

Living Creatures: Exploring their Characteristics

Class 6 — Science — Chapter 10

NCERT COMPREHENSIVE NOTES 2025-26

Section 01

Overview

Chapter 10 of the NCERT Class 6 Science textbook *Curiosity* introduces students to the fascinating world of living creatures and their distinguishing characteristics. The chapter begins with a story of two children, Avadhi and Aayush, who discover a snail inside a shell during a morning walk and wonder whether the shell is living or non-living. Through this engaging narrative, the chapter guides students to explore what makes living beings different from non-living things. Students learn about essential life processes such as movement, growth, nutrition, respiration, excretion, response to stimuli, reproduction, and death. The chapter further explores the conditions required for seed germination, how plants show growth and movement, and the complete life cycles of plants (bean plant), insects (mosquito), and amphibians (frog). It also highlights the contributions of Indian scientist Jagadish Chandra Bose (1858–1937) in the field of plant responses to stimuli.

★ USP Key Points

- ★ Living beings exhibit 7 essential characteristics: movement, nutrition, growth, respiration, excretion, response to stimuli, and reproduction.
- ★ Seed germination requires the right amount of water and air; most seeds do not need light to germinate.
- ★ The bean plant experiment uses 4 pots (A, B, C, D) placed under different conditions for 15 days to test germination needs.
- ★ Plant shoots grow upwards towards light while roots always grow downwards, regardless of plant orientation.
- ★ Jagadish Chandra Bose (1858–1937) invented the crescograph to measure plant responses to stimuli like light, heat, electricity, and gravity.
- ★ Mosquito life cycle has 4 stages: Egg → Larva → Pupa → Adult; adult mosquito survives 10–15 days.
- ★ Frog life cycle includes 4 major stages: Spawn/Egg (Day 1) → Tadpole (Day 7–10) → Froglet (12 weeks) → Adult Frog (14 weeks).

Section 02

What Sets the Living Apart from the Non-Living?

We are surrounded by numerous things — the pencil we hold, the book we read, the pigeon near the window. Some of these are living and some are non-living. But how do we decide? We can compare anything with

ourselves — a wonderful example of a living being — to check whether it shows the essential characteristics of life.

Movement

Movement is one of the most visible characteristics of living beings. Animals walk, run, fly, or swim. But a car also moves — does that make it living? No, because a car cannot move on its own without fuel and a driver; its movement is not a self-generated life process. Plants, unlike animals, do not move from one place to another, yet they show certain types of movements. The opening of flowers is a movement in plants. Insectivorous plants like *Drosera* have saucer-shaped leaves with sticky hair-like projections that move inward to trap insects for nutrition. Climbers wind themselves around nearby objects. These are all examples of movement in plants.

Important: Movement alone cannot be used to decide if something is living or non-living. A car moves but is non-living; plants do not move from place to place but are living.

Growth

Compare yourself with a childhood photo — you have become larger in size. This is due to growth. Plants and all other living beings also grow. You cannot wear the clothes you wore four years ago because your body has grown. Growth is a characteristic of living beings.

Nutrition

Living beings need food (nutrition) for their growth and development. Humans eat different types of food. Plants make their own food through photosynthesis. All living beings require nutrition to survive and carry out their life processes.

Respiration

Breathing is a process without which we cannot live. When we inhale, air moves from outside to inside our body. When we exhale, air moves from inside to outside. Breathing is part of a process called respiration. Plants also respire — they have tiny pores called stomata on the surface of their leaves that help them take air in and out. All living beings respire.

Respiration: The process by which living beings take in oxygen and release carbon dioxide to obtain energy from food. Breathing is part of respiration.

Excretion

Have you noticed white patches on shirts around the armpits during summers? These form due to sweat, which consists of water and salts removed as waste. The removal of waste products from the body is called excretion. Urine is also a product of excretion. Plants excrete too — they release excess water and minerals in the form of small droplets on leaves. For example, water droplets can be seen on grasses and roses. All living beings excrete.

Response to Stimuli

If you step on a sharp thorn while walking barefoot, or accidentally touch a hot cup of tea, your body reacts instantly. These are stimuli — anything that prompts a living being to respond is called a stimulus (plural: stimuli). Plants also respond to stimuli. The touch-me-not plant (mimosa, *chhui-mui*, *lajjalu*) folds its leaves when touched. Certain plants, like the amla (Indian gooseberry), fold their leaves after sunset. All living beings respond to stimuli.

Stimulus: Any thing or event that prompts living beings to respond. Examples include touch, heat, light, and sound.

