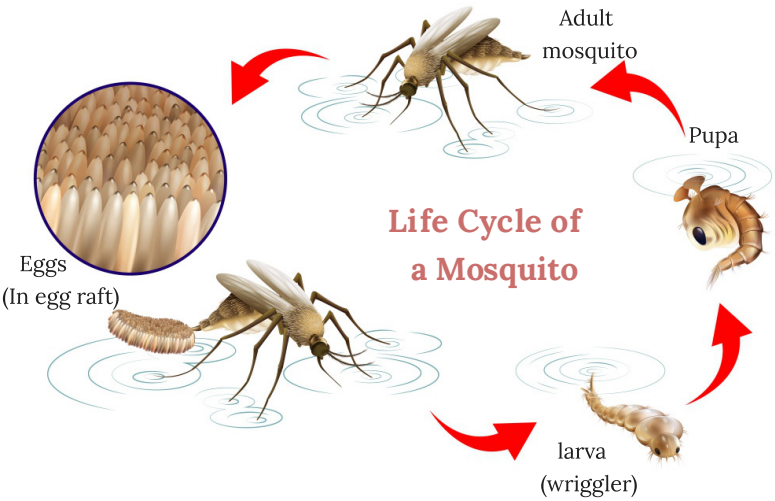


Fig. 10.10 Life Cycle of a Mosquito

Larva Stage:

- Larvae, called "**wrigglers**," live in water and feed on microorganisms and organic matter.
- They come to the surface to breathe through tubes called siphons.

Pupa Stage:

- The pupa, or "**tumbler**," does not feed and undergoes transformation into an adult mosquito.
- The pupal stage is a resting phase lasting a few days.

Adult Stage:

- The adult mosquito emerges from the pupa, resting briefly on the water before flying away.
- Adult females lay eggs on or near water, continuing the cycle. They typically live for 10-15 days.

Life Cycle of a Frog

The life cycle of a frog is a fascinating transformation process involving several distinct stages. You may have noticed white, jelly-like clusters on the surface of ponds or attached to aquatic plants—these are frog eggs, commonly known as spawn. Each spawn contains numerous frog eggs that begin their journey through various life stages, ultimately developing into adult frogs.

Stages of the Frog Life Cycle

Egg Stage

- The life cycle begins when frogs lay eggs in water.
- These eggs are surrounded by a jelly-like substance that provides protection and keeps them moist.

Embryo Stage

- Inside the egg, the embryo begins to develop.
- The embryo grows and undergoes changes, eventually hatching into a tadpole.

Tadpole Stage

After hatching, the young frog is called a tadpole.

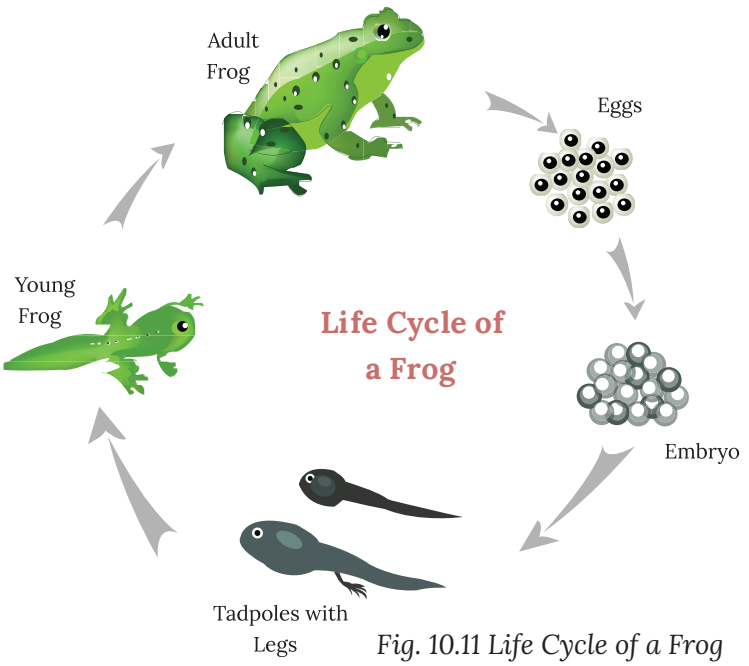


Fig. 10.11 Life Cycle of a Frog

- **Characteristics:** The tadpole has a long tail, no legs, and lives entirely in water, breathing through gills.
- **Development:** As it grows, the tadpole gradually develops hind legs, and later front legs, while its tail starts to shrink.

