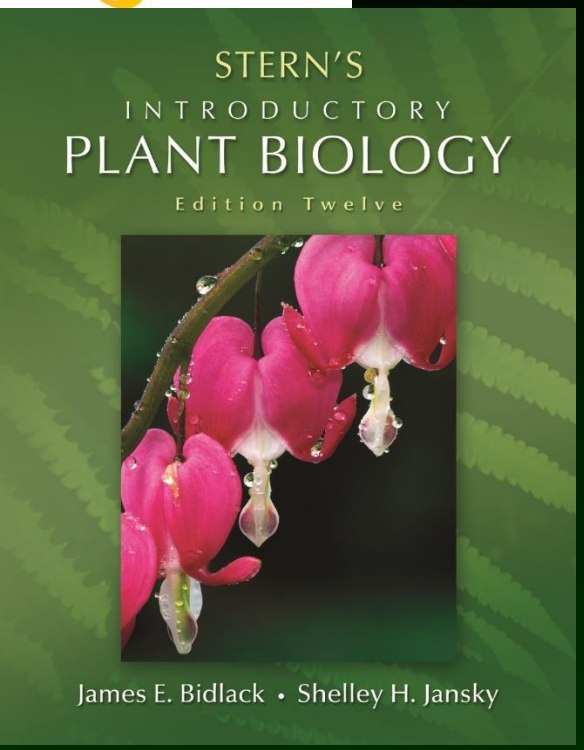
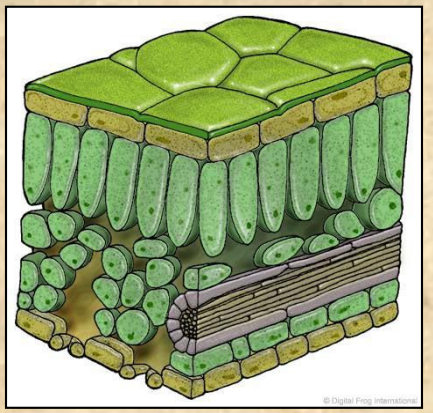
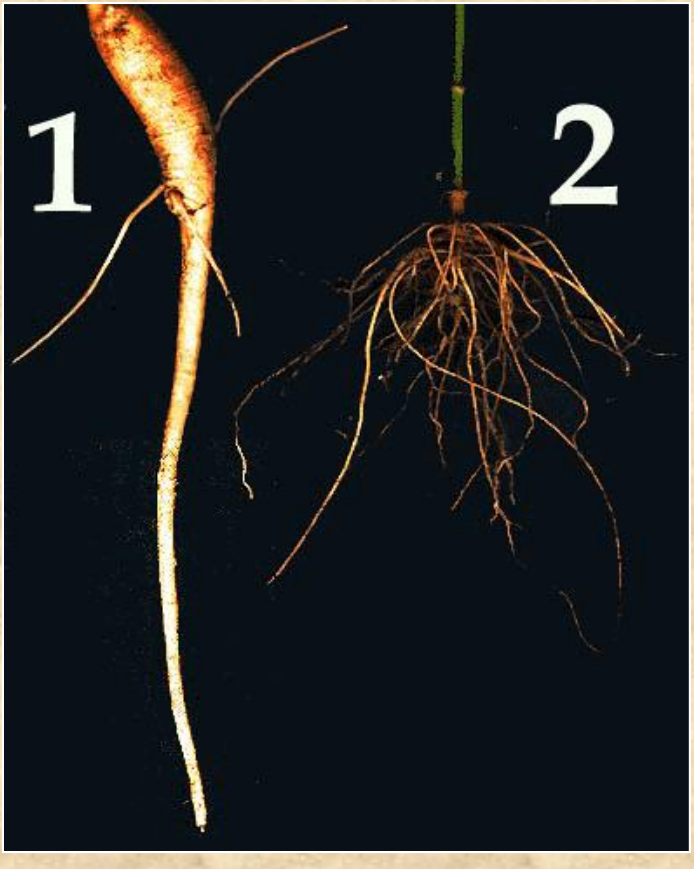


Roots and Soils

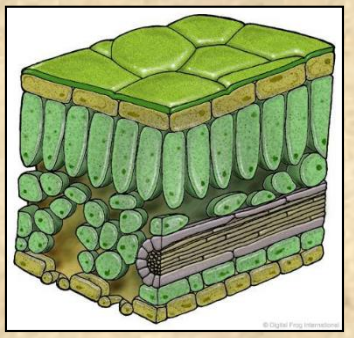
Types of Root Systems



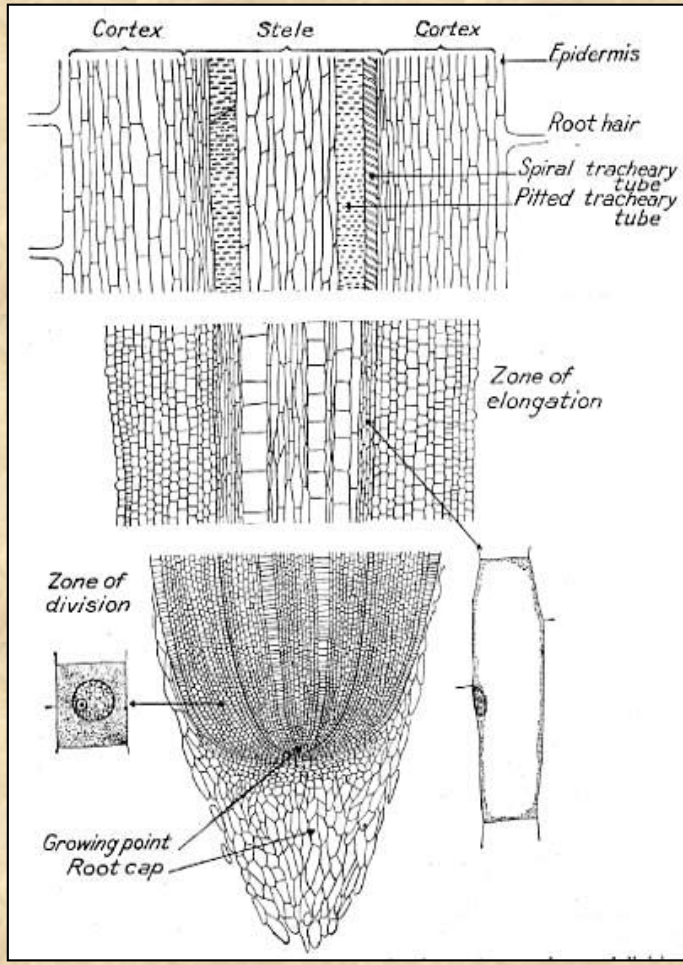
- **Taproot** systems are found in dicots, and consist of a main root with lateral branches.
- **Fibrous** root systems lose the primary root, which is replaced by many smaller roots.



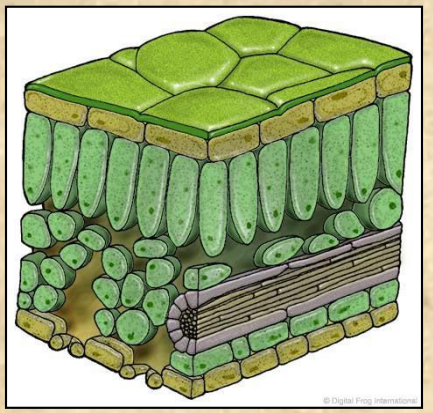
Root Anatomy



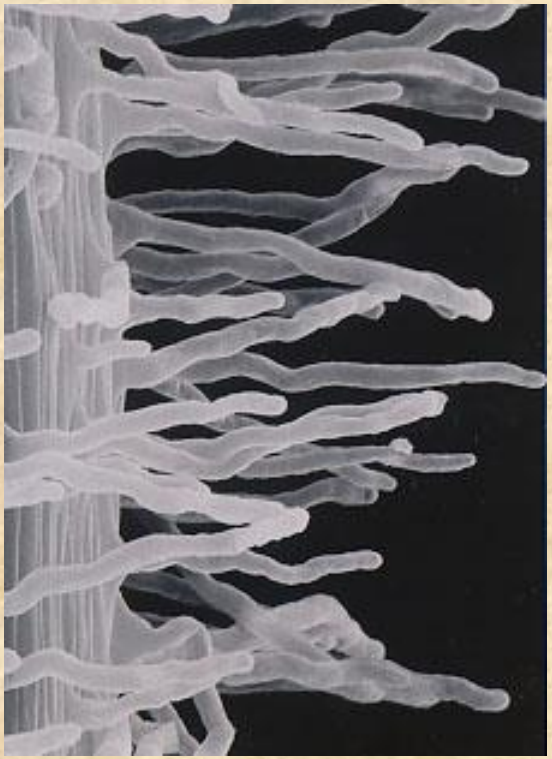
- **Parts of a Root:**
  - **Root cap**
  - **Root meristem**
  - **Zone of elongation**
  - **Zone of maturation**