Reproduction

All living beings reproduce — they produce new ones of their own kind. This is necessary for the continuity of life. Young ones of cats, dogs, and other animals are produced by their parents. Non-living things like pencils, chairs, or electric bulbs do not produce young ones.

Death

When a living being is not able to exhibit all the above-mentioned characteristics, despite the availability of food, air, and water, it is said to be dead.

CHARACTERISTIC	LIVING BEINGS	NON-LIVING THINGS
Movement	Show self-generated movement (animals locomote; plants show movements like opening of flowers)	Do not move on their own (a car needs fuel and driver)
Growth	Grow in size over time	Do not grow
Nutrition	Need food for energy and growth	Do not need food
Respiration	Breathe / respire (use oxygen)	Do not respire
Excretion	Remove waste products from body	Do not excrete
Response to Stimuli	Respond to changes in environment	Do not respond to stimuli
Reproduction	Produce young ones of their kind	Cannot reproduce
Death	Eventually die when life processes stop	Not applicable

Think About It: In which category would you place a seed — living or non-living? A seed is living because, given the right conditions, it can germinate, grow, and show all characteristics of life.

Section 03

Essential Conditions for Germination of a Seed

When a seed turns into a sprout, it is said to have germinated. Germination is the beginning of growth in a seed. But what conditions does a seed need to germinate? The NCERT textbook describes an experiment

using four pots to investigate this question.

Activity 10.2 – The Four-Pot Experiment

Four identical pots filled with garden soil were used, each containing four bean seeds. These pots were kept under different conditions for 15 days:

POT	CONDITION	AIR	SUNLIGHT	WATER	GERMINATION RESULT
Pot A	Direct sunlight, no water	Yes	Yes	No	No germination (no water available)
Pot B	Direct sunlight, excess water	No (water blocks air)	Yes	Excess	No germination (air blocked by excess water)
Pot C	Dark location, moist soil	Yes	No	Moderate	Seeds germinate (water + air present)
Pot D	Direct sunlight, moist soil	Yes	Yes	Moderate	Seeds germinate (all conditions favourable)

Key Finding: Seeds germinate in Pots C and D, but not in Pots A and B. This proves that the right amount of **water** and **air** are essential for germination. Light is not essential for germination of most seeds.

Role of Water in Germination

Seeds require water for germination. Water enables seeds to carry out the processes necessary for growth. The outer covering of a seed is called the seed coat. Water softens the seed coat and helps the tiny embryo inside it to develop into a plant.

Role of Air and Soil in Germination

Seeds need air for germination. They use the air available in spaces between soil particles. In Pot B, excess water filled up these spaces, blocking air from reaching the seeds. Soil spaces also allow roots to grow easily.

Role of Light in Germination

For bean seeds, presence of light is not essential for germination. In general, most seeds do not require light to germinate. However, after germination, sunlight is required for further growth of the seedling. Some seeds like Coleus and Petunia need light to germinate, while seeds like Calendula and Zinnia need darkness.

★ Key Facts – Seed Germination

- ★ Essential conditions: Right amount of water + air (oxygen).
- ★ Most seeds do NOT need light for germination.
- ★ Excess water blocks air in soil spaces, preventing germination.
- ★ Seed coat is softened by water, allowing the embryo to develop.
- ★ Coleus and Petunia seeds need light to germinate; Calendula and Zinnia need darkness.

☆ After germination, sunlight is required for further growth of seedlings.

Germination: The process by which a seed develops into a new plant (sprout). It requires water, air, and suitable temperature.

Seed Coat: The outer protective covering of a seed that is softened by water during germination.

Embryo: The tiny, undeveloped plant inside a seed that develops into a new plant during germination.

Section 04

Growth and Movement in Plants

Plants respond to sunlight and gravity in remarkable ways. The direction of growth of different parts of a plant is influenced by these factors. The NCERT textbook describes Activity 10.3 to investigate this.

Activity 10.3 – Direction of Growth Experiment

Bean or gram seeds are germinated on moist cloth until they develop a small root and shoot. These seedlings are then placed in three glass beakers under different conditions:

BEAKER	DIRECTION OF SUNLIGHT	DIRECTION OF PLANT	SHOOT GROWTH	ROOT GROWTH
A	All directions	Upright	Upwards	Downwards
B	All directions	Inverted	Bends and grows upwards	Bends and grows downwards
C	One direction only (through hole in box)	Upright	Grows towards the light source	Continues growing downwards

Conclusions from Activity 10.3:

1. When kept upright, roots grow downwards and shoots grow upwards.
2. When kept inverted, roots still bend and grow downwards; shoots still bend and grow upwards.
3. When light comes from one direction, shoots grow towards the light while roots continue growing downwards.