Froglet Stage

- The tadpole transforms into a froglet, which starts to resemble a small adult frog.
- The froglet still has a short tail but can now breathe through lungs and spend time both in water and on land.

Adult Frog Stage

- The cycle concludes when the froglet matures into an adult frog.
- The adult frog has no tail and is fully developed, capable of reproducing to start the life cycle again.

Fact Flash

Did you know that the lifespan of a mosquito in its adult stage can be as short as a few days for males, and only a few weeks for females? Yet, they undergo a complete metamorphosis during their short lives!

Common Misconceptions

× **Misconception:** All insects have the same life cycle.

✓ **Correction:** Some insects, like grasshoppers, undergo incomplete metamorphosis (egg, nymph, adult) without a pupal stage, unlike mosquitoes or butterflies.

× **Misconception:** Tadpoles are a different species from frogs.

✓ **Correction:** Tadpoles are the larval stage of frogs, part of the same species' life cycle, undergoing metamorphosis to become adult frogs.

Science Around You

Every living organism undergoes a series of developmental stages from birth to reproduction and ultimately death – this is known as its life cycle. Life cycles can be simple or complex, involving various transformations. For plants, it often involves a seed germinating into a seedling, growing into a mature plant that produces flowers, which then develop into fruits containing new seeds. Insects like mosquitoes undergo complete metamorphosis, starting as eggs, hatching into larvae, transforming into pupae, and finally emerging as winged adults. Amphibians like frogs also exhibit metamorphosis, beginning as eggs that hatch into aquatic tadpoles, which then gradually develop legs, lose their tails, and transform into terrestrial adult frogs. Understanding these life cycles is crucial for agriculture, pest control, and appreciating the incredible diversity and adaptations of life on Earth.

Activity

Life Cycle Flipbook Activity

Objective: To create a flipbook that shows the life cycle stages of different organisms.

Materials Required: A4 size drawing sheets (4–5 per student), Pencils, crayons, or markers, Scissors, Stapler or thread

Procedure:

- Choose an Organism: Each student selects one organism (plant, frog, or butterfly).

- Draw Stages: On separate sheets, draw each stage of its life cycle (e.g., for a frog: eggs → tadpole → tadpole with legs → frog).
- Cut & Arrange: Cut the sheets into equal size pieces and arrange them in order of the stages.
- Staple Together: Staple or tie them together on one side to make a flipbook.
- Flip to See Changes: When students flip through the pages quickly, they can see how the organism grows and changes.

Fig. 10.12 Materials Required

Observation: By flipping the pages, you can clearly see how one stage leads to another, showing that life cycles are a continuous process.

Knowledge Checkpoint

Gap Analyzer™ Homework | Watch Remedial

Remembering

Multiple Choice Questions:

1. Which stage comes after the egg stage in a mosquito's life cycle?
   a) Pupa ☐ b) Larva ☐ c) Adult ☐ d) Nymph ☐

Understanding

2. What is the transformation process called when a tadpole changes into a frog?
   a) Germination ☐ b) Reproduction ☐ c) Photosynthesis ☐ d) Metamorphosis ☐
3. In a plant's life cycle, what typically develops from a flower?
   a) Leaves ☐ b) Roots ☐
   c) Fruit containing seeds ☐ d) Stem ☐

Applying

Short Answer Question:

4. List the main stages in a plant's life cycle and explain how they occur in sequence.
5. Compare the life cycle of a mosquito with that of a butterfly to show their similarity.

Analyzing

Long Answer Question:

6. Compare and contrast the life cycles of a mosquito and a frog. Discuss at least two similarities and two differences in their developmental stages and habitats.

Factors Influencing Seed Germination

Seed Germination

Seed germination is the process through which a seed begins its journey into becoming a young plant or seedling. It is an essential phase of a plant's life cycle, marked by a transformation from dormancy to active growth. Germination is initiated only under specific favorable conditions, such as sufficient water, adequate air, and suitable light or dark conditions. These factors collectively trigger the growth of the seed's internal embryo, resulting in the emergence of a new plant.