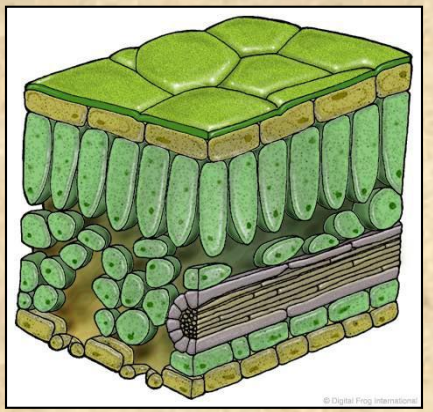
Root Anatomy: Epidermis



- **Root epidermis lacks a cuticle, and is porous. Usually has many root hairs.**
- **Water enters through membranes of epidermal cells or through spaces between cells.**

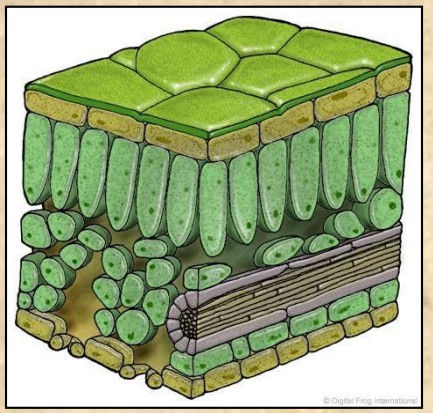


Root Anatomy: Cortex

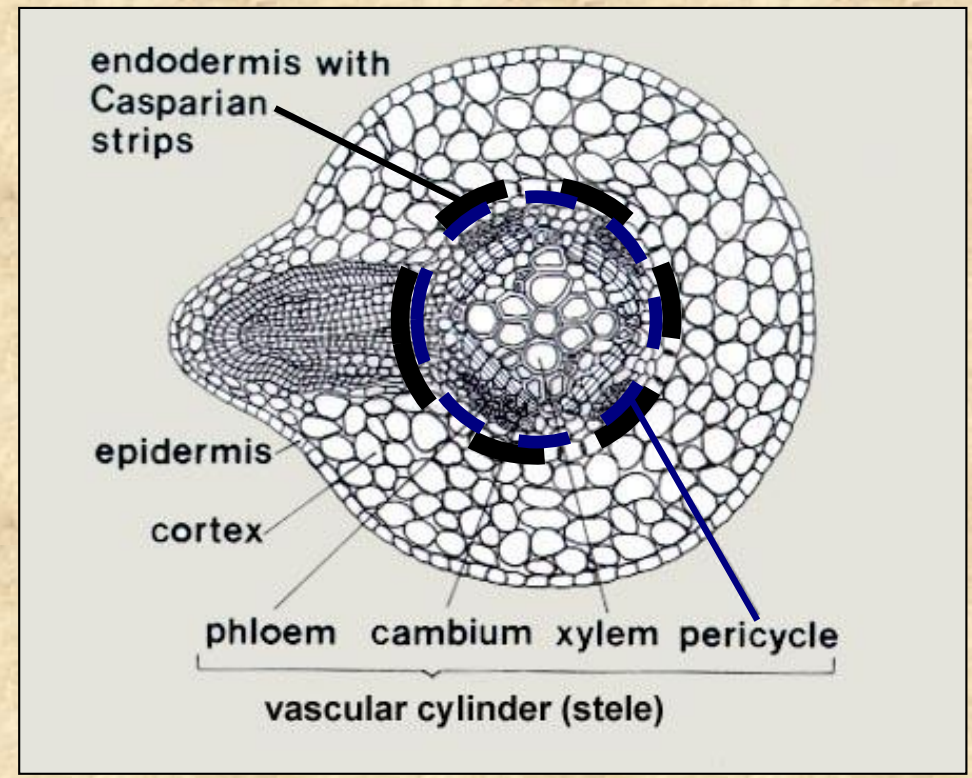


- The cortex layer is made up of parenchyma cells.
- Sugars are linked to make starch for <u>food storage.</u>
- <u>Endodermis</u> separates the cortex from the vascular cylinder.

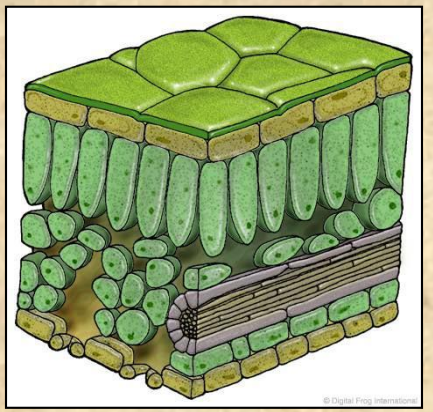
Root Anatomy: Vascular Cylinder



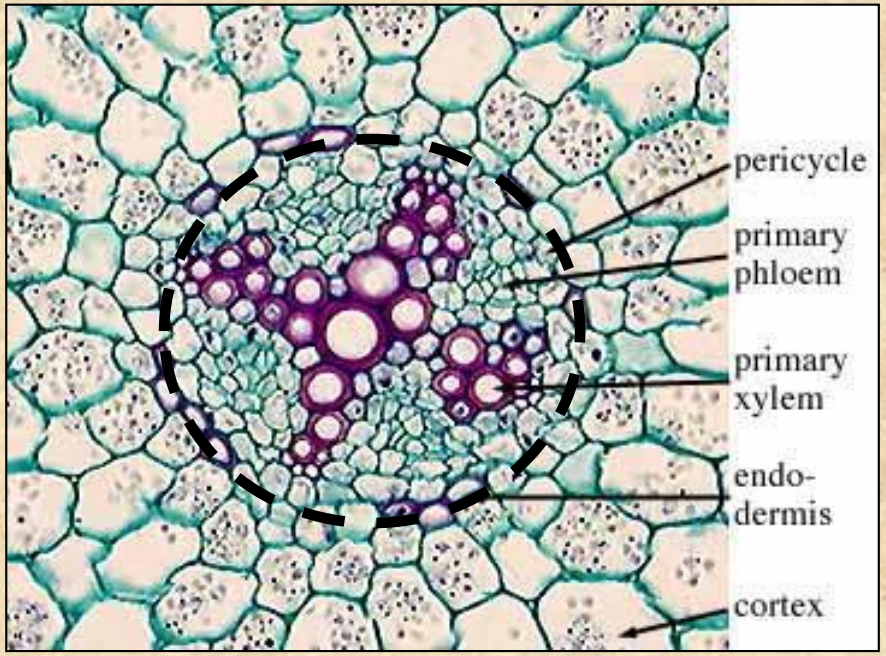
- **Casparian strip** around endodermis cells controls water movement.
- **Pericycle**: layer of parenchyma cells, inside of endodermis, from which branch roots can arise.