These observations clearly show that shoots of plants grow upward and move towards sunlight, while roots always grow downwards regardless of the plant's orientation. This demonstrates that plants respond to stimuli such as light and gravity.

Know a Scientist – Jagadish Chandra Bose (1858–1937): He was an Indian scientist who performed fascinating experiments with plants. He invented a machine called the **crescograph** that could record how plants respond to stimuli like light, heat, electricity, and gravity. With this device, he could measure how fast plants grow. He also demonstrated that plants can sense and respond to stimuli.

Life Cycle of a Plant

The life cycle of a plant describes the complete sequence of stages a plant goes through from seed to death. The textbook uses the bean plant as an example, which students observe over three months in Activity 10.4.

Stages in the Life Cycle of a Bean Plant

STAGE	DESCRIPTION
Stage I – Seed	The life cycle begins with a seed. The seed contains a tiny embryo protected by a seed coat.
Stage II – Seed Germination	When water and air are available, the seed coat softens and the embryo begins to develop. A root emerges first, followed by a shoot.
Stage III – Appearance of Leaves	The seedling develops leaves and begins to make its own food through photosynthesis. The plant grows taller.
Stage IV – Appearance of Flowers	The mature plant produces flowers, which are essential for reproduction.
Stage V – Appearance of Fruits	After pollination, flowers develop into fruits. In the bean plant, the fruit is a pod that contains seeds.
Death of Plant	After producing seeds, the plant becomes yellow and dry, even when watered. The plant dies.

The entire process from a seed to a plant, and then to the next generation of seeds, is called the **life cycle of a plant**. The seeds produced can be sown again to grow new bean plants, continuing the cycle. When a plant stops growing and all life activities come to an end, even with all necessary conditions available, it is considered dead.

Life Cycle: The complete sequence of stages that a living being goes through from birth (or germination) to death, including reproduction to produce the next generation.

★ Key Facts – Plant Life Cycle

- ★ Bean plant life cycle: Seed → Germination → Leaves → Flowers → Fruits (pods with seeds) → Death.
- ★ Seeds from the plant can germinate into new plants, continuing the cycle.
- ★ Plants need favourable conditions and nutrients for proper growth.
- ★ The plant dies after producing fruits, even when watering continues.

Life Cycle of Animals

Just like plants, animals also go through various changes during their lives. The chapter discusses the life cycles of two animals – the mosquito and the frog – both of which show significant changes in body shape, structure, and even habitat during different life stages.

Life Cycle of a Mosquito

Female mosquitoes are blood-sucking insects that transmit diseases like malaria, dengue, and chikungunya. Mosquitoes lay their eggs in or near stagnant water, which is why we are advised to prevent water stagnation in our surroundings. The mosquito passes through four stages in its life cycle.

STAGE	NAME	DESCRIPTION
Stage I	Egg	Female mosquito lays eggs directly on or near stagnant water.
Stage II	Larva	Egg develops into a worm-like larva that lives in water and comes to the surface to breathe air.
Stage III	Pupa	Larva grows into a pupa (comma-shaped), also lives in water and needs air to respire.
Stage IV	Adult Mosquito	Adult emerges from pupa, rests briefly on water surface, then flies away. Adult may survive 10–15 days.

Why kerosene on stagnant water? Kerosene oil forms a thin layer over the water surface. This layer separates water from air and does not allow larvae and pupae to inhale air. As a result, they die. This disrupts the mosquito life cycle.

Did You Know? The silk moth also passes through four life stages — egg, larva, pupa, and adult. Larvae secrete thread-like material (silk fibres) which they wrap around themselves before changing to pupae. In India, the Khadi and Village Industries Commission (KVIC) has set up several centres for silk production.

Life Cycle of a Frog

Frogs lay their eggs in or near shallow ponds during the rainy season. A white jelly-like substance seen on the water surface or attached to plants near water is actually a cluster of frog eggs, known as spawn. The frog passes through four major stages in its life cycle.