Essential Conditions for Seed Germination

Successful seed germination is dependent on several key factors: water, air, and suitable light or dark conditions. Each of these elements plays a critical role in enabling the seed to awaken from dormancy and develop into a healthy seedling.

Water

Water is perhaps the most crucial factor for seed germination. It plays multiple roles in initiating and supporting the germination process:

- **Hydration of the Seed Coat:** The outer layer of a seed, known as the seed coat, is often tough and needs to be softened for germination to begin.
- **Growth of the Embryo:** Water activates the enzymes within the seed, which are necessary for the embryo to begin its metabolic processes.
- **Dissolved Oxygen:** Water also dissolves oxygen, making it available for the growing embryo.

Air and Soil

Air, specifically oxygen, is another essential factor that plays a significant role in seed germination:

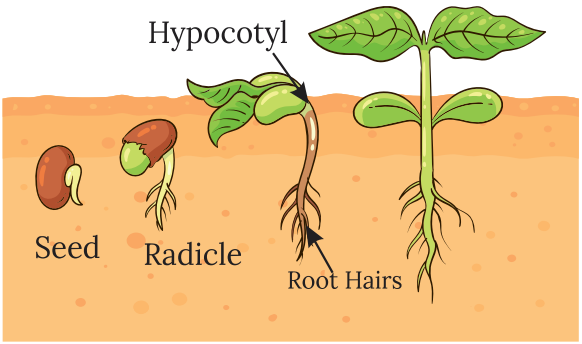


Fig. 10.13 Air and Soil

- **Oxygen Requirement:** Like all living organisms, the developing seed embryo requires oxygen for respiration.
- **Air in Soil:** Seeds obtain the required oxygen from the air trapped within the gaps between soil particles. When soil is loose and well-aerated, it has plenty of space between its particles, allowing the oxygen to reach the germinating seed.
- **Growth Without Soil:** Seeds can germinate without soil as long as other essential factors like water and oxygen are provided. For example, seeds can germinate on moist paper towels or cotton wool, as long as these conditions are met.

Note: While soil is not always necessary for the germination process itself, it becomes essential once the seedling begins to grow, as it provides a stable environment, moisture, and nutrients for further development.

Light and Dark Conditions

The role of light and dark conditions in seed germination varies based on the type of plant:

General Light Requirements: In general, most seeds do not require light for germination. Seeds rely on stored nutrients for energy during germination, which means light is not a critical factor for the seed to sprout.


Fig. 10.14 Light and Dark Conditions

- **Light-sensitive Seeds:** Some seeds, such as those of certain flowering plants like coleus and petunia, require light to germinate. Exposure to light acts as a signal for these seeds to start the germination process.
- **Dark-requiring Seeds:** On the other hand, some seeds require darkness to germinate effectively. For example, seeds from plants like Calendula and zinnia need to be covered with soil to germinate properly. Darkness acts as a trigger for these seeds, enabling them to begin the germination process.

Movement in Response to Stimuli

Geotropism (Response to Gravity)

- **Upright Position:** Shoots grow upwards for sunlight, and roots grow downwards for anchorage and nutrient absorption.
- **Inverted Position:** Shoots bend upward, and roots bend downward to reorient themselves to gravity.

Phototropism (Response to Light)

- **Shoots:** Grow towards light to maximize sunlight for photosynthesis.
- **Roots:** Grow downward, unaffected by light direction.