Root Anatomy: Vascular Cylinder



- **Vascular Cylinder contains:**
  - **<u>Phloem</u> for moving sugars.**
  - **<u>Xylem</u> for moving water and dissolved minerals.**



PLANT ORGANS

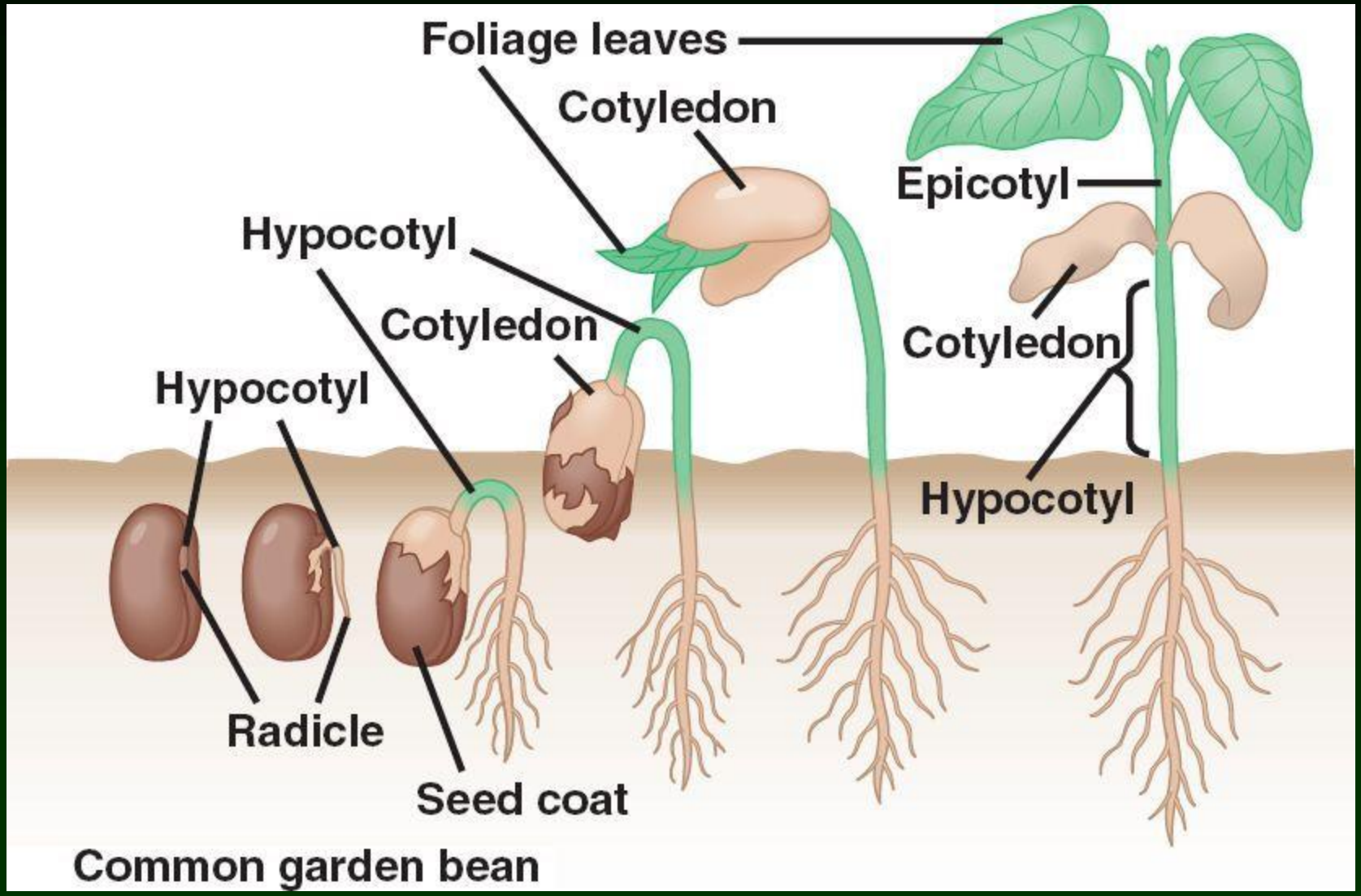
- Regions, Tissues, Sub-tissues, cells

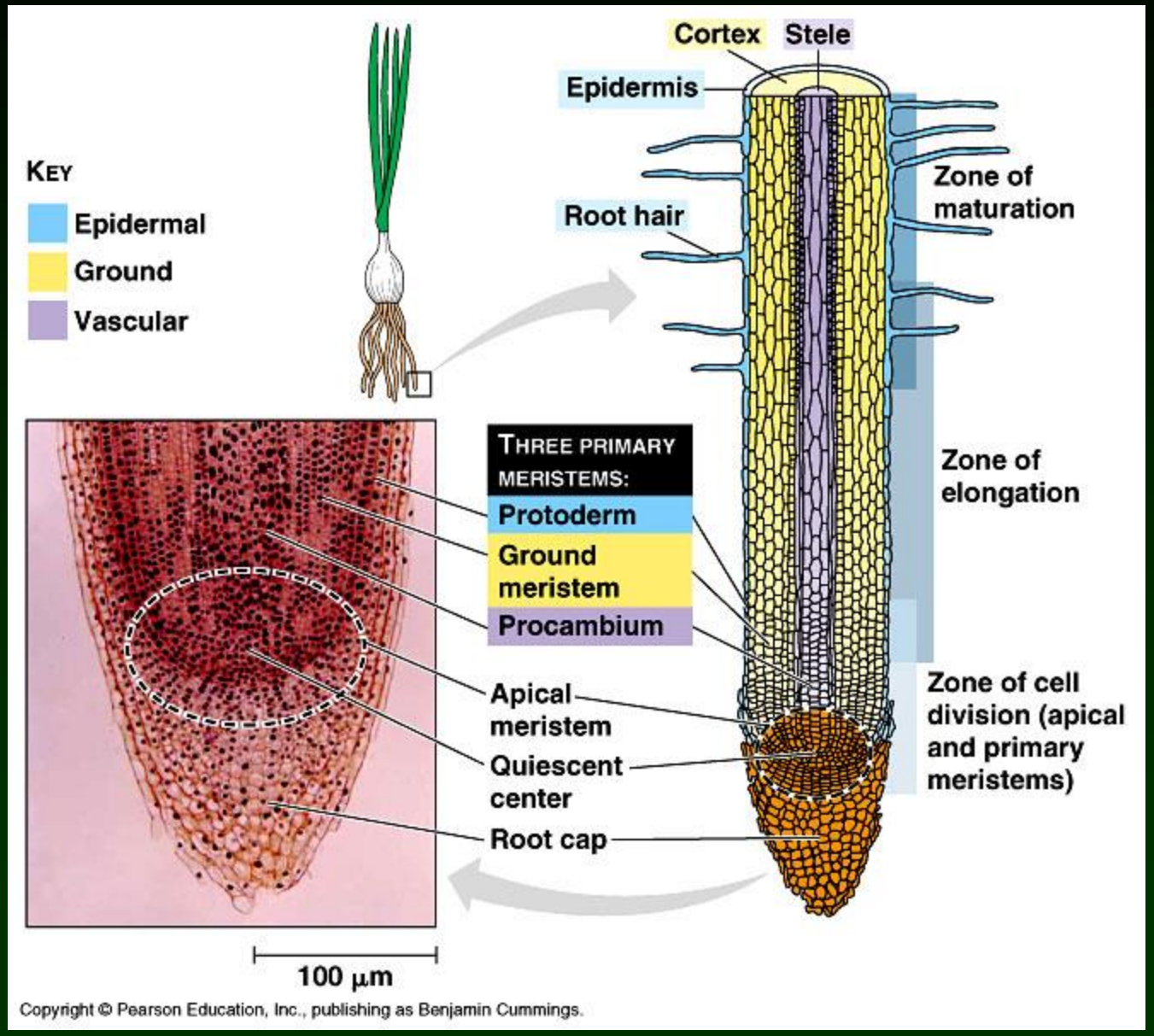
I. Function of Roots

- _____
- _____
- **OTHER:**

  Some store energy as _____

  Other Special





II. Root Development

- **RADICLE** embryo's

_____

- **ROOT SYSTEMS: 2**

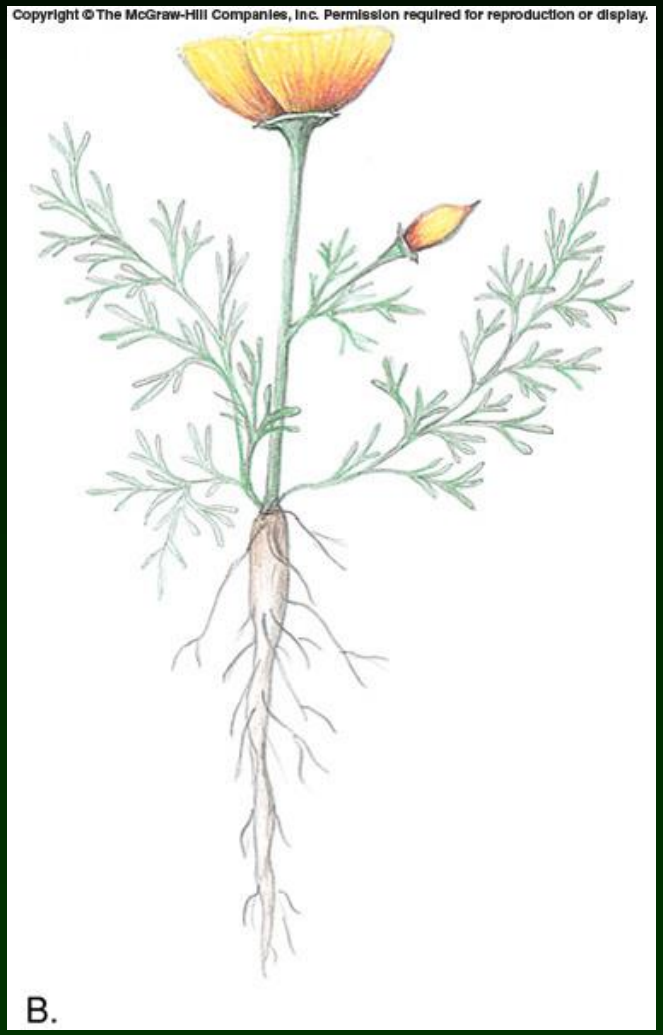
  1. TAPROOT: _____

  _____

  – Advantage of Taproots

  _____

  _____



Taproot system

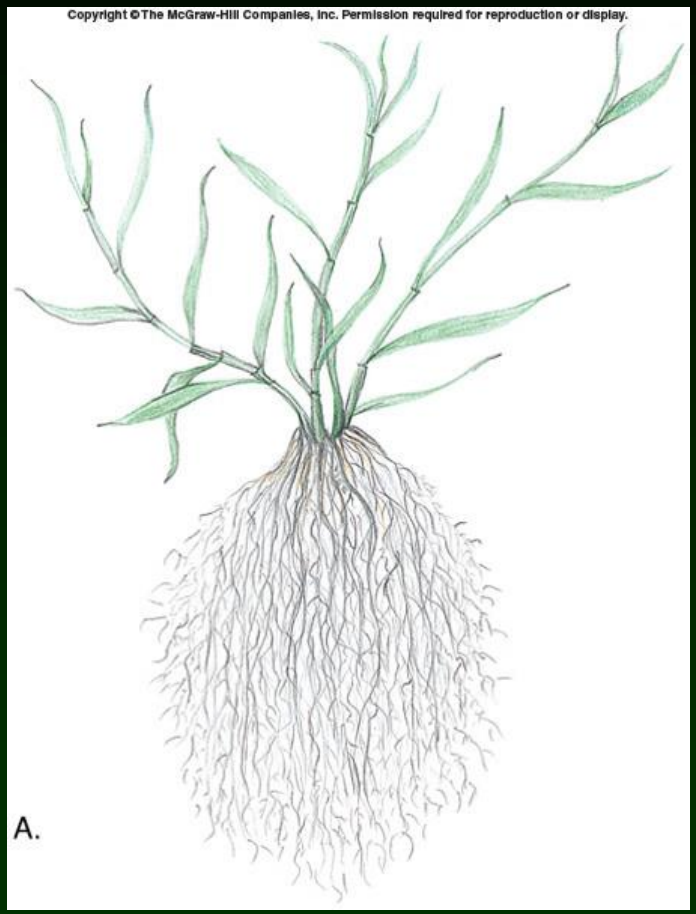
Root Development …

__2. FIBROUS ROOT SYSTEM: _____

_____

- Advantage?