STAGE	NAME	DURATION	DESCRIPTION
Stage I-A	Spawn (Eggs)	Day 1	Jelly-like cluster of eggs laid in water.
Stage I-B	Embryo	Day 3–4	Eggs develop into embryos.
Stage II-A	Tadpole with tail	Day 7–10	Embryo develops into a tadpole with a tail (no legs). Lives in water, tail helps in swimming.
Stage II-B	Tadpole with legs	8–10 weeks	Hind legs develop. Still has a tail. Lives in water.
Stage III	Froglet	12 weeks	Looks like a small frog with a shrinking tail. Begins spending time on land.
Stage IV	Adult Frog	14 weeks	Tail completely gone. Strong legs for jumping. Lives both in water and on land.

★ Key Comparison — Mosquito vs Frog Life Cycle

- ★ Both have 4 major stages in their life cycles.
- ★ Both begin life in water (eggs laid in/near water).
- ★ Both show significant body changes between stages.
- ★ Mosquito stages: Egg → Larva → Pupa → Adult (complete metamorphosis).
- ★ Frog stages: Egg → Tadpole → Froglet → Adult Frog.
- ★ Adult mosquito lives on land (flies); adult frog lives both on land and in water (amphibian).
- ★ Frog tadpole has a tail that disappears in adulthood; mosquito larva and pupa look very different from the adult.

Section 07

Activities & Experiments Summary

This chapter is rich in hands-on activities that help students observe and understand the characteristics of living beings. Here is a summary of all the activities covered in the chapter.

ACTIVITY	TITLE	OBJECTIVE	KEY LEARNING
10.1	Let us record	Classify objects as living or non-living	Living beings share common characteristics like movement, growth, respiration, excretion, response to stimuli, and reproduction.
10.2	Let us experiment	Find conditions needed for seed germination	Seeds need the right amount of water and air. Most seeds do not need light to germinate.
10.3	Let us design	Observe direction of root and shoot growth	Shoots grow upwards (towards light); roots grow downwards, regardless of plant orientation.
10.4	Let us explore	Observe the life cycle of a bean plant	A seed grows into a plant that flowers, fruits (pods with seeds), and then dies. Seeds give rise to the next generation.
10.5	Let us analyse	Determine correct sequence of mosquito life stages	By separating larvae and pupae and observing which transforms first, we can determine the correct order: Egg → Larva → Pupa → Adult.
10.6	Let us analyse	Observe frog life stages in a pond	Frogs go through spawn, tadpole (with tail, then with legs), froglet, and adult stages.

Practical Tip — Storage of Grains and Pulses: Since seeds germinate when they get water and air, we can prevent germination during storage by keeping grains and pulses dry and in airtight containers. This removes the two essential conditions for germination.

Safety Audit for Mosquito Prevention: Conduct a safety audit at school or home to check for stagnant water in desert coolers, potted plants, and open containers. If you find larvae or pupae (worm-like creatures in water), report to your teacher. Preventing water stagnation is the most effective way to control mosquito breeding.

Glossary

Stimulus

Any thing or event that prompts a living being to respond. Examples: touch, heat, light, sound, gravity.

Response

The reaction of a living being to a stimulus. Example: pulling your hand away from a hot object.

Germination

The process by which a seed turns into a sprout and begins developing into a new plant.

Respiration

The process by which living beings take in oxygen and release carbon dioxide to obtain energy. Breathing is part of respiration.

Excretion

The removal of waste products from the body. Examples: sweat, urine in animals; water droplets on leaves in plants.

Reproduction

The process by which living beings produce new individuals of their own kind. It ensures continuity of life.

Life Cycle

The complete sequence of stages a living being goes through from birth (or germination) to death, including reproduction.

Nutrition

The process by which living beings obtain and use food for growth, energy, and development.

Larva

An immature, worm-like stage in the life cycle of insects like mosquitoes and moths. It hatches from an egg and develops into a pupa.

Pupa

A stage between larva and adult in the life cycle of insects. The larva transforms inside the pupal case into an adult.

Tadpole

The aquatic larval stage of a frog. It has a tail for swimming and gradually develops legs before becoming a froglet.

Froglet

A young frog that still has a small tail. It begins spending time on land while the tail gradually disappears.

Spawn

A jelly-like cluster of frog eggs found on or near the surface of water in ponds.

Stomata

Tiny pores on the surface of leaves that help plants take in and release air (gases) for respiration and photosynthesis.

Seed Coat

The outer protective covering of a seed. Water softens it during germination, allowing the embryo inside to develop.

Crescograph

A machine invented by J.C. Bose to record how plants respond to stimuli like light, heat, electricity, and gravity.

Q&A + MCQs

Q1. List the similarities and differences in life cycles of plants and animals.

