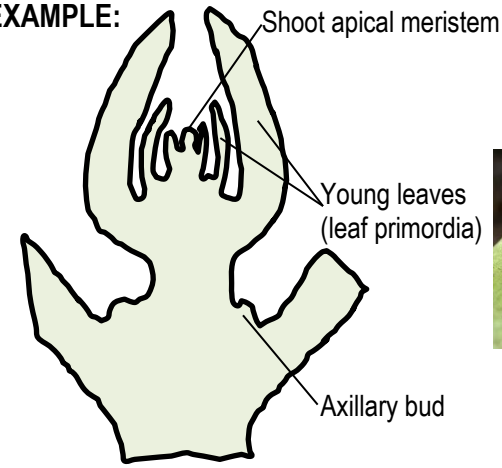
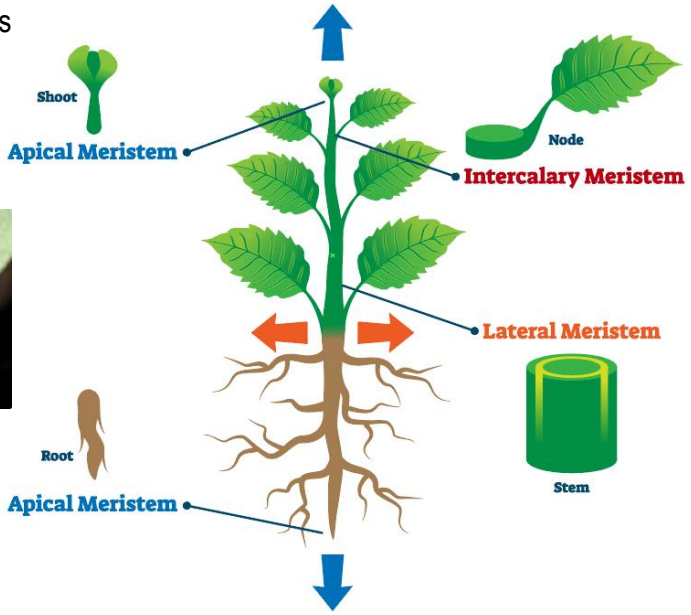
CONCEPT: PRIMARY GROWTH

- ***Indeterminate growth*** – growth that is not terminated, seen in most plants that grow throughout their lives
- ***Meristem*** – group of plant stem cells that can produce daughter cells and differentiate into adult tissues and structures
- ***Primary growth*** – plant extends roots through the soil, and grows shoots to increase absorption of light
    - □ ***Apical meristem*** – meristem located at tip of each root and shoot
        - ***Shoot apical meristem*** (SAM) – gives rise to organs like flowers and leaves
        - ***Root apical meristem*** (RAM) – gives rise to roots

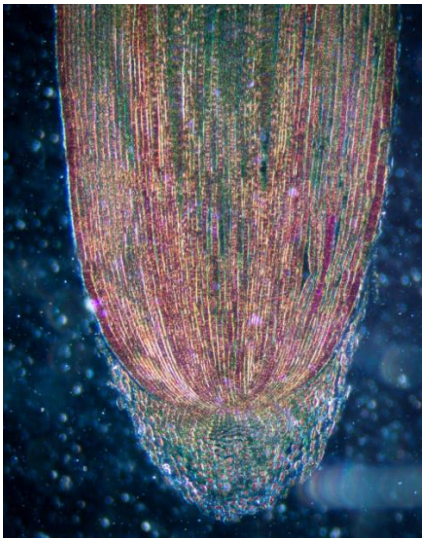
EXAMPLE:





- ***Primary meristems*** – meristems responsible for primary growth, differentiate from apical meristems
    - □ ***Protoderm*** – lies around the outside of the stem and develops into the epidermis
        - ***Epidermis*** (dermal tissue system) – protects plant from pathogens and water loss
    - □ ***Procambium*** – inside the protoderm, develops into vascular tissue, vascular cambium, and cork cambium
        - ***Vascular tissue system*** – transports water and nutrients, provides support for plant body
    - □ ***Ground meristem*** – gives rise to ground tissue system, site of photosynthesis and carbohydrate storage
        - ***Ground tissue system*** – tissue that is neither dermal nor vascular