_____



Fibrous root system

III. Root Structure

A. IMMATURE Regions:

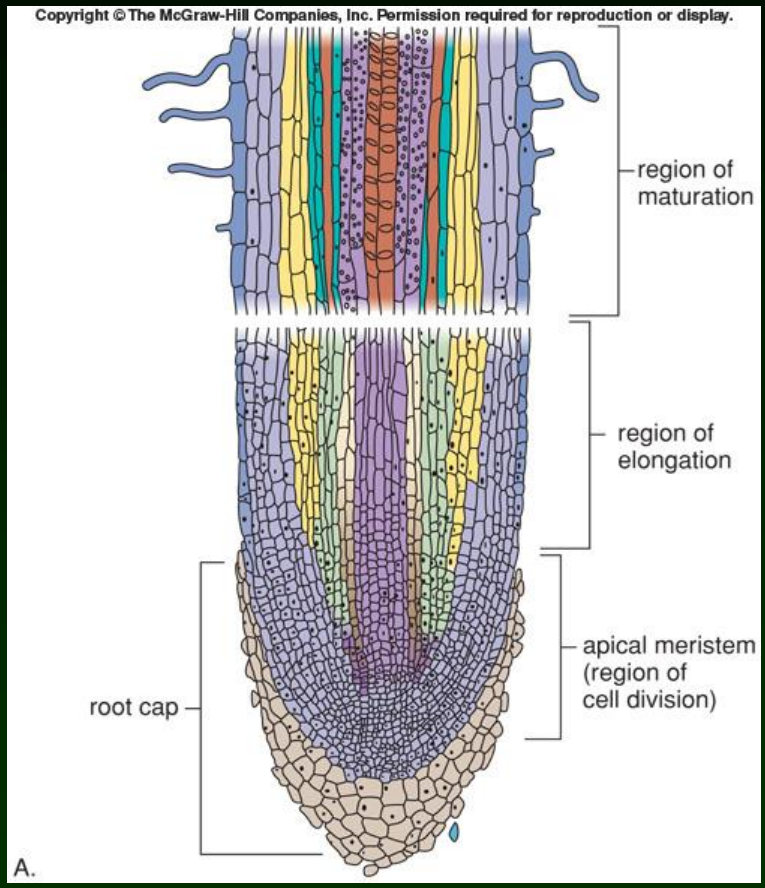
1. ROOT CAP –

1. Location
2. Tissue
3. Shape
4. Functions:

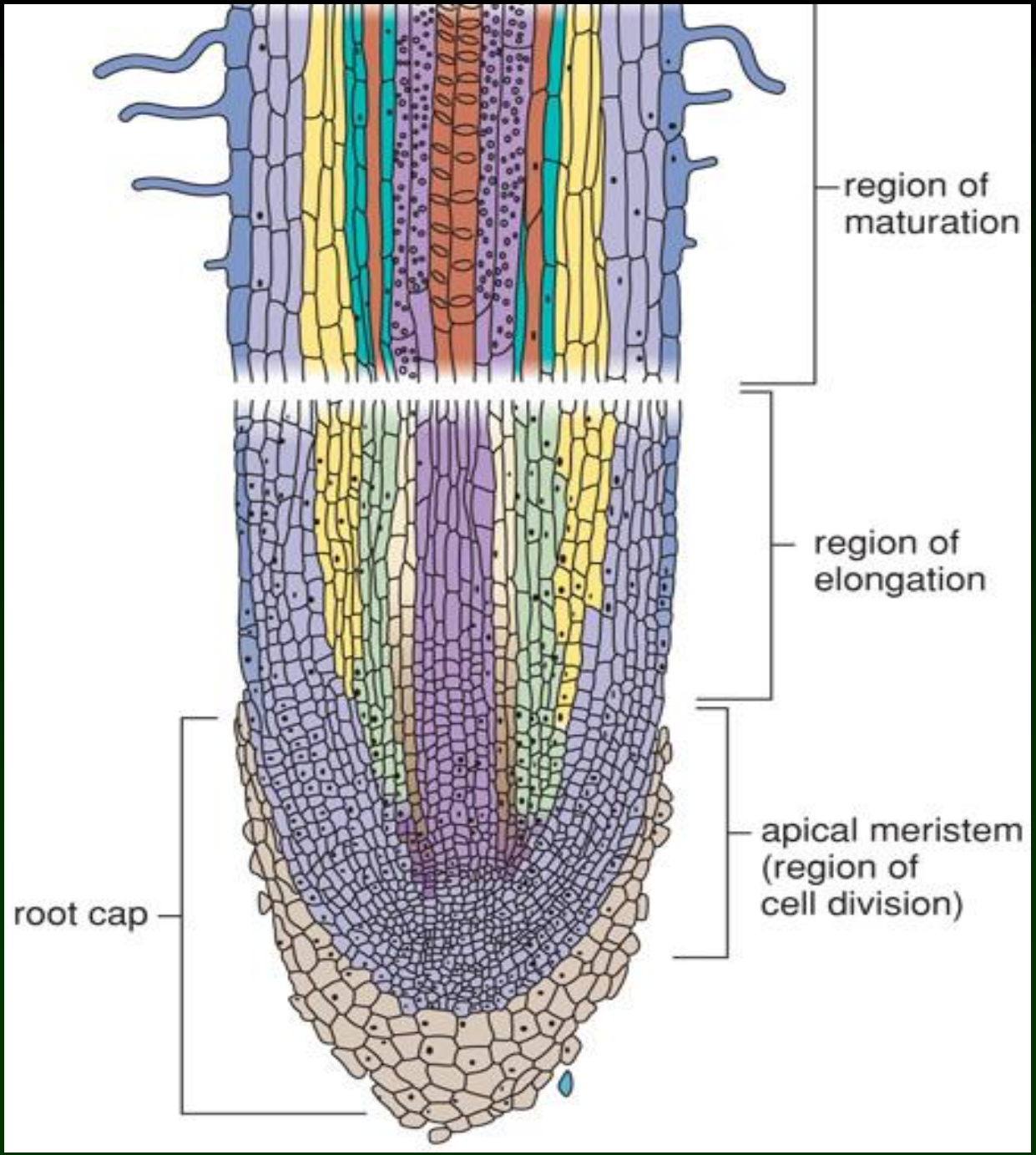
- Mucilage
- Gravitropism

– Produced by: _____

_____



Longitudinal section through root tip



Root Structure …

