

➤ Growth and Development in Plants

Growth: Growth is a permanent and irreversible increase in size that occurs as an organism matures.

Development: The changes in shape and degree of complexity in an organism are called development. Development is a programmed series of stages from a simpler to more complex form. As a result of development, cellular differentiation of structure and function takes place.

Growth and Development in plants

Growth and development in plants are two successive integrated physiological processes. Growth is a quantitative increase in the plant body. Because during growth a permanent change occurs in the size and overall dry weight of the plant is increased.

Development on the other hand is qualitative changes in the plant body. Growth and development therefore, cannot be separated but one follows the other. Mostly plants show indeterminate growth i.e. they continue to grow throughout their life. But some plants and animals show determinate growth i.e. they stop growing after reaching a certain size.

Growth Rate:

Plants differ in their growth rates. Bamboo plant grows up to 60 cm per day. Most of the cultivated plants grow 1-2 cm per day. The rate of growth is not uniform throughout the plant body.

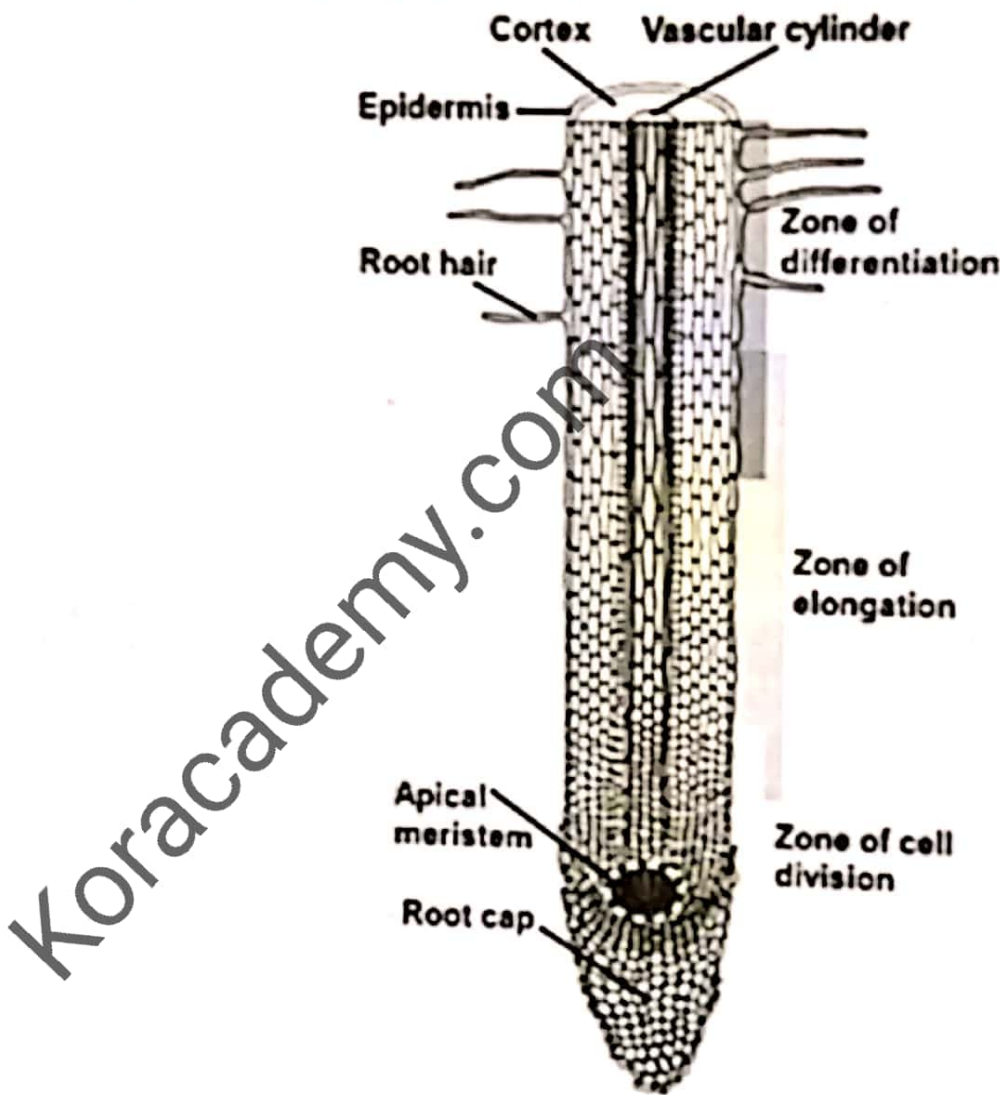
Phases of Growth

There are three phases of growth in root and stem tips:

1. **Phase of cell division:** Cell division is the first phase of growth. This phase is present at the tips of root and stem. In this phase the number of cells increases by mitosis. The cells have dense cytoplasm, central nuclei and thin cell walls. These cells are non-vacuolated or having small vacuoles.
2. **Phase of cell elongation:** The second phase of growth is cell elongation. It lies just behind the phase of cell division. Here the cells simply elongate to attain their maximum size. During elongation the cell volume increases up to 150 times due to uptake of water. The cells synthesize new cytoplasm,

cell wall material and a large central vacuole is formed. Thus cells show increase in weight and attain different shapes.