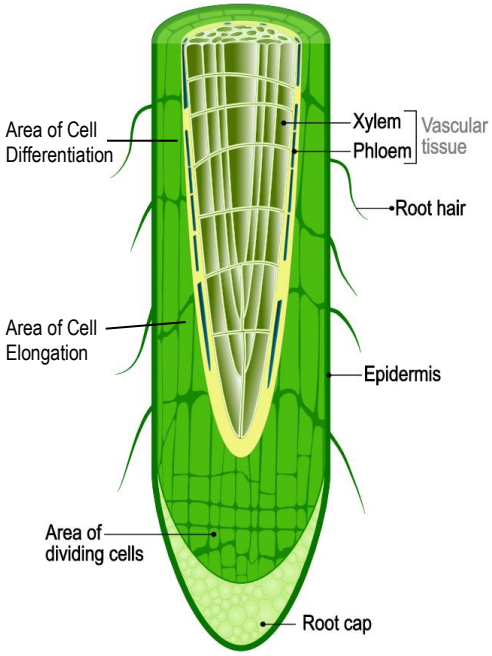
EXAMPLE:

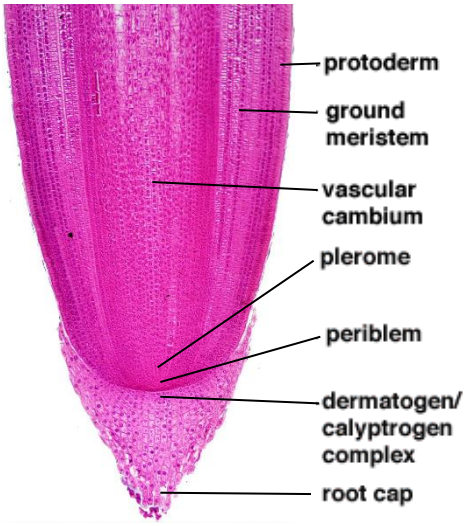


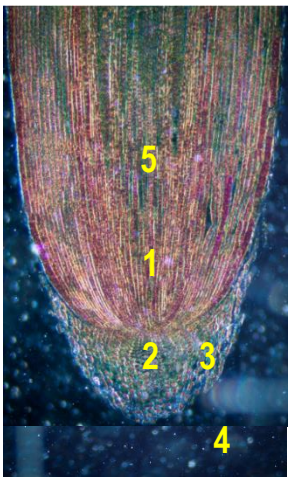
CONCEPT: ROOT GROWTH

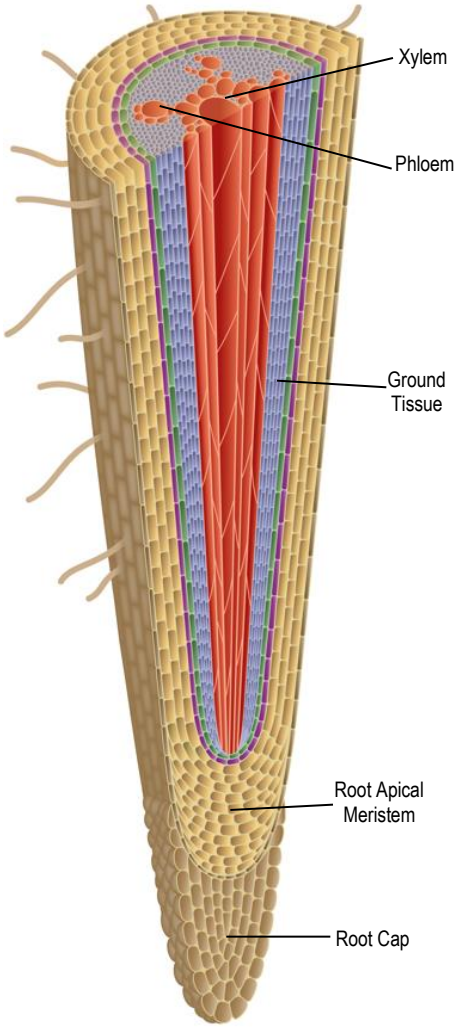
- ***Root cap*** – protects the apical meristem, senses gravity, and secretes lubricating polysaccharide
- ***Zone of cellular division*** – apical meristem and primary meristems, where cells are actively dividing
- ***Zone of elongation*** – cells derived from primary meristem tissue that are elongating
    - □ Cells elongate by swelling with water, providing the force to push the root cap through soil
- ***Zone of cellular maturation*** – cells completing their differentiation into dermal, vascular, and ground tissues
    - □ ***Root hairs*** – epidermal outgrowths that are the sites of water and nutrient absorption