2. Region of Cell Division

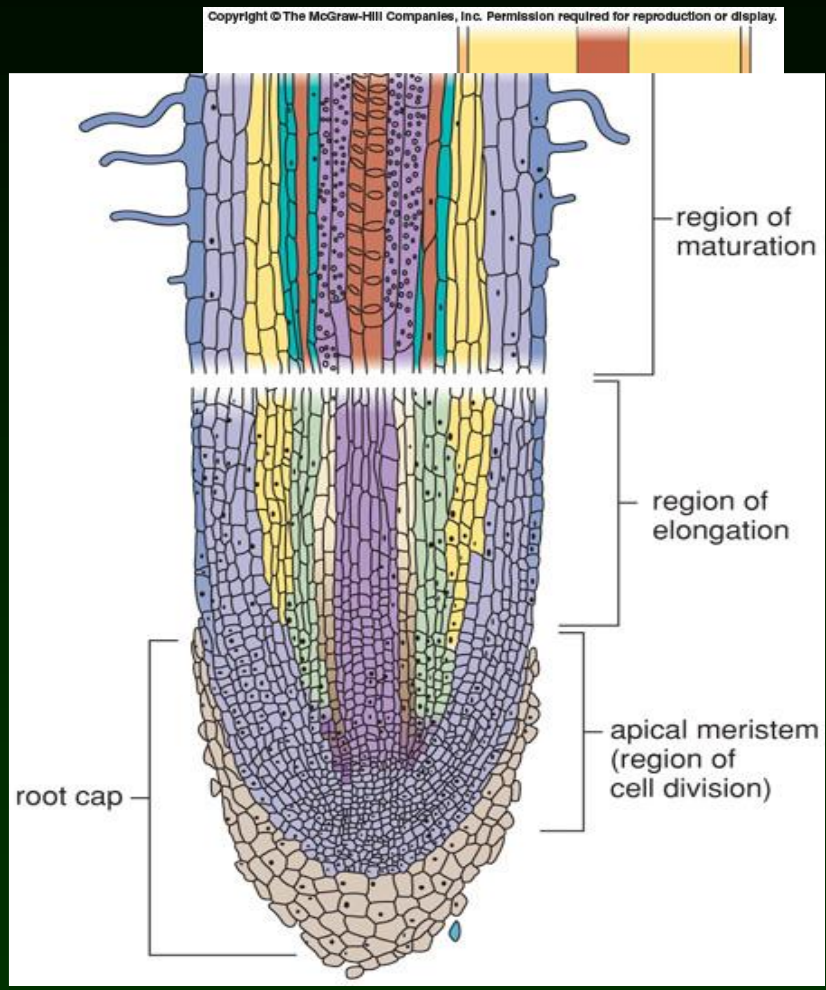
3. Region of Elongation:

_____

4. Region of Maturation

- Cells <u>Differentiate</u>, <u>Specialize</u>, and Mature to become different cell types.

  - HOW?



primary meristems

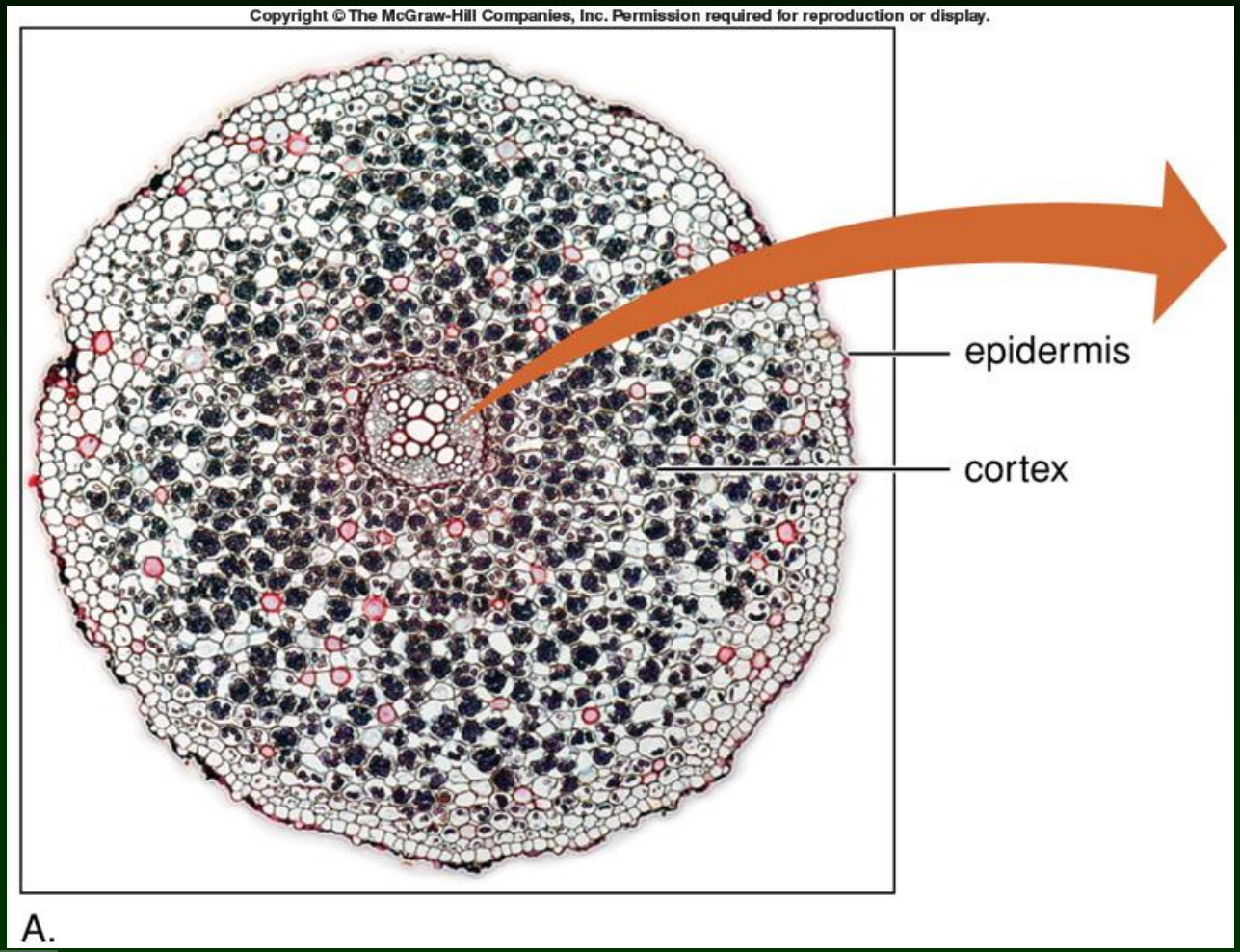
B. MATURE TISSUES produced by Region of Maturation