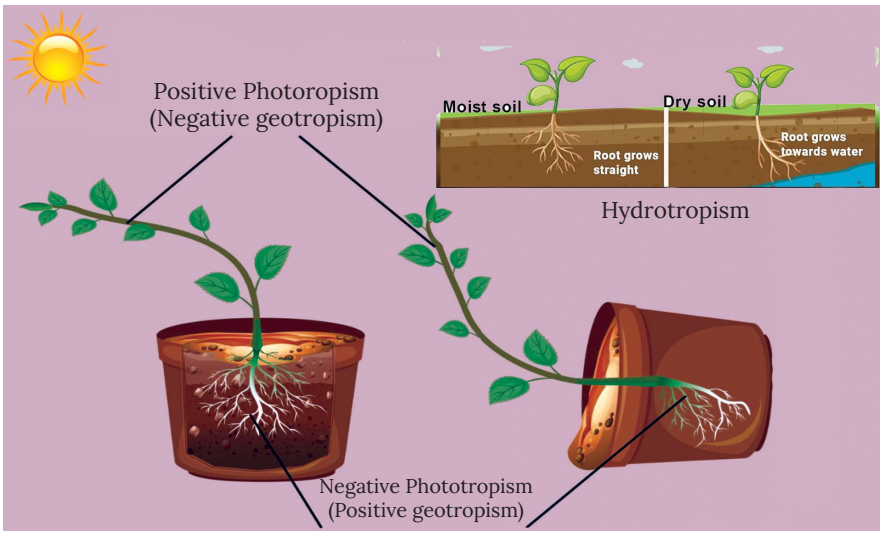


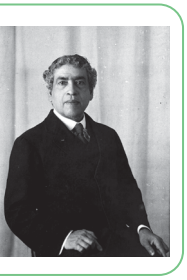
Fig. 10.15 Movement in response to Stimuli

Hydrotropism (Response to Water)

- **Roots:** Grow toward water sources to efficiently absorb moisture.

Fact Flash

Jagadish Chandra Bose (1858–1937) was a famous Indian scientist who conducted remarkable experiments on plants. He invented a device called the crescograph, which measured how plants grow and respond to stimuli like light, heat, electricity, and gravity. His experiments proved that plants can sense and respond to their surroundings. Bose's work greatly contributed to **plant physiology** and helped scientists understand plant life processes more clearly.



Common Misconceptions

× **Misconception:** All seeds need light to germinate.

✓ **Correction:** Many seeds (e.g., corn, beans) germinate well in darkness, and some are even inhibited by light. Only a small percentage truly require light.

× **Misconception:** Seeds start growing as soon as they get wet.

✓ **Correction:** While water is crucial, seeds also need the right temperature and oxygen levels. If any of these are missing, the seed won't germinate, even if wet.

Keywords

Gravity: It is a natural force that attracts objects towards the center of the Earth. It keeps everything on the ground and gives weight to objects. Plants sense gravity and grow their roots stems upward in response to it.
Plant Physiology: Plant physiology is the branch of science that studies how plants work and grow. It includes processes like photosynthesis, respiration, and water transport.

Science Around You

A seed is a miraculous package of life, containing a tiny undeveloped plant (embryo) and stored food, all protected by a seed coat. For this tiny embryo to grow into a new plant, it must first germinate. Germination is the process by which a seed sprouts and develops into a seedling. This crucial process is influenced by several external factors: water, which is essential for hydrating the seed, activating enzymes, and softening the seed coat; optimal temperature, as each seed type has an ideal range for germination, with extremes preventing it; oxygen, necessary for the embryo's respiration and energy generation for growth; and light, which is required by some seeds (positive photoblasty) but inhibits others (negative photoblasty).

Activity

Investigating Seed Germination Conditions

- **Objective:** To observe the effects of different factors on seed germination.
- **Materials Required:** Bean or pea seeds (about 30), Small transparent cups or containers (at least 6), Cotton wool or paper towels, Water, Refrigerator, Warm, dark place (e.g., cupboard), Warm, light place (e.g., windowsill)