Similarities: (i) Both plants and animals begin life from a single cell or unit (seed for plants, egg/embryo for animals). (ii) Both go through stages of growth and development. (iii) Both reproduce to produce the next generation. (iv) Both eventually die after completing their life cycle. (v) Both need nutrition, air, and water to grow.

Differences: (i) Plants grow from seeds through germination; animals grow from eggs or are born alive. (ii) Plants produce flowers and fruits for reproduction; animals produce eggs or give live birth. (iii) Plants remain in one place throughout their life; many animals can move from place to place. (iv) Plants make their own food (photosynthesis); animals depend on other organisms for food. (v) In animals like mosquitoes and frogs, the young ones look very different from adults (metamorphosis); in plants, the stages (seedling, mature plant) look like smaller/larger versions of each other.

Q2. Study the data table (Does it grow? / Does it respire?) and find examples for each condition. If not possible, explain why.

(i) No Growth, No Respiration: Example — A stone, a chair, or any non-living thing. Non-living things neither grow nor respire.

(ii) No Growth, Yes Respiration: Example — An adult animal that has stopped growing (e.g., a fully grown dog or human adult). They still respire to obtain energy even though they have stopped increasing in size.

(iii) Yes Growth, No Respiration: This is NOT possible. Growth requires energy, which comes from respiration. Without respiration, a living being cannot grow. All growing organisms must respire.

(iv) Yes Growth, Yes Respiration: Example — A growing child, a sapling, a kitten, a tadpole. All growing living beings respire.

Q3. How can we use our knowledge of seed germination conditions for proper storage of grains and pulses?

Seeds germinate when they receive the right amount of water and air. To prevent grains and pulses from germinating during storage, we should: (i) Keep them completely dry by drying them properly in sunlight before storage — this removes the water needed for germination. (ii) Store them in airtight containers — this limits the air (oxygen) available to the seeds. (iii) Keep the storage area cool and dry — moisture in the environment could be absorbed by the grains. (iv) Use sealed, moisture-proof packaging. By removing water and air, we prevent germination and also protect grains from fungal growth and insect damage.

Q4. A tail is present in a tadpole but disappears as it grows into a frog. What is the advantage of having a tail in the tadpole stage?

A tadpole lives entirely in water. The tail acts as a swimming organ that helps the tadpole move through water efficiently to find food and escape predators. The tail works like a fin, propelling the tadpole forward. As the tadpole develops into a froglet and eventually an adult frog, it grows strong legs for jumping on land and swimming. Once the legs are fully developed, the tail is no longer needed and is gradually absorbed by the body. The tail is therefore an adaptation that is perfectly suited to the aquatic life of the tadpole stage.

Q5. Charan says a wooden log is non-living because it cannot move. Charu says it is living because it is made of wood from trees. Give your arguments.

Charan's argument (non-living) is correct, but for the wrong reason. A wooden log is indeed non-living, but not just because it cannot move. A wooden log is non-living because it does not exhibit any of the essential characteristics of life — it does not grow, respire, reproduce, excrete, respond to stimuli, or need nutrition. It was once part of a living tree, but once cut, it lost all life processes.

Charu's argument is incorrect. Just because the wooden log was obtained from a living tree does not make it living. Once the wood is separated from the tree, it stops performing all life functions. It can no longer grow, respire, or reproduce. A dead leaf, a leather shoe, or a cotton cloth all come from living things but are themselves non-living. The origin of a material does not determine whether it is currently living or non-living — the presence of life processes does.

Q6. What are the similarities and distinguishing features in the life cycles of a mosquito and a frog?

Similarities: (i) Both have 4 major life stages. (ii) Both lay eggs in or near water. (iii) Both undergo significant changes in body shape during their life cycle. (iv) Early stages of both live in water. (v) Both need water to complete their life cycle.

Differences: (i) Mosquito stages: Egg → Larva → Pupa → Adult; Frog stages: Egg/Spawn → Tadpole → Froglet → Adult. (ii) The mosquito has a distinct pupa stage; the frog does not have an equivalent pupa stage. (iii) The adult mosquito is a flying insect; the adult frog is an amphibian that lives on both land and water. (iv) Mosquito larva breathes through the water surface; frog tadpole has a tail for swimming and later develops lungs. (v) The mosquito adult survives about 10–15 days; a frog can live for several years. (vi) Mosquito metamorphosis is faster (days to weeks); frog development takes about 14 weeks to reach adult stage.

Q7. A plant is provided with all conditions suitable for growth (kept along the ground as in Fig. 10.9). Draw what you expect to see in the shoot and root after one week. Write down the reasons.

Even though the plant is placed sideways (horizontally along the ground), the shoot will bend and grow upwards (away from the ground, towards light), and the root will bend and grow downwards (into the ground). This is because:

(i) Shoots always grow upwards towards sunlight — this was demonstrated in Activity 10.3 with the inverted plant in Beaker B.

(ii) Roots always grow downwards due to the pull of gravity.

(iii) The direction of growth is determined by the plant's response to stimuli (light and gravity), not by the orientation in which the plant is placed.

Q8. Tara and Vijay set up the experiment shown in Fig. 10.10 (seeds planted at different depths). What do you think they want to find out?

Tara and Vijay want to find out whether the depth at which a seed is planted in the soil affects its germination and growth. The experiment shows seeds placed at different depths. They can observe: (i) Which seeds germinate first. (ii) Whether very deep planting prevents the shoot from reaching the surface. (iii) Whether seeds planted too close to the surface dry out and fail to germinate. They will know they are correct by comparing the growth of seedlings at different depths over 7–10 days. Seeds planted at a moderate depth in moist soil will germinate best because they have adequate access to both air and water.

Q9. Design an experiment to check if temperature has an effect on seed germination.

Aim: To check whether temperature affects seed germination.

Materials: 3 identical pots with garden soil, 12 bean seeds (4 per pot), water.

Procedure:

- (i) Take three identical pots (A, B, C) filled with the same garden soil. Plant 4 bean seeds in each pot.
- (ii) Keep all three pots equally moist with the same amount of water.
- (iii) Place Pot A inside a refrigerator (very cold, about 4°C).
- (iv) Place Pot B at normal room temperature (about 25–30°C).
- (v) Place Pot C near a heater or in direct hot sunlight (about 45–50°C).
- (vi) Observe all three pots daily for 10–15 days. Record the germination observations.

Expected Observation: Seeds in Pot B (room temperature) will germinate best. Seeds in Pot A (cold) will germinate very slowly or not at all. Seeds in Pot C (very hot) may not germinate as extreme heat can damage the embryo.

Conclusion: Temperature does affect seed germination. Seeds germinate best at moderate (room) temperature.

Additional Short Answer Questions

Q10. Why is a seed considered living even though it does not appear to show any characteristics of life?

A seed is considered living because it has the potential to germinate, grow, and develop into a complete plant when given the right conditions (water, air, suitable temperature). Inside the seed, there is a tiny living embryo in a dormant (inactive) state. Once conditions become favourable, the embryo becomes active and shows all characteristics of life — growth, respiration, nutrition, and eventually reproduction. A non-living thing, no matter what conditions are provided, can never show these characteristics.

Q11. What is the role of stomata in plants?

Stomata are tiny pores present on the surface of leaves. They play an important role in the life processes of plants: (i) They allow the exchange of gases — oxygen and carbon dioxide — needed for respiration and photosynthesis. (ii) They help plants take in air (carbon dioxide) and release oxygen during photosynthesis. (iii) They also help in transpiration, the loss of excess water in the form of water vapour. Stomata are evidence that plants, like animals, carry out respiration.

Q12. Why do we see water droplets on grass early in the morning? Is it related to excretion in plants?

The water droplets seen on the tips of grass blades early in the morning are due to a process called guttation. In this process, plants push out excess water and dissolved minerals through special pores at the leaf tips. This is a form of excretion in plants, as the body is getting rid of excess water and minerals it does not need. It typically occurs at night when the soil is moist and the air is humid, causing pressure to build up in the roots and push water out through the leaves.

Q13. What is a crescograph? Who invented it?

A crescograph is a scientific instrument invented by the Indian scientist Jagadish Chandra Bose (1858–1937). This machine was designed to record and measure the growth of plants and their responses to various stimuli such as light, heat, electricity, and gravity. The crescograph could magnify the extremely slow movements of plants, making it possible to observe and measure how fast plants grow. Bose's experiments with this instrument proved that plants can sense and respond to their environment, much like animals.

Q14. Why is preventing stagnant water important for controlling mosquito-borne diseases?

Female mosquitoes lay their eggs in or near stagnant water. The eggs develop into larvae and then pupae, both of which live in water. If stagnant water is not available, mosquitoes cannot lay eggs and complete their life cycle. By preventing water stagnation in desert coolers, potted plant trays, open containers, and any other places where water collects, we break the mosquito life cycle at the very first stage. This reduces the mosquito population and helps prevent the spread of diseases like malaria, dengue, and chikungunya.

Q15. How does the habitat of a frog change during its life cycle?

The habitat of a frog changes dramatically during its life cycle: (i) Eggs (spawn) are laid in water and develop in water. (ii) Tadpoles are fully aquatic — they live entirely in water and breathe through gills, using their tail to swim. (iii) Froglets begin to spend some time on land while still living in water. Their tail shrinks as legs develop. (iv) Adult frogs are amphibians — they live both on land and in water. They breathe through lungs on land and through their moist skin in water. This change in habitat from aquatic to amphibious is a key feature of the frog's life cycle.

Multiple Choice Questions (MCQs)

1. Which of the following is NOT a characteristic of living beings?

- (a) Growth
- (b) Reproduction
- (c) Rusting
- (d) Respiration

Answer: (c) Rusting

2. Which two conditions are essential for the germination of bean seeds?

- (a) Water and sunlight
- (b) Water and air
- (c) Sunlight and soil
- (d) Air and sunlight

Answer: (b) Water and air

3. The correct sequence of stages in the life cycle of a mosquito is:

- (a) Egg → Pupa → Larva → Adult
- (b) Egg → Larva → Adult → Pupa

- (c) Egg → Larva → Pupa → Adult
- (d) Larva → Egg → Pupa → Adult

Answer: (c) Egg → Larva → Pupa → Adult

4. The jelly-like mass of frog eggs found in water is called:

- (a) Larva
- (b) Embryo
- (c) Spawn
- (d) Tadpole

Answer: (c) Spawn

5. Which scientist invented the crescograph to study plant responses?

- (a) C.V. Raman
- (b) Jagadish Chandra Bose
- (c) A.P.J. Abdul Kalam
- (d) Homi Bhabha

Answer: (b) Jagadish Chandra Bose

6. In Activity 10.2, seeds in Pot B (excess water) did not germinate because:

- (a) There was no sunlight
- (b) The soil was too cold
- (c) Excess water blocked air from reaching the seeds
- (d) The seeds were planted too deep

Answer: (c) Excess water blocked air from reaching the seeds

7. The touch-me-not plant (chhui-mui) folding its leaves on being touched is an example of:

- (a) Growth
- (b) Excretion
- (c) Response to stimulus
- (d) Reproduction

Answer: (c) Response to stimulus

8. An adult mosquito survives for approximately:

- (a) 1–2 days
- (b) 10–15 days
- (c) 2–3 months
- (d) 1 year

Answer: (b) 10–15 days

9. Which of the following seeds requires light for germination?

- (a) Bean
- (b) Calendula
- (c) Petunia
- (d) Zinnia

Answer: (c) Petunia

10. A tadpole's tail helps it to:

- (a) Breathe on land
- (b) Catch food
- (c) Swim in water
- (d) Jump on land

Answer: (c) Swim in water

11. Which part of the seed is softened by water during germination?

- (a) Embryo
- (b) Root
- (c) Seed coat
- (d) Shoot

Answer: (c) Seed coat

12. Removal of waste products from the body is called:

- (a) Respiration
- (b) Digestion
- (c) Excretion
- (d) Nutrition

Answer: (c) Excretion

Case-Based Questions

Case Study 1: The Germination Experiment

Ravi conducted an experiment to study seed germination. He took three pots — Pot X, Pot Y, and Pot Z. In Pot X, he planted seeds in dry soil and placed it in sunlight. In Pot Y, he planted seeds in moist soil and kept it in a dark cupboard. In Pot Z, he planted seeds in soil completely submerged in water and placed it in sunlight. He observed the pots for 10 days.

1. In which pot(s) will the seeds germinate? Why?
2. Why did the seeds in Pot X not germinate?
3. What happened to the seeds in Pot Z? Explain.

4. What are the two essential conditions for seed germination demonstrated by this experiment?

Answers:

1. Seeds will germinate only in Pot Y. Pot Y has moist soil (providing water) and air is available in the soil spaces. Light is not essential for germination, so the dark cupboard does not matter.
2. Seeds in Pot X did not germinate because there was no water. Water is essential to soften the seed coat and activate the embryo for growth.
3. Seeds in Pot Z did not germinate because the soil was completely submerged in water. Excess water filled all the air spaces between soil particles, cutting off the supply of air (oxygen) to the seeds. Seeds need both water and air to germinate.
4. The two essential conditions for seed germination are the right amount of water and air (oxygen).

Case Study 2: Mosquito Menace in Meera's Colony

Meera's colony has been facing a serious mosquito problem during the monsoon season. Many residents have fallen ill with dengue and malaria. During a community meeting, Meera noticed that many residents kept open water containers, unused tyres with collected rainwater, and desert coolers that were not regularly cleaned. A health officer explained the life cycle of mosquitoes and how stagnant water is connected to the problem.

1. Why are mosquitoes more common during the monsoon season?
2. How is stagnant water related to mosquito breeding?
3. A resident suggested pouring kerosene oil on stagnant water that cannot be drained. How does this help?
4. List two preventive measures the colony can take to control mosquito breeding.

Answers:

1. During monsoon, rainwater collects in many places — open containers, tyres, pots, coolers — creating stagnant water bodies. Female mosquitoes lay their eggs in or near stagnant water. More stagnant water means more breeding sites, leading to a larger mosquito population.
2. Female mosquitoes lay eggs directly on or near stagnant water. The eggs hatch into larvae and then develop into pupae — both these stages live in water and come to the surface to breathe. Without stagnant water, mosquitoes cannot complete their life cycle.
3. Kerosene oil forms a thin layer over the water surface. This layer separates the water from air and prevents larvae and pupae from reaching the surface to breathe. As a result, they suffocate and die, breaking the mosquito life cycle.
4. (i) Remove all stagnant water from coolers, pots, tyres, and open containers regularly. (ii) Keep water storage containers covered at all times to prevent mosquitoes from laying eggs.

Case Study 3: Aman's Garden Observation

Aman placed a potted plant on his windowsill where sunlight came only from one side (through the window). After two weeks, he noticed that the plant's stem and leaves had bent and grown towards the window. His father then rotated the pot 180 degrees. Aman was curious to see what would happen next. After another week, the stem had again bent towards the window.

1. Why did the plant bend towards the window?
2. What happened after the pot was rotated? Explain why.
3. If a seedling is placed upside down, in which direction will the root and shoot grow?
4. Name the Indian scientist who studied how plants respond to stimuli. What instrument did he invent?

Answers:

1. The plant bent towards the window because shoots grow towards the source of light. Since sunlight came only from one side (through the window), the stem grew in that direction. This is the plant's response to the stimulus of light.
2. After the pot was rotated 180°, the plant stem again bent towards the window after a few days. This happened because the plant always responds to the direction of light by growing towards it. No matter how the pot is oriented, the shoot will find and grow towards the light source.
3. Even if a seedling is placed upside down, the root will bend and grow downwards (towards the ground, due to gravity) and the shoot will bend and grow upwards (towards the sky and light). This was demonstrated in Activity 10.3 (Beaker B).
4. Jagadish Chandra Bose (1858–1937) studied how plants respond to stimuli. He invented the crescograph, which could measure how fast plants grow and record their responses to light, heat, electricity, and gravity.


Exam Tips

- 🕒 Memorise all 7 characteristics of living beings: Movement, Nutrition, Growth, Respiration, Excretion, Response to Stimuli, Reproduction (plus Death).
- 🕒 Remember the 4-pot germination experiment: Pot A (dry, no germination), Pot B (excess water, no germination), Pot C (dark + moist, germinates), Pot D (sunlight + moist, germinates). Key conclusion: Water + Air = essential; Light ≠ essential.
- 🕒 Know the exact life cycle stages with durations: Mosquito — Egg → Larva → Pupa → Adult (10–15 days lifespan). Frog — Spawn (Day 1) → Embryo (Day 3–4) → Tadpole (Day 7–10) → Tadpole with legs (8–10 weeks) → Froglet (12 weeks) → Adult (14 weeks).
- 🕒 The bean plant life cycle has 5 stages: Seed → Germination → Leaves → Flowers → Fruits (pods with seeds) → Death.
- 🕒 For comparison questions, always list similarities first, then differences. Use a table format for neatness in exams.
- 🕒 Remember: Jagadish Chandra Bose (1858–1937) invented the crescograph. This is a frequently asked factual question.
- 🕒 Understand WHY excess water in Pot B blocks germination — it fills air spaces between soil particles, cutting off oxygen supply to seeds.
- 🕒 Know plant-specific excretion examples: water droplets on grass and rose leaves (guttation).
- 🕒 For the experiment design question (Q9), always state: Aim, Materials, Procedure (with control variable), Expected Observation, and Conclusion.
- 🕒 Remember: A wooden log is non-living (not because it cannot move, but because it cannot grow, respire, reproduce, or show any life process). Origin from a living thing ≠ being alive.

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Classes VI–XII | Mathematics, Science & Social Science

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