- **EPIDERMIS:**
  - **Root hair Cells**
  - **Root Hairs**
  - **Function**

Root hair zone of radish seedling

Root Structure …

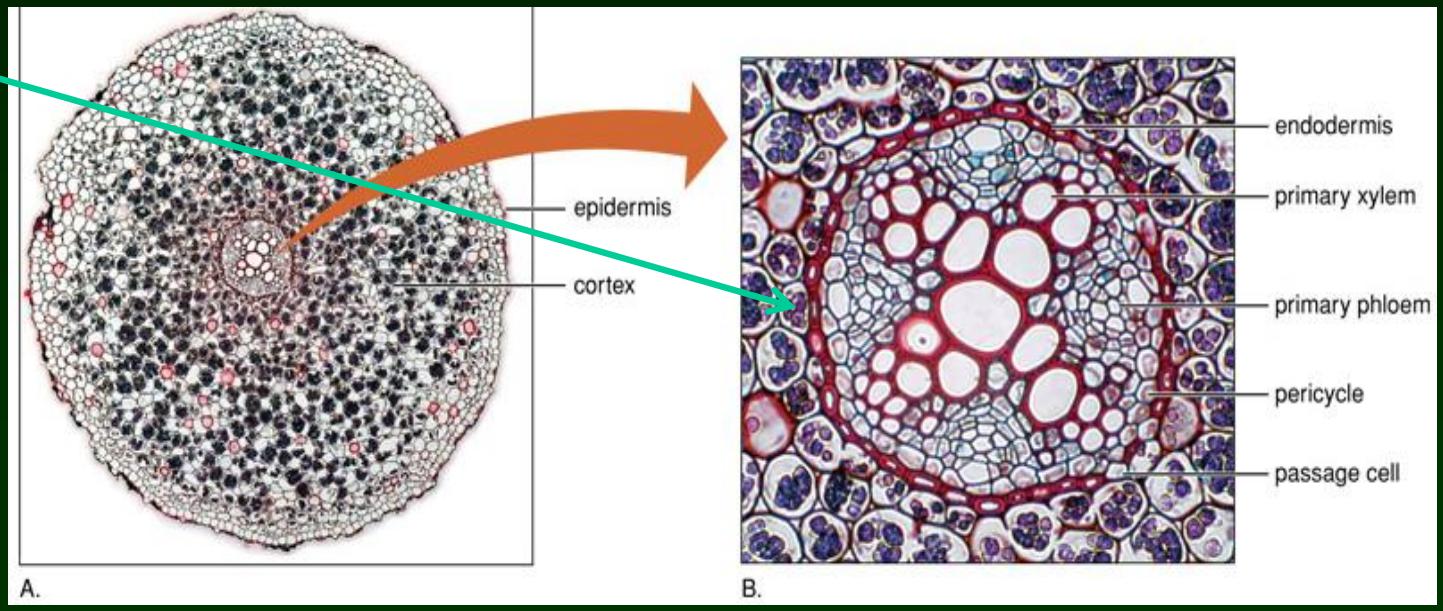
- **Cortex** - **Region** inside to epidermis
  - Tissue and cells:
  - Function: _____



Cross section of dicot root

Root Structure … Cortex …

- **Endodermis** - Inner boundary of cortex
- =
- **Casparian Strip:** wax (suberin) around Endodermis
  - Function: Substances moving in from soil with water must enter through endodermis cell membrane = control over _____

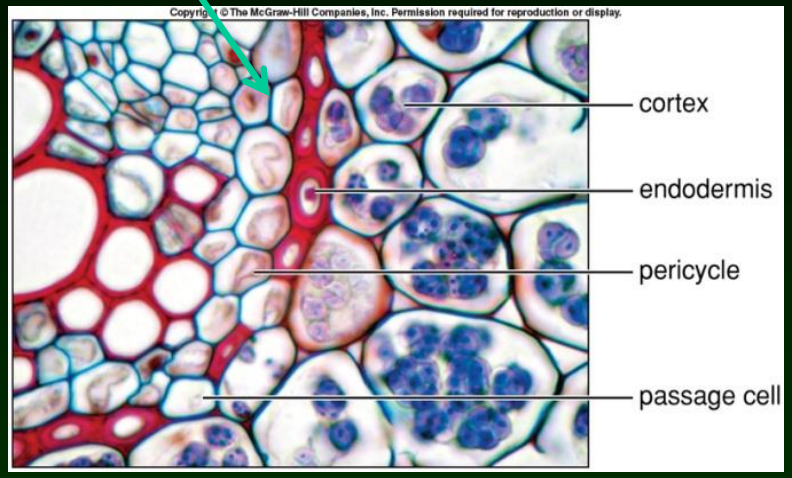


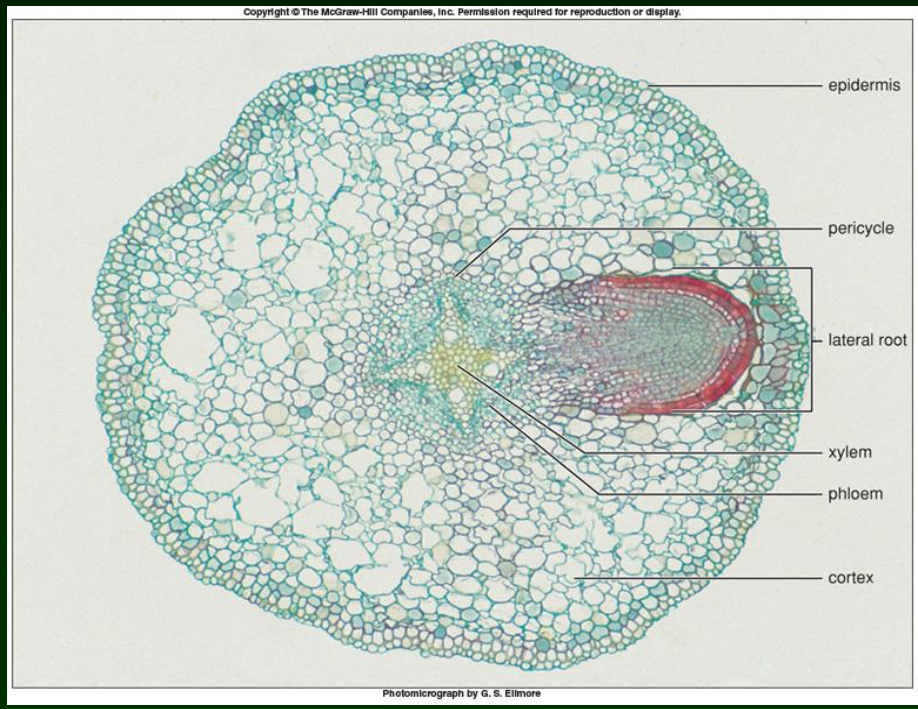
Enlargement of vascular cylinder of dicot root