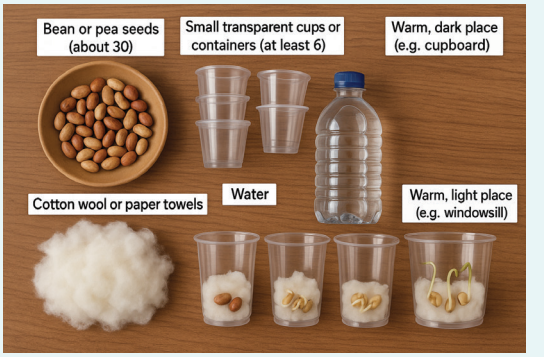


Fig. 10.16 Materials Required

- **Procedure:**
  1. **Setup for Water & Temperature:**
     - **Cup 1 (Control - Water, Warm, Light):** Place 5 seeds on moist cotton wool/paper towel in a cup. Place on a warm windowsill. Keep cotton moist.
     - **Cup 2 (No Water):** Place 5 seeds on dry cotton wool/paper towel in a cup. Place on warm windowsill.
     - **Cup 3 (Cold Temperature):** Place 5 seeds on moist cotton wool/paper towel in a cup. Place in refrigerator. Keep cotton moist.
  2. **Setup for Light:**
     - **Cup 4 (Warm, Dark):** Place 5 seeds on moist cotton wool/paper towel in a cup. Place in a warm, dark cupboard. Keep cotton moist.
     - **Cup 5 (Warm, Light):** Place 5 seeds on moist cotton wool/paper towel in a cup. Place on a warm windowsill (same as Cup 1, for direct comparison).
  3. **Setup for Oxygen (Optional, more advanced):**
     - **Cup 6 (Boiled Water - Less Oxygen):** Place 5 seeds on cotton wool. Use water that has been boiled and cooled (to reduce dissolved oxygen) to moisten the cotton. Place on warm windowsill.
  4. **Observe Daily:** Observe all cups daily for 5-7 days. Note which seeds germinate and which do not. Record observations in a table.
- **Observation:** Observe that seeds require specific conditions (water, warmth, oxygen) to germinate successfully, and lack of any one factor can inhibit growth.

Knowledge Checkpoint

Gap Analyzer™ Homework

Watch Remedial

Remembering

Understanding

Applying

Evaluating

Multiple Choice Questions:

1. Which of these is NOT an essential factor for most seed germination?

   a) Sunlight ☐ b) Water ☐

   c) Oxygen ☐ d) Appropriate temperature ☐

2. What is the primary role of water in seed germination?

   a) To keep the seed clean ☐ b) To make the seed heavier ☐

   c) To hydrate the seed and activate enzymes ☐

   d) To provide light for the embryo ☐

3. If a seed fails to germinate even with enough water and warmth, what might be the missing factor?

   a) Soil ☐ b) Carbon dioxide ☐ c) Oxygen ☐ d) Fertiliser ☐

Short Answer Question:

4. List three essential conditions that seeds need to germinate successfully.

5. Explain with reasons why seeds kept in a refrigerator may fail to germinate.

Long Answer Question:

6. You are a gardener trying to sprout new seeds for your garden. Describe an experiment you could conduct to determine the optimal temperature for a specific type of seed's germination.

SUMMARY

Distinguishing Living from Non-living

Living things exhibit growth, reproduction, respiration, excretion, response to stimuli, movement, and nutrition, while non-living things do not. Examples of living organisms include plants, animals, and microorganisms. Non-living examples include rocks and air.

- **Movement:** Animals move actively, while plants exhibit passive movement (e.g., phototropism towards light or hydrotropism towards water).
- **Growth:** Living organisms grow internally and irreversibly, while apparent growth in non-living things (e.g., snowballs) is external and reversible.
- **Response to Stimuli:** Plants like Mimosa pudica close leaves when touched, and animals react to external changes for survival.

Life Cycle of Living Beings

A life cycle represents the stages of an organism's life, from birth to reproduction and eventual death.

- **Plants:** Seeds germinate, grow into seedlings, mature, and reproduce to form seeds for the next generation.
- **Frogs:** Their life cycle includes eggs, tadpoles (aquatic, tail-bearing), froglets (develop legs, lose tail), and adult frogs.
- **Mosquitoes:** Eggs laid in stagnant water hatch into larvae, transform into pupae, and then into adult mosquitoes.

Factors Influencing Seed Germination

Seed germination is the process by which seeds develop into seedlings, requiring specific conditions:

- **Water:** Softens the seed coat (imbibition) and activates enzymes, enabling the embryo to grow.
- **Air:** Oxygen is essential for respiration, providing energy for germination. Aerated soil supports better oxygen flow to seeds.
- **Light/Dark:** Light-sensitive seeds (e.g., petunia) require light, while dark-sensitive seeds (e.g., zinnia) require darkness. However, most seeds germinate regardless of light if provided moisture and oxygen.

Seeds can germinate without soil in controlled conditions like moist paper towels.

Growth and Movement in Plants

Although stationary, plants exhibit movement in response to environmental stimuli:

- **Gravitropism:** Roots grow downward, and shoots grow upward, responding to gravity.
- **Phototropism:** Shoots grow towards light for photosynthesis.
- **Hydrotropism:** Roots grow towards water to access moisture.