3. **Phase of cell maturation and differentiation:** This phase is present behind the phase of cell elongation. Here the cell walls become thicker and cells attain their final size and shape. The cells are modified into different tissues according to their location and function. Some cells form parenchyma, collenchymas, xylem and phloem.



Growth phases in plants

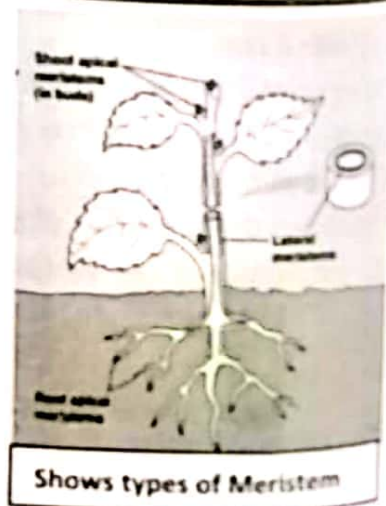
➤ Growth Points

In lower plants the whole body takes part in growth. In higher plants the growth occurs only in certain region called growth points. In these regions the cells divide rapidly these cells are known as meristems.

- **Meristem:** Meristems are undifferentiated, perpetually juvenile (young) plant tissues which are capable of dividing mitotically and results in plant growth.

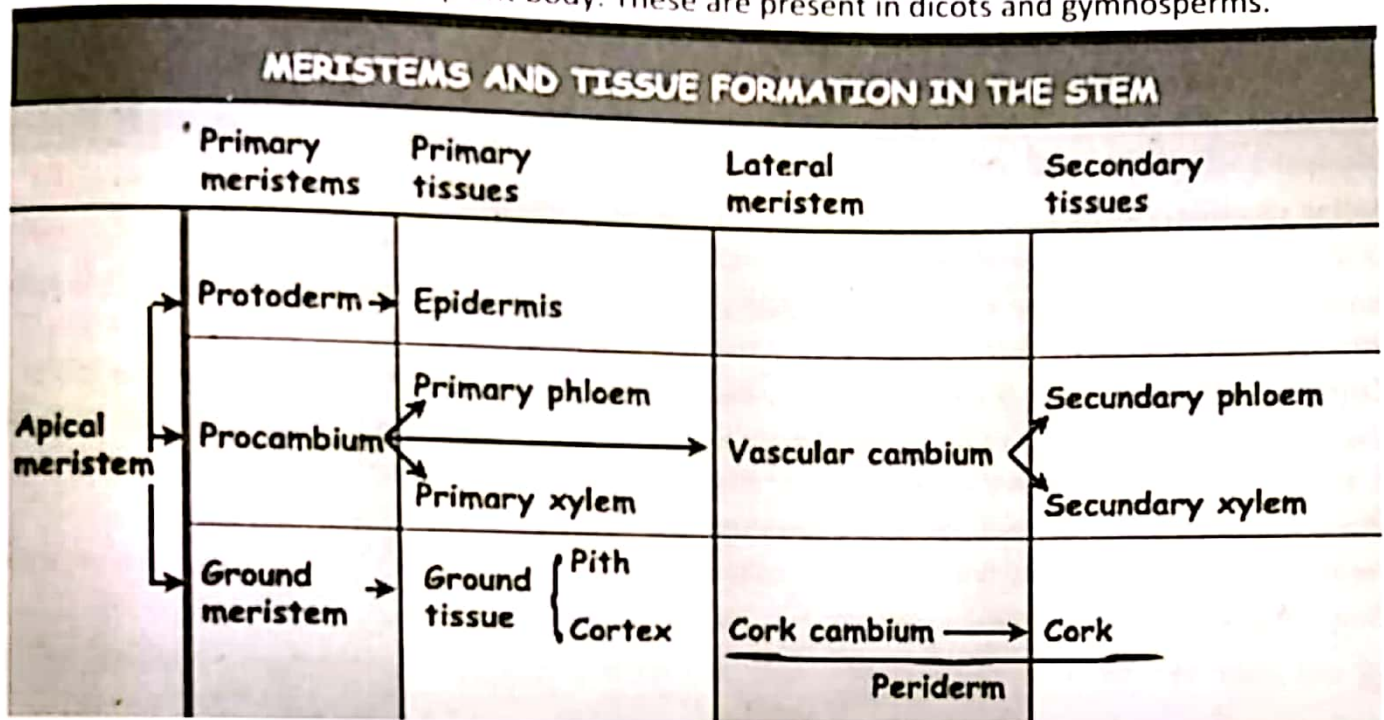
➤ **Meristem is of three types:**

1. **Apical meristem:** These cells are present at the tip of root and stem. They take part in the formation of branches, flowers and



leaves. They increase the length of plant at both the stem and root sides.