Root Structure …

- **Vascular cylinder – Region**
  - **Pericycle – outermost layer/region of Cylinder**
    - **Function: production of lateral roots**

and
dicot





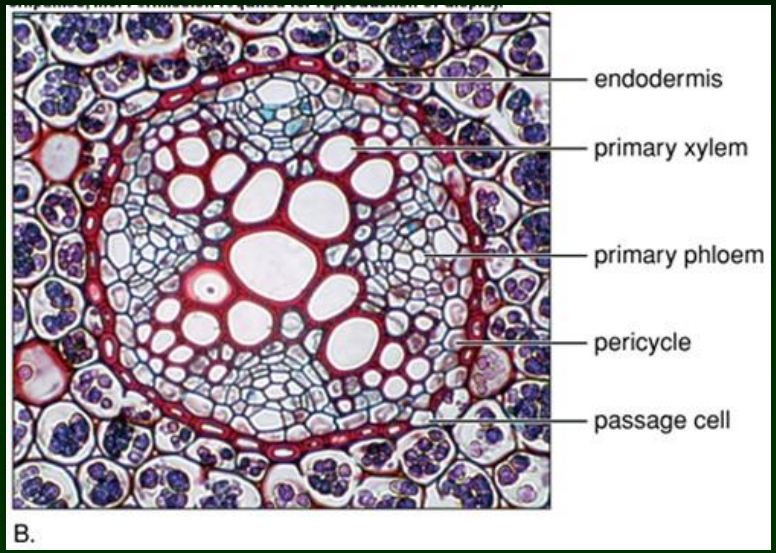
Lateral root formation

Root Structure …

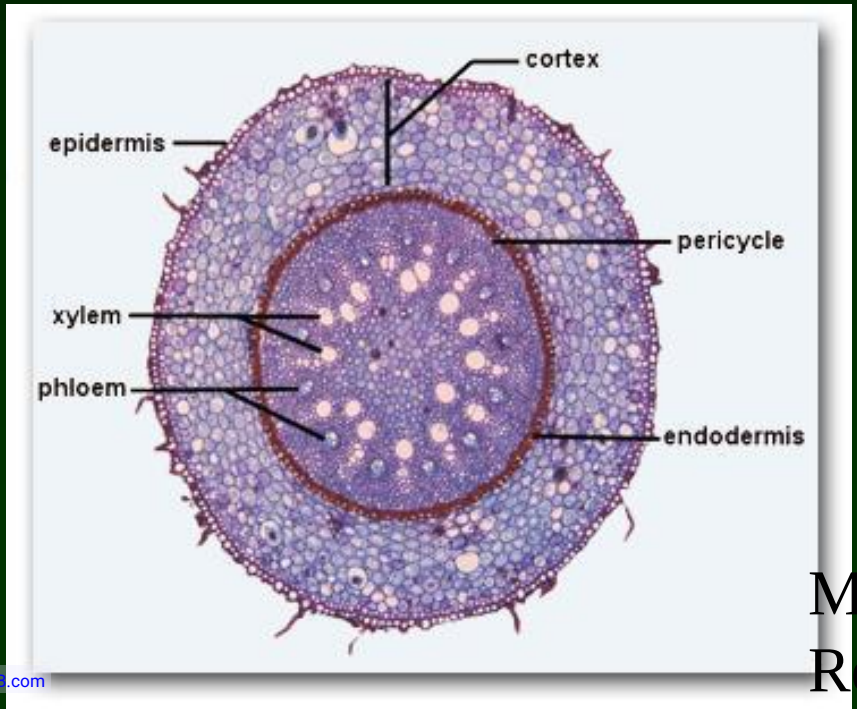
Vascular Cylinder …

- **Xylem T.: with Vessel Elements**
- **Phloem T. with Sieve-tube Elements and Companion Cells**

- **Other tissue patterns:**



Vascular cylinder
of dicot root

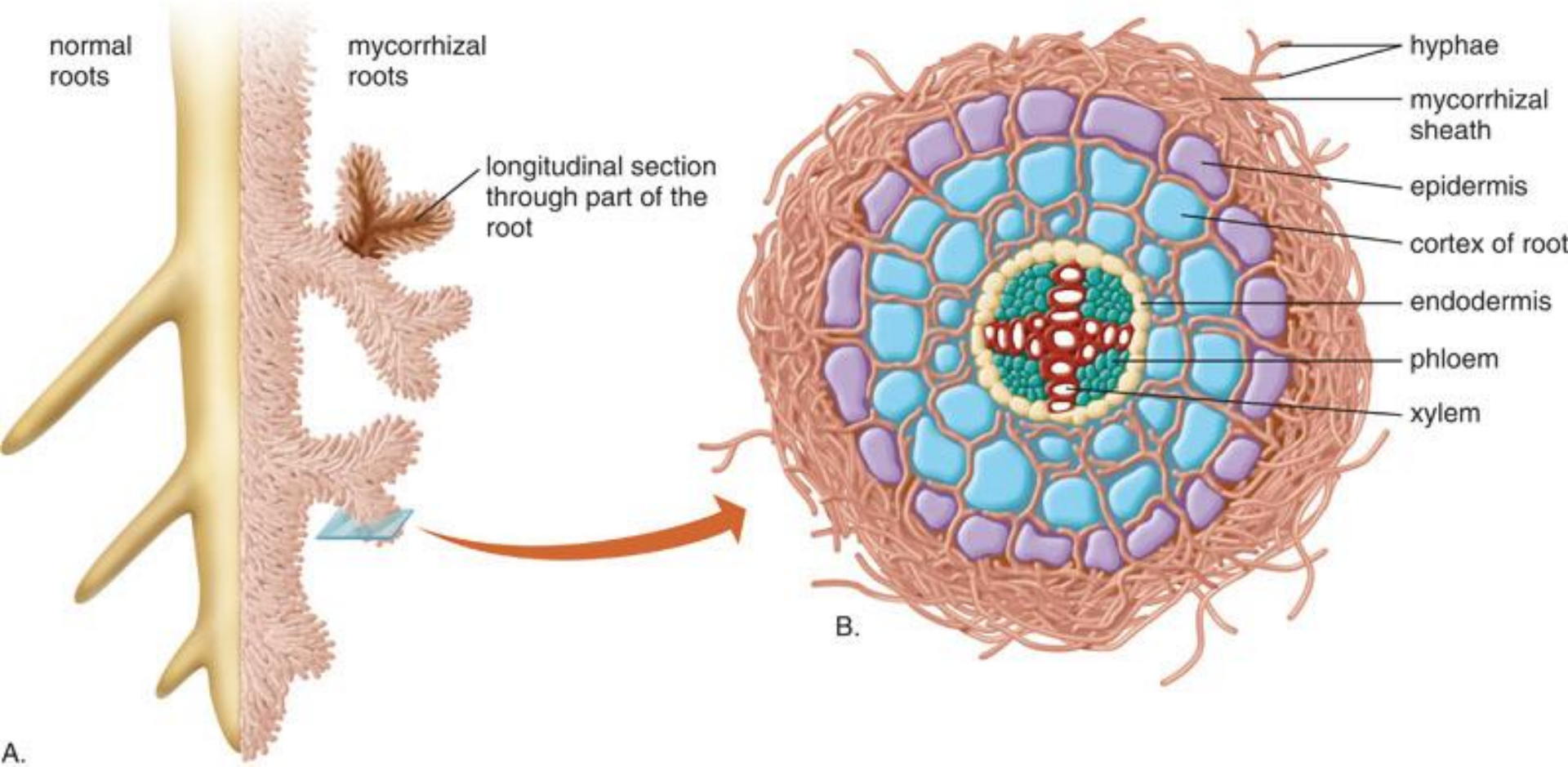


Monocot
Root

Mycorrhizae

- **Mycorrhizae - Fungi that form a mutualistic association with plant roots**
  - **Mutualistic association: + +Both organisms benefit**
    - **Plant benefits: more water and nutrients, (phosphorus)**
    - **Fungi benefits: sugars and amino acids to fungus.**

Mycorrhizae



Root Nodules

- **Bacteria and Plants:**
  - **Nitrogen-fixing Bacteria: convert N2 into nitrates for roots.**
  - **Root nodules contain large numbers of nitrogen-fixing bacteria.**
  - **Legume Family (Fabaceae)**

Root nodules on roots

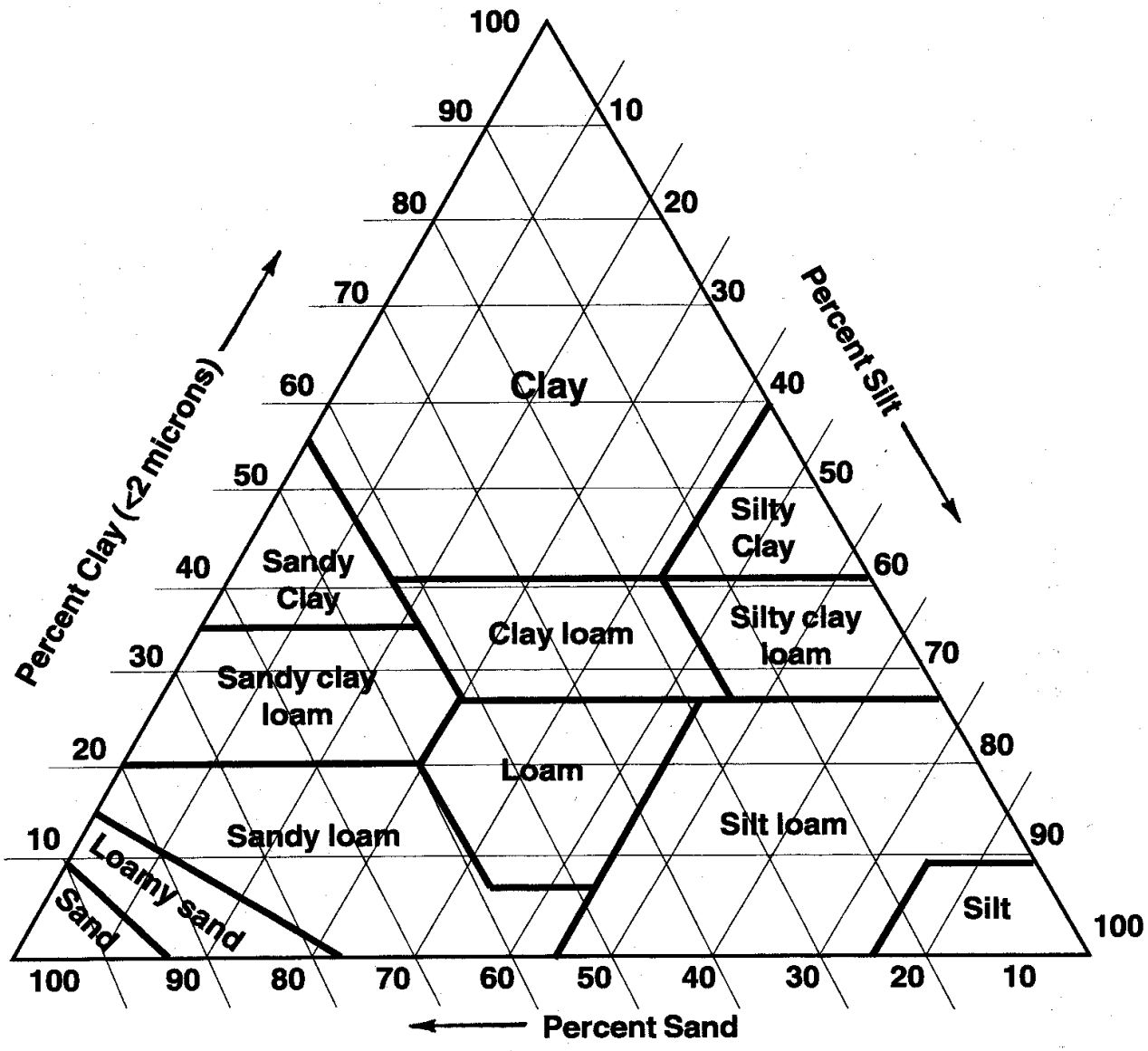
Soils

- **Soil Layers = horizons:**
  - **Topsoil**
    - **A horizon - Dark loam, more organic material**
    - **E horizon - Light loam**
  - **B Horizon - Subsoil**
    - **More clay, lighter in color**
  - **C Horizon - Parent material**

Soil profile

Soils
Soil Texture and Mineral Composition

- **Soil Texture** – particle sizes
  - **Sand** – Visible particles
    - Drain too quickly
  - **Silt** - Particles small; need microscope
  - **Clay** - seen with e- microscope
    - Clay particles = **Micelles**
      - charged and attract +ions = Mg^{++} and K^{+}



Soils

- Best soils: 40% silt, 40% sand and 20% clay
- Soil Structure - Arrangement of soil particles into aggregates
  - pore spaces occupying 40-60% of soil .

Soils
Water in the Soil

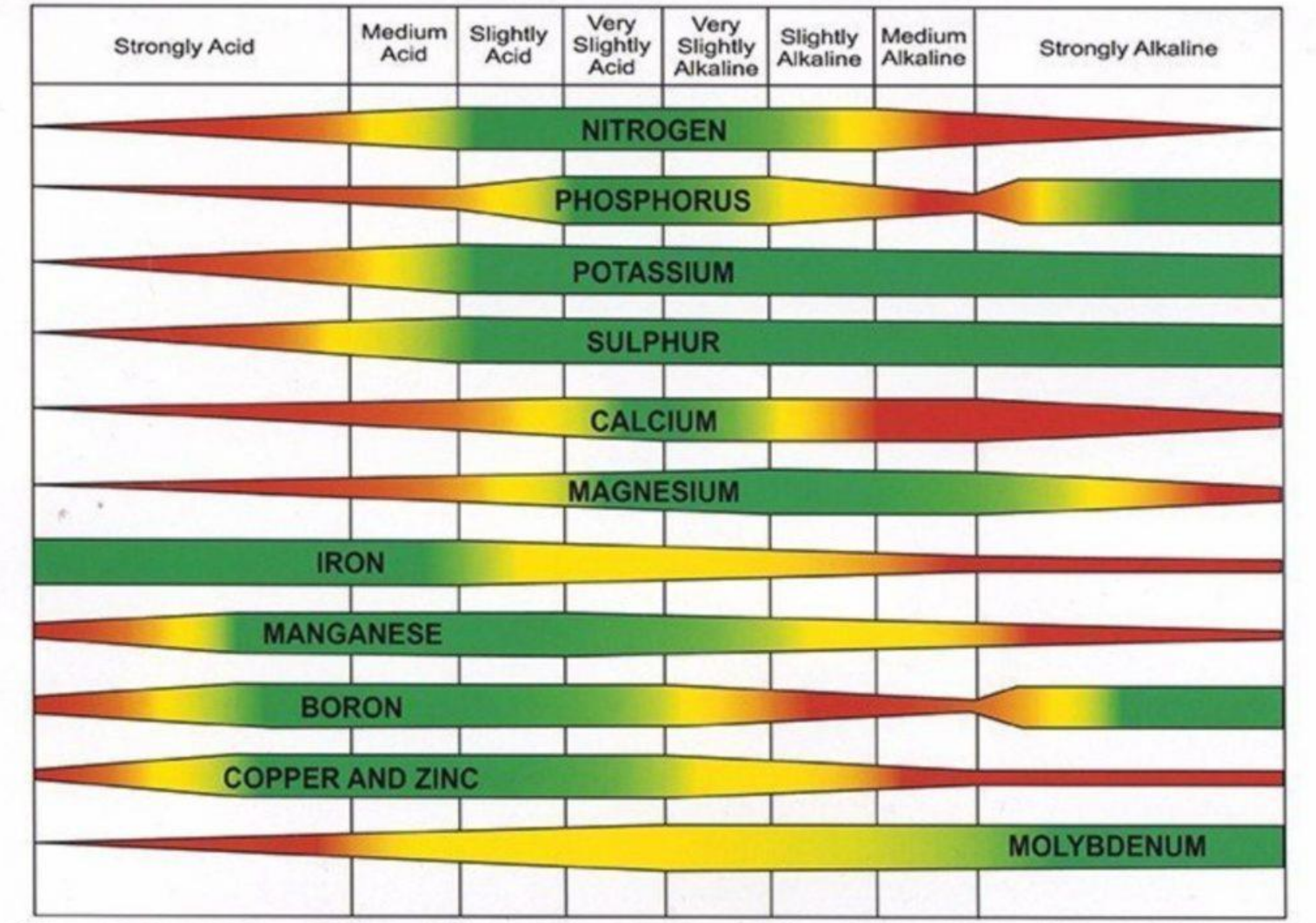
- **Hygroscopic Water** - Physically bound to soil → unavailable
- **Gravitational Water** - Drains out of pores
- **Capillary Water** - held against gravity in pores
  - Plants mostly dependent upon
  - Affected by organic matter and underground water

Soils
Soil pH

- **Alkalinity: some minerals less available**
  - **copper, iron and manganese**
  - **Solution: adding sulfur**
    - **→ sulfuric acid by bacteria, or by**
    - **add nitrogen fertilizers**

- **Acidit:y inhibits nitrogen-fixing bacteria.**
  - **Solution: liming = add calcium or magnesium**

How soil pH affects availability of plant nutrients.



SOURCE: https://www.emporiumhydroponics.com/what-is-ph-1-to-14