Example Based Questions

Multiple Choice Questions

1. Which of the following is a characteristic of living things?

(a) They grow and reproduce

(b) They can move on their own

(c) They respond to stimuli like light and sound

(d) All of the above

Answer: (d) All of the above

Explanation: Living things show growth, reproduction, movement, and response to surroundings. Non-living objects, like a stone, cannot perform these activities on their own.

2. Which stage in the life cycle of a butterfly comes just before the adult stage?

(a) Egg (b) Pupa

(c) Caterpillar (larva) (d) Seed

Answer: (b) Pupa

Explanation: A butterfly undergoes complete metamorphosis: Egg → Larva (caterpillar) → Pupa → Adult butterfly. The pupa stage is the transition point where the caterpillar transforms into an adult.

Short Answer Questions

4. How can we distinguish between a living and a non-living thing? Give one example for each.

Answer: Living things grow, reproduce, and respond to stimuli. For example, a dog (living) breathes and reacts to sound. Non-living things do not have these features; for instance, a chair (non-living) does not grow or reproduce.

5. What are the main stages in the life cycle of a frog?

Answer: The life cycle of a frog includes the following stages:

1. Eggs laid in water.
2. Tadpole (larva): Hatches from egg, breathes through gills, and swims like a fish.
3. Young Frog: Develops legs, lungs form, tail shortens.
4. Adult Frog: Fully developed, lives both on land and water.

This process shows metamorphosis—a complete transformation from larva to adult.

6. Why does a soaked seed kept in a closed box fail to germinate?

Answer: A seed needs air (oxygen) along with water and suitable temperature to germinate. In a closed box, there is no supply of fresh oxygen. Without oxygen, the seed cannot respire, and the process of germination fails. This shows that all three conditions (air, water, temperature) must be present for successful seed germination.

Long Answer Questions

7. Explain in detail the differences between living and non-living things with examples.

Answer:

Living things show the following characteristics:

1. **Growth:** Living things grow from within. Example: A child grows into an adult.
2. **Respiration:** They breathe to get energy. Example: Plants exchange gases through stomata.
3. **Reproduction**: Living organisms produce young ones. Example: Birds lay eggs, humans give birth to babies.
4. **Response to Stimuli:** They respond to light, sound, touch, etc. Example: A plant bends towards sunlight.
5. **Excretion:** They remove waste materials from the body.

Non-living things do not show these characteristics. For example, a stone does not grow, breathe, or reproduce. It may change shape if broken, but that is not real growth.

Conclusion: These features help us easily distinguish living organisms from non-living objects in our environment.

Gap Analyzer™
Complete Chapter Test

EXERCISE

A. Choose the correct answer.

1. Which of the following characteristics distinguishes living organisms from non-living objects?
   (a) Respiration ☐ (b) Hardness ☐
   (c) Weight ☐ (d) Color ☐
2. Which process is responsible for the movement of water in plants towards sunlight?
   (a) Phototropism ☐ (b) Hydrotropism ☐
   (c) Respiration ☐ (d) Gravitropism ☐
3. What is the primary factor required to trigger seed germination?
   (a) Soil ☐ (b) Water ☐
   (c) Oxygen ☐ (d) Light ☐
4. Which stage of a mosquito's life cycle involves a resting phase before becoming an adult?
   (a) Larva ☐ (b) Pupa ☐
   (c) Egg ☐ (d) Adult ☐
5. Which of the following seeds requires darkness to germinate?
   (a) Zinnia ☐ (b) Wheat ☐
   (c) Petunia ☐ (d) Maize ☐

B. Fill in the blanks.

1. _____ is the process through which living organisms eliminate waste from their bodies.
2. _____ is a stage in the life cycle of a frog where it has a long tail and no legs.
3. The primary role of water in seed germination is to _____ the seed coat and activate enzymes.
4. Plants grow towards light in a movement called _____.
5. _____ is the device invented by Jagadish Chandra Bose to measure plant growth.

C. Write True or False.

1. Living organisms can grow and reproduce, while non-living objects cannot. ____
2. A mosquito's larva is also known as a "tumbler." ____
3. Phototropism is the movement of plant roots towards water. ____
4. Seeds can germinate without soil if provided with moisture and air. ____
5. Frog eggs are protected by a jelly-like substance that prevents them from drying out. ____

D. Define the following terms.

1. Phototropism
2. Seed Germination
3. Excretion
4. Life Cycle
5. Respiration

E. Match the columns.

	Column A		Column B
1.	Seed Germination	(a)	Movement towards light
2.	Phototropism	(b)	Growth of a plant from a seed
3.	Froglet	(c)	Intermediate stage in frogs
4.	Excretion	(d)	Elimination of body waste
5.	Tadpole	(e)	Stage with tail and no legs

F. Assertion and Reason

Instructions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is NOT the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

e) Both A and R are false.

1. **Assertion:** A robot can move and talk, but it is considered non-living.
   Reason: Robots do not reproduce or grow through internal cellular processes.
2. **Assertion:** Mosquitoes undergo complete metamorphosis.
   Reason: Their life cycle includes distinct egg, larva, pupa, and adult stages.
3. **Assertion:** All seeds require sunlight to germinate.
   Reason: Light is a critical factor for the respiration of the embryo inside the seed.

G. Give reasons for the following statements.

1. Water is essential for breaking the seed coat during germination.
2. Plants exhibit phototropism to maximize their exposure to sunlight.
3. Excretion is necessary to maintain the health of living organisms.
4. Seeds can germinate even without soil if conditions like water and oxygen are provided.
5. A froglet is an important stage in the life cycle of a frog as it transitions to adulthood.

H. Answer in brief.

1. Why is water important in the seed germination process?
2. How does phototropism help plants grow?
3. What role does the tadpole stage play in the life cycle of a frog?
4. Why do mosquito eggs need stagnant water to hatch?
5. What is the purpose of excretion in living organisms?

I. Answer in detail.

1. Discuss the importance of distinguishing living from non-living things with examples.
2. Explain the stages of seed germination and the factors influencing it.
3. Describe the life cycle of a mosquito and how each stage contributes to its survival.
4. Compare the movements of plants in response to gravity and light.

SKILL-BASED PRACTICE

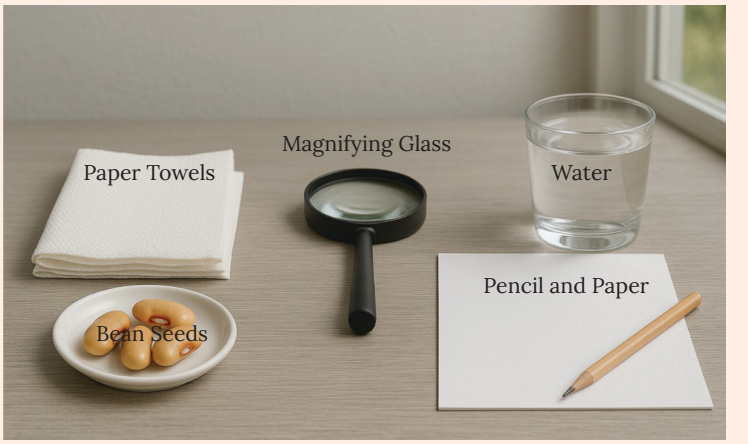
Activity Time

STEM

Dissecting a Bean Seed

Materials Needed:

- Large bean seeds (e.g., kidney beans or lima beans, soaked in water overnight)
- Paper towels
- Magnifying glass (optional)
- Small dish or plate
- Pencil and paper for drawing



Materials Required

Activity Steps:

1. **Soak Seeds:** Soak the bean seeds in water overnight. This softens the seed coat.
2. **Observe External Features:** Place a soaked seed on a paper towel. Observe its outer covering (seed coat) and the small scar on one side (hilum) where it was attached to the fruit. You might also see a tiny hole (micropyle).
3. **Peel Seed Coat:** Carefully peel off the outer seed coat.
4. **Separate Cotyledons:** Gently split the two halves of the seed. These are the cotyledons, which contain stored food.
5. **Identify Embryo:** Using a magnifying glass if available, identify the tiny embryo attached to one of the cotyledons. You should be able to see a miniature root (radicle), stem (plumule), and tiny first leaves.
6. **Draw and Label:** Draw a diagram of the dissected seed, labeling its parts: seed coat, hilum, cotyledons, radicle, and plumule.