EXAMPLE:



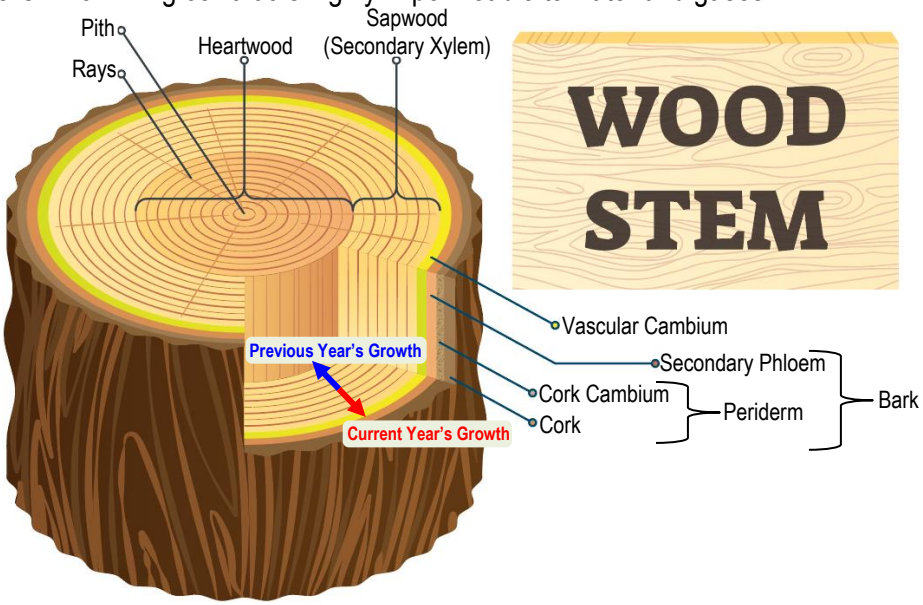






CONCEPT: SECONDARY GROWTH

- ***Secondary growth*** – growth in circumference in woody plants, occurs in places that no longer grow in length
  - □ ***Lateral meristem*** – meristem responsible for secondary growth
  - □ ***Vascular cambium*** – lateral meristem cells located between the secondary xylem and phloem
    - Cells produced to the outside become phloem, cells produced to the inside become xylem
    - Primary xylem and phloem develop from the procambium
    - Secondary xylem and phloem develop from the vascular cambium
  - □ ***Cork cambium*** – lateral meristem cells located near the outer layer of the root or stem, produces cork cells
    - Cork cells – non-living cell that is highly impermeable to water and gases



- ***Wood*** – porous structural tissue derived from secondary xylem
  - □ Only xylem in the outer layers transport water, the inner layers accumulate gums and resins to resist decay
    - Heart-wood – dark-colored inner xylem region
    - Sapwood – light-colored outer xylem region
- ***Bark*** – protective outer layer made form secondary phloem, cork cambium, and cork cells
  - □ ***Lenticels*** – porous tissue that creates small openings in bark to allow for gas exchange

EXAMPLE: