

Plant Growth and Development

Plant Growth and Development

Introduction

- You have already studied the **organization of a flowering plant** (refer to Chapter 5).
- Let us now explore how various plant structures arise in an orderly sequence during development.

Key Concepts and Questions

- Have you wondered where and how structures like roots, stems, leaves, flowers, fruits, and seeds originate?
- How do stages like **seed** → **seedling** → **plantlet** → **mature plant** follow such a specific progression?
- Why do **trees** grow in height and girth continuously, but leaves, flowers, and fruits are of limited size and appear/disappear periodically?
- Why does the vegetative phase occur before flowering?
- Can the **structure and function** of cells, tissues, or organs be altered?
- All cells descend from the zygote, yet they differentiate—how and why?

Growth vs Development

- Development is the **sum of two** key processes:
 1. **Growth** – an irreversible increase in size and volume.
 2. **Differentiation** – the process by which cells become structurally and functionally specialized.

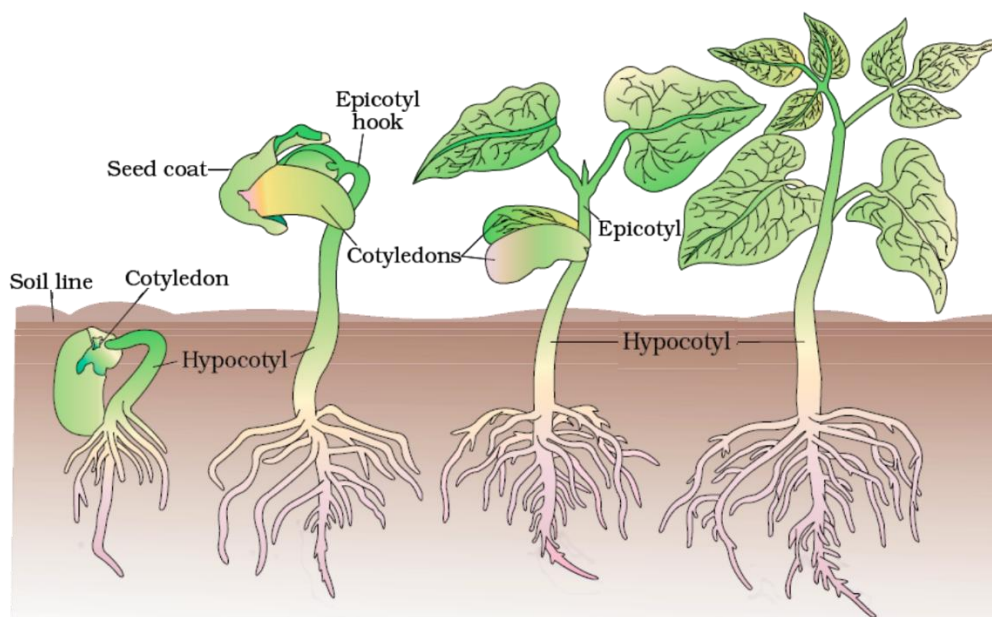
Sequence of Plant Development

- **Starts with:** A zygote (fertilized egg).
- **Progresses into:** A mature plant through a precise, orderly succession of events.
- **Outcome:** Formation of complex structures like:
 - Roots
 - Leaves
 - Branches
 - Flowers
 - Fruits
 - Seeds

- **Ends with:** The **death** of the plant.

First Step: Seed Germination

- **Seed germination** is the initial step in plant growth.
- Favorable environmental conditions trigger germination.
- **In unfavorable conditions**, seeds:
 - Do not germinate
 - Enter a period of dormancy (suspended growth).
- Once conditions improve, seeds:
 - Resume metabolic activity
 - Begin to grow



Germination and seedling development in bean

Factors Affecting Growth and Development

- Development is influenced by:
 - 1. Intrinsic (Internal) Factors**
 - Genetic makeup
 - Hormones
 - Cellular organization
 - 2. Extrinsic (External) Factors**
 - Temperature
 - Light
 - Water
 - Nutrients

Growth

Definition of Growth

- **Growth** is one of the most fundamental and visible characteristics of all living organisms.
- It is defined as:
 - An irreversible and permanent increase in the size of an **organ**, its **parts**, or even a **single cell**.