Questions:

1. What is the function of the seed coat?
2. What is the purpose of the cotyledons in the seed?
3. Which part of the embryo will develop into the roots of the new plant?
4. What does this dissection tell you about the structure and potential for growth within a seed?

Skills Covered: Observation, Dissection Skills, Understanding Plant Anatomy, Diagramming & Labeling

Creativity

Art

"Life Cycle Mobile"

Create a hanging mobile that visually represents the life cycle of either a plant, a mosquito, or a frog. Each stage of the life cycle should be depicted on a separate cut-out and hung in sequence using string or fishing line, showing the flow of the cycle. Use different materials or colors for each stage to make it visually appealing.

- **Materials to Use:**
  - Cardboard, thick paper, or craft foam
  - Scissors
  - String or fishing line
  - Hanger or stick for the top of the mobile
  - Markers, paints, glitter, fabric scraps, etc.
  - Hole punch

Materials Required

Questions:

- Which life cycle did you choose, and why?
- How did you ensure the stages were correctly sequenced on your mobile?
- What visual elements (colors, textures, shapes) did you use to distinguish between the different stages?

Skills Covered: Creativity, Artistic Expression, Understanding Celestial Patterns, Visual Representation

Germination Race Inquiry

Group Activity

The Fastest Germinator

1. **Choose Seeds:** Each group selects a different type of common seed (e.g., mung beans, radish seeds, lentil seeds – choose 3 different types across groups if possible).
2. **Standard Setup:** For each seed type, set up 5 seeds on moist paper towels in a clear plastic cup or petri dish. Ensure all conditions (water amount, temperature, light) are the same for all seed types.
3. **Daily Measurement:** Over 5-7 days, observe the seeds daily. Record the number of seeds that have germinated (when the radicle emerges) each day for each seed type.
4. **Analyze Data:** Compare the germination rates among the different seed types.

Questions:

- Which type of seed germinated the fastest in your experiment?
- What was the percentage of seeds that germinated for each type by the end of the activity?
- Why was it important to keep all conditions (water, temperature, light) the same for all seed types?
- Based on your observations, what conclusion can you draw about germination rates among different plant species?

Skills Covered: Experimental Design, Comparative Analysis, Understanding Germination Rates

The Mysterious Pond Organism

Case Study

Read the given passage below and answer the question:

A group of students finds a strange organism in a pond. It's small, swims actively, and has a tail, but no legs. Over a few weeks, they observe it growing, developing legs, and losing its tail, eventually becoming an animal that can live on land.

The Mysterious Pond Organism

Guiding Questions:

1. What is this mysterious pond organism likely to be?
2. What biological process is it undergoing as it changes from a tailed aquatic form to a legged terrestrial form?
3. What common amphibian has a similar life cycle?
4. At what stage of its life cycle would this organism be entirely dependent on water?
5. Based on this observation, what characteristic of living things is most evident in this organism's development?

Skills Covered: Classification, Analysis, Teamwork, Communication, Scientific Investigation

Battling Mosquitoes — Delhi's Real-Time Response

Source Based Question

"In response to rising dengue and malaria cases in Delhi, municipal authorities have launched an intensive anti mosquito campaign. Health teams inspected over 12,300 premises and eliminated breeding grounds at 1,415 sites, especially in places like vertical gardens and parks. The city also conducted anti-larval spraying, distributed educational stickers, displayed banners, and issued legal notices and prosecutions. In addition, larvivorous fish were released at 279 locations as a natural way to control mosquito larvae. Fogging and pest control measures were stepped up, along with public outreach, to reduce mosquito-borne diseases."

Guiding Questions:

Image Credit: Indian Express

1. **Mosquito Life Cycle Basics**
   - According to the passage, why was targeting the larval stage important? (**Hint:** They used larvivorous fish—what do these fish do?)
   - What does "breeding ground elimination" imply about the egg and larval stages of mosquitoes?
2. **Community & Environmental Strategies**
   - How did the community use biological control methods instead of just spraying insecticides?
   - Why might releasing larvivorous fish be considered more environmentally friendly?
3. **Public Participation & Education**
   - How did the campaign involve the public in fighting mosquitoes? Name two methods.
   - Why is educating the community important for controlling the mosquito life cycle?

Skills Covered: Observation, Curiosity, Critical thinking, Connecting real-life observations