DIFFERENTIATION, DEDIFFERENTIATION AND REDIFFERENTIATION

- **Differentiation:** Differentiation refers to the process wherein cells derived from the root apical meristem or shoot apical meristem undergo permanent alterations in their structure, biochemistry, size, and physiological characteristics of the cell wall and protoplasm content. These changes equip the cells to perform specific functions. Examples of differentiation include:
  Tracheary Element: Cells undergo elongation and lose protoplasm to form tracheids, developing a robust, elastic lignocellulosic secondary cell wall that prevents collapse under tension, enabling the transport of water over long distances.
  Chlorenchyma: Specialized for photosynthesis, chlorenchyma develops through the formation of chloroplasts in thin-walled living cells. Various structures such as aerenchyma, stomata, collenchyma, trichomes, and the root cap are formed after differentiation.

- **Dedifferentiation:** During differentiation, cells lose their ability to divide and become permanent cells. However, certain cells can regain the capacity to divide under specific conditions. This phenomenon, where certain differentiated cells regain or attain the ability to divide and form new cells, is known as dedifferentiation. Dedifferentiated tissue can act as a meristem, examples include interfascicular vascular cambium, cork cambium, and wound cambium, formed from fully differentiated parenchyma cells.

- **Redifferentiation:** Dedifferentiated cells can lose their ability to divide again, forming permanent cells specialized for specific functions. The process where dedifferentiated cells lose their ability to divide and form permanent cells is called redifferentiation. It mirrors the differentiation of cells and tissues formed by primary meristem. Examples of tissues formed through redifferentiation include secondary phloem, secondary xylem, cork, and secondary cortex. Similar to growth, differentiation in plants is an ongoing process. The same apical meristem produces various cell types like parenchyma, fibers, xylem, phloem, collenchyma, and epidermis. The final structure of a cell at maturity is influenced by neighboring cells within the tissue. For instance, cells positioned away from the root apical meristem differentiate into root cap cells, while those at the periphery mature into epidermal cells.