Nature of Growth

- Growth involves:
 - **Anabolism** – constructive metabolic processes
 - **Catabolism** – destructive metabolic processes
 - Both are part of metabolism and occur at the expense of energy.

Example of Growth

- Expansion of a **leaf** is a clear example of growth, as it:
 - Increases permanently in size
 - Involves metabolic activity

What Is Not Growth?

- Consider the **swelling of a piece of wood** placed in water:
 - This is not growth
 - It is a temporary, reversible physical change, **not** associated with metabolism or increase in living mass

Plant Growth is Generally Indeterminate

- **Plant growth is generally indeterminate**, meaning plants can grow continuously throughout their life due to the presence of active meristems.
- This is unlike most animals, which show determinate growth, where growth stops after reaching a specific size or stage.

Role of Meristems in Indeterminate Growth

- The indeterminate nature of plant growth is due to the presence of meristems—specialized tissues located at specific regions of the plant body.
- Meristematic cells have two key abilities:
 - **Self-perpetuation**: They can continuously divide and maintain their population.

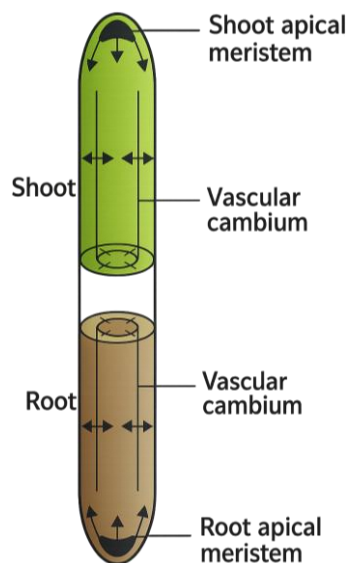
- **Cell division:** They generate new cells.

Note: The newly formed cells eventually lose the ability to divide and differentiate to form various tissues and organs of the plant.

Open Form of Growth

- This continuous addition of new cells to the plant body through meristem activity is called **open growth**.
- This means as long as meristems are active, the plant continues to grow.
- **Question to Consider:** What would happen if meristematic cells stopped dividing?
 - In such a case, growth would cease, and the plant would no longer elongate or expand.

Types of Meristems and Their Functions



Diagrammatic representation of locations of root apical meristem, shoot apical meristem and vascular cambium. Arrows exhibit the direction of growth of cells and organ

1. Apical Meristems

Location:

- Found at the tips of roots and shoots.

Function:

- Responsible for primary growth.
- This growth results in the **elongation** of the plant along its axis.

Examples:

- Root Apical Meristem
- Shoot Apical Meristem

2. Lateral Meristems

Examples:

- Vascular Cambium
- Cork Cambium

Function:

- Responsible for **secondary growth**.
- This growth leads to an increase in girth (thickness) of the plant organs.

Occurrence:

- Found primarily in dicotyledonous plants and gymnosperms.
- These meristems usually become active **later in the plant's life**.

Growth is Measurable

Measuring Growth at the Cellular Level

- At the cellular level, growth primarily results from an increase in the amount of protoplasm.
- However, **direct measurement** of protoplasm is **difficult**.
- Therefore, growth is generally measured indirectly using parameters that are proportional to protoplasmic increase.

Common Parameters Used to Measure Growth

- Growth can be measured by observing the increase in:
 - Fresh weight
 - Dry weight
 - Length
 - Surface area
 - Volume
 - Cell number

Examples of Measurable Growth

- A maize root apical meristem can produce over 17,500 new cells per hour, showcasing growth through cell number increase.
- In contrast, watermelon cells can increase in size up to 3,50,000 times, demonstrating growth through cell enlargement.
- The growth of a pollen tube is measured by the increase in its length.
- The growth of a dorsiventral leaf (like in dicots) is measured by the increase in surface area.

Summary Table

Plant/Structure	Growth Measure	Growth Type
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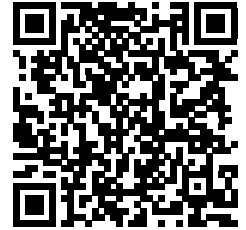


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