2. **Intercalary meristem:** They are present at the base of internodes in many plants. They also increase the length of plant.
3. **Lateral meristem:** These cells are present in the form of ring between xylem and phloem. They increase the thickness of plant body. These are present in dicots and gymnosperms.



1. Apical Meristem

Apical meristem occurs at tip of roots and shoots. The apical meristem gives rise to three types of primary meristem.

- I. Protoderm
- II. Ground meristem
- III. Procambium

I. **Protoderm:** It gives rise to epidermis, the outermost layer of roots and shoots cells.

II. **Ground Meristem:** Ground meristem gives rise to: Cortex and Pith (the inner most central part)

III. **Procambium:** Procambium gives rise to:

- a. Primary phloem
- b. Primary xylem
- c. Vascular cambium

As apical meristem is present at root and shoot tips therefore, give rise to primary growth. The increase in plant height is called primary growth.

Primary growth occurs in:

- i. Monocots
- ii. Herbaceous annual plants

2. Lateral Meristem

The group of dividing cells found in gymnosperms and dicots. They are concerned with secondary growth (increases in width/girth/thickness) of plant is called lateral meristem.

Lateral meristem is of two types:

I. Cork cambium

II. Vascular cambium

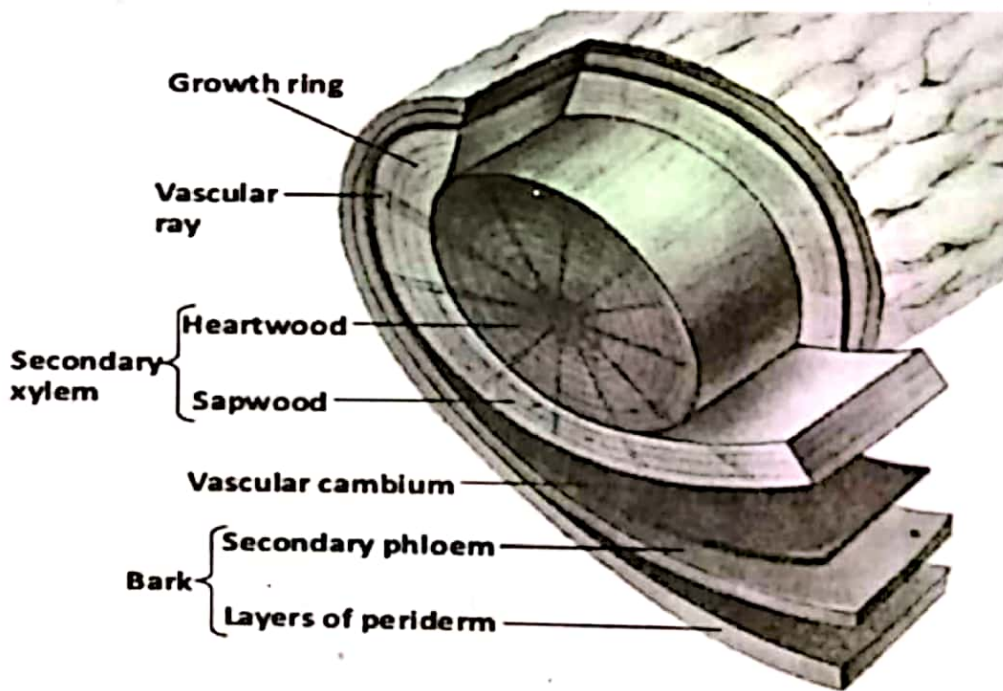
I. **Cork cambium:** Cork cambium produce cork cells i.e. bark, protect plant from injury, pathogens and herbivorous insects.

II. **Vascular Cambium:** Vascular cambium gives rise to secondary vascular tissues i.e. Secondary xylem and Secondary phloem

➤ Process of Secondary growth

- During secondary growth, cell division occurs in vascular cambium.
- As a result the epidermis and other tissues rupture.
- Inner cells are exposed to the attack of pathogens (viruses, bacteria and fungi) and evaporation of water.
- Cortical cells just beneath the epidermis become meristematic called Phellogen or cork cambium.
- The Phellogen divides and adds dead and thick walled cells on outer side forming a layer called phellem or cork and on inner side living cells called phelloderm or secondary cortex.
- Phellogen, phellem and phelloderm are collectively known as periderm.
- Periderm and living phloem are collectively called Bark.

(See the below given diagram)



Heart Wood

In stem and branches old trees, the central region of secondary xylem become filled with tannin and other secondary metabolites. It makes it hard and dark colour. This hard and darker central region of secondary xylem is called heart wood.

Function: It provides support and strength to the plant.

Sap wood

The outer region of secondary xylem consists of living and light colour cells, it is called sap wood.

Function: It serves conduction of water and storage of food materials.